The Impact of Price and Return Models on Value Relevance Studies: A Review of Theory and Evidence

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Abstract

This paper reviews some of the theory and evidence associated with value relevance studies in accounting. Two regression models are commonly used in value relevance studies, namely the price model and the return model. Although their theoretical foundations are the same; *i.e.* the Ohlson/RIV model, the results obtained using these two regression models are sometimes different. The problem related with the price model is often referred to as 'scale effects' and those with the return model are termed 'accounting recognition lag' and 'transitory earnings'. Some methods to mitigate these problems are suggested by researchers. However, none of them leads to a perfect solution to them. Perhaps, future research will benefit from testing for sensitivity to alternative specifications.

JEL classification: M41

Key Words: Value relevance, Price and return models, Scale effects, Accounting recognition lag, Transitory earnings.

1. Introduction

Few lines of research have drawn as much attention from accounting researchers over the last decade as value relevance studies. In the extant literature, an accounting number is defined as value relevant if it has a predicted and significant association with equity market values (see Barth 2000, p. 16; Lo and Lys 2000a, p. 7; Holthausen and Watts 2001, p. 4).[1] Value relevance studies investigate the empirical relation between stock market values (or changes in values) and various accounting numbers for the purpose of assessing those numbers' usefulness in equity valuation. Two types of regression models are commonly used to investigate the relation, namely the price model and the return model. The price model examines the relation between stock price, book value and earnings, and the return model examines the relation between stock returns, earnings and earnings changes. Although the theoretical foundations of both models are derived from the same sources, which are the Residual Income Valuation model and the Ohlson (1995) linear information model (hereafter Ohlson/RIV model), different results are sometimes obtained when both models are used. For example, Harris *et al*. (1994) compare the value relevance of accounting data for U.S. and German firms matched on industry and firm size. They report that the R^2 obtained for German firms using the return model is comparable to that for U.S. firms. However, the R^2 obtained for German firms using the price model is less than half that for U.S. firms.

A number of review papers that cover the value relevance literature have been published over the last couple of years (e.g., Barth 2000; Holthausen and Watts 2001; Barth *et al*. 2001; Kothari 2001). However, these review papers do not adequately address the issue associated with the regression models. Holthausen and Watts (2001, p. 57) write, "Twenty-nine studies in

[1] The definition of 'value relevance' is not always clear and somewhat different across studies. The key commonality appears to be a statistically significant association between the accounting number of interest and some measure of market value. See Barth *et al*. (2001, p. 79 and Note 3) for further discussion on this issue.

Table 1 (62 value relevance studies are surveyed) use the Ohlson (1995) model as motivation for specification of their empirical tests, but only 15 use the specification that includes both earnings and book values as independent variables (the price model). The others regress returns on earnings and earnings changes (the return model).” They do not mention why some studies choose the price model and others choose the return model, and they do not explain the econometric implications of their choices. Both Barth *et al*. (2001, p. 96) and Kothari (2001, p. 161) acknowledge the importance of the specification issue associated with the use of the price and the return models. Nonetheless, instead of discussing the issue in their papers, they list the relevant papers and refer the reader to them.

The objective and contribution of this paper are to fill the gap in these review papers by discussing the specification problems of the price and the return models and shedding some light on the different results reported in certain value relevance studies. Both the price and the return models are said to have serious specification problems that are often referred to as ‘scale effects’ for the price model and ‘accounting recognition lag’ and ‘transitory earnings’ for the return model. Scale effects imply a spurious relation in the price model regression that can be caused by failing to control for scale effects that presumably exist among firms. Simply stated, large (small) firms have large (small) accounting variables, therefore the difference in size among firms needs to be adequately controlled. The return model regresses current returns on earnings in the same period. However, value relevant events observed by the market in the current period and reflected in current returns may not be recorded in the same period’s earnings because of the accounting principles such as reliability and prudence. This problem is called the ‘accounting recognition lag’. Furthermore, current earnings contain transitory components such as unusual (abnormal) items and extraordinary items. The transitory component of earnings is not expected to perpetuate and therefore will have a weaker association with returns than a permanent component of earnings. This problem is termed 'transitory earnings'.

This paper further clarifies these problems and delineates the methods suggested by researchers to deal with them. Firstly, scale effects need the definition of 'scale'. Barth and Kallapur (1996) and Barth and Clinch (1999) argue that scale depends on the research context and is unobservable. On the other hand, Easton (1998) and Easton and Sommers (2000) contend that scale is market capitalization. This rather philosophical disagreement makes it difficult to deal with scale effects. In addition, the impact of scale effects on the estimated R^2 is unclear (Brown *et al*. 1999; Gu 2001a). Secondly, as for the accounting recognition lag, Easton *et al*. (1992) find that extending the measurement windows of both returns and earnings increases the R^2. However, this method is not applicable to all value relevance studies because varying returns and/or earnings measurement windows may not be possible in some studies. Thirdly, the effect of transitory earnings is not always clear-cut. For example, losses are considered transitory and therefore predicted to have a weak correlation with returns (Hayn 1995). At the same time, losses are likely to be recorded in earnings more quickly due to conservatism in accounting and therefore could be more highly correlated with returns (Basu 1997).

Thus, there appear to be no perfect solution to these problems and the superiority of one model over another is indeterminate. In this case, using alternative models may help ensure that a study's inferences are not sensitive to model specification.

The remainder of the paper is organized as follows. Section 2 reviews the regression models and demonstrates how both the price and the return models are derived from the Ohlson/RIV model. Section 3 reviews some studies that investigate changes in the value relevance of accounting data over time and shows how the results differ with the regression model employed. Section 4 discusses the problem associated with the price model, 'scale effects', while Section 5 discusses the problems associated with the return model, 'accounting recognition lag' and 'transitory earnings'. Finally, Section 6 concludes the paper.

2. Regression Models

Investigating the relation between accounting numbers and firm value requires an empirically testable regression model that is based on a theoretical valuation model. The price and the return models that are based on the Ohlson/RIV model are probably the most pervasive regression models used in recent value relevance studies (see Barth 2000, p. 13; Barth *et al*. 2001, p. 91). This section demonstrates how both models can be derived from the Ohlson/RIV model.

2.1 Residual income valuation model

The residual income valuation model comprises three basic assumptions. First, the dividend discount model defines the value of a firm as the present value of the expected future dividends.

$$P_t \equiv \sum_{\tau=1}^{\infty} E_t\left[\frac{d_{t+\tau}}{(1+r)^{\tau}}\right], \tag{1}$$

where P_t is the price of the firm's equity at time t, $E_t[d_{t+\tau}]$ is the expected dividends received at time $t+\tau$ conditional on time t information, and r is the discount rate that is assumed to be constant. Second, the clean surplus relation is assumed.

$$b_t = b_{t-1} + x_t - d_t, \tag{2}$$

where b_t is the book value of equity at time t, x_t is earnings for the period t, and d_t is dividends paid at time t. Third, the book value of equity grows at a rate less than $1+r$,

$$(1+r)^{-\tau}E_t[b_{t+\tau}] \rightarrow 0, \text{ as } \tau \rightarrow \infty. \tag{3}$$

Combining the clean surplus relation given by (2) with the dividend discount model in (1) yields

$$P_t = b_t + \sum_{\tau=1}^{\infty} E_t\left[\frac{x_{t+\tau} - rb_{t+\tau-1}}{(1+r)^{\tau}}\right] - E_t\left[\frac{b_{t+\infty}}{(1+r)^{\infty}}\right]. \qquad (4)$$

The last term of the equation is assumed to be zero by the regularity condition (3) and 'abnormal earnings' is defined as $x_t^a \equiv x_t - rb_{t-1}$. Equation (4) can be restated as a function of the book value of equity and the discounted expected abnormal earnings, which is called the Residual Income Valuation model (RIV model),[2]

$$P_t = b_t + \sum_{\tau=1}^{\infty} E_t\left[\frac{x_{t+\tau}^a}{(1+r)^{\tau}}\right]. \qquad (5)$$

2.2 Price and Return models

The Ohlson (1995) linear information model (hereafter LIM) postulates that the time-series behavior of abnormal earnings is as follows:

$$x_{t+1}^a = \omega x_t^a + v_t + \varepsilon_{1t+1}, \qquad (6a)$$

$$v_{t+1} = \gamma v_t + \varepsilon_{2t+1}, \qquad (6b)$$

where v_t is information other than abnormal earnings, ω is the persistence parameter of abnormal earnings and predicted to lie in the range $0 \leq \omega < 1$, γ is the persistence parameter of other information and predicted to lie in the range $0 \leq \gamma < 1$, and ε_{1t} and ε_{2t} are error terms.

Combining the RIV model given by (5) with the Ohlson (1995) LIM in (6a)(6b) yields the following valuation function (see Ohlson 1995, Appendix 1):

$$P_t = b_t + \alpha_1 x_t^a + \alpha_2 v_t, \qquad (7)$$

[2] Although the RIV model is sometimes referred to as the Ohlson model, the origin of this model dates back to Preinreich (1938), Edwards and Bell (1961), and Peasnell (1981 and 1982). See Palepu *et al.* (1996, chap. 7-5) for further details of the model. In Ohlson (2001, Note 2), he states that the equation of Ohlson (1995) and Feltham and Ohlson (1995) with the RIV model is unfortunate.

where $\alpha_1 = \dfrac{\omega}{1+r-\omega}$ and $\alpha_2 = \dfrac{1+r}{(1+r-\omega)(1+r-\gamma)}$.

Replacing x_t^a with $x_t - rb_{t-1}$ and invoking the clean surplus relation in (2), the valuation function (7) can be restated as

$$P_t = (1\text{-}k)b_t + k(\varphi x_t - d_t) + \alpha_2 v_t, \qquad \text{(Ohlson/RIV model)(8)}$$

where $k = r\alpha_1 = \dfrac{r\omega}{1+r-\omega}$ and $\varphi = \dfrac{1+r}{r}$.

Equation (8) indicates that the valuation model can be viewed as a weighted average of a book value model and an earnings model. Equation (8) is often cited as the theoretical foundation of the following price model (see Easton 1999, p. 402; Easton and Sommers 2000, p. 34):

$$P_t = \beta_0 + \beta_1 b_t + \beta_2 x_t + \varepsilon_t. \qquad \text{(Price model)(9)}$$

Equation (8) also can be rewritten to provide the theoretical basis for the return model. Taking the first differences in (8), using the clean surplus relation in (2), and dividing both sides of the equation by the beginning-of-period price gives

$$Ret_t = (1\text{-}k)\frac{x_t}{P_{t-1}} + k\varphi\frac{\Delta x_t}{P_{t-1}} + k\varphi\frac{d_{t-1}}{P_{t-1}} + \alpha_2\frac{\Delta v_t}{P_{t-1}}, \qquad (10)$$

where $Ret_t = \dfrac{P_t - P_{t-1} + d_t}{P_{t-1}}$, $\Delta x_t = x_t - x_{t-1}$, and $\Delta v_t = v_t - v_{t-1}$.

Equation (10) is viewed as the theoretical basis for the following return model:

$$Ret_t = \beta_0 + \beta_1 x_t/P_{t-1} + \beta_2 \Delta x_t/P_{t-1} + \varepsilon_t. \qquad \text{(Return model)(11)}$$

Thus, both the price and the return models are theoretically derived from the same model, which is the Ohlson/RIV model.

The next section reviews some value relevance studies that document changes in the value relevance of accounting data over time and examines how the results differ with the model employed in the study.

3. Different Results

3.1 Background

There is growing concern in the accounting community that historical cost financial statements have lost their value relevance because of the change evident when comparing an industrialized economy to a high-tech and service-oriented economy. This concern is embodied in the report of the AICPA special committee on financial reporting (the Jenkins report) and in numerous articles in the accounting literature. For example, Rimerman (1990, p. 79) states:

> "Financial statement users are turning increasingly to other sources to meet needs which are not being met by the information such statements contain. As more and more other data and analyses become available, the relative importance of financial statements decreases within the context of the total range of available information."

Elliott (1995, p. 118) expresses his concern from an auditing standpoint:[3]

> "A large part of the immediate problem is the limited usefulness of today's financial statements. They don't, for example, reflect information-age assets, such as information, capacity for innovation, and human resources. As a consequence, they have been a declining proportion of the information inputs to investors' decision making."

3.2 Studies on changes in the value relevance of accounting data

Motivated by the aforementioned claims that financial statements have become less useful, accounting researchers investigate the value relevance of accounting data over time. The general research method of these studies is as follows. Yearly cross-sectional regressions are run using the price model and/or the return model. Next, changes in the value relevance over time are examined using the following regression:

$$R^2_t = \theta_0 + \theta_1 \text{TIME}_t + \varepsilon_t,$$

where R^2_t is the R^2 of cross-sectional regression for year t and TIME_t is a time trend variable

[3] Similar themes are echoed in Elliott and Jacobson (1991), Miller (1992), and Jenkins (1994).

for the sample period. If the coefficient of $TIME_t$, θ_1, is negative (positive), it indicates a decline (increase) in the value relevance over the period.

Collins *et al*. (1997) investigate changes in the value relevance of book value and earnings using the price model for the period 1953-93 and find that the combined value relevance of book value and earnings has slightly increased over the period. They also find a decline (increase) in the incremental relevance of earnings (book value) during the period, and they attribute the shift to the increased reporting of losses and one-time items and to the increased economic importance of unreported intangible assets. Francis and Schipper (1999) examine changes in the value relevance of accounting numbers using both the price and the return models for the period 1952-94 and find an increase in the value relevance for the price model and a decline in the value relevance for the return model. They conclude that the decline for the return model could be due to increases in the volatility of market returns during the sample period. Ely and Waymire (1999) examine changes in the value relevance of accounting numbers over the tenure of different accounting standard-setting bodies. Their evidence indicates a decline in the value relevance from the *APB* era (1960-73) to the *FASB* era (1974-93) when the return model is used. However, when the price model is used, their results reveal an increase in the value relevance from the *APB* era (1960-73) to the *FASB* era (1974-93). Lev and Zarowin (1999) also investigate changes in the value relevance of accounting data for the period 1977-96 using both the price and the return models and find a decline in the value relevance over the period for both models. Their finding for the price model is inconsistent with that of Collins *et al*. (1997). They explain that the source of the inconsistency appears to lie in the periods examined. The major findings of these studies are summarised in Table 1.

Table 1 about here

Table 1 reveals that the overall results of studies on changes in value relevance are inconclusive. It appears that when the price model is used as a regression model, the value relevance of accounting data has increased over time, except for Lev and Zarowin (1999). On the other hand, when the return model is used as a regression model, the value relevance of the accounting data appears to have declined over time.[4] To explain this difference, Brown *et al*. (1999) argue that R^2 is an unreliable statistic in the presence of scale and the price model is affected by scale.[5] They replicate the study of Collins *et al*. (1997) and find that, after controlling for scale effects, the value relevance of accounting data has declined over time. They conclude that the patterns of increasing R^2s found in Collins *et al*. (1997) and Francis and Schipper (1999) using the price model are largely attributable to an increase in the scale effect having more than offset a decline in the explanatory power of accounting data.

Thus, "scale effects" seem to hold the key to explaining the different results in Table 1. The next section reviews scale and scale effects in detail.

4. Scale Effects

Scale and scale effects are arguably the most debated econometric, and to some extent philosophical, issue in the value relevance literature. Their implications have a far-reaching impact on the results of many value relevance studies. This section examines scale and scale

[4] Some studies use different approaches to investigate the time-series behavior of the relationship between accounting information and the stock market. Landsman and Maydew (2001) examine changes in the information content of earnings over the past thirty years to assess changes in the usefulness of accounting data. Lo and Lys (2000a) use three approaches, which are information content, valuation relevance, and value relevance, to examine the effect of accounting information in financial markets for the 1972-2000 period.

[5] Gu (2001b) maintains that R^2 is a descriptive measure specific to a sample and criticizes the use of R^2 as a metric to assess the value relevance of accounting data across different samples. Instead, he suggests the use of residual variance as an alternative measure of value relevance.

effects and reviews some of the relevant papers.

4.1 What is scale and scale effects?

Scale effects are generally understood to arise from the fact that large (small) firms will have large (small) market capitalization, large (small) book value, and large (small) earnings. Therefore, a cross-sectional regression of market capitalization on book value and earnings may capture no more than "scale" that is present among firms. However, there is no consensus among accounting researchers about what "scale" is. Barth and Kallapur (1996) and Barth and Clinch (1999) argue that scale depends on the research context and model assumed, and is unobservable. They name the number of shares outstanding, sales, total assets, market value of equity, book value, and net income as proxies for unidentifiable scale.[6]

On the other hand, Easton (1998) and Easton and Sommers (2000) posit that the best measure of scale is market capitalization (market value of equity) and use of accounting data (e.g., sales, total assets, book value) as proxies for scale is implicitly inferior to the use of market capitalization.[7] They argue that market-based accounting research uses market capitalization as a dependent variable, in other words, as the benchmark against which the validation of accounting data is examined. Easton and Sommers (2000, p. 11) go on to contend:

> "If, for example, the argument is made that total assets of the firm is a better measure of scale than market capitalization, then total assets would be the appropriate benchmark against which to validate accounting data. Such an argument is, at the very least, at odds with the fundamental idea of market-based accounting research…"

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[6] Barth and Clinch (1999, Note 6) argue that the number of shares outstanding can be a proxy for scale, because shares typically trade within a fairly narrow range relative to the variation in market value of equity.

[7] Christie (1987) and Brown *et al*. (1999) also suggest the use of market value of equity as an appropriate proxy for scale. On the other hand, Hand and Landsman (1999b, p. 4) support the contention of Barth and Clinch (1999) that accounting data such as sales, total assets, book value, and net income are plausible candidates for scale.

In summary, Barth and Kallapur (1996) and Barth and Clinch (1999) argue that scale is unobservable and depends on the research context. As a result, the appropriate response by researchers is to investigate the sensitivity of their inferences to using alternative proxies for scale. On the other hand, Easton (1998) and Easton and Sommers (2000) present the argument that, in view of the central role of market prices in market-based accounting research, the best measure of scale is market capitalization. Consequently, the best course of action for researchers to take would be to use the return model, because the variables used in the model are deflated by the lagged market value of equity and therefore scale-free.

4.2 Impact of scale effects on coefficient estimates

Barth and Clinch (1998) investigate whether upward asset revaluations in Australia are positively associated with market values. Their basic regression model is a variation of the price model as follows:[8]

$$P_{it} = \beta_0 + \beta_1 b_{it} + \beta_2 x_{it} + \beta_{\mathrm{k}it} \text{ (k explanatory variables of interest)} + \varepsilon_t, \qquad (12)$$

where P_{it} is the price per share for firm i at time t, b_{it} is the book value of equity per share for firm i at time t after subtracting the amounts of k explanatory variables, and x_{it} is earnings per share for firm i for the period t. They report that the estimated coefficients are all statistically significant.

In the discussion of Barth and Clinch (1998), Easton (1998) argues that the statistical associations between stock price and book value per share, earnings per share, and any other explanatory variables measured at levels may simply be a spurious effect of scale. To make his point clear, he conducts following tests using the U.S. data. First, both sides of the price model are divided by P_{it} to remove scale effects from book value per share and earnings per

[8] Equation (12) is simplified for an expository purpose. See Barth and Clinch (1998, p. 206) for the details of the real model.

share,

$$\$1 = \beta'_0 + \beta_1[b_{it}/P_{it}] + \beta_2\,[x_{it}/P_{it}] + \varepsilon_t. \tag{13}$$

Multiplying both sides of (13) by the scale of a firm, which is the price per share, the price model can be rewritten as

$$S_{it} = \beta_0 + \beta_1[S_{it}X_{1it}] + \beta_2\,[S_{it}X_{2it}] + \varepsilon_t, \tag{14}$$

where $S_{it} = P_{it}$ is the scale of firm i at time t, $X_{1it} = b_{it}/P_{it}$, and $X_{2it} = x_{it}/P_{it}$. Next, in order to gain an indication of the extent to which the coefficient estimates are due only to scale effects, observations of S_{it}, X_{1it}, and X_{2it} are shuffled and randomly picked to form triplets of unrelated variables (S_{it}, X_{1jt}, and X_{2kt}). This procedure leads to the following regression equation:

$$S_{it} = \beta_0 + \beta_1[S_{it}X_{1jt}] + \beta_2\,[S_{it}X_{2kt}] + \varepsilon_t. \tag{15}$$

The regression results from (14) and (15) yield similar and statistically significant coefficient estimates. Based on these results, Easton (1998) concludes that inferences drawn from the equation (14) regression may be simply due to scale effects.

In response to the argument presented by Easton (1998), Barth and Clinch (1999) reiterate the Easton (1998) procedure 500 times for the equation (15) regression and find that although the mean β_1 from (15) is somewhat similar to that from (14), the mean β_2 from (15) is not similar to that from (14). They contend that any similarity between coefficient estimates from (14) and (15) reported in Easton (1998) is a coincidence resulting from the sampling distribution of the particular variables used in his analysis (Barth and Clinch 1999, p. 27).

Easton and Sommers (2000) reject this contention and argue that the results of a regression of market capitalization (or price per share at the per share level) on financial statement data are driven by a relatively small subset of the very largest firms in the sample. They define this overwhelming influence of the largest firms as the "scale effect" (Easton and Sommers 2000, pp. 2-3). They use the following regression to conduct an analysis:

$$MC_{it} = \beta_0 + \beta_1 B_{it} + \beta_2 E_{it} + \varepsilon_t, \quad (16)$$

where MC_{it} is the market capitalization for firm i at time t, B_{it} is the book value of equity for firm i at time t, and E_{it} is earnings for firm i for the period t.

The regression (16) is run annually and the studentized residual is calculated for each observation. For each set of annual observations, 20 groups are formed based on the market capitalization with group 1 having the smallest capitalization and group 20 having the largest capitalization. These groups are pooled across the years and the mean absolute value of the studentized residuals is calculated for each of the 20 groups. The evidence indicates that the five-percentile of observations with the largest market capitalization (group 20) exhibits "undue influence" on the inferences of the regression results. Removal of this group from the sample does not remove the scale effect because the group of the largest firms in the remaining sample then becomes most influential. Their evidence suggests that the estimates of the regression coefficients for the whole sample are primarily due to the largest firms in the sample. Similar results are also obtained at the per share level.[9]

4.3 Impact of scale effects on R^2

Brown *et al.* (1999) analyze the consequence of scale effects on the regression R^2. They assume that the true economic relation is

$$z_i = \alpha + \beta w_i + \varepsilon_i, \quad (17)$$

where $\boldsymbol{z} = (z_1,\ldots,z_n)$ is the dependent variable, $\boldsymbol{w} = (w_1,\ldots,w_n)$ is the independent variable, and

[9] Related arguments are developed between Hand and Landsman (1998; 1999a; 1999b) and Lo and Lys (2000b). Hand and Landsman (1998; 1999a) find that a regression of market value of equity on book value of equity, earnings, and dividends results in a positive coefficient on dividends and attribute the results to a profitability-signaling role of dividends. Lo and Lys (2000b) argue that the results are due to scale effects and find that when all variables are deflated by the lagged market value of equity, the coefficient on dividends reverses in sign. In reply to Lo and Lys (2000b), Hand and Landsman (1999b) assign firms into deciles based on their lagged market value of equity to control for scale effects and find a positive coefficient on dividends in every decile. However, Lo and Lys (2000b) contend that this procedure is ineffective in controlling for scale effects, because if scale affects the entire sample, it will also be present in each decile.

$\boldsymbol{\varepsilon} = (\varepsilon_1,\ldots,\varepsilon_n)$ is the error term. The observed data are affected by a scale factor $\boldsymbol{s} = (s_1,\ldots,s_n)$, resulting in

$$s_i z_i = \alpha s_i + \beta s_i w_i + s_i \varepsilon_i.$$

Although the theoretically correct regression equation that satisfies this specification is

$$y_i = b + \alpha s_i + \beta x_i + \xi_i,$$

where $y_i = s_i z_i$, $x_i = s_i w_i$, $\xi_i = s_i \varepsilon_i$, and b is an intercept, researchers customarily estimate

$$y_i = b_0 + b_1 x_i + \eta_i, \tag{18}$$

because the scale factor is generally unobservable.

Brown *et al.* (1999) prove that, under certain conditions, the R^2 in scale-affected regression (18) is higher than the R^2 in scale-free regression (17) and the scale-affected R^2 increases in the coefficient of variation of the scale factor.[10] Furthermore, they find that the coefficient of variation of the scale factor has increased considerably over the last four decades and argue that the patterns of increasing R^2s found in Collins *et al.* (1997) and Francis and Schipper (1999) using the price model are largely attributable to an increase in scale effects having more than offset a decline in the explanatory power of accounting data. They also conjecture that the different results of Harris *et al.* (1994) using the price model may be due to the differing amounts of scale effects in Germany and in the U.S.

Contrary to the assertion by Brown *et al.* (1999) that the R^2 increases in a scale factor's coefficient of variation, Gu (2001a) argues that it cannot be generalized. He gives an intuitive example (see Gu 2001a, p. 1).

> "Suppose the same group of firms before the split have prices and EPS almost on a straight line with an intercept. Thus prices and EPS are almost perfectly correlated (R^2 close to 1). If half of the firms have a 2:1 split, prices and EPS would be distributed along two distinct lines and a regression would produce $R^2 < 1$."

[10] The coefficient of variation is defined as C.V. = $|\sigma/\mu|$. This gives the standard deviation as a proportion of the mean.

Gu (2001a) analytically shows that the conditions under which the Brown *et al*. (1999) proof holds depend on the variance of the error term σ_ε^2 in (17). His analysis indicates that there exists a threshold level of σ_ε^2 that determines the impact of scale effect on R^2. The probability limit of R^2 from (17) can be expressed as

$$\text{plim}R^2 = 1 - \frac{\sigma_\varepsilon^2}{\beta^2\sigma_w^2 + \sigma_\varepsilon^2}.$$

Thus, small (large) σ_ε^2 implies the strong (weak) scale-free economic relation. Based on this analysis, Gu (2001a) concludes that the scale-affected R^2 can be lower (higher) than the scale-free R^2 when the original scale-free economic relation is strong (weak) and therefore the Brown *et al*. (1999)'s conclusion that the increasing R^2 over time is due to an increasing scale factor is premature.

If scale effects are the problem with the price model, weak return-earnings correlation raises concern about the appropriateness of the return model specification. The next section reviews the problems associated with the return model.

5. Weak Return-Earnings Correlation

As can be seen in Table 1, the R^2s from the price model are much higher than those from the return model. Cramer (1987, p. 253) states, "Although it is generally conceded among insiders that they (R^2 and adj.R^2) do not mean a thing, high values are still a source of pride and satisfaction to their authors, however hard they may try to conceal these feelings." This may be one of the reasons why the price model is still popular among accounting researchers in spite of its well-documented problems such as scale effects.[11]

[11] Deng and Lev (1998) use a price-levels regression as one of the three specifications tested in their study. They recognize that the price-levels regression may suffer from size-related problems and may not be well specified. They go on to comment that the price-levels regression is used mainly because it is popular in the accounting literature.

In contrast to the price model, the return model is said to be scale-free because all variables are deflated by the lagged market value of equity, and also better specified than the price model (see Easton 1999, p. 404; Easton and Sommers 2000, p. 36). An econometric advantage of the return model over the price model stems from the fact that the return model is in differenced form. Christie (1987, p. 250) suggests that time-differencing a misspecified cross-sectional levels model can generate a well-specified model in the differences.[12]

However, the return model is not free of problems. The low R^2s reported using the return model could be a matter of concern. Lev (1989) examines 20 years of accounting research extensively and finds that the average R^2 of a return-earnings regression is about 5%. Lev (1989, p. 173) states, "The extent of earnings usefulness appears to be very modest. An information variable that explains only about 5% of stock return variability, and whose relation with returns is unstable, cannot be very useful." Although a low R^2 may not be a significant problem in itself in drawing inferences from the results, it raises doubts about the appropriateness of the return model specification. The observed weak return-earnings relation may be due to misspecification of the return model. In that case, the results obtained using the return model may not reveal the true economic relation between stock market values and accounting numbers.

There are many hypotheses to explain the observed weak return-earnings relation.[13] Among them, the effects of the accounting recognition lag and transitory earnings appear to be the dominant explanations for the weak relation (Easton *et al*. 2000, p. 281; Kothari 2001, p. 135). This study therefore focuses on these two specification problems and reviews them in

[12] See Plosser and Schwert (1978), Plosser *et al*. (1982), and Landsman and Magliolo (1988) for the econometric advantages of differencing the levels variables. However, Landsman and Magliolo (1988) also show that differencing could induce a greater bias in certain situations than if the model were estimated in the levels.

[13] Kothari (2001, p. 129) lists four hypotheses to explain the observed weak return-earnings relation. They are (i) prices lead earnings (similar to the accounting recognition lag); (ii) inefficient capital markets; (iii) noise in earnings and deficient GAAP; and (iv) transitory earnings.

detail.

5.1 Impact of the accounting recognition lag and transitory earnings on coefficient estimates and R^2

In an efficient market, price changes instantaneously incorporate the revisions in the market's expectations of future net cash flows. However, value relevant events observed by the market in the current period may not be recorded in earnings in the same period because of the accounting principles such as reliability and prudence in the determination of accounting earnings. Thus, current earnings do not reflect the underlying economic events in a timely manner and, therefore, are not synchronized with stock price movements. In short, accounting reports the effects of economic events with a lag (Basu 1997; Easton 1999; Easton *et al*. 2000). This accounting recognition lag is also noted in Kothari and Zimmerman (1995). They refer to a portion of earnings that the market had already anticipated before the announcement of earnings as a 'stale' component.

Figure 1 about here

Figure 1(a) illustrates how the accounting recognition lag affects the estimation of the return model. The return model regresses current returns on current earnings. However, current earnings are expected to contain a stale component that is not value relevant and future earnings are expected to have a component that is value relevant to current returns because of the accounting recognition lag. As a result, the return model will have an errors-in-variables problem, because the independent variable (current earnings) in the return model is measured with error due to the inclusion of the stale component. The return model will also suffer an omitted variable problem, because the value relevant component of future earnings is not included in the regression model. The econometric consequences of this errors-in-variables problem are that the estimated coefficient will underestimate the real coefficient if it is positive and the estimated R^2 will underestimate the real R^2.[14] The omitted variable will not bias the estimated coefficient if it is uncorrelated with the included independent variable, but it will always reduce the estimated R^2.

On the other hand, the impact of the accounting recognition lag on the price model is expected to be less significant than on the return model. Figure 1(b) illustrates this point. Current stock price contains all the information in past and current earnings and some forward-looking information in future earnings. Therefore, unlike the return model, there is no errors-in-variables problem in the independent variable. The omitted variable problem still exists in the price model because of the omitted forward-looking information. As a result, the estimated R^2 will underestimate the real R^2. However, its magnitude is expected to be smaller than that for the return model.

A weak return-earnings relation is also attributable to a transitory component of earnings. If earnings are assumed to be permanent, the earnings response coefficient (the slope coefficient in the regression of returns on earnings) is $1+1/r$ based on the capitalized earnings model. On the other hand, if earnings are completely transitory, the earnings response coefficient will be one. The R^2s will be unity in both cases. Since most reported earnings are a mixture of permanent and transitory earnings, a return-earnings regression will yield an earnings response coefficient that falls between one and $1+1/r$. Consequently, the estimated R^2 will decline from perfect correlation because reported earnings is the sum of two variables with different earnings response coefficients. (see Kothari and Zimmerman 1995, p. 178;

[14] See Ryan and Zarowin (1995) for further discussion.

Kothari 2001, pp. 133-134; Easton *et al*. 2000).

Thus, the accounting recognition lag and transitory earnings may explain the reported weak association between returns and earnings. The next subsection reviews some studies that attempt to improve the return-earnings specification.

5.2 Studies on the improvement of return-earnings relation

There has been voluminous work that attempts to improve the weak return-earnings relation.[15] Table 2 summarises some of the key studies that deal with 'accounting recognition lag' and 'transitory earnings'.

Table 2 about here

Accounting recognition lag

One way to tackle the problem of the accounting recognition lag is to extend the measurement windows of both returns and earnings. When earnings are aggregated over longer periods than the conventional one-year period, the accounting recognition lag will be mitigated. Easton *et al*. (1992) allow the measurement window to vary from 1 year to 2 years, 5 years, and 10 years. They find that the R^2 increases as the window becomes longer. The R^2 for 1-year, 2-year, 5-year, and 10-year window is 5%, 15%, 33%, and 63% respectively.

Warfield and Wild (1992) include the immediate next period's earnings in addition to current period's earnings to explain current period's returns. The R^2s without including the next period's earnings are 0.39%, 2.44%, 5.41%, and 21.21% for quarterly, semiannual, annual, and biannual reporting periods respectively. When the immediate next period's

[15] See Lev (1989) for early evidence of such studies and Kothari (2001) for more recent studies.

earnings are added, the respective R^2 increases to 1.26%, 4.41%, 15.71%, and 29.28%. When the next two periods' earnings are added, increases are marginal. Similar results are obtained when current and prior periods' returns are regressed on current earnings.[16]

Although these studies help us understand the existence and severity of the accounting recognition lag, the methods used in these studies are not applicable to all value relevance studies. In some cases, they conflict with the researcher's interest. For example, when the interest of research is to examine changes in the value relevance of accounting data over time, the return and the earnings periods have to be synchronized. Because the timeliness of accounting data is an essential ingredient of the value relevance of accounting data, varying returns and/or earnings measurement windows may defeat the purpose of the research.[17] Easton *et al*. (1992, p. 140) state, "We certainly do *not* wish to suggest that long return intervals are superior or more logical than shorter ones. Empirical research designs should be motivated by questions asked, and not by the magnitude of correlation measures."

Liu and Thomas (2000) and Ota (2001) deal with the accounting recognition lag by using forecast information. Liu and Thomas (2000) incorporate analyst forecast information into a return-earnings model. They regress unexpected returns (calculated using CAPM) on unexpected earnings. When revisions of future earnings forecasts are included in addition to unexpected earnings, the R^2 increases from 5.26% to 30.67%. However, the disadvantage of using analyst forecast information is expressed by Liu and Thomas themselves.[18] Liu and Thomas (2000, p. 100) write, "Although adding analyst forecast revisions and discount rate changes helps to explain better the relation between stock returns and reported earnings, our

[16] Kothari (2001) identifies four methods to deal with the accounting recognition lag and refers to the relevant studies. The four methods are: (i) Including future earnings as an independent variable in the return-earnings model; (ii) Expanding the return-earnings measurement window; (iii) Including leading period returns in the dependent variable; and (iv) Including future earnings and future returns as independent variables.

[17] The definition of 'timeliness' used in this paper follows Easton (1999, Note 1) and Easton and Sommers (2000, Note 8). They write, "The concept of the timeliness of the accounting summary is the extent to which the value change as reported in the financial statements is contemporaneous with the change in market value."

[18] A similar concern is expressed by Lev and Zarowin (1999, Note 6).

results cannot be used to infer the value relevance of accounting statements, since the information used in our multiple regression is obtained directly from analyst forecasts, and the link between those forecasts and accounting statements remains largely unexplored."

Ota (2001) uses management forecasts of earnings to improve a return-earnings relation. He exploits the unique setting in Japan where managers simultaneously announce the current earnings as well as forecasts of next period's earnings. Based on Ohlson (1995 and 2001), he shows that management forecasts of earnings can be used to calculate 'other information *v*' in the Ohlson LIM. The results indicate that the R^2 increases from 5.9% to 14.9% with the inclusion of management forecasts of earnings. He concludes that the importance of current earnings diminishes significantly in the presence of management forecasts of earnings.

Transitory earnings

Another problem to which a weak return-earnings relation is attributed is a transitory component of earnings. Freeman and Tse (1992) suggest that studies which use linear return-earnings regressions have reported low slope coefficients and R^2s due to the nonlinearities in the return-earnings relation. They argue that the return-earnings relation is nonlinear and *S*-shaped, *i.e.* concave for positive earnings and convex for negative earnings, because of transitory earnings components. The transitory component of earnings often implies losses and one-time items. Hayn (1995) documents that firms reporting negative earnings exhibit a weaker association with stock returns than firms reporting positive earnings. She reports that the R^2 of a return-earnings regression is 9.3% for the full sample, 16.9% for the profitable firms, and almost 0% for the loss-making firms. She hypothesizes that this is because shareholders have an abandonment option so that negative earnings cannot be expected to perpetuate. Elliott and Hanna (1996) examine the information content of earnings conditional on the presence of large nonrecurring or unusual charges. They run a regression of the market-adjusted excess returns on unexpected earnings before special items (a permanent component) and special items (a transitory component), and find that the coefficient on special items is small and statistically insignificant.

However, the effects of transitory earnings and the accounting recognition lag are sometimes difficult to unravel. Amir and Lev (1996) investigate the value relevance of accounting data in the wireless communication industry. They find almost no correlation between returns and earnings for the firms in the wireless communications industry. These firms are characterized by heavy investment in intangibles such as R&D and franchise development. Lev and Zarowin (1999) argue that intangible investments are usually immediately expensed, while the benefits are recorded later and are not matched with the previously expensed investments.[19] These arguments allow us to predict that firms in intangible-intensive industries have a weak return-earnings relation because of the accounting recognition lag. On the other hand, Easton *et al*. (2000) hypothesize that if reported earnings for firms in intangible-intensive industries are the result of such events as successful R&D and new products, they are likely to have more permanent effects. Thus, a strong return-earnings relation is expected for intangible-intensive firms from the perspective of transitory earnings. Easton *et al*. (2000, p. 283) find evidence in support of their hypothesis and conclude that the effect of the accounting recognition lag (which biases the coefficient downward) is swamped by the effect of the permanence of the accounting earnings that are recorded (leading to an upward bias).

A similar argument can be put forward with regard to losses. Basu (1997, p. 3) interprets conservatism as resulting in earnings reflecting 'bad news' more quickly than 'good news'.

[19] Lev has been a strong proponent of the capitalization of intangibles. His papers, such as Lev and Sougiannis (1996) and Aboody and Lev (1998), show that capitalized values of R&D costs and software development costs are significantly associated with market values.

He runs a reverse regression of earnings on returns and finds that the R^2 is 7.99% for the full sample, 2.09% for 'good news' (positive returns) sample, and 6.64% for 'bad news' (negative returns) sample. While both the abandonment hypothesis in Hayn (1995) and the conservatism hypothesis in Basu (1997) result in the same slope coefficient effect, which is that the slope coefficient is higher for profits than losses if returns are regressed on earnings but lower if earnings are regressed on returns, the two hypotheses predict different R^2s. If bad news (e.g., big losses) are incorporated into earnings more quickly due to conservatism, losses are likely to have a strong association with returns from the viewpoint of the accounting recognition lag. At the same time, if losses are more transitory according to the abandonment option theory hypothesized by Hayn (1995), then losses are predicted to have a weak association with returns. Basu (1997, pp. 31-31) writes, "The slope coefficient from the abandonment option is the same as that under conservatism. However, conservatism predicts a higher R^2 for bad news or negative return firms, while the abandonment option theory predicts a higher R^2 for good news or profit firms." [20]

These seemingly conflicting theories are described well in Easton *et al*. (2000). They state that the empirical isolation of these two effects (the accounting recognition lag and transitory earnings) is difficult and attributing differences in the return-earnings relation to one of these two effects without controlling for the other may lead to erroneous conclusions.

6. Conclusions

Value relevance studies are an important part of accounting research. These studies investigate the empirical relation between stock market values (or changes in values) and

[20] Basu (1997, p. 32) contends that, while the conservatism prediction is robust to many specifications, Hayn's annual R^2 results are sensitive to risk-adjustment. However, based on the analysis of scatter-plots and distributions of returns and earnings, Easton (1999, p. 406) indicates that, while the weak return-losses relation hypothesized by Hayn is clear, the strong earnings-negative return relation hypothesized by Basu appears to be primarily due to the left-hand tail of the earnings distribution (large negative earnings).

various accounting numbers to assess the usefulness of those numbers in equity valuation. The price model and the return model are probably the most pervasive regression models today. The price model regresses stock price on book value per share and earnings per share, and the return model regresses stock returns on earnings and earnings changes deflated by the lagged market capitalization. Although the Ohlson/RIV model is the theoretical valuation model that both the price and the return models are based on, the studies using both models sometimes report different results.

The specification problem associated with the price model is referred to as 'scale effects' and those with the return model are termed 'accounting recognition lag' and 'transitory earnings'. Scale effects imply a spurious relation in the price model regression that can be caused by failing to control for scale in the variables. The accounting recognition lag arises from the fact that accounting systems report the effects of value relevant events with a lag because of the accounting principles such as reliability and prudence. Transitory earnings are a component of earnings that are not as persistent as a permanent component of earnings and, therefore, have a weak association with returns.

Although some methods to deal with these problems are suggested by researchers, none of them gives a definitive solution. A rather philosophical discussion exists concerning what 'scale' is and this makes it difficult to cope with scale effects. Extending the measurement windows of both returns and earnings allays the effect of the accounting recognition lag and increases the R^2. However, this method is not applicable to all value relevance studies. Moreover, the effects of transitory earnings and the accounting recognition lag sometimes offset each other and are difficult to disentangle.

Thus, the aforementioned different results remain unsolved. Perhaps, in the absence of a definitive solution to these problems, future studies will be enriched by investigating the sensitivity of their inferences to the use of alternative specifications.

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Table 1
Changes in the value relevance of accounting data over time

	Sample Period	#Obs.[a]	Regression Model	Average R^2	Value relevance
Collins *et al*. (1997)	1953-93	110,000	Price	0.43	Increase
Francis and Schipper (1999)	1952-94	78,000	Price	0.62	Increase
			Return	0.22	Decline
Ely and Waymire (1999)	1960-93	3,400	Price	0.42	Increase
			Return	0.16	Decline
Lev and Zarowin (1999)	1977-96	100,000	Price	0.76	Decline
			Return	0.07	Decline

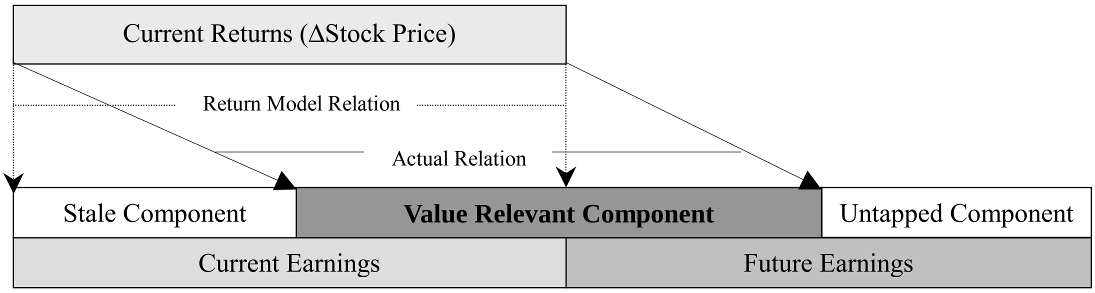
[a] #Obs. is the approximate number of observations used in a study.

Table 2
Studies on the improvement of return-earnings relation

Author	Problem	Features	Summary
Easton *et al.* (1992)	Accounting recognition lag	Measurement windows are extended	When both returns and earnings measurement windows are extended from 1 year to 2 years, 5 years, and 10 years, the R^2 increases accordingly from 6% to 15%, 33%, and 63%.
Warfield and Wild (1992)	Accounting recognition lag	Future earnings included & Past returns included	When the immediate next period's earnings are included in addition to current period's earnings to explain current period's returns, the R^2 increases by 223, 81, 190, and 38 percent for quarterly, semiannual, annual, and biannual reporting periods, respectively. Similar results are obtained when current and prior periods' returns are regressed on current earnings.
Freeman and Tse (1992)	Transitory earnings	Nonlinearity	The unexpected returns are regressed on unexpected earnings using a linear model and a nonlinear model. The nonlinear model uses the arctangent transformation for unexpected earnings. The R^2 and the *J* test indicate that the nonlinear model is better specified than the linear mode.
Hayn (1995)	Transitory earnings	Losses	The R^2 of a return-earnings regression is 9.3% for the full sample. The R^2 increases to 16.9% when only profit cases are considered, and drops to almost 0% when only loss cases are considered
Amir and Lev (1996)	Transitory earnings	Intangibles	When wireless communications (mobile) firms are used as the sample, the R^2 for the return model is close to 0%. These firms are characterized by heavy investment in intangibles, such as R&D and franchise development.
Elliott and Hanna (1996)	Transitory earnings	One-time items	The market-adjusted excess returns are regressed on unexpected earnings before special items (a permanent component) and special items (a transitory component). The coefficient on special items is small and statistically insignificant.
Basu (1997)	Accounting recognition lag	Conservatism	A reverse regression of earnings on returns is run. The R^2 is 7.99% for the full sample, 2.09% for 'good news' (positive returns) sample, and 6.64% for 'bad news' (negative returns) sample.
Liu and Thomas (2000)	Accounting recognition lag	Analyst forecasts of earnings	Unexpected returns are regressed on unexpected earnings. When revisions of future earnings forecasts are included, the R^2 increases from 5.26% to 30.67%.
Ota (2001)	Accounting recognition lag	Management forecasts of earnings	When management forecasts of next period's earnings are included in the return model, the R^2 increases from 5.9% to 14.9%.

Figure 1
The effect of the accounting recognition lag on the return and the price models

(a) The return model



(b) The price model