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Information Quality, Auditor Reputation and Capitalization Effects: The Legacy of Enron

Peter G. Dunne, Haim Falk, John Forker and Ronan Powell*

Abstract

The purpose of this paper is to investigate the change in quality of the information environment pre- and post- Enron. We test whether the reputations of all auditors declined as a result of Enron. The impact on the market risk premium is also examined. An information processing model is developed to show that a structural break in information quality can produce a variety of outcomes for the responsiveness of the market to accounting information. We find that there was a fall in information quality post-Enron across all auditors. We also find that the Enron scandal, at least temporarily, adversely affected the market risk premium, confirming that information quality is part of systematic risk. These findings have obvious implications for the US audit industry, for accounting regulators and for the international competitiveness of US capital markets.

JEL Classification: D8; G14

Keywords: Accounting information quality; Auditor reputation; Earnings-response-coefficients; Risk premium.

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1. Introduction

This paper addresses a number of important issues relating to the quality of the information environment pre- and post-Enron. We investigate the impact of the scandal on the perceived quality of accounting information in terms of the market risk premium and auditor reputation. The link between the cost of capital and accounting information quality has recently been explored by Leuz and Verrecchia (2005) and Francis, LaFond, Olsson and Schipper (2004, 2005). Easley and O'Hara (2004) identify a role for precise accounting information in reducing the cost of capital by reducing the information-based systemic risk of shares to uninformed investors. In this paper we focus on the contribution of audit assurance to the precision of such information. We find that there was a fall in information quality post-Enron across all auditors. We also find that the Enron scandal, at least temporarily, adversely affected the market risk premium confirming that information quality is part of systematic risk. The fall in the quality of the information environment has obvious adverse implications for the US audit industry, for accounting regulators and for the international competitiveness of US capital markets.

The immediate impact of the Enron scandal has been investigated using an event-based methodology. These studies find evidence that Andersen suffered an immediate loss of reputation that was reflected in a risk-adjusted decline in the value of the shares of its US clients relative to the effect on the clients of the other Big 5 accounting firms (Chaney and Philipich, 2002, Krishnamurthy, Zhou and Zhou 2002 and Asthana, Balsam and Krishnan, 2003). The fall identified in these studies can be attributed to a number of different effects. The most obvious of these is transitory, being a once-off reappraisal of the level of the reported earnings of auditor-related client portfolios. In this paper we focus on a less obvious but more lasting effect

relating to the impact of Enron on the perceived quality of accounting information. A decline in information-quality may be reflected in the weight given to new earnings information by the market. If this is a market wide-effect and is part of market risk, it will lead to a rise in the market risk premium and a fall in the capitalization of future expected earnings.

We refine the long-window earnings response coefficient (ERC) methodology (Collins and Kothari, 1989, Kothari, 2001) in order to accommodate idiosyncratic changes in auditor-specific coefficients and changes in the market-wide risk premium. This is important because it provides us with a measure of the systemic effect of the scandal and it enables us to distinguish between this effect and the individual auditor effect. In our analysis we regard the immediate reaction to the Enron scandal as a time fixed-effect that can be omitted using a fixed-effects estimator.

We highlight the fact that a problem of endogeneity arises in the final year of our study. This is because measurement and reporting of audited accounting earnings may have been affected by the Enron event itself making our explanatory variable endogenous. It is likely that audit partners became more diligent in ensuring the protection of their reputation by a stricter adherence to accounting principles and less aggressive earnings recognition strategies in the post-Enron environment. To deal with this problem we introduce a variable which is highly correlated with post-Enron audited earnings, but exogenous to the Enron event. Specifically, we instrument the post-Enron audited earnings using final year interims.

In a further contribution to the literature we provide a recursive Bayesian analysis of information processing that extends Holthausen and Verrecchia (1988) and Teoh and Wong (1993) to a dynamic context. This accommodates the possibility that the Enron crisis may have led to a retrospective revision of the precision of already

announced earnings information as well as changing the perceived reliability of information post-Enron. We demonstrate that, in the dynamic context, an impact-decline in earnings response coefficients (ERCs) must imply a decline in the quality of post-Enron information. However, we identify a number of alternative adjustment paths from impact-to-equilibrium involving radically different profiles. For example, the case of immediate post-Enron zero-change in ERCs cannot be interpreted as indicating no deterioration in the quality of post-Enron information. Furthermore, in contrast to Teoh and Wong (1993) we also demonstrate that a rise in ERCs cannot unambiguously be attributed to an improvement in information quality.

Our analysis also implies zero-unity bounds on the weight given to earnings surprises. Our unrestricted coefficient estimates usually lie within these limits. We obtain point estimates of these weights that exceed, but are not significantly different from one. This is an interesting result given that most research does not specify an expected value for ERCs: ‘It is rare to see research examining whether the estimated coefficient (for ERC) equals some predicted value’ (Kothari, 2001, p. 143).

We perform tests of cross-auditor restrictions and also test for pre- post-Enron equality of ERCs. These tests identify whether Andersen was the sole target for a downgrading of reputation or whether the effect was systemic. We find little evidence that ERCs differ across auditor pre- or post-Enron. Furthermore, ERCs are always lower in the post-Enron period confirming a systemic decline in auditor reputation. We find that instrumenting for endogeneity matters for the significance of our results and reveals a decline in information quality that is accompanied by a rise in the market risk premium.

The paper proceeds as follows. In section two we present a generalized analysis of information processing. In section three we set out our research design.

The sample selection procedure, variable definitions and descriptive statistics are reported in section four and the results are reported in section five. A discussion of the results and conclusion is provided in the final section.

2. Recursive Information Processing

In this section we present three information processing scenarios. The first scenario introduces notation and shows the conditions under which past market prices are irrelevant as a prior in a recursive Bayesian context. The second scenario involves the introduction of noisy earnings signals and shows how the variance of priors relates to the precision of these signals. This is a generalization of Teoh and Wong (1993), who assume that the precision of past price as a signal of current value is exogenously determined. We retain a distinction between Bayesian weights and capitalization factors in our analysis. This distinction is also maintained in the empirical implementation. The third scenario develops the analysis to deal with a structural break that affects the variance of priors and the variance of new signals differentially. We use this to develop our research design for measuring and interpreting the change in ERCs in response to the Enron event.

The analysis here is based on similar principles to those underlying the recursive nature of the Kalman filter (Kalman 1960, Harvey 1989) and applies the analysis of Dunne (2000) to a case of a structural break in the quality of information. In our case the recursion is applied to the mean and not the variance. Values for the variance of signal-innovations and the variance of noise are assumed to be subjective and are therefore manipulated to suit the analysis instead of being part of the recursive up-dating and smoothing that takes place in the usual application of a Kalman filter. This allows for a much simpler and more tractable set of results under various

assumptions about the subjective variances. In particular, this approach is more amenable to analytical manipulation designed to reflect a structural break in the subjective variances resulting from an event such as Enron.

2.1. Scenario 1: Random walk earnings without noise

Suppose P_t is the price of an asset that is traded publicly and V_t the fundamental value of the asset in period t , where fundamental value is assumed to be derived from economic earnings. Let γ be a capitalization factor for economic earnings, y_t assuming that this is capitalized as though it were received in perpetuity. Let the natural log of capitalized economic earnings, $\ln\{\gamma y_t\}$, be a process that follows a random walk such that $\ln(\gamma y_t) = \ln(\gamma y_{t-1}) + d_t$ which implies $\gamma y_t = \gamma y_{t-1}(1 + d_t)$ where $d_t \sim iidN(0, \sigma_d^2)$ is the new information in this period's capitalized earnings. If y_t is observable in period t then under the random walk assumption the prediction at time t of any future earnings would be $E_t y_{t+k|k>0} = y_t$ for all k . This implies that $\ln\{P_t\}$ would follow a random walk with innovations d_t . This result would deliver $P_t = V_t = \gamma y_t$ or an 'efficient markets' pricing of the asset since P_t and V_t are both derived from economic earnings.

What is notable about this scenario is that past price changes would be uninformative regarding the future and P_t itself would be the best prediction of fundamental value of the asset in the future. In this case, newly revealed economic earnings information is all that matters for the up-dating of the price of the asset. The old price will simply be replaced with γ times the new earnings signal. The old price has no role in determining the new price.

2.2. Scenario 2: economic earnings observed with noise

Suppose that the time series of capitalized accounting earnings $\{\gamma z_t\}$ provide a noisy signal of capitalized economic earnings such that, $\ln(\gamma z_t) = \ln(\gamma y_t) + e_t$, or $\gamma z_t \approx \gamma y_t(1 + e_t)$, where the noise element is described by $e_t \sim iidN(0, \sigma_e^2)$. In what follows we assume that investors have subjective beliefs about σ_e^2 and regarding the underlying innovation variance σ_d^2 . Under these assumptions investors will regard $\ln(\gamma z_t)$ as an unbiased signal of log fundamental value, $\ln V_t$. Clearly $\ln\{\gamma z_t\}$ does not itself follow a random walk. It is a random walk plus noise such that $\ln(\gamma z_t) = \ln(\gamma z_{t-1}) + d_t + e_t - e_{t-1}$ and it is best represented as a moving average process of order one.¹

Since $\ln(\gamma z_t)$ does not follow a random walk it cannot be concluded that the best prediction of future economic earnings can be made with reference to $\ln(\gamma z_t)$ alone. In this case $P_t \neq \gamma z_t \neq \gamma y_t = V_t$. It is also impossible for price to fully reflect underlying value in this case. Price in any period 't' will be a noisy signal of period 't' fundamental value. In this case, a Bayesian information processor would give some weight to the previous price (representing the prior) as well as the new earnings signal when forming a posterior belief since both of these are noisy signals of the underlying value. If we suppose that $\ln\{\gamma z_t\}$ is the only source of economic information then the natural log of price at 't-1' can be written in terms of a repeated application of Bayes rule to the past information shocks. If the noise in the prior and new signal is normally distributed and independent, the up-dating of beliefs should be derived using the following rule;

$$E_t(\ln V_t) = \ln P_t = \phi \ln(\gamma z_t) + (1 - \phi) \ln P_{t-1} \quad (1)$$

or

$$\Delta \ln P_t = \phi [\ln(\gamma z_t) - E_{t-1}(\ln V_t)] \quad (2)$$

where $\phi = \frac{k}{k + \sigma_e^2}$, $E_{t-1}(\ln V_t) = \ln P_{t-1}$ and k , or $Var(\ln P_{t-1} - \ln V_t)$, is the variance of

the prior. Equation (2) is a logged version of a familiar exposition in the extant accounting research literature (e.g., Teoh and Wong 1993). In the extant literature estimated ERCs are considered to be the empirical counterpart of the Bayesian weight, ϕ , while the capitalization factor, γ , is typically not explicitly explored. In our empirical analysis we separately estimate these two parameters allowing us to control for variation in capitalization factors.

Teoh and Wong (1993) assume that k is exogenously given and derive the result that the ERC is negatively related to σ_e^2 . We show in Appendix 1 that k is a more complex function of σ_e^2 due to the recursive nature of the up-dating of beliefs. This gives the following quadratic in k ;

$$k^2 - k\sigma_d^2 - \sigma_e^2\sigma_d^2 = 0 \quad (3)$$

Only one of the solutions to this gives a meaningful value for k as follows;

$$k = 0.5 \left[\sigma_d^2 + \sqrt{(\sigma_d^2)^2 + 4\sigma_e^2\sigma_d^2} \right] \quad (4)$$

Although we obtain a similar sign in the derivative of ERC with respect to changes in σ_e^2 the relation is more complex than in Teoh and Wong (1993). In a dynamic context the derivative in question will not be observed in the immediate aftermath of the event. This is because in the transition to the long-run equilibrium the weight given to prior beliefs will be dependent on a mixture of the revised subjectively held pre-event

precision and the post-event precision. Over time the prior will become dominated by signals having the post-event precision and so the ERC will reach a long-run equilibrium associated with this new equilibrium signal-to-noise ratio. This facilitates the generalization we discuss in scenario three.

The derivative of the ERC (long-run) with respect to σ_e^2 is derived in Appendix 2 and can be written as;

$$\frac{\partial \phi}{\partial \sigma_e^2} = \frac{-k}{(k + \sigma_e^2)^2} \left(1 - \sigma_e^2 k^{-1} \left[\frac{\partial k}{\partial \sigma_e^2} \right] \right) \quad (5)$$

The first part of the expression on the right hand side is the same as in Teoh and Wong (1993) and the second part is a positive fraction as shown in Appendix 2. Thus the long-run change in the ERC w.r.t. a change in the variance of the noise in the earnings signal (applicable to all periods) must be negative but smaller than the derivative obtained by Teoh and Wong (1993).

One way of interpreting this result is to note that the number of past signals (combined as a weighted average) used to form the prior, ensures that the prior is more reliable in general than any individual signal. Changes in the precision of all signals will therefore affect the precision of the prior less than it affects the precision of the most recently arrived signal. Thus, despite the fact that the Enron event may have reduced the perceived precision of both new and past earnings signals, in the case where this change has been similar for all signals, the ERC will still have fallen. Of course, it is possible that the perceived reliability of pre-Enron signals is affected significantly more than the reliability of the post-Enron signals. In a dynamic context this matters for the impact-effect immediately surrounding the event and this is something we considered in the third scenario below.

In Appendix 3 we also show that the ERC, or ϕ , can be expressed in a more insightful way as the solution to the following quadratic;

$$\phi^2 + \phi R - R = 0 \quad (6)$$

where $R = \frac{\sigma_d^2}{\sigma_e^2}$. The positive solution to this gives;

$$\phi = -0.5R + 0.5\sqrt{R^2 + 4R} \quad (7)$$

This is bounded from below by zero when accounting earnings are noiseless signals of economic earnings (as in scenario 1 above) and approaches 1 as R tends to infinity. If we regard both components of R as subjective and allow both to change simultaneously then the ERC only falls if σ_e^2 rises more than σ_d^2 . This is what we would expect for a case like Enron, although we allow even more generality in this relation in the discussion that follows.

2.3. *Scenario 3: Differential revision of the precision of past and future earnings signals*

Here we outline the ways in which an event such as Enron can modify the components that make up the post-event ERC and from this we determine the impact-derivative.² For clarity we assume that pre-Enron the ERC is based on time invariant parameters $\{\phi, k, \sigma_e^2, \sigma_d^2\}$ as in Teoh and Wong (1993). We introduce subscripts on these parameters to indicate revised parameters in the light of the Enron event. We use the subscript π to denote retrospective revisions (i.e., to denote the revised pre-Enron parameters) and we use the subscript ρ to denote the revised parameters post-dating the event. Thus the post-Enron ERC can be written as follows;

$$\phi_\rho = \frac{k_\pi}{k_\pi + (\sigma_e^2)_\rho} \quad (8)$$

Note that $k_\pi = f\left((\sigma_e^2)_\pi, (\sigma_d^2)_\pi\right)$ where equation (8) above applies and therefore $\phi_\rho = f\left((\sigma_e^2)_\rho, (\sigma_e^2)_\pi, (\sigma_d^2)_\pi\right)$.

Appendix 1 shows that $k_\pi > k$ if we assume that the Enron event raised the subjective variance of the earnings signal such that $(\sigma_e^2)_\pi > \sigma_e^2$. The sign of the change in the ERC post-Enron will depend on the relative size and signs of the changes in $(\sigma_e^2)_\pi$ and $(\sigma_e^2)_\rho$. It is possible that $(\sigma_e^2)_\rho$ actually fell (due to more diligence in accounting measurement in the light of the scandal) while $(\sigma_e^2)_\pi$ rose. Even if they both rose it is possible that, for a significantly larger rise in $(\sigma_e^2)_\pi$, the post-Enron ERC could have risen, although the long-run ERC will always be lower in this case due to the eventual disappearance of the term $(\sigma_e^2)_\pi$ from the ERC equation. The actual direction of change that occurred is an empirical matter and is the subject of our application. In Figure 1 below we illustrate diagrammatically various possible adjustment paths for ERC to the long-run equilibrium following an event such as Enron. In all of the alternative paths an eventual decline in ERCs occur (i.e., post-Enron information is of lower quality). The difference arises due to the effect of the Enron event on the revised perceptions of the quality of information pre-dating the event. Where this has deteriorated significantly more than the post-event information quality, there can actually be a positive impact-effect.

Insert Figure 1 about here

3. Research design

In this section we review issues relating to the estimation of ERCs and we describe the innovations we apply in our estimation procedures. One important aspect of our approach is to explicitly recognize the role of the capitalization factor in the relation between equity valuation and earnings. In estimating auditor-specific ERCs (ϕ) we apply a multiple factor model that allows for different firm-specific capitalization factors (γ) that depend on firm-specific betas and changes in the risk-free rate of interest. We apply a nonlinear estimation approach to jointly estimate the implied time-varying risk premiums and auditor-specific ERCs. We then follow the literature in dealing with measurement error by applying a reverse regression technique. Finally, we deal with the issue of endogeneity arising from the possibility that there was a change in the auditor-specific characteristics of the manipulation of earnings information post-Enron.

The empirical model involves returns and the unexpected change in earnings ($\Delta z_{i,t}$) relative to market value (P_{t-1}). Thus equation (1) of the theoretical analysis can be rewritten as;

$$\Delta \ln P_t = \phi \ln \left(\frac{\gamma z_t}{P_{t-1}} \right) \quad (9)$$

and by further simplification as;

$$\Delta \ln P_t = \phi \ln \left(1 + \frac{\gamma \Delta z_t}{P_{t-1}} \right) \quad (10)$$

Although this is an appealing representation it has practical limitations. The changes in accounting earnings include noise and this can give rise to large negative declines that exceed 100%. This motivates our use of the following alternative representation which is obviously approximate especially for large values;

$$\Delta \ln P_t = \phi \left(\frac{\gamma \Delta z_t}{P_{t-1}} \right) \quad (11)$$

As in the extant literature the approximation error, along with the usual measurement error, is likely to be mitigated by our reverse regression approach outlined below.

We estimate ERCs that are constant across firms associated with particular auditors (indexed by j) and that differ pre- and post-Enron ($\phi_{j[pre,post]}$). We jointly estimate risk premia for various factors keeping these premia constant across firms. We allow the market risk premium to vary pre- and post-Enron. This leads to the nonlinear empirical specification given in equation (12) below, in which $D_{j[pre,post]}$ is a set of dummy variables designed to select firms associated with specific auditors in the pre- and post-Enron periods and $\gamma_{i,t} = \left(r_{f,t} + \omega_{[pre,post]} \beta_{i,t} + \mu mtb_{i,t} + \lambda lev_{i,t} + \zeta siz_{i,t} \right)^{-1}$, where $r_{f,t}$ is a time specific risk-free rate of return; $\omega_{[pre,post]}$ is an estimate of the market risk premium pre- and post-Enron; $\beta_{i,t}$ are observed time- and firm-specific betas; mtb , lev , and siz are time- and firm-specific variables representing sensitivities to market-to-book, leverage and size factors, respectively with factor-specific risk premia μ , λ and ζ that are directly estimated. The mtb , lev , and siz variables enter as factors following the spirit of Pettit and Westerfield (1972) and Fama and French (1992). An error term ($u_{i,t}$) is added to indicate that this is an estimable relation.

Specifically;

$$\Delta \ln P_t = \sum_j \phi_{j[pre,post]} D_{j[pre,post]} \ln \left[1 + \frac{\gamma_{i,t} \Delta z_{i,t}}{P_{i,t-1}} \right] + u_{i,t},$$

or with the approximation $\frac{\gamma_{i,t} \Delta z_{i,t}}{P_{i,t-1}} \approx \ln \left[1 + \frac{\gamma_{i,t} \Delta z_{i,t}}{P_{i,t-1}} \right]$ then we estimate

$$\Delta \ln P_t = \sum_j \phi_{j[pre,post]} D_{j[pre,post]} \left[\frac{\gamma_{i,t} \Delta z_{i,t}}{P_{i,t-1}} \right] + u_{i,t} \quad (12)$$

Unlike recent Enron-related event-based studies (Chaney and Philipich, 2002, Krishnamurthy, Zhou and Zhou, 2002, and Asthana, Balsam and Krishnan, 2003) we use a long-window (annual) ERC methodology to focus on the aspect of the earnings measurement process that relates to investor confidence in the reliability of audited earnings. The long-window approach has previously been employed by Collins and Kothari (1989) to investigate the determinants of ERCs. We use the actual change in earnings scaled by beginning period market value to proxy the unexpected change in earnings.

We apply adjustments to our variables to achieve a fixed-effect estimator. The fixed-effects approach deals with omitted variable bias and provides a structure for cross sectional restrictions. The omitted variables of concern are those for which the effects are constant over time but not across sector (i.e., industry-wide effects) and the effects that are constant for sectors but not across time (e.g., macroeconomic conditions and the market-wide effect of the Enron event itself). The Enron fixed-effect is not of interest to our analysis so excluding this fixed-effect is of particular importance to achieving an unbiased estimated of the proportional relation between returns and earnings in the post-Enron period. Specifically, we demean returns and unexpected-earnings by year-end annual averages to exclude time fixed-effects. We then demean for cross-sectional fixed-effects by demeaning each time-demeaned observation for its sectoral-average across all periods pre- and post-Enron using SIC identifiers. In the case of market-to-book, leverage and size we are interested in the relation of each observation relative to its period-specific average so we only demean

by the time period. This reflects the view that relative positions of these variables can be used to adjust firm-specific beta-based capitalization factors. We expect a positive adjustment to beta-based capitalization factors for relatively high market-to-book firms and likewise for relative size. A negative adjustment for relative leverage would indicate a reduction in capitalization reflecting the impact of financial risk.

Our ERC estimate should be viewed as a ‘within estimator’ as opposed to a ‘between estimator’ (Greene 2003, Bhattacharya, Daouk and Welker 2004). Although there may be some benefit from a GLS estimation approach which combines the ‘within’ and ‘between’ estimates, we believe that the ‘within estimator’ is the most appropriate for our purposes since it is likely to be unbiased when measurement error is properly accounted for (Hausman and Taylor, 1987).

Demeaning will not, however, remove proportional-effects and therefore is unlikely to provide a noiseless estimate of the unexpected component of these variables. This introduces measurement error and we use a non-linear ‘reverse regression’ technique to deal with this and other sources of measurement error, such as those arising from the capitalization of earnings. In our empirical implementation, we refer to the regression model of equation (12) as the ‘direct regression’ and the related ‘reverse regression’ can be written as;

$$\left[\frac{\Delta z_{i,t}}{P_{i,t-1}} \right] = \sum_j \phi_{j[pre,post]}^{-1} D_{j[pre,post]} \left(\gamma_{i,t}^{-1} \Delta \ln P_{i,t} \right) + v_{i,t}. \quad (13)$$

Our theoretical analysis suggests that market reaction to earnings information depends on the perceived precision of that information. The theory has direct empirical implications for the regression based relation between earnings surprises and the associated market reaction. In theory, auditor-specific ERCs are expected to differ from each other to reflect differential reputation effects. We test this proposition

in the pre- and post-Enron periods. Theory also suggests that ERCs would most likely decline in the post-Enron period, unless the change in the precision of the prior sufficiently exceeded changes in the precision of the post-Enron signals. We examine this by testing the restriction that the ERCs are equal pre- and post-Enron at the individual auditor level and for all auditors as a group. This helps us to discern whether the Enron legacy is market-wide as opposed to an Andersen-only effect identified in the existing event-based literature.

The issue of endogeneity arises in the final year of our study because accounting earnings, our explanatory variable (in the direct regression), may have been affected by the Enron event itself. To deal with this endogeneity issue we instrument the post-Enron annual earnings with the firm's semi-annual earnings immediately prior to the Enron scandal. We test for this endogeneity using the Hausman (1978) specification test.

4. Data

4.1. Data and Sample Selection

The accounting data for this study are obtained from the Compustat database and market based data are extracted from CRSP. We identify the associated auditor for each company using the Compustat #149 identifier. We examine four years of pre-Enron data starting from 1998 and one year Post-Enron. We are restricted to a single year in the post-Enron period due to the take-over of Andersen by Deloitte in July 2002. Excluding ADR's, subsidiaries, mutual funds and trusts (CRSP code greater than 11) and firms with financial reporting periods not equal to twelve months yields a sample of 16,776 firm year-ends.

Companies with financial years ending in the period December 2001 to March 2002 are selected for the post-Enron sample. Since firms are required to report to shareholders within 3 months of the year-end, it is assumed that the annual market return measured with a three-month lag includes the Enron-related events (i.e., up to June 30th 2002). With reference to the endogeneity problem, discussed in section 3 above, interim earnings for the half-years ending June to September 2001 are used to instrument the annual audited earnings of these firms on the assumption that their measurement pre-dates any managerial or auditor reaction to Enron. This restricts our sample to exclude firms with year-ends later than March 2002 so as to ensure that the related semi-annual earnings are definitely previous to the Enron event. For the purpose of comparison, the sample for the pre-Enron period is also restricted to December to March year ends. Altogether, the selection of firms with December to March year-ends contains roughly 75% of all those listed, and yields a final sample of 12,658 firm year-ends.³

4.2. *Variable definition and descriptive statistics*

Table 1 reports the variable definitions and CRSP/Compustat codes.

Insert Table 1 about here

Table 2 reports descriptive statistics for the source data. The source data is treated as follows. Earnings before extraordinary items (EBEI) is winsorized at +/- 500%. This affected only 29 extremely outlying observations so the original sample remained substantially intact. Negative values for BETA, MTB and LEV are set to zero. We truncate these variables at their 99th percentile. We demean EFO and RET by time and sector while MTB, LEV and SIZ are demeaned by time only as discussed in section 3. Few insights about the relation between variables can be made by

examination of the correlations between the treated variables. In general, there is not much to conclude from these correlations except to note that they are very low. In essence, the conditional relations between these variables allowing for their non-linear relation with each other are of more interest and can only be revealed by more sophisticated regression analysis.

Insert Table 2 about here

5. Results

5.1 Direct and Reverse regressions

The results for both the ‘direct’ and ‘reverse’ regressions as described by equations (12) and (13), respectively are reported in Table 3. The results adjusting for endogeneity are reported in Table 4. Regressions were produced using the RATS (Estima) 6.0 econometrics package using the robust errors option to control for the effects of serial correlation and heteroscedasticity. In the case of Table 3, the direct and reverse regression coefficient estimates are directly comparable with each other since the inversion of the parameters in the reverse regression is implemented in the equations of the nonlinear estimation routine. The risk premiums are freely estimated in the direct and reverse regressions presented in Table 3 and also in the direct regression presented in Table 4.

Our estimates of ERCs are not directly comparable with those reported in the existing literature but are consistent with the interpretation as Bayesian weights. We estimate the ERCs separately from the capitalization factor and this is not the usual practice. Our ERC estimates are plausible in that they remain close to their theoretical bounds from zero to one. Previous reverse-regression estimates of ERCs in the literature tend to exceed one.⁴

The direct regression results presented in Table 3 show very low values for the ERCs when compared with the reverse regression. This is what would be expected in the case of measurement error. Indeed, it is well known that fixed-effects regression estimates tend to suffer from exacerbated downward bias due to measurement error (Lewbel, 1997). While the ERC estimates are small in the direct regression they are all positive and significantly different from zero. The reverse regression ERCs are also all statistically significant and positive. Indeed in the pre-Enron period the point estimates exceed the maximum they could take theoretically. Although the point estimates are above unity they are not significantly different from unity. The reverse regression results therefore appear to suggest that the pre-Enron accounting information was of such quality that it merited full weight in determining the posterior belief about fundamentals to the exclusion of prior information. This is an extreme outcome and could be explained by measurement error in the returns process (e.g., a bubble in the market).

A comparison of the direct and reverse regressions indicates that measurement error is significant in its effects. On the basis of point estimates, the ranking of the auditors pre- and post Enron is more consistent in the reverse regression. Here the only change pre- and post Enron involves the improvement in Deloitte's ranking post-Enron from 6th largest to 4th largest. Significantly, Andersen does not suffer a fall in its position. However, these rankings could easily be rejected on the basis of statistical significance. Despite measurement error, there is surprisingly little difference in the conclusions that can be drawn from the two alternative regressions regarding the risk premium. The estimated market risk premium is roughly 1.5% in the reverse regression and 1.7% in the direct regression. The direct and reverse regressions are

also similar with regard to the signs of the factor risk premiums for market-to-book, leverage and size.

Overall, the sign and size of the estimated risk premiums accord with our expectations although there is no evidence of a systemic effect on the risk premium. The negative estimated premium for relative market-to-book indicates the increased capitalization of future expected earnings as would be expected. The positive estimated premium on relative leverage indicates a reduction in capitalization reflecting the impact of financial risk. In the case of relative size the conclusion is similar to the case of market-to-book. The estimated market risk premium is quite plausible in both the direct and reverse regressions having controlled for market-to-book, leverage and size premiums.

5.2 *Testing Restrictions*

We use Wald tests to investigate whether auditor-specific ERCs differ from each other reflecting differential reputation effects in the pre- and post-Enron periods. Under the null being true the test statistic is Chi-squared distributed with degrees of freedom equal to the number of restrictions being imposed. The test statistics are presented beneath the associated regression where p-values for the statistics are also provided. The same conclusions generally hold in both the direct and reverse regressions. The null hypothesis of no difference in auditor-specific ERCs pre-Enron is not rejected. This result accords with earlier Australian findings (Ferguson, Francis and Stokes, 2003) that while auditor reputation effects reflected in audit fee premiums exist at the office level, based on industry expertise, they do not exist at the firm level. However, in the direct regression Post-Enron, there is some evidence of the market responding differentially to earnings signals across auditors and the null of no

differences is rejected at a slightly greater than conventional level of significance ($p=0.1168$).

We also test the restriction that ERCs are equal pre- and post-Enron at the individual auditor level and for all auditors as a group. In both the direct and reverse regressions it is possible to conclude that the post-Enron ERCs are smaller than the pre-Enron ERCs. Taken together, post-Enron ERCs are smaller than those in the pre-Enron period and the null of no difference is rejected at very high levels of significance for both regressions. In terms of the theoretical analysis, this result is consistent with an increase in the noise associated with earnings signals post-Enron reflecting a reduction in perceived reliability. The tests at the individual auditor level confirm this finding for the Big-5 in the reverse regression.

5.3 *Endogeneity*

To deal with the possibility that the post-Enron earnings measurement and reporting process was influenced by Enron we control for endogeneity by an instrumental variables approach to the direct regression. The results are reported in Table 4. We use semi-annual earnings as the instrument for annual earnings in the final year. We allow the risk premium to be freely estimated in a non-linear direct regression. The results show little difference in the signs, size and significance of the coefficients for the capitalization factors MTB, LEV and SIZE. The coefficients and significance of pre-Enron auditor-specific ERCs are slightly higher than in the non-instrumented direct regression. In the post-Enron period, however, across all auditors the coefficients are about one-tenth of their previous level and as a group they are even more significantly below pre-Enron levels. This serves to confirm the robustness of the result that there has been a fall in reputation across all auditors. Although the

post-Enron coefficients are not significantly different from zero the Hausman specification test shows that they are significantly different from those obtained from the non-instrumented regression.

More importantly, we also find that the estimated risk premium has risen significantly in the post-Enron period. This is consistent with the view that information quality is a factor that enters into systematic risk. It is unlikely that this result arises from the purely statistical effects of adding the instrument. Instruments usually affect the efficiency of estimates and not their expected level.

6. Conclusions

This paper gives rigorous underpinnings to the analysis of information processing around the Enron crisis. We demonstrate analytically that, in the dynamic context, an impact-decline in earnings response coefficients (ERCs) must imply a decline in the quality of post-Enron information. The empirical implementation of our analysis introduces a number of innovations. In contrast to the existing literature we estimate the empirical analogue of Bayesian weights of our theoretical analysis. This required that we separately consider the capitalization of earnings. To achieve this empirically we used a non-linear estimation method that allowed for the joint estimation of risk adjusted capitalization factors and ERCs. The capitalization also controlled for market-to-book, leverage and size effects. We also deal with the issues of measurement error and endogeneity respectively by the use of a reverse regression and the instrumentation of post-Enron earnings with their semi-annual counterparts.

Having dealt with theoretical and estimation issues our findings indicate the extent of the impact and legacy of the Enron crisis. A systematic decline in the

perceived reliability of earnings signals post-Enron was found to apply across all auditors and, conditional on instrumenting for endogeneity, this was combined with a rise in the market risk-premium.

The apparent fall in the quality of the information environment has adverse implications for the US audit industry and for accounting regulators. Our findings suggest that there was a fall in confidence in the quality of accounting information as a result of the Enron scandal. The reputation gap between the most reputable auditor post-Enron and the least reputable auditor pre-Enron far exceeds the reputation gap between the most and least reputable auditors in the pre-crisis period. This identifies and quantifies the extent of the problem facing auditors and regulators in restoring confidence in audited information post-Enron.

In terms of the international competitiveness of US capital markets our study identifies a significant rise (50%) in the market-wide risk premium post-Enron. This has consequences for the attractiveness of the US as a source of capital internationally particularly if the effects of the crisis were confined to the US market. An issue for future research is whether there has been contagion arising from the crisis to other capital markets.

Appendices

Appendix 1: Information Processing, Scenario 2

Assume P_t is the market value of an asset following earnings announcements for period t . Let V_t be the unknown fundamental, or fair-value of the asset at the same time. Let y_t be the unobservable economic earnings associated with the asset and γ be a suitable capitalization factor such that for all periods, $\ln(\gamma y_t) = \ln(\gamma y_{t-1}) + d_t$,

where $d_t \approx N(0, \sigma_d^2)$. Since capitalized log economic earnings are assumed to follow a random walk it follows that $\{\ln V_t\}$ is a random walk process. Let z_t be the observable accounting earnings associated with the asset such that for all periods, $\ln(\gamma z_t) = \ln(\gamma y_t) + e_t$, where $e_t \approx N(0, \sigma_e^2)$. Thus, capitalized accounting earnings provide an unbiased noisy signal of fundamental value by way of the relation $\ln(\gamma z_t) = \ln(V_t) + e_t$ or $\gamma z_t = V_t(1 + e_t)$. The noise in this signal therefore has a variance σ_e^2 .

Suppose $\ln P_t$ is derived as a Bayesian posterior for $\ln V_t$ arrived at by combining the accounting earnings signal $\ln(\gamma z_t)$ and the previous posterior $\ln P_{t-1}$ (representing the prior belief). Thus,

$$\ln P_t = E_t(\ln V_t) = \phi \ln(\gamma z_t) + (1 - \phi) \ln P_{t-1}. \quad (\text{A1})$$

Where $\phi = \frac{k}{k + \sigma_e^2}$, and k , or $\text{Var}(\ln P_{t-1} - \ln V_t)$, is the variance of the prior.

Rearranging and lagging gives the following expression for P_{t-1} in terms of $\{z_t\}$;

$$\ln P_{t-1} = \phi [1 - (1 - \phi)L]^{-1} \ln(\gamma z_{t-1}). \quad (\text{A2})$$

Where L is a lag operator such that $L^i x = x_{t-i}$. Assume for now that $\ln P_{t-1}$ has expected value equal to $\ln V_t$ (this is explicitly confirmed as part of the following proof). Using this expression it is possible to obtain a tractable solution for the variance k . Note that the variance can be stated as follows;

$$k = E \left[\phi (1 - (1 - \phi)L)^{-1} \ln(\gamma z_{t-1}) - \ln V_t \right]^2. \quad (\text{A3})$$

Since $\ln V_t = \ln V_{t-1} + d_t$, then it is possible to express past earnings-related value signals in terms of current fundamental value, past fundamental value innovations and current signal noise as follows;

$$\ln(\gamma z_{t-1}) = \ln V_t - d_t + e_t, \quad (\text{A4})$$

or more generally;

$$\ln(\gamma z_{t-k}) = \ln V_t - d_t - \dots - d_{t-k-1} + e_{t-k}. \quad (\text{A5})$$

Thus, we can expand one of the expressions in (A3) as follows;

$$\begin{aligned} \phi(1 - (1 - \phi)L)^{-1} \ln(\gamma z_{t-1}) &= \phi[\ln V_t - d_t + e_{t-1}] \\ &\quad + \phi(1 - \phi)[\ln V_t - d_t - d_{t-1} + e_{t-2}] \\ &\quad + \phi(1 - \phi)^2[\ln V_t - d_t - d_{t-1} - d_{t-2} + e_{t-3}] \\ &\quad \dots \dots \dots \\ &\quad + \phi(1 - \phi)^k[\ln V_t - d_t - \dots - d_{t-k} + e_{t-k-1}] \end{aligned} \quad (\text{A6})$$

This can be rearranged so that like-terms are combined to give;

$$\begin{aligned} \phi(1 - (1 - \phi)L)^{-1} \ln(\gamma z_{t-1}) &= \phi[1 + (1 - \phi) + (1 - \phi)^2 + \dots] \ln V_t \\ &\quad - \phi[1 + (1 - \phi) + (1 - \phi)^2 + \dots] d_t \\ &\quad - \phi(1 - \phi)[1 + (1 - \phi) + (1 - \phi)^2 + \dots] d_{t-1} \\ &\quad \dots \dots \dots \\ &\quad - \phi(1 - \phi)^k [1 + (1 - \phi) + (1 - \phi)^2 + \dots] d_{t-k} \\ &\quad + \phi(1 - (1 - \phi)L)^{-1} e_{t-1} \end{aligned} \quad (\text{A7})$$

Simplifying this expression gives;

$$\phi(1 - (1 - \phi)L)^{-1} \ln(\gamma z_{t-1}) = \ln V_t - (1 - (1 - \phi)L)^{-1} d_t + \phi(1 - (1 - \phi)L)^{-1} e_{t-1}. \quad (\text{A8})$$

Notice that the expected value of this is $\ln V_t$ as assumed above. Returning now to the expression (A3) we can express the variance in question as;

$$k = E[(1 - (1 - \phi)L)^{-1} (\phi e_{t-1} - d_t)]^2. \quad (\text{A9})$$

This is,

$$k = (1 - (1 - \phi)^2)^{-1} [\phi^2 \sigma_e^2 + \sigma_d^2 + 2\text{Cov}(e_t, d_t)]. \quad (\text{A10})$$

Notice that the expression for k can be simplified by rearranging $\phi = \frac{k}{k + \sigma_e^2}$. This

gives;

$$k = \frac{\phi}{(1 - \phi)} \sigma_e^2. \quad (\text{A11})$$

Replacing k in equation (A10) with this gives;

$$\frac{\phi}{(1 - \phi)} \sigma_e^2 = (1 - (1 - \phi)^2)^{-1} [\phi^2 \sigma_e^2 + \sigma_d^2 + 2\text{Cov}(e_t, d_t)]. \quad (\text{A12})$$

Further simplification of this expression leads to the following quadratic;

$$\phi^2 [\sigma_e^2 + 2\text{Cov}(e_t, d_t)] + \phi [\sigma_d^2 + 2\text{Cov}(e_t, d_t)] - \sigma_d^2 = 0. \quad (\text{A13})$$

We can now revert back to a quadratic expression for k by substituting $\phi = \frac{k}{k + \sigma_e^2}$ in

order to obtain an expression for k that does not include ϕ . This leads to the

following expression;

$$\frac{k^2}{(k + \sigma_e^2)^2} [\sigma_e^2 + 2\text{Cov}(e_t, d_t)] + \frac{k}{(k + \sigma_e^2)} [\sigma_d^2 + 2\text{Cov}(e_t, d_t)] - \sigma_d^2 = 0 \quad (\text{A14})$$

and multiplying both sides by $(k + \sigma_e^2)^2$ gives;

$$k^2 [\sigma_e^2 + 2\text{Cov}(e_t, d_t)] + (k + \sigma_e^2) k [\sigma_d^2 + 2\text{Cov}(e_t, d_t)] - (k + \sigma_e^2)^2 \sigma_d^2 = 0. \quad (\text{A15})$$

Simplification of this expression gives the following quadratic;

$$k^2 - k [\sigma_d^2 + 2\text{Cov}(e_t, d_t)] - \sigma_e^2 \sigma_d^2 = 0. \quad (\text{A16})$$

Under the assumption that the covariance term is zero we obtain equation (3) in the paper.

Appendix 2: Derivation of derivative and its relation to Teoh and Wong's

The variance k is the solution to the following quadratic relation (see Appendix 1 equation 16):

$$k^2 - k[\sigma_d^2 + 2\text{Cov}(e_i, d_i)] - \sigma_e^2 \sigma_d^2 = 0.$$

We assume that the covariance term is zero. This gives rise to two possible solutions for k but only one of these gives rise to a positive value for this variance. This is;

$$k = 0.5 \left[\sigma_d^2 + \sqrt{(\sigma_d^2)^2 + 4\sigma_e^2 \sigma_d^2} \right] \quad (\text{A17})$$

Thus,

$$\frac{d\phi}{d\sigma_e^2} = \frac{d\phi}{d\phi^{-1}} \frac{d\phi^{-1}}{d\sigma_e^2 k^{-1}} \frac{d\sigma_e^2 k^{-1}}{d\sigma_e^2} \quad (\text{A18})$$

or,

$$\frac{d\phi}{d\sigma_e^2} = \frac{-\phi^2}{k} \left[\frac{k - \sigma_e^2 \left(\frac{dk}{d\sigma_e^2} \right)}{k} \right]. \quad (\text{A19})$$

This is the Teoh and Wong (1993) derivative multiplied by a positive fraction (i.e., it is a smaller derivative than obtained by Teoh and Wong). To prove this it is

necessary to show (i), $\frac{dk}{d\sigma_e^2} > 0$ and that (ii), $k > \sigma_e^2 \left(\frac{dk}{d\sigma_e^2} \right)$. These are now proved.

(i) Using the implicit function theorem with $f = k^2 - k\sigma_d^2 - \sigma_e^2 \sigma_d^2 = 0$.

$$\frac{dk}{d\sigma_e^2} = \left[-\frac{df}{d\sigma_e^2} \frac{dk}{df} \right] = \frac{\sigma_d^2}{2k - \sigma_d^2} > 0. \quad (\text{A20})$$

A slight rearrangement of (A.17) shows that $2k > \sigma_d^2$ so that the above statement is true. Q.E.D.

(ii) The approach used to show that the second inequality holds is to start with the statement of the inequality and re-express both sides until the inequality is obviously true.

Thus,

$$k > \sigma_e^2 \frac{dk}{d\sigma_e^2}. \quad (\text{A21})$$

implies that,

$$k = 0.5 \left[\sigma_d^2 + \sqrt{(\sigma_d^2)^2 + 4\sigma_e^2 \sigma_d^2} \right] > \frac{\sigma_e^2 \sigma_d^2}{2k - \sigma_d^2} = \sigma_e^2 \frac{dk}{d\sigma_e^2}. \quad (\text{A22})$$

or from a rearrangement of (A.17),

$$k = 0.5 \left[\sigma_d^2 + \sqrt{(\sigma_d^2)^2 + 4\sigma_e^2 \sigma_d^2} \right] > \frac{\sigma_e^2 \sigma_d^2}{\sqrt{(\sigma_d^2)^2 + 4\sigma_e^2 \sigma_d^2}} = \sigma_e^2 \frac{dk}{d\sigma_e^2}. \quad (\text{A23})$$

or multiplying all terms by $\sqrt{(\sigma_d^2)^2 + 4\sigma_e^2 \sigma_d^2}$ the inequality becomes;

$$0.5 \left[\sigma_d^2 \sqrt{(\sigma_d^2)^2 + 4\sigma_e^2 \sigma_d^2} + (\sigma_d^2)^2 \right] + 2\sigma_e^2 \sigma_d^2 > \sigma_e^2 \sigma_d^2. \quad (\text{A24})$$

This is obviously true since all terms are positive and the last term in the expression on the left hand side of the inequality is double the size of the right hand side of the inequality. This proves that the second inequality is true. Q.E.D.

Appendix 3: Exploring the expression ϕ and the relation between scenarios

Recall that,

$$k = (1 - (1 - \phi)^2)^{-1} \left[\sigma_d^2 + \phi^2 \sigma_e^2 \right]. \quad (\text{A25})$$

And since $\phi = k(k + \sigma_e^2)^{-1}$ we have $k = \phi(1 - \phi)^{-1} \sigma_e^2$.

Substituting for k in the first expression gives,

$$\phi(1-\phi)^{-1}\sigma_e^2 = (1-(1-\phi)^2)^{-1}[\sigma_d^2 + \phi^2\sigma_e^2]. \quad (\text{A26})$$

or,

$$\phi \frac{(1-(1-\phi)^2)}{(1-\phi)} \sigma_e^2 = [\sigma_d^2 + \phi^2\sigma_e^2]. \quad (\text{A27})$$

or,

$$\frac{\phi^2}{(1-\phi)} \sigma_e^2 = \sigma_d^2. \quad (\text{A28})$$

Let $R = \frac{\sigma_d^2}{\sigma_e^2}$, which is the signal-to-noise ratio and gives rise to the following quadratic;

$$\phi^2 + \phi R - R = 0. \quad (\text{A29})$$

Solving for ϕ we obtain;

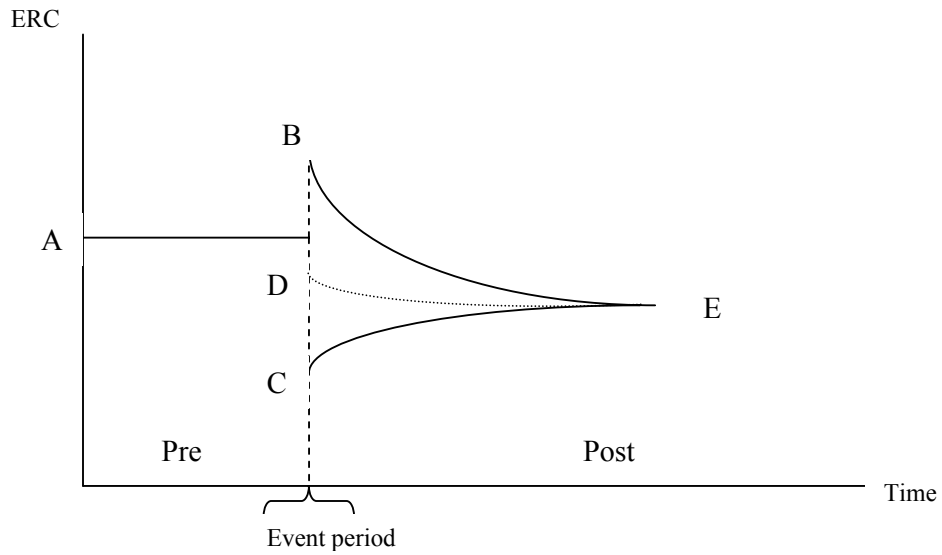
$$\phi = \frac{-R \pm \sqrt{R^2 + 4R}}{2}. \quad (\text{A30})$$

So $0 < \phi < 1$ and $\phi \rightarrow 1$ as $R \rightarrow \infty$. This is just another form of the adage that the signal-to-noise ratio matters greatly for the weight given to new information signals.

For the case where $R \rightarrow \infty$ as $\sigma_e^2 \rightarrow 0$, we obtain the result that was discussed in scenario 1. This is the case where signals are noiseless and all the weight is given to the new information signal.

Since it is possible to think of σ_e^2 and σ_d^2 as subjective objects, our analysis can be extended to allow the Enron event to affect both of these subjective variances. Although this presents some interesting avenues for investigation, we expect that the Enron event will have affected σ_e^2 more than σ_d^2 and for most reasonable assumptions our results are unaffected by this generalization.

Figure 1. Impact and long-run effect of Enron on ERCs



A indicates the pre-Enron equilibrium ERC. **E** indicates the new long-run post-Enron equilibrium ERC. **B**, **C** and **D** represent three alternative impact-effects of the Enron event on ERCs. In the case of **B** both pre- and post-Enron information is viewed as less reliable but the perceived deterioration of pre-Enron information is significantly greater than the perceived deterioration of post-Enron information. In the case of **C** both pre- and post-Enron information is viewed as less reliable but the perceived deterioration of pre-Enron information is less than the perceived deterioration of post-Enron information. **D** is an intermediate case.

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Table 1
Variable definitions

<i>Variable and definition(CRSP/Compustat codes)</i>
RET: Annual return, calculated by compounding 12-monthly returns (RET) starting 3-months after the accounting year end.
(EBEI): Change in income before extraordinary items (#237) scaled by market value at the beginning of the accounting year (#25 * #PRC).
SIZ: Natural log of total capital employed (#6 - #5) measured at the beginning of the accounting year.
MTB: Market value (#PRC * #25) relative to book value (#60) measured at the beginning of the accounting year.
LEV: Leverage, calculated as long-term debt (#9) scaled by capital employed (#6-#5) measured at the beginning of the accounting year.
Beta: The start of year beta.

Table 2
Descriptive statistics:

	Pre-Demeaned Data					De-Meaned Data		
	Mean	Median	StDev	Min	Max	StDev	Min	Max
RET	-18.84	-9.1	84.3	-582.9	316.1	78.1	-591.5	303.3
EBEI	-0.16	0.018	42.0	-500	500	41.9	-425.5	505.3
MTB	3.3565	1.999	3.568	0	13.893	3.510	-4.283	11.616
LEV	0.2293	0.150	0.253	0	1.122	0.263	-0.270	1.328
SIZ	12.3019	12.106	2.082	4.615	20.620	2.069	-7.528	8.089
Beta	0.9973	0.906	0.701	0	3.681	N/A	N/A	N/A

Correlation coefficients for the demeaned data

	RET	EFO	MTB	LEV	SIZ
RET	1				
EBEI	0.154	1			
MTB	-0.158	0.024	1		
LEV	0.009	0.028	-0.084	1	
SIZ	0.071	-0.040	-0.073	0.246	1

Notes:

The Table reports descriptive statistics for raw and demeaned data and correlation coefficients for the demeaned data. RET is the annual % return, calculated by compounding the monthly returns starting from 3 months after the accounting year-end. EBEI is the % change in income before extraordinary items scaled by market value at the beginning of the period. Size is the natural log of total assets. MTB is the market to book ratio, calculated as the market value of equity scaled by the book value of assets. LEV is leverage, calculated as long-term debt scaled by total capital employed. Detailed variable definitions are reported in Table 1.

Table 3
Nonlinear Least Squares Direct and Reverse Regressions
Auditor specific ERCs Pre- and Post-Enron

<i>Explanatory Variables</i>	Direct Regression		<i>Explanatory Variables</i>	Reverse Regression	
	<i>Coefficients</i>	<i>Std error</i>		<i>Coefficients</i>	<i>Std error</i>
MTB	-0.0029***	0.0001	MTB	-0.0094***	0.0026
LEV	0.0198***	0.0026	LEV	0.0541*	0.0327
SIZ	-0.0068***	0.0002	SIZ	-0.0011	0.0041
KPM*EBEI_PRE	0.0497***	0.0126	KPM*RET_PRE (5 th)	1.0529***	0.2553
AND*EBEI_PRE	0.0415***	0.0091	AND*RET_PRE (2 nd)	1.3915***	0.3788
DEL*EBEI_PRE	0.0356***	0.0081	DEL*RET_PRE (6 th)	1.0023***	0.2680
ERN*EBEI_PRE	0.0274***	0.0077	ERN*RET_PRE (1 st)	1.4301***	0.3724
PWC*EBEI_PRE	0.0316***	0.0079	PWC*RET_PRE (4 th)	1.1190***	0.3296
RES*EBEI_PRE	0.0336***	0.0129	RES*RET_PRE (3 rd)	1.2329***	0.5024
KPM*EBEI_POST	0.0229***	0.0041	KPM*RET_POST (6 th)	0.2016**	0.0659
AND*EBEI_POST	0.0081**	0.0041	AND*RET_POST (2 nd)	0.4344***	0.2153
DEL*EBEI_POST	0.0188***	0.0068	DEL*RET_POST (4 th)	0.3054**	0.1220
ERN*EBEI_POST	0.0134***	0.0046	ERN*RET_POST (1 st)	0.5092**	0.2352
PWC*EBEI_POST	0.0131***	0.0037	PWC*RET_POST (5 th)	0.2649**	0.1062
RES*EBEI_POST	0.0256***	0.0059	RES*RET_POST (3 rd)	0.3582**	0.1889
Risk Premium Pre	0.0170***	0.0019	Risk Premium Pre	0.0149*	0.0105
Risk Premium Post	0.0173***	0.0029	Risk Premium Post	0.0146	0.0142
Adjusted R ²	0.0302		Adjusted R ²	0.0494	
DW	2.06		DW	2.16	
N	12,658		N	12,658	
Big-5 Equality pre-Enron	3.093 (p=0.5424)		Big-5 Equality pre-Enron	2.692 (p=0.6106)	
Big-5 Equality post-Enron	7.385 (p=0.1168)		Big-5 Equality post-Enron	3.387 (p=0.4952)	
Big-5 Equality pre-post	24.439 (p=0.0002)		Big-5 Equality pre-post	18.813 (p=0.0021)	
Equality pre-post	4.146 (p=0.0417)		Equality pre-post	13.618 (p=0.0002)	
KPMG			KPMG		
Equality pre-post ANDERSEN	11.3165 (p=0.0008)		Equality pre-post ANDERSEN	6.542 (p=0.0105)	
Equality pre-post DELOITTE	2.614 (p=0.1059)		Equality pre-post DELOITTE	6.789 (p=0.0091)	
Equality pre-post ERNST	2.43 (p=0.1190)		Equality pre-post ERNST	6.401 (p=0.0114)	
Equality pre-post PWC	4.424 (p=0.0354)		Equality pre-post PWC	6.996 (p=0.0082)	
Equality pre-post REST	0.320 (p=0.5717)		Equality pre-post REST	3.138 (p=0.0765)	
Equality risk premium	0.0424 (p=0.8368)		Equality risk premium	0.001 (p=0.9734)	

Notes

The Table reports the results of direct and reverse nonlinear regressions involving unexpected returns (RET) and unexpected earnings (EBEI). Multiplicative auditor dummies are included for the pre and post Enron periods to capture auditor specific ERCs where the auditors are denoted as follows; KPM=KPMG, AND=Andersen, DEL=Deloitte & Touche, ERN=Ernst & Young, PWC=PricewaterhouseCoopers and RES= all others. Market-to-book, Leverage and Size variables are demeaned for time only while returns and earnings are demeaned for time and sectoral fixed-effects. *** ** and * denotes significance at the 1%, 5% and 10% levels (two-tailed), respectively. In the case of the reverse regression results, we list the ranking of the ERC (in size terms) next to the explanatory variable name. Wald tests of restrictions that are reported have Chi-Squared distributions under the null. P-values for these test statistics are given in brackets. All tests are conducted subject to robust estimation for heteroscedasticity.

Table 4
Nonlinear Least Squares Instrumental Variable Regression
Auditor specific ERCs Pre- and Post-Enron

<i>Explanatory Variables</i>	Direct Regression	
	<i>Coefficients</i>	<i>Std error</i>
MTB	-0.0031***	0.0001
LEV	0.0742***	0.0075
SIZ	-0.0095***	0.0002
KPM*EBEI_PRE	0.0569***	0.0133
AND*EBEI_PRE	0.0623***	0.0090
DEL*EBEI_PRE	0.0494***	0.0078
ERN*EBEI_PRE	0.0292***	0.0076
PWC*EBEI_PRE	0.0457***	0.0080
RES*EBEI_PRE	0.0523***	0.0131
KPM*EBEI_POST	0.0018	0.0134
AND*EBEI_POST	0.0094*	0.0061
DEL*EBEI_POST	0.0022	0.0114
ERN*EBEI_POST	0.0010	0.0046
PWC*EBEI_POST	0.0117*	0.0050
RES*EBEI_POST	-0.0098	0.0188
Risk Premium Pre	0.0391***	0.0028
Risk Premium Post	0.0607***	0.0066
Adjusted R ²	0.022	
DW	2.058	
N	12,658	
Equality pre-post	61.375 (p=0.0000)	
Equality of Premium	21.271 (p=0.0000)	
Hausman Test,	228.802 (p=0.0000)	
Chi-Squared(7)		

Notes

The Table reports the results of the direct nonlinear regression involving unexpected returns (RET) and unexpected earnings (EBEI). In the case of the post-Enron period the earnings are instrumented by semi-annual earnings. Multiplicative auditor dummies are included for the pre and post Enron periods to capture auditor specific ERCs where the auditors are denoted as follows; KPM=KPMG, AND=Andersen, DEL=Deloitte & Touche, ERN=Ernst & Young, PWC=PricewaterhouseCoopers and RES= all others. Market-to-book, Leverage and Size variables are demeaned for time only while returns and earnings are demeaned for time and sectoral fixed-effects. ***, ** and * denotes significance at the 1%, 5% and 10% levels (two-tailed), respectively. Wald tests of restrictions that are reported have Chi-Squared distributions under the null. P-values for these test statistics are given in brackets. All tests are conducted subject to robust estimation for heteroscedasticity. The Hausman test for the significance of the instruments is also provided.

Endnotes

¹ This is also predicated on the assumption that investors are incapable of decomposing z_t into its components (or estimates of the components). Note that under certain assumptions about $Cov(e_t, d_t)$ it would be possible to decompose the signal into its permanent and transitory components (see, e.g., Beveridge and Nelson 1981 and Watson 1986). We assume that the typical investor does not possess knowledge of this covariance and cannot decompose the signal but we assume that the variance of the noise in the signal σ_e^2 can be estimated and we regard this as public knowledge.

² In doing so we ignore the fact that the variance process itself can be regarded as reviseable in the light of new information (see Harvey 1989).

³ Chaney and Philipich (2002) find no significant abnormal market reaction to Andersen's clients in either November or December 2001, but find an adversely significant reaction in January 2002.

⁴ An example from Collins and Kothari (1989, page 160) is an inverse-ERC of 5.8 (standard error 0.34). If we assume a capitalization factor of 10 this implies a Bayesian weight of $(0.58)^{-1}$ or 1.72.