Valuation Weights, Linear Dynamics and Accounting Conservatism: An Empirical Analysis

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Abstract

Residual income models provide an important theoretical link between equity valuation and financial statement variables. While various researchers have developed models of how accounting policy impacts on the structure of these models, empirical support for these models is at best weak and frequently contradictory. In this paper, we develop an analytical model, which identifies the dependency between valuation weights in residual income models and the associated structure of earnings information dynamics and accounting conservatism. In contrast to many earlier studies, we find strong evidence of conservatism in our reformulation of the linear dynamics. We proceed to test our predictions of the dependency of the weights on two measures of conservatism, the conventional measure of price-to-book ratio and the recent measure of a C-Score index developed by Khan and Watts (2009) and find that the empirical results accord well with our theoretical predictions in the case of the former but not the latter measure.

Keywords: Equity valuation, Accounting conservatism, Book value, Residual income models

JEL classification: M41; G12

Data: Compustat and CRSP

Valuation Weights, Linear Dynamics and Accounting Conservatism: An Empirical Analysis

Residual income valuation models attempt to link the intrinsic value of equity to observable financial statement variables (see for example Edwards and Bell 1961; Peasnell 1982; Ohlson 1995). One of the major problems faced in this literature is how to deal with distortions produced by differing accounting policies. One such distortion that has attracted considerable attention is the principle of accounting conservatism. While much theoretical progress has been made in understanding how conservatism affects valuation models[1], less progress has been made as regards the specification of the functional dependency of these valuation weights on conservatism. In this paper, we develop an analytical structure that makes strong predictions on how the weights attached to accounting variables in residual income valuation models are affected by conservatism. This leads to a reformulation of the associated linear information dynamics. We then proceed with extensive testing of these predictions using U.S. data over the period 1963-2006. Our empirical investigations explore a number of related issues, including the basic structure of residual income models and the efficacy of alternative measures of conservatism.

In contrast to Feltham and Ohlson (1996) and Ashton and Wang (2008), who develop detailed parametric models of specific types of accounting conservatism, such as accelerated depreciation and delayed recognition of 'good' news, we start from the premise that the essential feature of conservatism is the delay in the recognition of increases in the economic value of assets. An over cautious depreciation policy, the expensing of investment in research and development or human resources, the ignoring of holding gains in the nominal value of assets subject to inflation, are all examples of unconditional conservatism that result in the delay of the

[1] See Feltham and Ohlson 1995, 1996; Beaver and Ryan 2000; Zhang X 2000; Zhang G 2000; Rajan, et al. 2007; Ashton and Wang 2008.

recognition of economic income and asset values. The early recognition of 'bad' news and the delayed recognition of 'good' news (Basu 1997) is an example of conditional conservatism, which also fits neatly into our paradigm. Hence, our general theoretical modelling approach captures aspects of both conditional and unconditional forms of conservatism (Beaver and Ryan 2005; Lara, et al. 2009). Our approach enables us to identify a linear transformation linking the hypothesized unbiased and unobservable accounting system of Ohlson (1995) to that of a reported system biased by conservatism. In order to reconcile comprehensive income to reported core earnings, we recognize the role played by dirty surplus items. Hence, in our empirical implementation of a residual income valuation model, we introduce an accounting variable, which represents the dirty surplus items.

These transformation and adjustments for conservatism result in strong predictions about the dependency on the degree of conservatism of the coefficients of the reported accounting variables in the residual income valuation model as well as the structure of the associated information dynamics. Using a comprehensive list of U.S companies, on the Compustat and the CRSP database from 1963 to 2006, we subject these predictions to extensive empirical testing. We find strong support for the predictions of the dependency of the valuation weights on conservatism and strong support for our reformulation of the associated linear information dynamics but our research revisits fundamental questions about the basic structure of the Ohlson (1995) valuation model[2]. Our empirical investigation consists of two distinct phases. In the initial phase of our empirical investigation, we estimate the values of the parameters in the linear information dynamics. Residual income valuation models are in one to one correspondence with their associated linear information dynamics, which describe how earnings and book values evolve over time or time series property of abnormal earnings. If we view conservatism as merely a process that delays the recognition of economic earnings, then we can see that one way to approach this issue is to identify the impact of conservatism on linear information dynamics.

[2] Dechow, et al. (1999) find that analysts place much more emphasis on earnings than on equity book values.

This line of reasoning has been investigated by several researchers (Feltham and Ohlson 1995; Myers 1999), arguing that accounting conservatism is reflected in the information dynamics by adding a lagged book value component with a positive coefficient increasing in the degree of conservatism. However, almost all empirical investigations so far fail to detect a positive coefficient for book value in their formulation of the linear information dynamics (Dechow, et al. 1999; Myers 1999; Beaver and Ryan 2000; Choi, et al. 2006). The structure of the linear dynamics implied by our valuation model involves two lags in the book value terms, with restrictions on these coefficients similar to that in Pope and Wang (2005) and Clubb (2012). We find the empirical evidence strongly supports this structure.

In the second and follow up phase, we estimate the coefficients, or weights, defining the relationship between prices and accounting fundamentals. We test the dependency of these coefficients on two different measures of conservatism, price-to-book (P/B) and C-score (Khan and Watts 2009). The first of these, the ratio of price-to-book value, is a natural measure of accumulated conservatism. It is a convenient and widely used metric despite its limitations[3]. It is essentially a measure of 'balance sheet conservatism' largely arising from the undervaluation of assets. Its weakness is that it captures elements of financial policy not solely related to accounting conservatism. For example, Fama and French (1992, 1993, 1995) suggest that P/B may capture firms' growth opportunity. Price-to-book can be useful in predicting expected equity return since price-to-book has been viewed as a leading indicator of companies' growth. However, of overriding importance in our use of this metric is that we develop a simple, yet general, functional relationship between valuation, linear information parameters and the long-run price-to-book ratio.

Theory also suggests that conservatism is related to a firm's leverage, size and growth opportunities (Watts 2003a, 2003b). Hence we might expect that the effect of conservatism to differ across industries, since leverage and growth opportunities vary across industries.

[3] See for example, Ahmed, et al. 2000; Beaver and Ryan 2000, 2005; Givoly and Hayn 2000; Givoly, et al. 2007.

Motivated by the notion and measurement of conditional accounting conservatism in Basu (1997), Khan and Watts (2009) develop C-score. C-score is a linear function of firm-specific characteristics: price-to-book ratio, size and leverage providing a firm-year index of conservatism. This provides an alternative measure of conservatism and a further test of the relationships that we develop between the valuation parameters and conservatism. Recently, Givoly, et al. (2007) examine the relationship among a number of proxies of conservatism, including the timeliness measure (Basu 1997), the amount of ‘‘unrecorded reserves’’ (Penman and Zhang 2002), the sensitivity of the firm’s current return to the change in cash investments and the lagged change in operating assets (Easton and Pae 2004), and the ratio of the book value of operating assets to their market value. Consistent with earlier research, they find a negative association between the Basu’s (1997) measure and alternative measures of conservatism (Pope and Walker 2003; Pae, et al. 2005; Beaver and Ryan 2005). Givoly et al. (2007) argue, “The exclusive reliance on any single measure to assess the overall conservatism of a reporting regime (firms, countries, or time periods) is likely to lead to incorrect inferences.” We also find that the strength of our results does depend on the measurement of conservatism used, with the simple price-to-book measure producing the strongest results.

The rest of the paper is set out as follows. In Section 1, we introduce the formal modelling, specifying the valuation equations and the form of the linear information dynamics from which we will estimate the relevant parameters. In Section 2, we set up our hypotheses concerning the dependency of these parameters on the degree of conservatism. Section 3 describes the data and sample descriptive statistics. In Section 4, we report the results of our empirical investigations into the impact of conservatism on alternative formulations of the linear dynamics. Section 5 explores the dependency of the valuation weights attached to accounting variables on our two measures of conservatism. In section 6, we review our findings and their possible implications for future research.

1. Information Dynamics, Valuation Models and Conservatism

We start by assuming a reported accounting information set, $\Lambda_t = \{b_t, e_t, d_t\}$, where b_t, e_t and d_t are respectively book values of equity, earnings and dividends at time t. Under the assumption that the clean surplus relationship (CSR) holds, the information set $\{b_t, e_t, d_t\} \equiv \{b_t, b_{t-1}, e_t\}$, where b_{t-1} is the one-year lag in book value. This reported system is presumed biased because of accounting conservatism and is the manifestation of transactions in a hypothesised unbiased[4], but unobservable, accounting system, represented by $\Lambda'_t = \{b'_t, e'_t, d_t\} \equiv \{b'_t, b'_{t-1}, d_t\}$. In this system, b'_t, b'_{t-1} and e'_t are respectively unbiased book value and lagged book value of equity and earnings at time t. We interpret conservatism as the delay in the recognition of increases in economic wealth in reported earnings. For example, in the case of accelerated depreciation, we are delaying the recognition of the economic income stream from those assets. In historical cost accounting under inflationary conditions, we delay the recognition of assets holding gains (Ashton et al. 2011), while conditional conservatism usually involves the reluctance to recognise uncertain 'good' news. Thus, conservatism implies that we recognise immediately only a fraction $\frac{\chi_t}{1+\chi_t}$ of the increase in wealth[5], i.e.

$$e_t = e'_t - \frac{\chi_t}{1+\chi_t}(b'_t - b'_{t-1}), \tag{1}$$

where $\chi_t > 0$ captures the degree of accounting conservatism. Under CSR $d_t = e'_t - (b'_t - b'_{t-1}) = e_t - (b_t - b_{t-1})$, we have:

$$b'_t - b'_{t-1} = (1+\chi_t)(b_t - b_{t-1}), \tag{2}$$

and

$$e_t = e'_t - \chi_t (b_t - b_{t-1}). \tag{3}$$

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[4] Consistent with Ohlson (1995), an unbiased system implies the expected long run convergence of book value and market value of equity. In addition to conservative accounting standards, other reasons, such as earnings manipulation can cause the biases. However, conservative accounting is our focus in this paper.

[5] We measure wealth in term of unbiased book values. In the long run, this measure converges to market values but in the short run unbiased book and market values may differ by the extent of positive or negative residual income.

Hughes, et al. (2004) and Ashton and Wang (2008) develop parametric models of specific examples of conservatism such as accelerated depreciation, historical cost accounting under inflation and the delayed recognition of 'good' news. Their analysis is consistent with our more general framework. These parametric approaches establish the existence of a summary measure of conservatism that is dependent on the specific accounting policy being analysed and is mathematically equivalent to our general summary measure χ_t. For the purpose of our analysis, we assume a long-run consistency in accounting policy such that

$$\chi_t = \chi + u_t,\ \forall t, \tag{4}$$

where χ is a constant and u_t is an independent and identically distributed (i.i.d.) random variable with zero mean. This randomness is not driven by any arbitrariness in the accounting policy, rather the policy is consistently applied but economic events change the circumstances under which the policy is implemented. Thus for example in the case of accelerated depreciation, while the long-run average asset-mix may be assumed to be a constant, it is likely to change from year to year. In the case of historical cost accounting, the inflation rate changing over time induces different degrees of conservatism. In the case of the conditional conservatism of Basu (1997), it is the size and arrival rate of 'good' news that drives the stochastic nature of u_t. Thus with the foregoing assumptions the expected long-run solution to equation (2) implies $b'_t - b'_0 = (1+\chi)(b_t - b_0)$. Under the assumption that long-run growth is positive ensuring that b_0 and b'_0 are insignificant compared with b_t and b'_t, we can write book value and earnings in unbiased system in terms of accounting observables as follows:

$$E[b'_t \mid \Lambda_t] = (1+\chi)b_t, \tag{5}$$

and

$$E[e'_t \mid \Lambda_t] = e_t + \chi(b_t - b_{t-1}). \tag{6}$$

These equations are identical to those established in Ashton and Wang (2008) who examine a number of different examples of accounting conservatism in detail and hypothesise the existence of a general form.

Ohlson's (1995) modelling of an unbiased accounting system provides a natural framework and starting point for exploring how, and the extent to which, conservatism affects accounting fundamentals in equity valuation. He assumes that expected unbiased economic rents x'_t are eroded by competition and follow a simple autoregressive process decaying at a rate ω, where $x'_t = e'_t - (R-1)b'_{t-1}$ and R is one plus the cost of capital, as in equation below:[6]

$$x'_{t+1} = \omega x'_t + \varepsilon_{t+1}, \tag{7}$$

where ε_{t+1} is a mean zero error term. This leads to the following valuation equation:

$$V'_t = b'_t + \frac{\omega}{R-\omega} x'_t = \frac{R(1-\omega)}{R-\omega} b'_t + \frac{R\omega}{R-\omega} e'_t - \frac{(R-1)\omega}{R-\omega} d_t . \tag{8}$$

In equation (8), income is assumed to be comprehensive. However, valuations by analysts are normally based on forecasts of long-term 'core' earnings. To reflect this, we partition comprehensive income e_t 'core earnings' denoted by ce_t and dirty surplus earnings denoted by de_t. In terms of the reported accounting numbers, equation (8) is transformed under the conservative accounting relations in equations (5) and (6) as follows:

$$E[V_t \mid \Lambda_t] = \frac{R(1-\omega)(1+\chi)}{R-\omega} b_t + \frac{R\omega(1+\chi)}{R-\omega} ce_t + \frac{R\omega(1+\chi)}{R-\omega} de_t + \frac{\omega}{R-\omega} d_t , \tag{9}$$

where the revised clean surplus relationship is $b_t = b_{t-1} + ce_t + de_t - d_t$. Thus following ideas in Ohlson (1999), the adjusted dirty surplus earnings (by dividends) can be estimated by the difference between increases in book equity and reported (core) earnings, $\left[(b_t - b_{t-1}) - ce_t\right] - d_t$, where term d_t represents the net (of new equity issues and share repurchases) cash dividends.

Similarly, equation (9) can be rewritten in terms of opening book value and abnormal core earnings using CSR as:[7]

[6] Since our purpose in this paper is to discuss the impact of accounting conservatism, we ignore the 'other information' variable.

[7] The model can also be rewritten in terms of book value, abnormal earnings and dividends. We have not reported the empirical results based on this model since they are very similar to those based on equation (10).

$$E[V_t \mid \Lambda_t] = R(1+\chi)b_{t-1} + \frac{R}{R-\omega}(1+\chi)x_t + \frac{R}{R-\omega}(1+\chi)de_t + \frac{\omega}{R-\omega}d_t, \qquad (10)$$

where the abnormal core earnings term, x_t is defined by $x_t = ce_t - (R-1)b_{t-1}$. Thus, the value of equity under this transformation depends on four variables, where the weights on (lagged) book values, (abnormal) earnings and adjusted dirty surplus earnings are adjusted by the parameter χ specifying the degree of conservatism. While equation (9) is in terms of book value, core earnings, adjusted dirty surplus earnings and net dividends, equation (10) is in terms of lagged book value, abnormal core earnings, adjusted dirty surplus earnings and net dividends. Consistent with intuition, the valuation weights on the understated book value and earnings are inflated by the degree of accounting conservatism.

Both models (9) and (10) will form the basis of our subsequent tests of the impact of conservatism on the valuation model. More specifically, we investigate empirically the relationship between our measures of conservatism and the coefficients of b_t, b_{t-1}, ce_t, x_t, de_t and d_t, obtained from regressions of price or market value on these variables.

Assuming that long-run economic rents are eroded by competition as in equation (7) and that changes in dirty surplus items are not forecastable[8], under the conservative accounting relations in equations (5) and (6), we can establish a relationship between abnormal earnings (x_{t+1}) and two abnormal growth in book value terms: ($Rb_t - b_{t+1}$) and ($Rb_{t-1} - b_t$), using the no arbitrage condition $E[V_{t+1} + d_{t+1} \mid \Lambda_{t+1}] = R\ E[V_t \mid \Lambda_t]$. However, this information dynamic is unsuitable for econometric testing because of the dependency between b_{t+1} and ε_{t+1}, resulting from the need to forecasts dividends. In the spirit of Lintner's (1956) analysis of dividend policy, by assuming that dividends are 1+g times the previous year's dividends, adjusted by the extent to which abnormal earnings exceed or fall short of this growth target, we can show that the abnormal earnings follow the process below:

[8] This is equivalent to the assumption that dirty surplus items are reported at fair value or have zero future net present value.

$$x_{t+1} = \omega x_t + \chi(1+g-\omega)(Rb_{t-1} - b_t) + \varepsilon_{t+1}. \qquad (11)$$

This is the same form, albeit derived from a different starting point as that in Pope and Wang (2005). They show that if price can be written in terms of book value, earnings and dividends and capital markets are free of arbitrage opportunities, the information dynamics obeyed by the reported system must be adjusted for conservative accounting policies as in equation (12),

$$x_{t+1} = \omega x_t + \omega_2 (Rb_{t-1} - b_t) + \varepsilon_{t+1}. \qquad (12)$$

Further, accounting is conservative if ω_2 > 0. In model (11), ω_2 assumes the specific form $\omega_2 = \chi(1+g-\omega)$ and conservatism corresponds to positive values for χ ($0 < \omega < 1$). Both Pope and Wang (2005) and model (11) suggest that conservatism can be captured by the inclusion of two book value terms, ($Rb_{t-1} - b_t$), in the information dynamics of abnormal earnings. Relative to Feltham and Ohlson (1995) model, this form for the linear information dynamics has at least two advantages. First, no matter what traditional deflator, such as book value and lagged book value we use, the conservatism embedded in the linear information dynamics does not affect the sign of the parameter, ω_2. We will explore this issue in our empirical investigation. Second, and most importantly, the valuation model does not require the estimation of growth rate of book value. Explicit estimates of the growth in book values are redundant in the valuation.

2. Testable Hypotheses

Equations (9), (10) and (12) provide a rich source for the testing of our theoretical valuation models and information dynamics. Initially we shall concentrate on tests of the linear information dynamics as identified in equation (12) and the determination of the value of the information parameter, ω since the valuation weights in equations (9) and (10) are functions of the parameter ω and the cost of capital *R*. This will enable us to examine separately the accuracy of the valuation weights as in Ohlson (1995) and the validity of the adjustments for conservatism made in this paper.

2.1 Linear information dynamics and accounting conservatism

To date, published empirical tests of conservatism in earnings information dynamics have been restricted in a simple Feltham and Ohlson (1995) setup with a single book value and abnormal earnings. Specifically, the implemented linear information dynamics, excluding the 'other information' variable is:

$$\frac{x_{t+1}}{\pi_t} = \omega_0 + \omega_1 \frac{x_t}{\pi_t} + \omega_2 \frac{b_t}{\pi_t} + \varepsilon_{t+1}. \qquad (13)$$

Here we denote our information parameter ω by ω_1 to distinguish it from the 'conservative' parameter ω_2, which is expected to be positive under accounting conservatism. The deflator π_t, used to control for the inherent heteroskedasticity in accounting variables, has normally been one of price (P_t), lagged book value (b_{t-1}) and book value (b_t) in prior literature.[9]

If theory is correct, deflated information dynamics should reflect the property of accounting conservatism no matter whether the deflator $\pi_t = P_t$, b_t or b_{t-1}; thus, from equation (12) it follows that conservatism implies that $\omega_2 > 0$ in the following equation:

$$\frac{x_{t+1}}{\pi_t} = \omega_0 + \omega_1 \frac{x_t}{\pi_t} + \omega_2 \frac{Rb_{t-1} - b_t}{\pi_t} + \varepsilon_{t+1}. \qquad (14)$$

Based on the above theoretical analysis, and assuming that market is competitive and accounting is conservative, we can develop the following hypotheses.

Hypothesis 1(a): $0 < \omega_1 < 1$ and $\omega_2 > 0$, independent of the choice of deflator $\pi_t = P_t$, b_t or b_{t-1} in equation (14).

If we separate two book value terms, we can test:

$$\frac{x_{t+1}}{\pi_t} = \omega_0' + \omega_1' \frac{x_t}{\pi_t} + \omega_2' \frac{b_{t-1}}{\pi_t} + \omega_2'' \frac{b_t}{\pi_t} + \varepsilon_{t+1}. \qquad (15)$$

[9] See for example, Myers 1999; Dechow, et al. 1999; Akbar and Stark 2003; Choi, et al. 2006; Barth and Clinch 2009.

Consistent with theoretical prediction, the sign of deflated b_{t-1} is positive and deflated b_t is negative and combined term, $(Rb_{t-1} - b_t)$, is positive. Specifically, based on the model, we can develop hypothesis and predict $\omega_2' > 0$, and $\omega_2'' < 0$ in the following equation:

$$\frac{x_{t+1}}{P_t} = \omega_0' + \omega_1' \frac{x_t}{P_t} + \omega_2' \frac{b_{t-1}}{P_t} + \omega_2'' \frac{b_t}{P_t} + \varepsilon_{t+1}. \tag{16}$$

We expect $\omega_2'' < 0$ in the following equation:

$$\frac{x_{t+1}}{b_{t-1}} = \omega_0 + \omega_1' \frac{x_t}{b_{t-1}} + \omega_2'' \frac{b_t}{b_{t-1}} + \varepsilon_{1,t+1}, \tag{17}$$

and $\omega_2' > 0$ in the following equation:

$$\frac{x_{t+1}}{b_t} = \omega_0 + \omega_1' \frac{x_t}{b_t} + \omega_2' \frac{b_{t-1}}{b_t} + \varepsilon_{1,t+1}. \tag{18}$$

Hypothesis 1(b): $0 < \omega_1' < 1$, $\omega_2' > 0$, and $\omega_2'' < 0$ when the deflator $\pi = P_t$ in equation (16). $\omega_2'' < 0$ when $\pi = b_{t-1}$ in equation (17) and $\omega_2' > 0$ when $\pi = b_t$ in equation (18).

2.2. Valuation weights and conservatism

We next turn our attention to corresponding tests of the valuation equations, (9) and (10). We write equation (9) in the form:

$$V_{jt} = \alpha_{0j} + \alpha_{1j} b_{jt} + \alpha_{2j} ce_{jt} + \alpha_{3j} de_{jt} + \alpha_{4j} d_{jt} + \varepsilon'_{jt}, \tag{19}$$

and base our analysis on a group *j*, which is assumed homogeneous in the degree of accounting conservatism χ_j. In our empirical investigations, group j, will consist of one of; a single firm, an industry group, or a group formed from a decile ranking of some measure of the degree of conservatism. Regression gives us estimates of $\alpha_{1j}, \alpha_{2j}, \alpha_{3j}$ and α_{4j}, which incorporate the measure of conservatism χ_j. This leads us to the following testable hypothesis.

Hypothesis 2(a): In equation (9), the coefficients of equity book value, core earnings, and adjusted dirty surplus earnings, α_{1j}, α_{2j} and α_{3j}, are increasing functions of the degree of conservatism, while the coefficient of net dividends α_{4j} is independent of our measure of conservatism. Further, the weights α_{1j}, α_{2j} and α_{3j} obtained from the regression of price on book value, core earnings and adjusted dirty surplus earnings, as in equation (9) are directly proportional to the degree of conservatism where the constants of proportionality of α_{1j}, α_{2j} and α_{3j} are $\frac{R(1-\omega)}{R-\omega}$, $\frac{R\omega}{R-\omega}$ and $\frac{R\omega}{R-\omega}$ respectively.

Similarly, we can express equation (10) in the form:

$$V_{jt} = \alpha_{0j} + \alpha_{1j} b_{jt-1} + \alpha_{2j} x_{jt} + \alpha_{3j} de_{jt} + \alpha_{4j} d_{jt} + \varepsilon''_{jt}, \qquad (20)$$

and develop a corresponding hypothesis for this model.

Hypothesis 2(b): In a regression of price on lagged book value, abnormal core earnings, adjusted dirty surplus earnings, and the dividend terms, the coefficients of lagged book value, abnormal core earnings and adjusted dirty surplus earnings are increasing functions of the degree of conservatism, while the coefficient of net dividends is independent of our measure of conservatism. Similarly, the weights α_{1j}, α_{2j} and α_{3j} obtained from the regression of price on lagged book value, abnormal core earnings and adjusted dirty surplus earnings, as in equation (10) are directly proportional to the degree of conservatism where the constants of proportionality of α_{1j}, α_{2j} and α_{3j} are R, $\frac{R}{R-\omega}$ and $\frac{R}{R-\omega}$ respectively.

Hypotheses 2(a) and 2(b) are of course joint hypotheses. They rely on the validity of the original Ohlson (1995) formulation, the appropriateness of any adjustments for accounting conservatism and the treatment dirty surplus earnings. They also rely on whether any measures of conservatism that we use accurately reflect the reality of conservative accounting practices. We can at least, in part, extricate ourselves from issues surrounding the validity of the parameters of proportionality and their dependency on ω and R in hypotheses 2(a) and 2(b). If we compute scaled values of $\frac{\alpha_{ij} - \bar{\alpha}_{i.}}{\bar{\alpha}_{i.}}$, where $\bar{\alpha}_i$ (i =*1-3*) is the average value of α_{ij} over conservative groups *j*, then these scaled values should be independent of the parameters ω and R and equal to $\frac{\chi_j - \bar{\chi}}{1+\bar{\chi}}$ for each j, where $\bar{\chi}$ is the average value of χ_j. This gives rise to hypothesis 2(c) below.

Hypothesis 2(c) : The rescaled weights $\frac{\alpha_{ij} - \bar{\alpha}_i}{\bar{\alpha}_i}$ $, i = 1-3$ for group *j*, assumed homogeneous in the degree of accounting conservatism χ_j obtained from regression equations (19) and (20) should be equal across *i*.

3. Data and Sample Descriptive Statistics

We collect relevant data from Compustat's entire dataset from 1963-2006. Firms with negative book values (Compustat item #60) are deleted. (Core) earnings are measured as net income before extraordinary items (#18). Following Khan and Watts (2009), when we estimate C-score, price is the market value of equity at the end of the fiscal year (#199). We also use this price to compute our first proxy measurement of conservatism, ratio of price-to-book. However, when we estimate parameters in equations (9) and (10), the dependent variable is the market value of equity at three months after the end of the fiscal year from CSRP. Here we implicitly assume that valuation relevant information in financial statements becomes public information three months after the end of the fiscal year. All variables used in our estimation are divided by the number of shares in issue to reduce heteroskedasticity in the pooled data samples. Size is the logarithm of a firm's market capitalisation, computed from the product of price and number of shares outstanding (#25). Leverage is total debt divided by the firm's market capitalisation. Total debt is the sum of long-term debt (#9) and short-term debt (#34). Price-to-book ratio is measured by the market value of equity and the book value of equity at the end of the year. Net dividends are common dividends (#21) adjusted for purchases and sales. Observations with a price per share less than $1 are deleted. Firms in the extreme percentiles of earnings, book value, price, earnings-to-price, return on book equity, size, market-to-book ratio and leverage are also excluded (Ball, et al. 2000; Khan and Watts 2009). Summary descriptive statistics can be found in Table 1.

<Insert Table 1 about here>

4. Empirical Results: Time Series Property of Abnormal Earnings and Conservatism

We first explore the structure of the linear information dynamics and hypothesis 1. We construct a panel data set of 11,342 companies over the period 1963-2006, a total of 85,957 company-year observations. Following Dechow et al. (1999) and others, we assume a cost of capital R = 1.12 in the calculation of residual incomes and as the discount factor in the valuation models[10]. We used a fixed effects model on an unbalanced panel to produce estimators of the aggregate values of ω_1 and ω_2 for the entire data set. The results are shown in Table 2, where the t-statistics shown are based on robust estimators of the standard errors allowing for intra-firm correlations. In Panel A we note whatever the deflator used the coefficient ω_2 of $(Rb_{t-1} - b_t)$ is significantly positive, while ω_1 is in a plausible range comparable with the existing literature. In Panel B, we report on the separate treatments of lagged book value and contemporary book values as well as an unrestricted combination. In all cases, we find a positive coefficient ω_2' attached to lagged book value, a negative coefficient ω_2'' attached to current book values and ω_1 is between 0.4 and 0.5. For comparison in Panel C, we also report the case where only a single book value term is included on the right hand side.[11] As in prior literature (Myers 1999; Choi, et al. 2006), we note

[10] We tried the effect of using other constant costs of capital, R=1.09, and R=1.15. We also tried to estimate the time-varying cost of equity capital as the mean of the treasury yield for the relevant calendar year plus an assumed market risk premium of 5 percent. The monthly yield on U.S. treasury bonds with maturities greater than 10 years is collected from Datastream. Although this altered the significance of some of the coefficients, it did not appear to affect the sign of the coefficients.

[11] Single book value, either b_t or b_{t-1}, shows the similar results.

a strong negative dependency for the coefficient ω_2 of book value, contrary to the prediction in the Feltham and Ohlson (1995) model.

<Insert Table 2 here>

One may argue that information parameters should reflect firm-specific characteristics. This is because the information parameters may reflect firms' economic environment, production technology and accounting policies. As a robustness test, we repeat the above analysis for individual firms using per share data by investigating firms that have more than 20 consecutive annual observations. In Panel A of Table 3, we note a strong preponderance of positive estimates for the values for ω_2, the coefficient of ($Rb_{t-1} - b_t$) with 79% of the coefficients being positive and 30% significantly positive at a 5% level. Only 21% are negative of which only 2.4% are significantly negative. In contrast, when we use just a single book value term as reported in Panel B, we note that 84% of the coefficients are negative with 27% being significantly negative. Only 1.2% of the coefficients are significantly positive[12]. We also note that the persistence of abnormal earnings, ω_1, is between zero and 1 as expected.

<Insert Table 3 here>

In summary, our reformulation of the linear information dynamics consistent with a residual income model incorporating conservatism in its weights suggests that a possible reason for the failure to detect conservatism in earlier studies is attributable to a misspecification of the econometric model to be tested. Moreover, our empirical investigations of the linear information dynamics have furnished us with plausible estimates of the information parameter, $\omega (= \omega_1)$ which we can use when we explore the impact of conservatism on the valuation weights.

5. Empirical Results: Valuation and Conservatism

[12] We observe a similar preponderance of negative coefficients when we replace b_t by b_{t-1} in panel B of Table 3.

So far, we have discussed conservatism as a relatively abstract concept in terms of a measure χ that links the unbiased accounting of Ohlson (1995) to that of a reported system. To test our hypotheses with respect to valuation weights, we need a measure of conservatism.

5.1 Measurement of accounting conservatism

Ohlson (1995) definition of unbiased accounting implies the long run expected convergence of book and market values. In our case this implies

$$\lim_{s\to\infty} E_t[P_{t+s} - b'_{t+s}] = \lim_{s\to\infty} E_t[P_{t+s} - (1+\chi)b_{t+s}] = 0 . \qquad (21)$$

When accounting is more conservative, book value is understated more relative to its true economic value. Hence, we can use the long run mean ratio of price-to-book as our first proxy measurements of conservatism. Consistent with the convergence condition implied by equation (21), we also use the metric of the ratio of $\sum P_t$ to $\sum b_t$, where the summation is over time for individual firms and over all company-years for an industry grouping. The aggregated values of price-to-book are expected to mitigate against trends and extreme observations (Bernard and Durluf, 1996). Our other measure of conservatism, C-score, is documented in Khan and Watts (2009). Following their estimation procedure, we run the following cross-sectional fixed effect panel model using annual data:

$$e_{it} / P_{it-1} = \beta_1 + \beta_2 D_{it} + r_{it}\mu F_{it} + D_{it} r_{it} \lambda F_{it} + v_{it} ,$$

where D is a dummy variable, which takes the value 1 if $r_{it} < 0$ and 0 otherwise,

$\mu = (\mu_1, \mu_2, \mu_3, \mu_4),\ \lambda = (\lambda_1, \lambda_2, \lambda_3, \lambda_4),$ and $F_{it} = (1, size_{it}, P_{it} / b_{it}, Lev_{it})'$, r_{it} is equity return for firm i at year t, v_{it} is an error term. We use the same factors that they claim give the most promising measure of conservatism, C-score = λF_{it} . This results in equation (22) as the computational basis for C-score.

$$\text{C-score} = 0.180 - 0.046\times\text{size} + 0.051\times\text{P/B} + 0.033\times\text{leverage} . \qquad (22)$$

Increasing values of C-score are associated with higher levels of conservatism. Hence if we were to rank firms by increasing C-scores we would also expect to observe higher values of α_{1j}, α_{2j} and α_{3j} in equations (9) and (10).

5.2 Valuation weights and conservatism

Our hypotheses 2(a)-2(c), contain a series of predictions about how the weights in linear regression models of price against accounting variables depend upon the degree of conservatism. In particular, it states that the weights attached to book value, lagged book value, reported earnings, abnormal earnings and adjusted dirty surplus earnings are all increasing functions of conservatism, while those attached to dividends are independent of conservatism. We form panel data sets by classifying each company into one of 10 deciles *j*, according to their mean price-to-book over the period. We also form decile panel data sets constructed from grouping firms according to the mean values of their C-score over the period. We use a fixed effects panel data model with both a firm dummy and time dummy to estimate the values of $\alpha_{1j}, \alpha_{2j}, \alpha_{3j}$ and α_{4j} using equation (9):

$$p_{ijt} = \alpha_{0j} + \eta_i + \eta_t + \alpha_{1j}\, b_{ijt} + \alpha_{2j}\, ce_{ijt} + \alpha_{3j}\, de_{ijt} + \alpha_{4j}\, d_{ijt} + \varepsilon_{ijt}, \tag{23}$$

where subscript *ijt* denotes firm *i*, in decile group *j*, at time period *t*, η_t captures the cross-sectional year-by-year variations for all firms in the group at year *t*, η_i controls for components of ε_{ijt} that are fixed for firm *i*. We adopt robust estimation procedure to allow for intra-group correlations. In our subsequent analysis, we shall refer to the results derived from using equation (23) as model 1.

We repeat this process for the different combination of the relevant accounting variables as defined in equations (10) to run the regression:

$$p_{ijt} = \alpha_{0j} + \eta_i + \eta_t + \alpha_{1j}\, b_{ijt-1} + \alpha_{2j}\, x_{ijt} + \alpha_{3j}\, de_{ijt} + \alpha_{4j}\, d_{ijt} + \varepsilon_{ijt}\, p_{ijt}, \tag{24}$$

In the subsequent analysis, we shall refer to the results derived from using equation (24) as model 2. We display our results in Table 4.

<Insert Table 4 here>

In Panel A of Table 4, deciles are formed on the basis of mean price-to-book; in Panel B of these tables, deciles are formed based on mean C-score. Our theoretical model predicts that the coefficients of book value, lagged book value (α_{1j}), earnings and abnormal earnings (α_{2j}) as well as that of adjusted dirty surplus earnings (α_{3j}) should be monotonic increasing in the degree of conservatism. When we use mean P/B as a proxy measure of conservatism, Panel A shows that this prediction is borne out in the case of lagged book value in model $2(\alpha_{1j})$, earnings and abnormal earnings (α_{2j}) and reasonably well in the case of adjusted dirty surplus earnings (α_{3j}). Net dividends on the other hand show no relationship to price-to-book decile rankings, in line with hypotheses 2(a) and 2(b). Somewhat surprisingly,[13] we find no strong relationship between the coefficient of book value in model $1(\alpha_{1j})$ and our measure of χ based on price-to-book. We shall return to this issue later after we have explored other conservative groupings.

When we classify the degree of conservatism according to C-score, as shown in Table 4, Panel B, the results provide very limited support for our hypotheses. A cursory inspection reveals in general the absence of monotonicity with just some evidence of a positive dependency in the case of book value and lagged book value (α_{1j}). This is of course consistent with the fact that C-score contains price-to-book as an element in its construction. The weakness of C-score is that its construction suggests that it identifies a propensity for a firm to pursue conservative accounting policies. In contrast the use of price-to-book as a measure of conservatism is

[13] It might be thought that using P/B as the dependent variable that it would load strongly on current book values. However in determining the coefficient α_{1j}, the price is taken as three months after the fiscal year end, whereas P/B is a historical measure based on average values over the period of the firms existence within our data set.

consistent with our earlier theoretical development as in equation (21). It should also be remembered that this test for monotonicity is a joint test of the Ohlson (1995) model, the theoretical adjustments to the original parameters made in this paper plus the appropriateness of our measurement of conservatism. The mere existence of the positive relationships observed when we use price-to-book as our measure of conservatism, while encouraging, does not in itself establish the validity of our modelling process. We need to carry out further empirical tests to explore both the linearity and proportionality of the dependence of the valuation weights on price-to-book as is implied in hypotheses 2(a)-2(c).

Table 5 presents a linear regression analysis of the coefficients $\alpha_{ij}, i = 1-4$ against the mean price-to-book as reported in Panel A in Table 4 for each of the 10 deciles. It is clear that the relationship for earnings, abnormal earnings and lagged book value is very strong with R-squared in excess of 90% and R-squared in excess of 72% for the regression of dirty surplus items against the price-to-book decile. In this context model 2 performs particularly well, with strong positive linear relationships for abnormal earnings, lagged book value and dirty surplus items and no significant relationship for dividends. These relationships for model 2, α_{ij} ,$1 = 1,3$ are illustrated in Figure 1, Figures A-C. However, we notice that for the book value, core and abnormal earnings terms the constant is significantly different from zero contrary to our theoretical predictions. Perhaps this is not surprising since the coefficients, α_{ij} are also functions of the cost of capital (R) and persistence of abnormal earnings (ω). The cost of capital and persistence of abnormal earnings are likely to differ between firms in the same 'conservative' decile.

<Insert Table 5 and Figure 1 about here>

Our theoretical valuation modelling as in equations (9) and (10), implies not only that the relationship between earnings, abnormal earnings and dirty surplus items should be monotonic but it should also be proportional to $1+\chi$ with slope coefficients based on Ohlson (1995) residual income model as in equation (8). This idea is formalised in our Hypotheses 2(a) and 2(b).

The analysis of Section 4 provides us with theoretical parameter bounds for the slope coefficients of the regression reported in Table 3, Panel A. For the restricted sample, we estimate the interquartile range for ω to be 0.042 to 0.592 with a median of 0.389. The mean as reported in Table 2 appears to be somewhat higher taking a value between 0.406 and 0.509. Ashton and Wang (2012) suggest a plausible range for the cost of equity capital for US market over the period to be between 8 percent to 15 percent. We can use these estimates to identify a theoretical ranges for the slope of the coefficients ($\alpha_{ij}, i = 1, 4$) when regressed against price-to-book ($= 1 + \chi$), as in Table 6.

<Insert Table 6 here>

As can be seen by a comparison of the slope coefficients in the regression of price-to-book with the theoretical interquartile ranges in Table 6, only the slope of the coefficient of abnormal earnings, with a value of 1.695, lies within the theoretical range. The slope of the earnings coefficient is too high while those of book value, lagged book value and dirty surplus are too low. Referring back to Table 4, Panel A, we also note that the mean coefficients of dividends, with values of 0.078 and 0.178 for models 1 and 2 respectively lie at the lower end of the theoretical ranges. These results are in line with earlier research. Dechow et al. (1999) in their investigation of the Ohlson (1995) model over the period 1976-1995 in regressions of price on book values and abnormal earnings obtained coefficients for book value of 0.40 and 3.88 for abnormal earnings. In Table 4, Panel A, we report the mean coefficients (α_{1j}) of b_t, column 3, in model 1 and of abnormal earnings (α_{2j}), column 8, in model 2 to be 0.425 and 3.91 respectively.

We also note in this context that the parameter values are very sensitive to the value of the information parameter ω, as opposed to the value of the cost of capital *R*. Ashton and Wang

(2008) using an almost identical data set, but one which is based on per share data adjusted for capitalisation changes as opposed to aggregate data used in this paper, estimate an interquartile range for ω of 0.37 to 0.84 with a median value[14] of 0.61. This results in interquartile ranges of 0.55 to 3.82 and 1.48 to 4.54 for earnings and abnormal earnings respectively, while those for dirty surplus earnings are 0.55 to 3.88 and 1.48 to 4.54. Although this brings a few more observations into the fold, it does not totally resolve the issue; neither does it explain the observed coefficients on book values. The explanation proffered by Dechow et al. (1999) is that analysts place much more emphasis on earnings than on equity book values. This may well be so and as a result prices at least in the short-term track earnings rather than book values. An alternative explanation is that the Ohlson (1995) model is too simplistic, particularly its failure to separate operating assets and income from financial assets and income. We have adopted a simple treatment of assets where we assume that we can treat the book value of all assets as generating a constant return *R* and all income components being subject to the same degree of erosion ω by competition[15].

The tests reported above are of course joint tests of the Ohlson (1995) residual income model and of our adjustments to it. Hypothesis 2(c) provides a way of exploring empirically our adjustments to the valuation weights in the Ohlson (1995) model independent of the actual values of those weights. Using the results reported in Table 2, we carry out analysis in which we regress scaled[16] values of the coefficients for abnormal earnings against lagged book value and dirty surplus items. We display the results for models 1 and 2 in the last two columns of Panels C and D of Table 5, while Figure 1D illustrates the graph for the case of the coefficients of abnormal earnings plotted against those for lagged book values. In the case of model 1, there is

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[14] We presume that these higher values for ω are attributable to the inherent intertemporal smoothing with such data.

[15] For example Franzen and Radhakrishnan (2009) suggest that the degree of erosion attached to R&D expense may only be appropriate to profit making firms. Stark (2008) provides further evidence of the importance of attaching different weights to individual components of earnings such as R&D.

[16] For example in the case of abnormal earnings and *j*=7, $\frac{\alpha_{2,7}-\bar{\alpha}_{2.}}{\bar{\alpha}_{2.}}=\frac{4.223-3.91}{3.91}=0.079$.

no evidence of a relationship between the scaled coefficients for core earnings and book values. However, in the case of the scaled coefficients of core earnings against dirty surplus earnings the slope is significantly different from zero but not from unity. Although the fit is better for the coefficients in model 2, hypothesis 2(c) is not fully supported in that the slopes are both less than unity. However, this may well be caused by the fact that both regressor and regressand are subject to the problem of errors in variables, which will likely create an underestimation of the true slope coefficient. Certainly, we cannot reject the hypothesis that the adjustment of weights by the long run measure of price-to-book is in line with the theory developed in this paper.

We merely note at this stage that in general the results from using model 1, which involves price, book value, core earnings and dividends are less satisfactory. We also note that judged purely on the values of R-squared, model 2 is superior to model 1. One possible explanation is in the classification of income and capital items. If we rewrite the clean surplus relationship as $b_t - de_t + d_t = R\,x_t + b_{t-1}$, we see that cum-dividend book value less dirty surplus items can be written in terms of abnormal earnings and lagged book value. Now, total abnormal earnings will be equal to the abnormal operating earnings given zero abnormal financial earnings in an efficient capital market. Thus the partitioning of the various component items, particularly those where the choice of accounting treatment is ambiguous, is likely to affect the valuation weights and hence their dependency on conservatism. This problem is likely to be more prevalent in items such as closing book values, dirty surplus adjustments and adjustments for new equity. For these reasons and that of space we do not present further detailed tabular analysis of either C-score or model 1. Instead we merely report our findings in footnotes emphasising where the results differ from those reported on model 2.

Another unsatisfactory feature of the regression results reported in Table 5, is the existence of constants in the regression that are significantly different from zero. Hypotheses 2(a) and 2(b) argue for direct proportionality to the degree of conservatism. One possible explanation of this is that the decile groupings in Table 4, while homogeneous in the degree of conservatism are not homogeneous in the proportionality constants, being as they are, functions of both the parameter ω in the linear information dynamics and the cost of capital *R*. We thus explore an alternative grouping of conservatism by industry. We group the 11,342 firms into 48 industries using the Fama and French (1997) industry classification to form 48 unbalanced panel data sets. Again we first estimate the coefficients $\alpha_{ij}, i = 1-4$ for each industry group j, using the specifications as in equations (9) and (10). We then regress these observed coefficients against our two preferred measures of conservatism, the mean price-to-book[17] and the long run price-to-book. The results of this analysis based on model 2[18] are reported in Table 7.

<Insert Table 7 here>

We observe in Table 7 that, in line with hypothesis 2(a), the slope coefficients of $\alpha_{ij}, i = 1-3$ based on the measure price-to-book are all of the correct sign and are all significant, whilst that for dividends α_{4j} is not significant. In Table 7, we notice that, with the exception of the coefficient of abnormal earnings when regressed against mean value of price-to-book, none of the constants is significantly different from zero, neither is there a significant difference between the regression coefficients based on mean values of price-to-book with those observed in Table

[17] In industry panel analysis, we have tried to de-trend the price-to-book values for each industry by calculating

$$\left(\frac{P}{b}\right)_j = \frac{1}{N_{i\in j}} \frac{1}{T} \sum_{i\in j} \sum_t \left[\frac{P_{ijt}}{b_{ijt}} - \left(\frac{P}{b}\right)_t \right] + \frac{\overline{P}}{b},$$

where N is the number of firms in industry j, T is the number of sample years, $\left(\frac{P}{b}\right)_t = \frac{1}{N_i} \sum_i \frac{P_{it}}{b_{it}}$, i.e. the mean P/B for each year t; and $\frac{\overline{P}}{b} = \frac{1}{T} \sum_t \left(\frac{P}{b}\right)_t$, i.e. the mean P/B for all years.

We also de-trend price-to-book by regressing price-to-book on stock return on an industry basis to remove market sentiment. The λ_j residual in $\left(\frac{P}{b}\right)_{jt} = \lambda_j + \lambda_t + \beta_j R_{jt} + \varepsilon_{jt}$ can be regarded as de-trended measurement of accounting conservatism. This is in the spirit of Beaver and Ryan (2000) without any lagged return as explanatory variables. The results, without reported here, are similar.

[18] We also carried out this analysis for model 1 and C-score (neither reported in detail). The results for model 1 with price-to-book as our measure of conservatism were similar in that the signs and significance of the coefficients were the same. However, both the R-squareds and t-statistics were smaller. The results for C-score were much weaker for both models than those when using P/B as our measure of conservatism.

5, Panel B. We note however that the values of R-squared are significantly less than those observed in Table 5. Hence, we appear to swap homogeneity in our measure of conservatism, which impacts on the significance of the slope for the reduced heterogeneity in the parameters, ω and R which determine the value and significance of the constant.

In our final test, again we concentrate purely on model 2, ignore C-score and focus on individual firms. In order that we can make reasonable regression estimates of the four $\alpha-$coefficients together with a constant term, we restrict ourselves to the subset of firms that have at least 20 continuous observations. This subset consists of 996 firms with 26,408 observations over the sample year from 1963-2006. The results of our analysis are reported in Table 8.

<Insert Table 8 here>

We observe that the coefficients of lagged book value, abnormal earnings and dirty surplus earnings all have the correct signs and are highly significant. We also note that none of the constants for these regressions is significantly different from zero, supporting the hypothesis of strict proportionality dependence on our price-to-book measure of conservatism. The coefficient of dividends (defined as the net flow to shareholders) shows a negative dependency whose significance or otherwise depends on the scaling. Here we cite the work of Ashton and Wang (2008) who carry out a similar piece of analysis on individual firms with an almost identical data set using model 1 but using data adjusted for capitalisation changes. This compares with our treatment of dividends as net cash flows[19] to shareholders, (i.e. after new issues and buy backs). These observations revisit the question about the nature and degree of aggregation/disaggregation that is appropriate in the formulation of residual income valuation models.

6. Concluding Remarks

[19] Even then, our treatment of dividends is still relatively simplistic. For example, Dedman, et al. (2010) find that the coefficient capturing the relationship between regular dividends and market value is higher than that for special dividends and share buybacks. This is in contrast to our treatment of dividends where the various components are treated by just one weighting coefficient.

In this paper, we have developed a mathematical formulation of the dependency of the valuation weights on conservatism in the residual income model developed by Ohlson (1995). The model development is based on the simple yet powerful insight that conservative accounting practice merely delays the recognition of uncertain future income. The resulting structure embraces the results of earlier parametric modelling, including Feltham and Ohlson (1996), Ashton and Wang (2008), and Basu (1997) of specific examples of conservative accounting practices. This reformulation of the valuation function also leads to a reformulation of the associated linear dynamics. In contrast to nearly all earlier studies (Dechow et al. 1999; Myers 1999; Beaver and Ryan 2000; Choi et al. 2006) investigating conservatism in the linear information dynamics, with our revised formulation we find strong evidence of conservatism. Moreover, we both argue, and show empirically, that the failure to detect conservatism in the linear information dynamics is almost certainly attributable to a misspecification of the problem.

Our next task was to explore the revised valuation models. Here we were subject to the problem of joint hypotheses where empirical testing depends on the correctness of each of; the Ohlson (1995) model, our reformulation and the measure of conservatism. In this context, we find that C-score performs poorly and proffer the explanation that C-score is really a measure of propensity to follow a conservative accounting policy and is too weak as an instrument for the sort of empirical work carried out in this paper. Our preferred measure of price-to-book, while closely related to the valuation structure, appears to equally well as regards both book value terms and income terms. Although we find strong evidence of direct proportionality to our measure of conservatism, we also find that the constant of proportionality differs significantly, except in the case of income measures, from that predicted in the Ohlson (1995) model. The other contribution resulting from our reformulation is the observations that a formal treatment of dirty surplus items helps to explain earlier empirically puzzling observation that the observed sign on dividends is positive when simple theory predicts a negative value (Rees, 1997; Hand and Landsman, 2005).

Despite our many positive findings, the research leaves a substantial number of questions on the structure of Ohlson (1995) residual income models unanswered. The first and most obvious one concerns the weights, irrespective of conservative adjustments, attached to book values and abnormal earnings. Nearly all the evidence in this paper and that of earlier researchers (e.g. Dechow et al. 1999) suggests that too little weight is attributable to book value. We also find that in general, but not always, too little weight is attached to dirty surplus items. The fact that the latter are frequently a mix of both 'book' and 'income' adjustments suggests that the problems may be related. One possible way of developing the model is a separate, and more detailed treatment of assets, by partitioning assets into operating assets from financial assets. As it stands, the formal mathematical treatment of theoretical accounting valuation models is relatively simplistic. Like most previous research carried out on US data, we have used aggregate data. In contrast, Ashton and Wang (2008) use data adjusted for changes in capitalisation. This results in higher values for the persistence of abnormal earnings and somewhat stronger results for dividend distributions. Which is the more appropriate is a moot point. A more formal treatment of operating and financial assets together with dirty surplus items may well prove a way forward to resolve some of these issues and to produce implementable accounting valuation models.

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Table 1: Sample Descriptive Statistics

Panel A	Mean	Stdev	Q1	Median	Q3
Price-to-Book ratio	1.970	1.746	0.956	1.479	2.333
Forward Earnings Yield	0.060	0.106	0.025	0.065	0.109
Return on Equity	0.084	0.159	0.043	0.108	0.161
Abnormal Earnings	-0.227	1.209	-0.659	-0.091	0.379
$Rb_{t-1} - b_t$	1.180	2.527	-0.028	0.596	1.654
Size	4.777	1.764	3.421	4.701	6.108
Leverage	0.743	0.981	0.128	0.393	0.948

Panel B: Correlation Matrix (Pearson Top; Spearman Bottom)

	P	*e*	*b*	*d*	*p/b*	roe	ey	size	Lev
P		0.64	0.62	0.47	0.18	0.34	0.22	0.68	-0.15
e	0.72		0.71	0.55	-0.14	0.57	0.67	0.37	0.02
b	0.71	0.74		0.59	-0.34	0.19	0.36	0.34	0.17
d	0.58	0.66	0.69		-0.15	0.18	0.25	0.32	0.10
p/b	0.30	-0.07	-0.40	-0.17		-0.07	-0.20	0.23	-0.29
roe	0.42	0.69	0.21	0.27	0.24		0.73	0.22	-0.07
ey	0.27	0.75	0.47	0.40	-0.28	0.71		0.07	0.04
size	0.73	0.42	0.40	0.37	0.38	0.25	0.03		-0.14
Lev	-0.12	0.08	0.26	0.20	-0.51	-0.12	0.17	-0.14	

Panel A shows descriptive statistics for 117,931 firm-years between 1963 and 2006. Firms in the extreme percentiles are deleted. Only stocks with price > $1 are included. The mean, standard deviation (stdev), median and first (Q1) and third (Q3) quartiles are reported. Forward earnings yield is net income before extraordinary items scaled by lagged market value of equity. Return on equity is net income before extraordinary items scaled by lagged book value. Size is the natural log of market value of equity. Leverage is defined as the sum of long term and short term debt deflated by market value of equity. R is assumed to be 1.12. Abnormal earnings = net income before extraordinary items per share – 0.12×lagged book value per share. b_t is book value per share at time t.

Panel B shows the annual cross-sectional correlations. The upper (lower) right triangle of the matrix shows Pearson (Spearman) correlations. *P*, *b* and *d* are respective price per share, book value per share and dividend per share. *e* is net income per share before extraordinary items. p/b is the market-to-book ratio. roe is eps scaled by lagged book value. Earnings yield (ey) is eps scaled by lagged price. Size is the natural log of market value of equity. Lev is leverage, defined as the sum of long term and short term debt deflated by market value of equity.

Table 2: Linear Information Dynamics and Conservatism: Pooled Sample

Panel A. Aggregate values of ω_j (j=0,1,2) for the entire sample, computed from

$$\frac{x_{t+1}}{\pi_t} = \omega_0 + \omega_1 \frac{x_t}{\pi_t} + \omega_2 \frac{Rb_{t-1} - b_t}{\pi_t} + \varepsilon_{t+1}$$

	ω_0	ω_1	ω_2	R^2
Deflated by Book Value	-0.023	0.406	0.069	0.343
	(-129.48)	(53.98)	(38.01)	
Deflated by Market Value	-0.019	0.509	0.058	0.367
	(-103.39)	(74.62)	(22.63)	
Deflated by Lagged Book Value	-0.024	0.431	0.081	0.326
	(0.0)	(49.66)	(23.58)	
Per Share Data (not deflated)	-0.234	0.470	0.064	0.312
	(-94.67)	(47.55)	(28.35)	

Panel B. Abnormal Earnings Dynamics and Relative Book Value Changes

$$\frac{x_{t+1}}{b_t} = \omega_0' + \omega_1' \frac{x_t}{b_t} + \omega_2' \frac{b_{t-1}}{b_t} + \varepsilon_{t+1},$$

$$\frac{x_{t+1}}{P_t} = \omega_0' + \omega_1' \frac{x_t}{P_t} + \omega_2' \frac{b_{t-1}}{P_t} + \omega_2'' \frac{b_t}{P_t} + \varepsilon_{t+1},$$

$$x_{t+1} = \omega_0' + \omega_1' x_t + \omega_2' b_{t-1} + \omega_2'' b_t + \varepsilon_{t+1}$$

	Intercept	ω'_1	ω_2'	ω_2''	R^2
Deflated by Book Value	-0.092	0.406	0.077		0.343
	(-47.94)	(53.98)	(38.01)		
Deflated by Market Value	0.009	0.429	0.063	-0.094	0.374
	(11.59)	(58.71)	(22.49)	(-36.38)	
Per share Data	0.424	0.466	0.065	-0.106	
	(23.47)	(50.80)	(27.33)	(-43.81)	0.270

Panel C : Information Dynamics with Only One Lagged Book Value

$$\frac{x_{t+1}}{\pi_t} = \omega_0 + \omega_1 \frac{x_t}{\pi_t} + \omega_2 \frac{b_t}{\pi_t} + \varepsilon_{t+1}$$

	ω_0	ω_1	ω_2	R^2
Deflated by Book Value	-0.018	0.327		0.311
	(-118.32)	(47.76)		
Deflated by Market Value	0.012	0.368	-0.038	0.359
	(15.22)	(57.43)	(-35.21)	
Deflated by Lagged Book Values	0.067	0.431	-0.081	0.326
	(18.22)	(49.66)	(-23.58)	

Table 2 Panel A reports ω_0, ω_1 and ω_2 for the entire sample, estimated from equation (14) for 1963–2006 corresponding to 85,957 firm-year observations. Panel B shows how relative book value changes capture accounting conservatism in linear information dynamics, specified in equations (16), (17) and (18)corresponding to 85,957 firm-year observations. Panel C reports ω_0, ω_1 and ω_2 for the entire sample based on linear information dynamics with one lagged book value. Cost of equity capital is assumed to be 12%. Values in the parenthesis are t-statistics.

Table 3: Linear Information Dynamics and Conservatism: Individual Firms

Panel A: The model: $x_{i,t+1} = \omega_{1i} x_{i,t} + \omega_{2i} (Rb_{i,t-1} - b_{i,t}) + \varepsilon_{i,t}$

	Coefficient Values				Coefficient Signs			
	Average	Lower Quartile	Median	Upper Quartile	Positive	Positive& Significant	Negative	Negative & Significant
ω_{1i}	0.476	0.042	0.389	0.592	92.1%	50.0%	7.9%	0.3%
ω_{2i}	0.052	-0.140	0.040	0.092	78.8%	30.0%	21.2%	2.4%

Panel B: The model: $x_{i,t+1} = \omega_{1i} x_{i,t} + \omega_{2i} b_{it} + \varepsilon_{i,t}$

	Coefficient Values				Coefficient Signs			
	Average	Lower Quartile	Median	Upper Quartile	Positive	Positive & Significant	Negative	Negative & Significant
ω_{1i}	0.381	-0.003	0.296	0.480	90.7%	46.8%	9.3%	0.8%
ω_{2i}	-0.054	-0.145	-0.063	-0.030	15.6%	1.2%	84.4%	27.2%

Table 3 summarises the magnitude and signs of the parameters in alternative formulations of the linear dynamics. Panel A shows the analysis of the parameters in the linear dynamics according to the revised formulation in this paper. Panel B shows analysis of the parameters in the linear dynamics in the formulation used by most previous researchers. The sample contains 996 US firms with at least 20 years of observations between 1963 and 2006. The cost of equity capital is assumed to be 12% and accounting variables are per share data. The level of significance is 5%.

Table 4: Analysis of Valuation Coefficients and Conservatism Based on Decile Sorts

Panel A: Decile Sorted on Mean Price-to-Book Ratio

Decile-j	Mean P/B	Model 1				Model 2			
		$\alpha_{1j}(\uparrow)$	$\alpha_{2j}(\uparrow)$	$\alpha_{3j}(\uparrow)$	$\alpha_{4j}(\rightarrow)$	$\alpha_{1j}(\uparrow)$	$\alpha_{2j}(\uparrow)$	$\alpha_{3j}(\uparrow)$	$\alpha_{4j}(\rightarrow)$
1	0.699	0.387	1.794	0.193	0.087	0.610	2.212	0.375	0.241
2	0.928	0.407	2.329	0.302	0.033	0.700	2.746	0.498	0.207
3	1.203	0.492	2.135	0.283	-0.021	0.744	2.689	0.538	0.132
4	1.284	0.470	2.572	0.260	0.022	0.776	3.119	0.452	0.123
5	1.419	0.479	3.225	0.172	0.037	0.870	3.823	0.391	0.111
6	1.705	0.422	3.274	0.445	-0.036	0.815	3.783	0.678	0.069
7	1.766	0.363	3.833	0.348	0.155	0.828	4.223	0.535	0.228
8	1.999	0.368	4.615	0.370	-0.123	0.961	4.997	0.604	-0.046
9	2.726	0.365	5.370	0.502	0.394	1.107	5.668	0.755	0.469
10	2.969	0.500	5.423	0.893	0.228	1.301	5.882	1.263	0.246
Mean	1.670	0.425	3.46	0.377	0.078	0.871	3.91	0.609	0.178

Panel B: Decile Sorted on Mean C-score

Decile-j	Mean P/B	Model 1				Model 2			
		$\alpha_{1j}(\uparrow)$	$\alpha_{2j}(\uparrow)$	$\alpha_{3j}(\uparrow)$	$\alpha_{4j}(\rightarrow)$	$\alpha_{1j}(\uparrow)$	$\alpha_{2j}(\uparrow)$	$\alpha_{3j}(\uparrow)$	$\alpha_{4j}(\rightarrow)$
1	-0.074	0.464	2.657	0.145	0.031	0.767	3.320	0.390	0.177
2	-0.018	0.443	3.313	0.323	0.103	0.838	3.858	0.564	0.228
3	0.014	0.356	3.593	0.274	-0.038	0.794	4.036	0.430	0.054
4	0.034	0.384	3.588	0.514	0.126	0.827	4.008	0.691	0.174
5	0.050	0.477	2.990	0.504	-0.055	0.889	3.413	0.779	0.086
6	0.069	0.431	3.482	0.222	-0.154	0.911	3.856	0.410	-0.113
7	0.082	0.471	3.098	0.219	0.060	0.884	3.519	0.498	0.181
8	0.117	0.545	2.893	0.460	0.075	0.942	3.390	0.775	0.200
9	0.130	0.556	2.612	0.144	-0.240	0.982	3.056	0.525	-0.104
10	0.185	0.564	1.971	0.372	-0.342	0.951	2.475	0.812	-0.244
Mean	0.059	0.469	3.020	0.318	-0.043	0.878	3.493	0.587	0.064

In Table 4, we compute the mean values of price-to-book and C-score for each of the 11,342 firms in our sample. We classify each firm into one of ten deciles based on their mean values of price-to-book and C-score. We used a fixed effects panel data to calculate the values of the coefficients $\alpha_{1j}, \alpha_{2j}, \alpha_{3j}$, and α_{4j} using the following equations:

Model 1: $$p_t = \alpha_0 + \eta_i + \eta_t + \alpha_{1j} b_t + \alpha_{2j} ce_t + \alpha_{3j} de_t + \alpha_{4j} d_t + \varepsilon_{jt}$$

Model 2: $$p_t = \alpha_0 + \eta_i + \eta_t + \alpha_{1j} b_{t-1} + \alpha_{2j} x_t + \alpha_{3j} de_t + \alpha_{4j} d_t + \varepsilon_{jt}$$

where i denotes firm i, in decile group j, at time period t. The subscripts attached to the accounting variables have been suppressed for the sake of clarity. $p_t, b_t, ce_t, x_t, de_t$ and d_t are respectively price, book value, core earnings, abnormal earnings, adjusted dirty surplus earnings and dividends.

Table 5: Regression of Relevant Coefficients in Panel A of Table 4 on Mean Price-to-Book

Panel A: Analysis of Model 1					Panel C: Analysis of Model 1, Scaled Coefficients		
	Book value (α_{1j})	Core Earnings (α_{2j})	Dirty Earnings (α_{3j})	Net Dividend (α_{4j})		Core Earnings v Book Values	Core Earnings v Dirty Earnings
P/B	-0.001	1.745	0.242	0.117	c_1	-0.059	1.106
t-value	(-0.02)	(11.38)	(4.62)	(2.02)	t-value	(-0.49)	(3.34)
Constant	0.426	0.543	-0.028	-0.118	c_0	0.000	0.000
t-value	(8.84)	(1.96)	(-0.29)	(-1.12)	t-Value	(-0.00)	(-0.00)
R^2	0.0%	94.2%	72.7%	33.7%	R^2	-9.2%	53.0%

Panel B: Analysis of Model 2					Panel D: Analysis of Model 2, Scaled Coefficients		
	Lagged Book Value (α_{1j})	Abnormal Earnings (α_{2j})	Dirty Earnings (α_{3j})	Net Dividend (α_{4j})		Abnormal Earnings v Lagged Book Values	Abnormal Earnings v Dirty Surplus
P/B	0.270	1.695	0.300	0.062	c_3	0.684	0.526
t-value	(11.07)	(12.44)	(4.58)	(0.99)	t-value	(8.53)	(3.34)
Constant	0.420	1.084	0.108	0.075	c_2	0.000	0.000
t-value	(9.52)	(4.40)	(0.91)	(0.67)	t-Value	(-0.00)	(0.00)
R^2	93.9%	95.1%	72.4%	-0.1%	R^2	88.8%	53.0%

In Table 5, Panels A and B in columns 2-5 we report the dependency of the coefficients $\alpha_{ij}, i=1,4$ for each decile j estimated in Table 4 on the corresponding mean value of Price-to-Book for decile j, using simple OLS regression.

In columns 7-8 we report the coefficients of $c_i, i=1,4$ in the regressions:

$$\frac{\alpha_{2j}-\bar{\alpha}_2}{\bar{\alpha}_2} = c_0 + c_1 \frac{\alpha_{1j}-\bar{\alpha}_1}{\bar{\alpha}_1}$$

and

$$\frac{\alpha_{2j}-\bar{\alpha}_2}{\bar{\alpha}_2} = c_2 + c_3 \frac{\alpha_{3j}-\bar{\alpha}_3}{\bar{\alpha}_3}$$

Table 6: Estimated Interquartile Range of Parameter Values in Equations (9) and (10)

	Form	Source Equation Model	Lower Quartile	Median	Upper Quartile
Book Value b_t	$\frac{R(1-\omega)}{R-\omega}$	Eq (9), Model 1	0.841	0.936	0.997
Lagged Book Value b_{t-1}	R	Eq (10), Model 2	1.080	1.120	1.150
Core Earnings e_t	$\frac{R\omega}{R-\omega}$	Eq (9), Model 1	0.044	0.596	1.310
Abnormal Earnings x_t	$\frac{R}{R-\omega}$	Eq (10), Model 2	1.038	1.532	2.213
Dirty Surplus Earnings	$\frac{R\omega}{R-\omega}$	Eq (9), Model 1	0.044	0.596	1.310
Dirty Surplus Earnings	$\frac{R}{R-\omega}$	Eq (10), Model 2	1.038	1.532	2.213
Dividends	$\frac{\omega}{R-\omega}$	Eq (9) and (10) Models 1 and 2	0.038	0.532	1.213

In Table 6, we estimate interquartile ranges for the constants of proportionality based on equation (9):

$$E[V_t \mid \Lambda_t] = \frac{R(1-\omega)(1+\chi)}{R-\omega} b_t + \frac{R\omega(1+\chi)}{R-\omega} ce_t + \frac{R\omega(1+\chi)}{R-\omega} de_t + \frac{\omega}{R-\omega} d_t \,,$$

and equation (10)

$$E[V_t \mid \Lambda_t] = R(1+\chi) b_{t-1} + \frac{R}{R-\omega}(1+\chi) x_t + \frac{R}{R-\omega}(1+\chi) de_t + \frac{\omega}{R-\omega} d_t \,.$$

We take the range for R, based on Ashton and Wang (2012) to be between 1.08 and 1.15 over the period. The interquartile range for ω is taken from Table 3, panel A.

Table 7: Valuation Coefficients and Conservatism Based on Industry Classification

	Dependent Variables			
	Coefficient of Lagged Equity Book Value		Coefficient of Abnormal Earnings	
Constant	0.089	0.165	1.208	1.547
t-value	(0.68)	(1.25)	(2.33)	(2.94)
$\sum p_i / \sum b_i$	0.515		1.547	
t-value	(5.98)		(4.54)	
Mean p/b		0.388		1.104
t-value		(5.31)		(3.82)
Adj-R^2	42.53%	36.61%	29.43%	22.44%

	Coefficient of Adjusted Dirty Surplus Earnings		Coefficient of Net Dividends	
Constant	0.465	0.352	0.688	0.833
t-value	(1.47)	(1.13)	(1.45)	(1.83)
$\sum p_i / \sum b_i$	0.724		-0.288	
t-value	(3.48)		(-0.92)	
Mean p/b		0.543		-0.323
t-value		(3.17)		(-1.29)
Adj-R^2	19.15%	16.14%	-0.31%	1.39%

Table 7 reports the relationship between valuation weights, $\alpha_{1j}, \alpha_{2j}, \alpha_{3j}, \alpha_{4j}$ and conservatism measured by price-to-book ratio. We group 11,342 firms (denoted by i) into 48 industries using the Fama-French industry classification. We estimate the coefficients $\alpha_{1j}, \alpha_{2j}, \alpha_{3j}, \alpha_{4j}$ for each industry j using a fixed effects panel model in equation:

$$V_{it} = \alpha_{0i} + \eta_i + \eta_t + \alpha_{1j} b_{it-1} + \alpha_{2j} x_{it} + \alpha_{3j} de_{it} + \alpha_{4j} d_{it} + \varepsilon_{it}$$

on a per share basis. A cost of capital of 12% was used in the calculation of abnormal returns. Values in the brackets are t-statistics.

Table 8: Valuation Coefficients and Conservatism Based on Time Series Analysis of Individual Firms

	Deflated by Market Index		Deflated by Annual Mean of (Price –Book)	
Panel A. Dependent variable: Coefficient of Lagged Equity Book Value				
Constant	-0.059	0.050	-0.040	0.047
t-value	(-0.85)	(0.72)	(-0.63)	(0.76)
$\sum p_i / \sum b_i$ (+)	0.746		0.748	
t-value	(18.07)		(20.13)	
Mean p/b (+)		0.633		0.649
t-value		(16.60)		(18.95)
R^2	24.72%	21.70%	28.97%	26.53%
Panel B. Dependent variable: Coefficient of Abnormal Earnings				
Constant	0.178	0.333	-0.653	-0.599
t-value	(0.43)	(0.82)	(-1.31)	(-1.24)
$\sum p_i / \sum b_i$ (+)	2.531		3.031	
t-value	(10.30)		(10.35)	
Mean p/b (+)		2.278		2.806
t-value		(10.21)		(10.60)
R^2	9.64%	9.50%	9.73%	10.15%
Panel C. Dependent variable: Coefficient of Adjusted Dirty Surplus Earnings				
Constant	1.166	0.959	1.680	1.463
t-value	(1.26)	(1.07)	(1.87)	(1.68)
$\sum p_i / \sum b_i$ (+)	1.928		1.905	
t-value	(3.55)		(3.61)	
Mean p/b(+)		1.683		1.655
t-value		(3.41)		(3.46)
R^2	1.25%	1.16%	1.29%	1.19%
Panel D. Dependent variable: Coefficient of Net Dividends				
Constant	5.082	5.344	2.240	2.671
t-value	(4.47)	(4.84)	(1.96)	(2.41)
$\sum p_i / \sum b_i$	-2.182		-1.218	
t-value	(-3.26)		(-1.81)	
Mean p/b		-2.198		-1.395
t-value		(-3.63)		(-2.29)
R^2	1.06%	1.30%	0.33%	0.52%

We estimate equation $V_{it} = \alpha_{0i} + \alpha_{1i} b_{it-1} + \alpha_{2i} x_{it} + \alpha_{3i} de_{it} + \alpha_{4i} d_{it} + \varepsilon_{it}$ for each of 996 firms with at least 20 observations using the S&P 500 index and the annual difference between mean of price and book value as a deflator. In the table, we report the relation between α_{ki} (k=1,2,3,4) and the measurement of conservatism χ_i by incorporating industry dummy variables. We use two measurements of conservatism: (i) mean of price-to-book ratio for the firm over the sample period; (ii) ratio of sum of price and sum of book value over the sample period.

Figure 1A

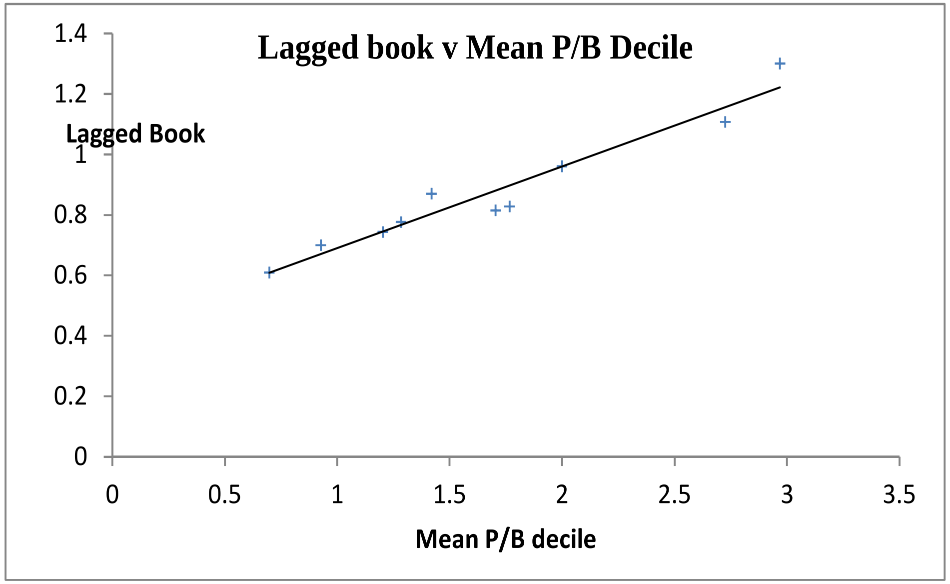


Figure 1B

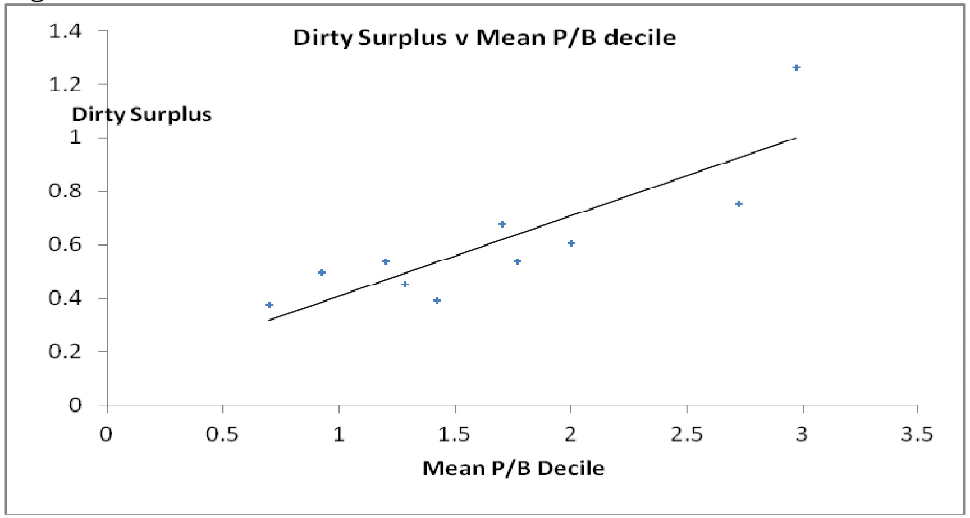


Figure 1C

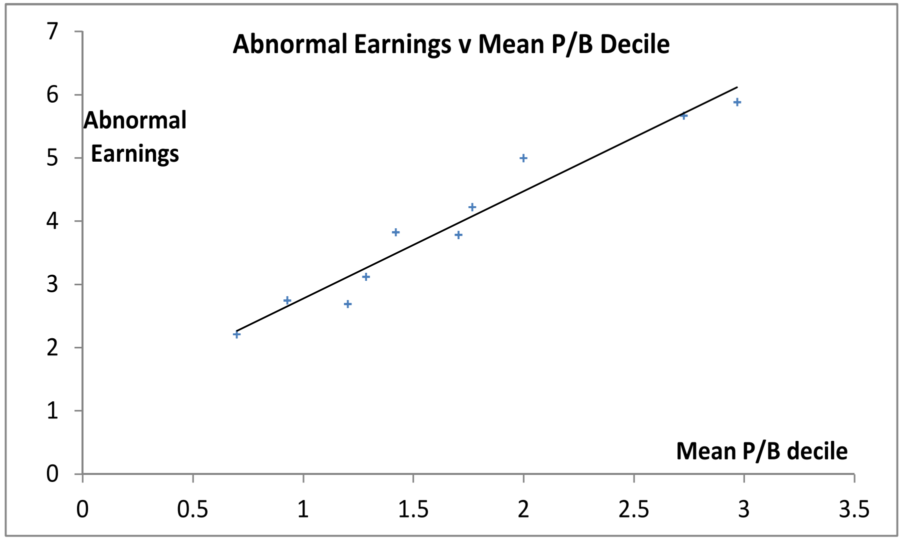
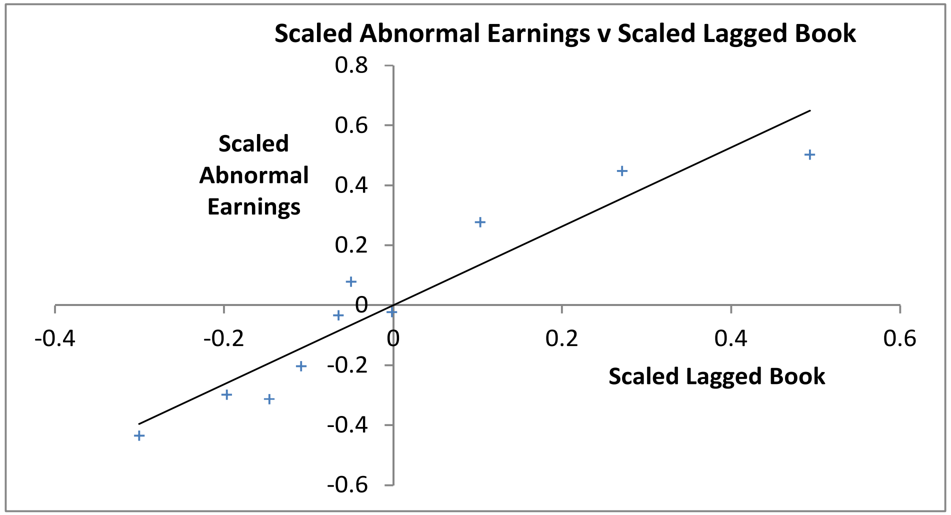


Figure 1D



Figures A-C, illustrate the graphs of the coefficients of accounting variables observed in Table 4, Panel A, Model 2. Figure D is the regression observed in Table 5, Panel D.