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Measuring Value Relevance in a (Possibly) Inefficient Market

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ABSTRACT

An interesting question in assessing value relevance of accounting variables is whether measures of value relevance are materially affected by market inefficiencies. We explore this question in two steps: First, we analytically examine the impact of market inefficiencies on the estimation of coefficients in value relevance regressions and derive a procedure that corrects potential biases caused by such inefficiencies. The procedure adjusts contemporaneous stock prices for future risk adjusted price changes, and yields value relevance coefficient estimates that capture both contemporaneous and delayed market reactions. Second, we apply this procedure to three types of studies that have attracted much attention in the accounting literature: 1) the value relevance of earnings and book values; 2) the value relevance of residual income value estimates; and 3) the value relevance of accruals and cash flows. We compare coefficient estimates obtained from conventional value relevance regressions with those from regressions employing our adjustment procedure, and find statistically significant differences in both level and return regression coefficient estimates. The magnitude of differences in coefficient estimates for return regressions is large enough to affect economic inferences. We find that coefficients of lagged price deflated residual income value estimates move significantly closer toward a predicted value of one implying a meaningful reduction of bias. Last, we find that cash flows now have significantly larger coefficient estimates than accruals consistent with their greater persistence.

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1. *Introduction*

Value relevance studies routinely employ regressions of contemporaneous stock prices or returns on accounting variables to evaluate how accounting information maps into those measures. Most studies of this nature are silent on market efficiency and appear to make inferences based on the implicit assumption that the stock market is efficient in the semi-strong form. However, substantial empirical evidence exists to suggest that the market may not be completely efficient in its processing of public information. In particular, associations have been found between publicly available accounting information and future abnormal returns. These findings raise the intriguing question of whether the conclusions drawn from conventional value relevance studies remain intact given that part of the impact of information captured by those variables is likely to surface in future rather than contemporaneous prices.[1]

Our analysis seeks to address this question. We contribute to the accounting literature in two ways. First, we evaluate, from first principles, how market inefficiency effects cause biases in inferences drawn from conventional value relevance studies, and offer an econometric solution to simultaneously correct the bias and adjust for delayed market reactions. Second, we empirically demonstrate that the adjustment produces statistically and economically significant results in return regressions, and statistically (though not economically) significant results in level regressions. These results suggest that it is important to consider market inefficiency effects when drawing inferences in value relevance studies.

We define value relevance as the mapping from accounting information to "intrinsic value," i.e., the present value of expected future dividends conditional on all available information. The market is considered inefficient if the stock price measures the intrinsic value with error. Violation of semi-strong form market efficiency in this context equates to a correlation between this measurement error in stock price and the publicly disclosed accounting variables of interest. In such a setting, the conventional linear projection of price onto the space of accounting information produces biased coefficients due to the omitted-correlated-variables problem. However, assuming that market inefficiencies become resolved over time, we show that information in future price changes can be exploited to estimate the measurement error (omitted variable) in current stock prices. Adjusting current prices to encompass delayed price reactions reflected by that estimate yields

[1] Concern about this issue is best exemplified by Holthausen and Watts's [2000] recent commentary on value relevance studies: "One aspect common to all of these studies is their reliance on market efficiency. In order to interpret the evidence from value-relevance studies as telling us anything about the relevance and reliability of some component of a financial statement, it must be that the market is capable of processing the relevance and reliability of that particular component. While there is much evidence consistent with semi-strong market efficiency (efficiency with respect to the set of publicly available information), in recent years there has been an increase in evidence inconsistent with that view."

coefficients that measure future as well as current price effects of information about intrinsic value contained in those accounting variables.

Next, we empirically apply this adjustment procedure to three types of studies that have served as benchmarks in many, if not most, value relevance research in recent years: 1) the value relevance of earnings and book values (e.g., Collins, Maydew, and Weiss [1997], Lev and Zarowin [1999], and Francis and Schipper [1999]); 2) the value relevance of residual income value estimates (e.g., Frankel and Lee [1998]); and 3) the value relevance of accruals and cash flows (e.g., Sloan [1996] and Pfeiffer and Elgers [1999]).

Specifically, we estimate value relevance coefficients over years 1962–1995. We contrast coefficient estimates obtained from conventional value relevance regressions with those from regressions including an adjustment for future price effects not attributable to systematic risk. In the case of earnings and book values, we find statistically significant mean and median increases in both levels and returns regression coefficient estimates. These findings are consistent with the existing literature that suggests that the market under-reacts to information contained in earnings and book values.

While differences in coefficient estimates in levels regressions are statistically significant, they are small in magnitude. For example, in multiple regressions of per share price on earnings and book values, when we use three-year future returns for price adjustments, the mean (median) increase in estimated coefficients as we move from conventional to proposed regressions is approximately 15.6% (13.2%) for earnings and 4.6% (4.3%) for book values. Accordingly, these differences are unlikely to affect results of conventional value relevance studies in a qualitative sense.

In contrast, the magnitude of differences in coefficient estimates is much larger for return regressions. For example, in multiple regressions of returns on lagged price deflated earnings and book values, when we use three-year future returns for price adjustments, the mean (median) increase in estimated coefficients as we move from conventional to proposed regressions is approximately 90% (46%) for earnings and 82% (70%) for book values. Clearly, differences of these magnitudes have the potential to change conclusions in some settings.[2]

Interpretation of the increase in coefficients, however, is hindered by the difficulty of establishing a prediction on the benchmark coefficients for earnings and book values without simultaneously considering "other information" available to the market (Liu and Thomas [2000]). Therefore, we also investigate a case where the independent variable is a lagged price deflated residual income value estimate. The advantage of this case is that

[2] Looking at the magnitudes of coefficient estimates year-by-year, we observe a downward trend in earnings and an upward trend in book values, for both conventional levels and returns regressions and regressions using adjusted prices or returns. This finding is consistent with trends reported by Francis and Schipper [1999] and Lev and Zarowin [1999]. It is not meaningful to compare changes in measures of the goodness-of-fit, the focus of those studies, given the change in dependent variables.

the predicted coefficient is one. We construct the residual income measure using IBES earnings forecasts and a terminal value based on the generic projection adopted in Frankel and Lee [1998]. Similar to the case employing earnings and book values, we find that the mean (median) increase in coefficient is 24% (28%). Since the direction of change is toward the predicted coefficient of one, we conclude that the correction for market inefficiencies provides a meaningful reduction of bias in the value relevance coefficients.

Sloan [1996] finds that although accruals are less persistent than cash flows, the market appears to act as if they possess the same persistence, implying that the market under-reacts to cash flows relative to accruals. This finding provides an interesting opportunity to see if our procedure would affect these findings in a qualitative sense. Because our procedure corrects biases due to market inefficiency, the resulting value relevance coefficients should reflect the underlying time series properties of accruals and cash flows, implying that cash flows should have higher coefficients than accruals in our adjusted regressions. As predicted, we find that cash flows have significantly higher average value relevance coefficients than accruals when we adjust for delayed price reactions, while the two are statistically indistinguishable from each other when only contemporaneous stock returns are used.[3]

Broadly speaking, our results suggest that it's important to consider future as well as contemporaneous price effects when studying value relevance of accounting information. This is especially true in more refined studies where not only the sign but also the magnitude of coefficients are of interest. The less dramatic results for price level regressions than for return regressions are reasonable given that stock prices reflect the accumulation of information since the inception of the firm, and market inefficiencies are more likely to be associated only with "new information."

Remaining sections of this paper are organized as follows: section 2 reviews related literature; section 3 models effects of market inefficiencies on value relevance coefficients and devises a procedure to control for their impact; section 4 presents our sampling rules and empirical findings; and section 5 provides concluding remarks.

2. *Related Studies*

There is a large literature on the value relevance of accounting information. The conventional approach in assessing value relevance is to regress either stock prices or returns on the accounting variables of interest. Due in part to Ohlson [1995], earnings and book values are almost always included as benchmark variables.

Value relevance studies are normally silent on whether the market is assumed to be efficient. However, recent evidence of market "anomalies"

[3] Pfeiffer and Elgers [1999] find similar results.

has challenged the implicit belief that the semi-strong form of market efficiency must hold. If the market is not as efficient as we have thought, then a question arises as to how we should interpret the results in those value relevance studies that use contemporaneous market prices as dependent variable. The question has been raised by several authors, including Bernard [1995], Holthausen and Watts [2000], and Lee [2000]. Bernard [1995] best describes the limitation of the conventional approach by commenting that value relevant studies "preclude from the outset the possibility that researchers could ever discover something that was not already known by the market."

Many of the anomalies documented by an extensive literature have to do with accounting information. Stattman [1980] and Basu [1983] report book-to-price and earnings-to-price anomalies, respectively. Fama and French [1992] contend that these effects may be attributable to risk factors, while Lakonishok, Shleifer and Vishney [1994] view these effects as indicators of market inefficiency. Ou and Penman [1989] find that probability estimates of future earnings changes from statistical analysis of fundamentals can predict future returns. Their findings are further supported by Holthausen and Larcker [1992] through direct use of fundamentals to predict abnormal returns. Studies by Bernard and Thomas [1989, 1990] demonstrate that under-reaction to earnings announcements can be translated into profitable trading strategies. Results by Sloan [1996] suggest that although cash flows are more persistent than accruals, the market acts as if they have the same persistence. Therefore, abnormal profits can be earned by going long in high cash flow firms and short in high accrual firms. Frankel and Lee [1998] find that their intrinsic value measure constructed from analysts' earnings forecasts predicts future abnormal returns, with a magnitude that is much larger than the price to book effect.

Although we are unaware of any formal analysis on the impact of market inefficiency on value relevance studies, it has been suggested intuitively that in return regressions, lengthening the time horizon over which one measures price effects is likely to mitigate market inefficiency effects (e.g., Holthausen and Watts [2000], Pfeiffer and Elgers [1999]). In this paper, we formalize that intuition and obtain an explicit formula for both level and return specifications net of systematic risk effects.

3. *Econometric Model*

We define "value relevance" of accounting variables in terms of the extent to which they explain "intrinsic value," i.e., the present value of expected future dividends conditional on all information available to the market. We characterize an inefficient market by assuming that price measures intrinsic value with a measurement error. We then consider a case where the semi-strong form of market efficiency is violated in that the measurement error and accounting information are correlated. This correlation causes the conventional regressions of prices on accounting variables to produce biased estimates of value relevance coefficients due to the standard omitted-correlated-variables problem. Moreover, the estimated coefficients fail to reflect the effects of information contained in accounting variables that surface in future prices.

In order to deal with this problem, we show how information about the measurement error can be extracted from future price changes under the weak assumption that all inefficiencies resolve over time. We then add the present value of future price changes unrelated to systematic risk factors to the current price to obtain unbiased coefficients for the mapping from accounting information to intrinsic value. Again, the idea is that these coefficient estimates more fully reflect the value relevance of that information. Next, we extend the price level model to a return model by using lagged stock price to deflate both sides of the valuation equation.

3.1 VALUE RELEVANCE AND MARKET EFFICIENCY

We assume that value relevance is measured by coefficients in the following linear relationship:[4]

$$E(V_{it} \mid X_{it}) = B_t' X_{it}. \tag{1}$$

where V_{it} and X_{it} denote, respectively, the intrinsic value and accounting variables of interest for firm i at time t. We further assume that the market price at time t, P_{it}, deviates from intrinsic value by a measurement error, u_{it}:[5]

$$P_{it} = V_{it} + u_{it}, \tag{2}$$

where V_{it} and u_{it} are independently distributed.

Note that (2) is inconsistent with an efficient market: that is, it follows from (2) that P_{it} and u_{it} are correlated, i.e., $\mathrm{E}(u_{it} \mid P_t) \neq 0$. This further implies that P_{it} is a biased estimate of V_{it}; i.e.,

$$E(V_{it} \mid P_{it}) = E(P_{it} - u_{it} \mid P_{it}) = P_{it} - E(u_{it} \mid P_{it}) \neq P_{it}.$$

The value relevance relation in this setting can be restated by substitution of V_{it} from (2) into (1),

$$E(P_{it} \mid X_{it}) - E(u_{it} \mid X_{it}) = B_t' X_{it}. \tag{3}$$

[4] Although this specification resembles a cross-sectional regression, the same analysis extends to time series regressions and pooled regressions. Because the anomalies literature generally found stronger evidence using cross-sectional data rather than time series data, we only use the cross-sectional specification to illustrate the point.

[5] Summers (1986) proposes this specification as a "natural" alternative to the efficient market model. To appreciate the subtlety of this specification, consider exchanging sides of market value and intrinsic value, $V_{it} = P_{it} + u_{it}$, P_{it} and u_{it} are independently distributed. Unlike (2), this specification is consistent with efficient markets since stock price is an unbiased estimate of intrinsic value, i.e., $E(V_{it} \mid P_{it}) = E(P_{it} + u_{it} \mid P_{it}) = P_{it}$. In their well-known studies on market efficiency using variance bounds, Shiller (1981) and LeRoy and Porter (1982) exploit this relationship.

Equation (3) implies that the conventional approach for measuring value relevance of regressing the contemporaneous stock price on accounting variables is valid if and only if the market is efficient in the semi-strong form, i.e., $E(u_{it} \mid X_{it}) = 0$. In a setting where this condition is violated, $E(u_{it} \mid X_{it}) \neq 0$, it is clear that the conventional regressions are subject to the standard omitted-correlated-variables problem and, hence, produce biased estimates of value relevance that fail to capture future price effects.

3.2 EXTRACTING INFORMATION FROM FUTURE RETURNS

What we seek is an estimate of the measurement error u_{it} conditional on X_{it}. We cannot estimate $E(u_{it} \mid X_{it})$ directly because neither intrinsic value nor measurement error is observable. However, given that the market resolves all inefficiencies over time due to arbitrage forces, the resolution of the inefficiencies should be reflected in future price changes. Therefore, in principle, we should be able to extract information about the measurement error u_{it} based on knowledge of those price changes. The key to this operation is to decompose future price changes into two parts, with one part due to the realization of systematic risk factor(s), and the other part due to the resolution of market inefficiency.[6]

Two simplifying assumptions are needed to achieve the intended separation. First, we assume that the time t market inefficiencies are resolved by time $t+1$, implying that

$$E(u_{it+1} \mid I_{it}) = 0, \tag{4}$$

where I_{it} is any information set regarding firm i available at time t. (4) states that one can not use time t information to predict time $t+1$ measurement error u_{it+1}, or equivalently, that measurement errors become fully reflected in price by the next period. While the unit of time is arbitrary in our theoretical development, we employ periods of one to three years for the empirical work that follows.[7]

Second, since intrinsic value V_{it} fully reflects all available information, we assume it satisfies properties of asset prices based on rational asset pricing theory. In particular, we assume conditional expected return in intrinsic value is driven by risk and nothing else:

$$\bar{R}^v_{it+1} = E(R^v_{it+1} \mid F_{t+1}, I_t) = E(R^v_{it+1} \mid F_{t+1}), \tag{5}$$

where $R^v_{it+1} = \frac{V_{it+1} + D_{it+1} - V_{it}}{V_{it}}$ is the return measure based on intrinsic values, F_{t+1} is the realization of time $t+1$ systematic risk factor(s), and I_t is all available information at time t.[8]

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[6] Idiosyncratic risk does not play a role since it is pure white noise.

[7] A more refined treatment would be to define a time series process generating $\{u_{it}; t = 1, 2, \ldots\}$ and to exploit that specification to eliminate more noise in estimates of price adjustments. In appendix A, we analytically show that our one period model can be extended to a multi-period model while preserving all crucial insights.

[8] In our empirical tests, we follow standard practice in finance to use size decile returns to proxy for $\bar{R}^v_{it+1}$. This approach assumes that the "size" factor effectively controls for systematic risk.

To derive an econometric specification to correct biases in coefficients and reflect full value relevance of accounting variables, we evaluate the expectation of time $t+1$ cum-dividend stock price conditional on X_{it}, P_{it}, V_{it} and F_{t+1}:

$$\begin{aligned} & E(P_{it+1} + D_{it+1} \mid F_{t+1}, X_{it}, P_{it}, V_{it}) \\ & \quad = E(V_{it+1} + D_{it+1} + u_{it+1} \mid F_{t+1}, X_{it}, P_{it}, V_{it}) \\ & \quad = E(V_{it+1} + D_{it+1} \mid F_{t+1}, X_{it}, P_{it}, V_{it}) \\ & \quad = \left(1 + \bar{R}^{v}_{it+1}\right) V_{it}, \end{aligned} \tag{6}$$

where the first equality is due to (2), the second equality is due to (4), and the third equality is due to (5). Rearranging (6) and moving V_{it} to the left-hand-side, we obtain

$$V_{it} = E\left(\frac{P_{it+1} + D_{it+1}}{1 + \bar{R}^{v}_{it+1}} \,\middle|\, F_{t+1}, X_{it}, P_{it}, V_{it} \right). \tag{7}$$

Taking the expectation of (7) conditional only on X_{it}, and applying the law of iterated expectations, we get

$$E(V_{it} \mid X_{it}) = E\left(\frac{P_{it+1} + D_{it+1}}{1 + \bar{R}^{v}_{it+1}} \,\middle|\, X_{it} \right) = B'_t X_{it}. \tag{8}$$

Equation (8) provides a surprisingly simple solution to our problem: under very general assumptions, value relevance relations can be estimated free of bias due to market inefficiencies by changing the dependent variable from the contemporaneous stock price to the future cum-dividend price deflated by conditional expected returns. This deflated future price not only corrects the bias in estimates of value relevance, it adjusts for the future price effects of the accounting variables that appear on the right-hand-side. To see more clearly how the adjustment works, we isolate the expression for the measurement error in stock price:

$$E(u_{it} \mid X_{it}) = E\left(-\left(\frac{R_{it+1} - \bar{R}^{v}_{it+1}}{1 + \bar{R}^{v}_{it+1}} \right) P_{it} \,\middle|\, X_{it} \right), \tag{9}$$

where $R_{it+1} = \frac{P_{it+1} + D_{it+1} - P_{it}}{P_{it}}$ is stock return from time t to time $t+1$. Equation (9) states that the adjustment to the contemporaneous stock price needed to pick up expected future price effects in measuring value relevance is the expected present value of future price changes unrelated to systematic risk factors.

A natural concern is whether the price adjustments recommended by equation (8) could cause estimates of value relevance coefficients to systematically differ from those estimated by conventional value relevance regressions, even if the market is indeed efficient. To alleviate this concern, we note that due to equation (9), $E(u_{it} \mid X_{it}) = 0$ is necessary and sufficient for $E[-(\frac{R_{it+1}-\bar{R}^v_{it+1}}{1+\bar{R}^v_{it+1}})P_{it} \mid X_{it}] = 0$. In other words, the condition of market efficiency is both necessary and sufficient for the adjustment to disappear in expectation. Of course, this result is only valid within the confines of our model. Its empirical validity hinges on the degree to which 1) our model assumptions reflect reality, and 2) our control for systematic risk and measurements of relevant accounting variables are free of error.

3.3 EMPIRICAL IMPLEMENTATION

To estimate equation (8), we run the following cross-sectional regression:

$$\hat{P}_{it} = B_t' X_{it} + \varepsilon_{it}, \tag{10}$$

where $\hat{P}_{it} = (\frac{1+R_{it+1}}{1+\bar{R}^v_{it+1}})P_{it}$. Following the common convention in value relevance studies that conduct empirical tests in levels, we deflate both sides of (10) by the number of shares outstanding.[9]

Brown et al. [1999] suggest that deflating by beginning of the period stock price satisfactorily eliminates the biases caused by the scale effects. This deflation essentially transforms the price level model into a return model. Accordingly, since we are interested in both level and return regressions routinely used in value relevance studies, we also deflate equation (10) by the lagged stock price P_{it-1}:

$$\hat{R}_{it} = \frac{\hat{P}_{it}}{P_{it-1}} = B_t' X^p_{it} + \xi_{it}, \tag{11}$$

where $X^p_{it} = \frac{1}{P_{it-1}} \cdot X_{it}$ is a vector of lagged price deflated accounting variables.[10]

In the empirical section that follows, we estimate equations (10) and (11), and contrast the results with those obtained from analogous conventional value relevance regressions.

3.4 A NUMERICAL EXAMPLE

In order to illustrate the intuition underlying our theoretical development, we offer the following numerical example:

Consider a simple case where intrinsic value is a multiple of earnings: $V_t = 10X_t$, implying a true value relevance coefficient of 10. Suppose that the market systematically under-reacts to earnings information and prices the firm at $P_t = 9X_t$. Accordingly, given earnings of \$2, the price of the firm would be \$18 rather than its intrinsic value of \$20. Therefore, if one were

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[9] Several recent papers (e.g., Easton [1998] and Brown, Lo, and Lys [1999]) have raised concerns that this approach may yield biases due to variations in the dependent variable related to a firm's decision to split its common shares. As indicated below we adjust for such effects by further deflating by beginning stock price.

[10] The distinction between (11) and the conventional returns model, $R_{it} = B_t' X^p_{it} + \varepsilon_{it}$, can be more easily seen by linearizing the dependent variable using first-order Taylor expansion, $\frac{1+R_{it}R_{it+1}}{1+\bar{R}^v_{it+1}} \approx 1 + R_{it}R_{it+1} - \bar{R}^v_{it+1}$. This dependent variable includes not only contemporaneous stock returns, but also future returns adjusted for systematic risk factors.

to econometrically check the relationship between price and earnings, one would find a biased value relevance coefficient estimate of 9.

Next, suppose that the intrinsic value of the firm increases 12% from time t to time $t+1$ due to the realization of systematic risk factors, so that intrinsic value becomes \$22.4, i.e., $V_{t+1} = \$22.4$. If, as above, we assume the market resolves inefficiencies in one period, then the $t+1$ market price (cum dividends) P_{t+1} will also be \$22.4 (plus a new measurement error not correlated with X_{it} that we ignore). The price change from t to $t+1$, however, has two components: \$2 to correct for time t market under-reaction and \$2.4 due to realization of systematic risk factors. Deflate P_{t+1} by one plus the risk induced conditional expected returns, $\frac{22.4}{1+12\%} = \$20$. This adjusted price has the correct multiple of 10 on the time t earnings X_{it}, therefore reflecting the full value relevance of X_{it}.

Alternatively, if the market is efficient with respect to X_{it}, then the time t price would be \$20, and P_t would have the correct multiple on X_{it} with a value of 10. Now the interesting question is whether the adjusted price would also generate the correct multiple on X_{it}. Observe that in this scenario the time $t+1$ price P_{t+1} would still be \$22.4. The difference from the inefficiency case is that the change in price of \$2.4 is completely driven by the realization of systematic risk factors. One can easily check that our adjusted price again produces the correct multiple of 10 on X_{it}. Thus, the example illustrates that, at least in principle, our methodology does not produce unwanted biases even when the market is efficient with respect to the underlying accounting information.

3.5 RELATING TO THE ANOMALIES LITERATURE

The derived adjustment to stock price under market inefficiency has a close link with extant studies on market anomalies. In this section, we show that one can anticipate the direction and approximate magnitude of adjustments to current price provided one has prior knowledge of an association between accounting variables and future abnormal returns. This analysis emphasizes one of the major goals of this paper to bring together the anomalies literature and the value relevance literature.

To begin, we observe that in most accounting-based anomalies studies, market inefficiency is assumed to take a particular form where future returns are predicted using price deflated accounting variables:

$$E\left(R_{it+1} - \bar{R}^{v}_{it+1} \mid X_{it}, P_{it}, F_{t+1}\right) = \frac{1}{P_{it}} \cdot \Gamma'_t X_{it} \tag{12}$$

The market is said to under-react (over-react) to an accounting variable x_j if the coefficient on that variable γ_j is greater (less) than zero. For example, the market inefficiency explanation of book-to-price and earnings-to-price effects points to a market under-reaction to these accounting variables.

Multiplying both sides of (12) by $\frac{P_{it}}{1+\bar{R}^{v}_{it+1}}$ and taking the expectation conditional on X_{it}, we get

$$E(-u_{it} \mid X_{it}) = E\left(\left(\frac{R_{it+1} - \bar{R}^v_{it+1}}{1 + \bar{R}^v_{it+1}}\right) P_{it} \,\middle|\, X_{it}\right) = E\left(\frac{1}{1 + \bar{R}^v_{it+1}} \,\middle|\, X_{it}\right) \Gamma'_t X_{it}. \tag{13}$$

To the extent that the first element on the far right-hand-side of (13) has relatively small cross-sectional variation compared with X_{it}, we can approximate it as a constant, i.e., $E(\frac{1}{1+\bar{R}^v_{it+1}} \mid X_{it}) \approx \frac{1}{1+\bar{R}_t}$. In this case abnormal-return-predicting power exhibited by $\frac{1}{P_{it}} \cdot X_{it}$ can be directly translated into an adjustment in value relevance coefficient $\frac{\Gamma_t}{1+\bar{R}_t}$. Hence, we expect our adjusted regression models (10) and (11) to produce higher (lower) coefficients if the anomaly studies show under-reaction (over-reaction).

We should note, however, the above analysis does not in itself imply that anomalies studies of this genre provide "empirical evidence" in support of our proposed methodology. The analysis assumes that 1) the functional form for abnormal return prediction is a linear one with price deflated accounting variables on the right-hand-side, and 2) cross-sectional variation in conditional expected returns can be ignored. While these two assumptions may make sense approximately, there is no guarantee that they hold universally. Accordingly, since equation (10) and (11) are valid in the absence of these two simplifying assumptions, it still behooves us to examine our proposed methodology empirically.

4. *Empirical Findings*

As alluded to in the introduction, we apply the procedure proposed in section 3 to three types of studies: 1) the value relevance of earnings and book values (e.g., Collins, Maydew, and Weiss [1997], Lev and Zarowin [1999], and Francis and Schipper [1999]); 2) the value relevance of residual income value estimates (e.g., Frankel and Lee [1998]); and 3) the value relevance of accruals and cash flows (e.g., Sloan [1996]).

We obtain accounting information from COMPUSTAT annual files, earnings forecasts from IBES summary tape, and price information from CRSP. For the analysis on earnings and book values, we obtain 105,362 firm-year observations for years 1962–1995.[11] Requirements on accrual and cash flows data reduce the sample to 70,551 observations. Finally, the analysis on the residual income intrinsic value measure have a sample size of 16,650 for years 1982–1995, because in addition to accounting and price information, analyst forecast data are also required. Table 1 contains the descriptive statistics of the sample.

An important variable used in all empirical tests is the systematic risk induced stock return $\bar{R}^v_{it}$. Following the predominant practice in the accounting and finance literature, we use CRSP size decile returns to proxy for this variable. Nonetheless, we acknowledge that there is still much controversy in the finance literature as to what factors should be included to

[11] 1,683 observations with an absolute studentized residual greater than 3 were excluded.

TABLE 1

Descriptive Statistics

NI_{it} is earnings per share; BV_{it} is book value per share; P_{it} is stock price three months after the fiscal year end t, ACC_{it} is the accrual component in earnings, calculated as change in current assets minus the change in cash, minus the change in current liabilities, plus the change in short-term debt, plus the change in taxes payable minus the annual depreciation; CF_{it} is net income minus ACC_{it}. $AR_{it+\tau}$ ($\tau = 1, 2, 3$) are firm i's size-adjusted returns for 12, 24, 36 months beginning three months after the fiscal year end t. P_t^* is a value measure using the residual income model:

$$P_t^* = bv_t + \sum_{s=1}^{5}\left(\frac{E_t(eps_{t+s} - k_t bv_{t+s-1})}{(1+k_t)^s}\right) + \frac{E_t(eps_{t+s} - k_t bv_{t+4})}{k_t(1+k_t)^s}$$

where eps_{t+s} ($s = 1, 2, 3, 4, 5$) are earnings forecasts, k_t is the discount rate calculated as the risk-free rate plus beta times the equity risk premium. See section 4 of the text for detailed description for the construction of this variable.

Variable	# obs	Mean	Median	STD	Q1	Q3
NI_{it}	105,362	1.225	0.964	2.343	0.123	2.173
BV_{it}	105,362	12.616	8.967	13.14	3.847	17.557
P_{it}	105,362	18.051	13.00	19.82	5.250	24.75
NI_{it}/P_{it-1}	105,362	0.021	0.068	0.275	0.022	0.117
BV_{it}/P_{it-1}	105,362	0.823	0.710	0.592	0.410	1.123
ACC_{it}/P_{it-1}	70,551	−0.081	−0.039	0.435	−0.130	0.013
CF_{it}/P_{it-1}	70,551	0.124	0.098	0.437	0.023	0.207
P_{it}^*/P_{it-1}	16,650	0.772	0.701	0.639	0.524	0.932
$AR_{it+\tau}$	102,597	0.018	−0.050	0.603	−0.283	0.199
$AR_{it+\tau}$	95,727	0.046	−0.100	0.900	−0.413	0.270
$AR_{it+\tau}$	89,197	0.069	−0.148	1.135	−0.504	0.301

control for risk. To the extent that imperfect measurement of risk can bias results upward in favor of market inefficiency, our results should be subjected to the same criticisms faced by all anomaly studies. However, our objective is not to contribute to the debate on how efficient the market may be or the best method to control for systematic risk. Rather, it is to bridge the anomaly literature and the value relevance literature under the prospect that there is a significant possibility that the market may not be efficient.

4.1 PRICE AND RETURN REGRESSIONS ON EARNINGS AND BOOK VALUES

Table 2 presents results with respect to price level regressions on earnings and/or book values. We first run conventional year-by-year cross-sectional regressions of price on earnings and/or book values, deflating all variables by the number of shares outstanding. Then we run cross-sectional regressions using the adjusted price according to equation (10).

The second column of panel A contains the regression results using unadjusted stock prices. The mean book value and earnings coefficients are 0.961 and 6.099, respectively, in simple regressions, while the mean coefficients reduce somewhat in the multiple regression to 0.585 for book value and 4.181 for earnings. These differences in mean coefficients are expected

TABLE 2

Price Level Regressions on Earnings and Book Values

Stock prices are cross-sectionally regressed on earnings and (or) book values in each year. Summary statistics of the cross-sectional regression coefficients are reported in panel A. All variables are deflated by number of shares outstanding. To control for market inefficiency, stock price is adjusted to construct $\hat{P}_{it}$: $\hat{P}_{it} = (\frac{1+R_{it+\tau}}{1+\bar{R}^{v}_{it+\tau}})P_{it}$, where $R_{it+\tau}$ $(\tau = 1, 2, 3)$ are firm i's stock returns for 12, 24, 36 months beginning three months after the fiscal year end t, and $\bar{R}^{v}_{it+\tau}$ $(\tau = 1, 2, 3)$ are corresponding size decile returns. For panels B, C, and D, the change in the coefficients is defined as the coefficient from regression using P_{it} (unadjusted coefficient) minus the corresponding coefficient from regression using $\hat{P}_{it}$ (adjusted coefficient), deflated by the unadjusted coefficient. Statistical tests are based on 34 annual observations of the change in coefficients from 1962 to 1995. # > (<)0 indicates the number of coefficients in panel A and coefficient changes in panels B, C, and D greater (less) than zero.

Panel A: Level regression coefficient estimates (all are significant at the 1% level)

Adjustment Horizon	Unadjusted		One-year $\tau = 1$		Two-year $\tau = 2$		Three-year $\tau = 3$	
	BV		BV		BV		BV	
Mean	0.961		0.989		1.013		1.023	
Median	0.920		0.973		1.022		1.030	
# > 0	34		34		34		34	
	NI		NI		NI		NI	
Mean	6.099		6.367		6.599		6.773	
Median	5.216		5.210		5.595		5.850	
# > 0	34		34		34		34	
	NI	BV	NI	BV	NI	BV	NI	BV
Mean	4.181	0.585	4.481	0.583	4.636	0.592	4.783	0.592
Median	2.751	0.565	2.872	0.576	2.942	0.586	3.029	0.635
# > 0	34	32	34	32	34	32	34	32

Panel B: Summary statistics for the percentage change on the coefficient of BV

Adjustment Horizon	One-year $\tau = 1$	Two-year $\tau = 2$	Three-year $\tau = 3$
Mean	−0.034	−0.061	−0.077
Median	−0.044	−0.046	−0.075
# < 0	21	28	28
p-value for mean test	0.005	0.001	0.001
p-value for median test	0.003	0.001	0.001

Panel C: Summary statistics for the percentage change on the coefficient of NI

Adjustment Horizon	One-year $\tau = 1$	Two-year $\tau = 2$	Three-year $\tau = 3$
Mean	−0.044	−0.086	−0.111
Median	−0.056	−0.075	−0.110
# < 0	27	30	29
p-value for mean test	0.001	0.001	0.001
p-value for median test	0.001	0.001	0.001

Panel D: Summary statistics for the percentage change on the coefficient of BV and NI

Adjustment Horizon	One-year $\tau = 1$		Two-year $\tau = 2$		Three-year $\tau = 3$	
	NI	BV	NI	BV	NI	BV
Mean	−0.084	−0.069	−0.134	−0.096	−0.156	−0.046
Median	−0.092	−0.022	−0.124	−0.036	−0.132	−0.043
# < 0	29	19	29	19	31	21
p-value for mean test	0.001	0.274	0.001	0.209	0.001	0.362
p-value for median test	0.001	0.435	0.001	0.167	0.001	0.172

given the high correlation between earnings and book values. The third, fourth and fifth columns contain regression results when stock prices are adjusted using one, two, and three year ahead size adjusted returns according to equation (10). Compared with regressions using unadjusted prices, future return adjusted prices yield higher average coefficients in all scenarios. The implication is that not all information contained in earnings and book values is reflected in current stock prices; some portion is reflected in future price changes.

In panels B, C, and D, we report mean and median percentage changes in regression coefficients from conventional regressions to adjusted regressions. The procedure we employ in constructing tests is essentially that of Fama and MacBeth [1973] wherein each year's cross-sectional percentage change is considered an independent observation. When three-year returns are used, the mean increase in book value and earnings coefficients is 7.7% and 11.1% in simple regressions, and 4.6% and 15.6% in multiple regressions. Median results are similar. These increases are systematic in that very few years experience the opposite result. When we treat each annual change in coefficients as an independent observation a la Fama and MacBeth [1973], we find the mean increase is significant at the 1% level in almost all cases. The mean increase in book value coefficient estimates in the multiple regressions is less significant, possibly due to the high correlation between earnings and book values.

Overall, the changes in levels regression coefficient estimates, although highly significant in the statistical sense, are less likely to be significant in an economic sense because of the modest magnitudes. Consistent with the resolution of measurement errors in one to three years, a plausible explanation for the modest magnitudes is that market inefficiencies are more likely to pertain to "new information." Since levels regressions inherently pick up information accumulated since the inception of the firm, market inefficiency is less likely to play a large role. The natural extension of this reasoning is to look at return regressions for which only new information appears on both sides of the equation.

Table 3 reports results from return regressions on earnings and book values. For the returns specification, we simply deflate the level specification by the lag stock price. The columns of panel A report mean and median return regression coefficients employing unadjusted returns and returns adjusted using one-, two- and three-year ahead returns. As observed in prior research, estimated value relevance coefficients are generally smaller in the return specification than in the level specification. Similar to the results for the levels specification, estimated coefficients on average increase as we move from unadjusted coefficients to adjusted coefficients. But, the magnitudes of the increases far exceed those observed for level regressions.

For example, as depicted in panels B, C, and D, when three-year ahead returns are used for adjustment, estimated coefficients on book value and earnings increase on average by 77.4% and 96.7%, respectively, in simple regressions, and by 81.8% and 90.3%, respectively, in multiple regressions.

TABLE 3

Return Regression on Earnings and Book Values

Stock return (price deflated by lag price) is cross-sectionally regressed on earnings and (or) book values deflated by stock price of previous year. Summary statistics of the cross-sectional regression coefficients are reported in Panel A. To control for market inefficiency, stock price is adjusted to form $\hat{R}_{it}$: $\hat{R}_{it} = \frac{\hat{P}_{it}}{P_{it-1}}$, where $\hat{P}_{it} = (\frac{1+R_{it+\tau}}{1+\bar{R}^{v}_{it+\tau}})P_{it}$, $R_{it+\tau}$ $(\tau = 1, 2, 3)$ are firm i's stock return for 12, 24, 36 months beginning three months after the fiscal year end t, and $\bar{R}^{v}_{it+\tau}$ $(\tau = 1, 2, 3)$ are corresponding size decile returns. For panels B, C, and D, the change in the coefficients is defined as the coefficient from the regression using R_{it} (unadjusted coefficient) minus the corresponding coefficient from regression using $\hat{R}_{it}$ (adjusted coefficient), deflated by the unadjusted coefficient. Statistical tests are based on 33 annual observations of change in coefficients from 1963 to 1995. # >(<)0 indicates the number of coefficients in panel A and coefficient changes in panels B, C, and D greater (less) than zero.

Panel A: Return regression coefficient estimates (all are significant at the 1% level)

Adjustment Horizon	Unadjusted		One-year $\tau = 1$		Two-year $\tau = 2$		Three-year $\tau = 3$	
	BV_t/P_{t-1}		BV_t/P_{t-1}		BV_t/P_{t-1}		BV_t/P_{t-1}	
Mean	0.212		0.282		0.316		0.363	
Median	0.218		0.283		0.289		0.378	
# > 0	34		34		34		34	
	NI_t/P_{t-1}		NI_t/P_{t-1}		NI_t/P_{t-1}		NI_t/P_{t-1}	
Mean	0.581		0.761		0.791		0.853	
Median	0.425		0.594		0.615		0.821	
# > 0	33		34		33		32	
	NI_t/P_{t-1}	BV_t/P_{t-1}	NI_t/P_{t-1}	BV_t/P_{t-1}	NI_t/P_{t-1}	BV_t/P_{t-1}	NI_t/P_{t-1}	BV_t/P_{t-1}
Mean	0.446	0.182	0.601	0.242	0.625	0.280	0.638	0.327
Median	0.303	0.200	0.540	0.242	0.494	0.246	0.526	0.341
# > 0	33	34	34	33	33	33	32	33

Panel B: Summary statistics for the percentage change on the coefficient of BV

Adjustment Horizon	One-year $\tau = 1$	Two-year $\tau = 2$	Three-year $\tau = 3$
Mean	−0.341	−0.532	−0.774
Median	−0.290	−0.366	−0.663
# < 0	27	27	24
p-value for mean test	0.001	0.001	0.001
p-value for median test	0.001	0.001	0.001

Panel C: Summary statistics for the percentage change on the coefficient of NI

Adjustment Horizon	One-year $\tau = 1$	Two-year $\tau = 2$	Three-year $\tau = 3$
Mean	−0.315	−0.632	−0.967
Median	−0.343	−0.428	−0.561
# < 0	29	31	28
p-value for mean test	0.001	0.001	0.004
p-value for median test	0.001	0.001	0.001

Panel D: Summary statistics for the percentage change on the coefficient of BV and NI

Adjustment Horizon	One-year $\tau = 1$		Two-year $\tau = 2$		Three-year $\tau = 3$	
	NI_t/P_{t-1}	BV_t/P_{t-1}	NI_t/P_{t-1}	BV_t/P_{t-1}	NI_t/P_{t-1}	BV_t/P_{t-1}
Mean	−0.478	−0.322	−0.742	−0.534	−0.903	−0.818
Median	−0.367	−0.315	−0.465	−0.468	−0.461	−0.698
# < 0	28	26	30	24	28	28
p-value for mean test	0.001	0.009	0.001	0.001	0.001	0.001
p-value for median test	0.001	0.001	0.001	0.001	0.001	0.001

Similar to results for the levels specification, mean percentage increases become larger as the time horizon for future returns lengthens from one to three years. The median coefficient increases are equally impressive, although with somewhat smaller magnitudes implying that the change in coefficients is somewhat skewed to the left. As in table 2, we found all changes to be significant at the 1% level, again, assuming that each annual change is an independent observation. The point to be emphasized is that the return results are not only significant in a statistical sense, and they are likely to be significant in an economic sense in some settings.[12]

4.2 RETURN REGRESSIONS ON P^*

Although most value relevance studies employ earnings and book values as benchmark variables, regressions that use only earnings and book values invariably suffer from the absence of control for "other information" (Liu and Thomas [2000]). Hence, it is in general difficult to make a prediction on the coefficients because the regression coefficients are biased due to the omission of correlated variables. Accordingly, it is not easy to concretely make a case that, after adjusting for market inefficiency, the value relevance coefficients of the included variables, earnings and book value, move in the correct direction. We therefore evaluate a case where we can more confidently predict the "correct" coefficient. Specifically, we derive a residual income based intrinsic value, P^*, and regress stock return on the lagged price deflated P^*.[13] Since P^* is a direct value measure, the predicted coefficient on P^* is one.

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[12] The existing longitudinal studies on the value relevance of earnings and book values (e.g. Collins et al. [1997], Francis and Schipper [1999], Lev and Zarowin [1999]) found increasing (decreasing) value relevance coefficients on book value (earnings) over time. Although our adjusted regressions generated much larger coefficients, which is especially true in return regressions, the general trend of increasing (decreasing) book value (earnings) coefficients is preserved.

[13] P^* is calculated in a similar manner to that of Frankel and Lee [1998] by assuming that abnormal earnings is a perpetuity after five years: i.e.,

$$P_t^* = bv_t + \sum_{s=1}^{5} \left(\frac{\mathrm{E}_t(eps_{t+s} - k_t bv_{t+s-1})}{(1+k_t)^s} \right) + \frac{\mathrm{E}_t(eps_{t+s} - k_t bv_{t+4})}{k_t(1+k_t)^s},$$

where eps_{t+s} ($s = 1, 2, 3, 4, 5$) are earnings forecasts, k_t is the discount rate. The discount rate (k_t) is calculated as the risk-free rate plus beta times the equity risk premium. We use the 10-year Treasury bond yield on April 1 of year t as the risk-free rate and assume a constant 5% equity risk premium. We measure beta as the median beta of all firms in the same beta decile in year t. We estimate betas using monthly stock returns and value-weighted CRSP returns for the five years that end in March of year t (at least 30 observations are required). For a subgroup of firm-years (less than 5 percent), we were able to obtain mean IBES forecasts for all years in the five-year horizon. For all other firms, with less than complete forecasts available between years 3 and 5, we generated forecasts by applying the mean long-term growth forecast (g) to the mean forecast for the prior year in the horizon; i.e., $eps_{t+s} = eps_{t+s-1} * (1+g)$. The book values for future years, corresponding to the earnings forecasts, are determined by assuming the "ex-ante clean surplus" relation (ending book value in each future period equals beginning book value

TABLE 4

Return Regression on P^*

Stock return (price deflated by lag price) is cross-sectionally regressed on P^* deflated by stock price of previous year, P_t^*/P_{t-1}. P_t^* is a value measure using the residual income model:

$$P_t^* = bv_t + \sum_{s=1}^{5}\left(\frac{\mathrm{E}_t(eps_{t+s} - k_t bv_{t+s-1})}{(1+k_t)^s}\right) + \frac{\mathrm{E}_t(eps_{t+s} - k_t bv_{t+4})}{k_t(1+k_t)^s},$$

where eps_{t+s} ($s = 1, 2, 3, 4, 5$) are earnings forecasts, k_t is the discount rate calculated as the risk-free rate plus beta times the equity risk premium. See section 4 of the text for a detailed description of the construction of this variable. To control for market inefficiency, stock price is adjusted to form $\hat{R}_{it}$: $\hat{R}_{it} = \frac{\hat{P}_{it}}{P_{it-1}}$, where $\hat{P}_{it} = (\frac{1+R_{it+\tau}}{1+\bar{R}^v_{it+\tau}})P_{it}$, $R_{it+\tau}$ ($\tau = 1, 2, 3$) are firm i's stock return for 12, 24, 36 months beginning three months after the fiscal year end t, and $\bar{R}^v_{it+\tau}$ ($\tau = 1, 2, 3$) are corresponding size decile returns. For panel B the change in the coefficients is defined as the coefficient from regression using R_{it} (unadjusted coefficient) minus the corresponding coefficient from regression using $\hat{R}_{it}$ (adjusted coefficient), deflated by the unadjusted coefficient. Statistical tests are based on 13 annual observations of change in coefficients from 1983 to 1995. # > (<)0 indicates the number of coefficients in panel A and changes in coefficients in panel B greater (less) than zero. The sample covers 16,650 observations from 1983 to 1995.

Panel A: Return regression coefficient estimates (all are significant at the 1% level)

Adjustment Horizon	Unadjusted	One-year $\tau = 1$	Two-year $\tau = 2$	Three-year $\tau = 3$
	P_t^*/P_{t-1}	P_t^*/P_{t-1}	P_t^*/P_{t-1}	P_t^*/P_{t-1}
Mean	0.484	0.561	0.580	0.599
Median	0.494	0.536	0.562	0.615
# > 0	13	13	13	13

Panel B: Summary statistics for the percentage change on the coefficient of P_t^*/P_{t-1}

Adjustment Horizon	One-year $\tau = 1$	Two-year $\tau = 2$	Three-year $\tau = 3$
Mean	−0.170	−0.209	−0.237
Median	−0.178	−0.220	−0.275
# < 0	10	10	10
p-value for mean test	0.003	0.017	0.023
p-value for median test	0.004	0.017	0.027

Table 4 presents the return regressions results for P^* on the right hand side. Panel A reports the regression coefficients for both unadjusted returns and returns adjusted using one, two and three-year ahead returns. Similar to results on earnings and book values, estimated coefficients increase from unadjusted regressions to adjusted regressions. The mean (median) increase

plus forecasted earnings less forecasted dividends). Since analyst forecasts of future dividends are not available on IBES, we assume that the current dividend payout ratio will be maintained in the future. We measure the current dividend payout as the ratio of the indicated annual cash dividends to the earnings forecast for year $t+1$ (both obtained from the IBES summary file). To minimize biases that could be induced by extreme dividend payout ratios (caused by forecast $t+1$ earnings that are close to zero), we winsorize payout ratios at 10% and 50%.

in coefficients is 23.7% (27.5%) when we use three-year ahead returns for adjustment. Because this increase in coefficients is toward the predicted value of one, we believe this result supports our claim that our adjustment procedure offers meaningful error reduction in value relevance estimation.[14] Statistical tests in panel B indicate that all changes in average coefficient estimates are highly significant. Also, noteworthy is that the largest average percentage increase is obtained using one-year ahead returns suggesting that the resolution of market inefficiencies relative to this measure is less protracted.

4.3 RETURN REGRESSIONS ON ACCRUALS AND CASH FLOWS

A final application of our procedure is to measure the value relevance of accruals and cash flows.[15] Sloan [1996] finds that although accruals are less persistent than cash flows, they possess the same value relevance. Because our procedure captures future as well as current price effects of these variables, if cash flows are more persistent than accruals, then we should see cash flows have higher coefficients in our adjusted regressions.

While we use Sloan's definition for accruals and cash flows,[16] to be consistent with our adjustment procedure, instead of deflating accruals and cash flows by total assets, we deflate them by the prior year stock price. As shown in table 5 panel A, unadjusted regressions yield mean (median) coefficient estimates of 0.506 (0.376) for accruals and 0.624 (0.467) for cash flows. Although the mean and median cash flow coefficient estimates are higher than the mean and median accrual coefficient estimates, one cannot reject the hypothesis that they are equal (panel B). As we move from unadjusted regressions to adjusted regressions, all regression coefficients increase. This suggests that the market under-reacts to both accrual and cash flow components of earnings. However, the average cash flow coefficient estimate increases much more than the average accrual coefficient estimate, suggesting a more substantial under-reaction for cash flows than for accruals. When we use three-year ahead returns for adjustments, the mean (median) accrual coefficient estimate increases to 0.741 (0.691), and the mean (median) cash flow coefficient estimate increases to 1.095 (0.992). Panel B reports the *P*-values for testing the hypothesis that the coefficient on cash flows is higher that the coefficient on accruals. Again, in the spirit of Fama and MacBeth [1973], for each test year we

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[14] Liu and Thomas [2000] find return regressions coefficients to be close to one. Our result is expected to differ from theirs because 1) their returns include dividends, 2) their terminal value is based on information extracted from the beginning of the return period market prices, and 3) their sample was subject to extensive outlier treatment.

[15] This part of the analysis is similar to that in Pfeiffer and Elger [1999]. Our findings are consistent with theirs.

[16] Accruals = $(\Delta CA - \Delta Cash) - (\Delta CL - \Delta STD - \Delta TP) - Dep$, where CA is current assets, Cash is cash/cash equivalents, CL is current liabilities, STD is debt included in current liabilities, TP is taxes payable and Dep is depreciation and amortization expense. CF is income from continuing operations minus accruals.

TABLE 5

Return Regression on Accruals and Cash Flows

Stock return (price deflated by lag price) is cross-sectionally regressed on accruals and cash flows deflated by stock price of previous year. ACC_{it} is the accrual component of earnings, calculated as change in current assets minus the change in cash, minus the change in current liabilities plus the change in short-term debt plus the change in taxes payable minus the annual depreciation; CF_{it} is net income minus ACC_{it}. To control for market inefficiency, stock price is adjusted to form $\hat{R}_{it}$: $\hat{R}_{it} = \frac{\hat{P}_{it}}{P_{it-1}}$, where $\hat{P}_{it} = (\frac{1+R_{it+\tau}}{1+\bar{R}^{v}_{it+\tau}})P_{it}$, $R_{it+\tau}$ $(\tau = 1, 2, 3)$ are firm i's stock return for 12, 24, 36 months beginning three months after the fiscal year end t, and $\bar{R}^{v}_{it+\tau}$ $(\tau = 1, 2, 3)$ are corresponding size decile returns. Panel B reports the P-value for one-tailed tests on whether mean or median cross-sectional coefficients on ACC_t/P_{t-1} and CF_t/P_{t-1} are different. The statistical tests treat each annual observation of the difference in the coefficients as one independent draw. # > 0 indicates the number of coefficients greater than zero. The sample size is 70,551.

Panel A: Return regression coefficient estimates (all are significant at the 1% level)

Adjustment Horizon	Unadjusted	One-year $\tau = 1$	Two-year $\tau = 2$	Three-year $\tau = 3$
	ACC_t/P_{t-1}	ACC_t/P_{t-1}	ACC_t/P_{t-1}	ACC_t/P_{t-1}
Mean	0.506	0.679	0.671	0.741
Median	0.376	0.571	0.634	0.691
# > 0	30	28	27	27
	CF_t/P_{t-1}	CF_t/P_{t-1}	CF_t/P_{t-1}	CF_t/P_{t-1}
Mean	0.624	0.887	0.974	1.095
Median	0.467	0.697	0.800	0.992
# > 0	31	31	31	31

Panel B: *P*-values for one-tailed tests that the coefficient on CF is higher than the coefficient on ACC

Adjustment Horizon	Unadjusted	One-year $\tau = 1$	Two-year $\tau = 2$	Three-year $\tau = 3$
Mean	0.159	0.113	0.034	0.040
Median	0.103	0.049	0.019	0.020

calculate the difference in the cross-sectional regression coefficients on accruals and cash flows, and treat each year's difference as a random draw. When we use three-year ahead returns for adjustments, we cannot reject the null at 4% significance level for the mean test, and 2% for the median test.

5. *Conclusion*

Overall, our results provide strong evidence that conventional value relevance regressions fail to pick up the price effects of information contained in accounting variables that surface in the future. Based on a model that assumes market price measures intrinsic value with error, we demonstrate that in order to measure value relevance with respect to intrinsic value, stock price needs to be adjusted for predictable future price changes that may be driven by this measurement error. We then derive a procedure for adjusting current prices to reflect those future changes.

We empirically apply this procedure in three types of inquiries that have generated considerable interest among accounting researchers: 1) the value relevance of earnings and book values; 2) the value relevance of residual income value estimates; and 3) the value relevance of accruals and cash flows. In all three cases, the adjustment procedure produces statistically significant changes in mean and median estimated regression coefficients. The changes are especially pronounced in return regressions. For example, coefficients on earnings and book value increase by 90% and 82%, respectively, when we adjust stock prices using three-year-ahead returns. When a residual income intrinsic value measure is used as an independent variable, our adjustment results in a 24% mean increase in regression coefficients toward the predicted value of one. Finally, we confirm Pfeiffer and Elger's [1999] finding that cash flows map into returns with a statistically significantly higher coefficient than accruals after adjustment for future returns, while the two coefficients are statistically indistinguishable from each other when stock price is not adjusted.

Our adjustment procedure does not yield economically important differences in estimated value relevance coefficients using price level regressions. We conjecture the reason is that, given measurement errors tend to be resolved in no more than three years, market inefficiencies pertain to relatively "new information." While return regressions pick up new information, level regressions reflect an accumulation of information since the inception of the firm.

As research in capital markets evolves toward more refined predictions on not only the signs but also the magnitudes of value relevance coefficients, we believe market inefficiency considerations will play a more important role.

APPENDIX A

Multi-Period Resolution of Market Inefficiencies

This appendix extends the one-period analysis presented in section 3 to a multi-period setting in which measurement errors are assumed to follow a well-defined time series process. Specifically, we adopt an AR(1) characterization of the measurement error process suggested by Summers [1986]:

$$u_{it+1} = \rho u_{it} + \varsigma_{it+1} \tag{A1}$$

where the AR(1) coefficient $\rho < 1$.

To derive an econometric specification to correct biases in coefficients and reflect full value relevance of accounting variables, we evaluate the expectation of time $t+\tau$ stock price conditional on X_{it}, P_{it}, V_{it} and F_{t+1} (to simplify derivation, we ignore dividends):

$$
\begin{aligned}
E(P_{it+\tau} \mid F_{t+\tau}, X_{it}, P_{it}, V_{it}) \\
&= E(V_{it+\tau} + u_{it+\tau} \mid F_{t+\tau}, X_{it}, P_{it}, V_{it}) \\
&= \left(1 + \bar{R}^{v}_{it+\tau}\right) V_{it} + \rho^{\tau} u_{it} \\
&= \left(1 + \bar{R}^{v}_{it+\tau} - \rho^{\tau}\right) V_{it} + \rho^{\tau} P_{it} \qquad \text{(A2)}
\end{aligned}
$$

Rearranging (A2) and moving V_{it} to the left-hand-side, we obtain

$$
V_{it} = E\left(\frac{P_{it+\tau}}{1 + \bar{R}^{v}_{it+\tau} - \rho^{\tau}} \,\middle|\, F_{t+\tau}, X_{it}, P_{it}, V_{it}\right) + \frac{\rho^{\tau} P_{it}}{1 + \bar{R}^{v}_{it+\tau} - \rho^{\tau}}. \qquad \text{(A3)}
$$

Taking the expectation of (A3) conditional only on X_{it}, and applying the law of iterated expectations, we get

$$
E(V_{it} \mid X_{it}) = E\left(\frac{P_{it+\tau} + \rho^{\tau} P_{it}}{1 + \bar{R}^{v}_{it+\tau} - \rho^{\tau}} \,\middle|\, X_{it}\right) = B_t' X_{it}. \qquad \text{(A4)}
$$

A caveat to this approach empirically is the difficulty of estimating ρ. We avoid this difficulty by assuming that the time horizon employed is sufficiently long for ρ^{τ} to approximate 0. A tradeoff is made when deciding what horizon to adopt: a short horizon raises the prospect of a conservative bias in estimating the above price adjustment, a long horizon, however, introduces more noise and reduces the efficiency of the estimation.

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