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Time-series coefficient variation in value-relevance regressions: a discussion of Core, Guay, and Van Buskirk and new evidence☆

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Abstract

Many claim that GAAP financial information has become largely irrelevant to explaining valuations. Core et al. compare financial information's value relevance for the New Economy stocks with other stocks. We supplement their analysis with new evidence on the economic determinants of the time-series variation in the coefficients mapping financial information into prices. We document significant variation in the coefficients related to proxies for changing market growth expectations and discount rates and additional variation consistent with time-varying correlated omitted variables. Such findings make it difficult to draw unambiguous inferences about the relevance and reliability of financial information from value-relevance regressions.

JEL classification: G1; M4

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1. Introduction

Core et al. (2003) examine whether equity valuation using financial variables in the New Economy Period, i.e., 1995–2000, differs from that in other time periods. Their

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research is motivated by the widespread belief among researchers and practitioners that financial statements' value relevance (i.e., the explanatory power of contemporaneous financial information with respect to stock prices) declined in the New Economy Period. High market-to-book ratios and large market capitalization of loss-making firms were not uncommon in the New Economy Period. Those valuations appear to have contributed to the belief that financial statements have relatively little role in explaining firm valuations in the New Economy. Research closely related to Core et al. offers corroborating evidence of a diminishing role for the contemporaneous financial information in explaining the prices of New Economy stocks (e.g., Rajgopal et al., 2000; Trueman et al., 2000). This finding complements similar evidence from broad sample studies examining the explanatory power of earnings for stock prices (e.g., Collins et al., 1997; Brown et al., 1999; Lev and Zarowin, 1999).

Core et al. provide mixed evidence for the hypothesis that the relation between equity values and financial variables in the New Economy Period differs from that in other periods. They find that the financial variables' ability to explain stock prices is significantly lower in the New Economy Period. However, the magnitude of out-of-sample prediction errors for the New Economy Period is not unusual compared to those in other time periods.[1] Core et al. interpret the evidence as consistent with greater stock return volatility without a change in the properties of accounting information (also see Francis and Schipper, 1996). For example, a greater influence of changing expectations about growth opportunities can induce stock price volatility and diminish the explanatory power of current financial information even if the accounting rules governing financial statement preparation were unchanged.

Core et al. conduct careful empirical analysis and in large part we concur with their interpretation of the results. Their use of a broad sample of firms as well as various subsamples (e.g., high technology firms, young firms, and young firms incurring losses) lends credibility to their conclusions. However, the reader is left with important unanswered questions. Lower explanatory power of the financial variables in the New Economy Period, but similar out-of-sample prediction errors throughout the period they examine implies large variation in the slope coefficients that map the financial variables into stock prices.[2] Such large variation in the coefficients can arise for three reasons: (i) changing growth expectations and discount rates; (ii) time-varying bias due to correlated omitted variables; and (iii) changes in the reliability of accounting numbers through time (i.e., uncertainty about the estimated asset, liability, or earnings numbers in the financial statements). Discriminating between these potentially overlapping explanations is important in

[1] Core et al. do not perform a formal statistical test for the difference, but the pattern of prediction error variance through the years suggests the New Economy Period is not unusual.

[2] Prediction errors are the sum of the fitted errors and a component that reflects the impact of changing slope coefficient, i.e., the product of the explanatory variable and $(\beta_t - \beta_{t-1})$, where $(\beta_t - \beta_{t-1})$ is the change in the estimated slope coefficient from period $t-1$ to t, i.e., the historical to the current time period. Fitted errors are calculated using estimated β_t. Since Core et al. find that prediction errors are similar over their entire sample period, but fitted errors are unusually large in the New Economy Period, it is reasonable to hypothesize that slope coefficient estimates are varying through time.

the context of the analysis in Core et al. and, more generally, in the value-relevance literature. Core et al. offer a limited discussion and virtually no empirical analysis of the determinants of the (changing) magnitudes of the coefficients on financial variables and of the financial variables' changing explanatory power through time. However, to be fair, some of those issues are beyond the scope of their study.

Our discussion mainly revolves around analyzing the time-series variation in the magnitudes of the slope coefficients in cross-sectional regressions of prices on financial variables. The total variation in these coefficients is examined, as well as the relation to proxies for temporal variation in the aggregate investment opportunity set, future profitability, and the expected market rate of return. This is relevant in the context of the issues of inference encountered in financial accounting research. Inferential issues are often critical, especially in research assessing the reliability of reported financial statement numbers with a stated objective of guiding standard setting. We discuss the inferential issues in the context of a typical value-relevance regression (i.e., a regression of prices on contemporaneous financial variables like earnings and the book value of equity). We offer indirect evidence of bias due to correlated-omitted variables in value-relevance studies. Previous research discusses this bias in detail (e.g., Christie, 1987; Holthausen, 1994; Lambert, 1996; Skinner, 1996; Shevlin, 1996; Easton, 1998; Holthausen and Watts, 2001), but to our knowledge evidence of the bias is absent.

In a value-relevance study regressing prices, P, on financial variables, X, the explanatory power, R^2, is

$$R^2 = \beta^2 \operatorname{Var}(X)/\operatorname{Var}(P). \tag{1}$$

The slope, the variability of X, and/or the residual variability of P affect the explanatory power of the value-relevance regression model. Core et al. conclude that increased cross-sectional variability of prices in the New Economy Period, perhaps due to large growth opportunities, contributed to lower explanatory power in the New Economy Period. Prices are forward looking and historical cost financial numbers do not reflect the consequences of changing expectations of growth in current financial statements. Therefore, it is plausible that in periods of high growth expectations, like the New Economy Period, increased variability of price lowers the explanatory power of the value-relevance regression. However, the explanatory power also depends on the slope coefficient and its various economic determinants (e.g., Collins and Kothari, 1989), which makes it difficult to compare explanatory power across samples or time periods (see Brown et al., 1999).

Core et al. study statistical properties (i.e., explanatory power and prediction error variance) of the value-relevance regressions. However, recognizing how different factors influence the estimated slope coefficient is crucially important in economic interpretations of the results from value-relevance research (see Holthausen and Watts, 2001). This research examines accounting variables' value relevance (i.e., the estimated coefficient's magnitude and statistical significance) and on that basis draws conclusions about the accounting variables' properties, generally their relevance and reliability. For example, in their discussion of value-relevance research, Barth et al. (2001, p. 81) state that some value-relevance "studies test whether the estimated coefficient on the accounting amount being studied differs from those on other amounts recognized in financial statements (e.g., Barth et al., 1998; Aboody et al., 1999). Rejecting the null that the coefficients are the same is interpreted as evidence that the accounting amount being studied has relevance and reliability that differ from recognized amounts." In this spirit, Barth (1994, pp. 1–2) motivates her study of the value-relevance of fair-value accounting as follows: "By examining how share prices reflect historical costs and fair values, evidence is provided on measures' relevance and reliability. Because these are the FASBs two principal criteria for choosing among accounting alternatives [Statement of Financial Accounting Concepts (SFAC) No. 2, FASB, 1980], the evidence can inform the FASB's deliberations on using fair value accounting for investment securities…"

Another example is a study by Choi et al. (1997) who examine the value relevance of non-pension post-retirement obligation disclosures required under the Statement of Financial Accounting Standards No. 106 titled Employers' Accounting for post-retirement Benefits Other than Pensions. Choi et al. (1997, p. 352) use a "standard cross-sectional equity valuation model (Landsman, 1986; Barth, 1991)" to test "whether a dollar of APBO is valued the same as a dollar of pension obligation", where APBO stands for the accumulated post-retirement benefit obligation or liability under SFAS No. 106.

Previous research draws inferences about a particular financial variable's reliability based on the estimated coefficient from a value-relevance regression. For example, Holthausen and Watts (2001, p. 6) observe, "For example, Venkatachalam (1996) also tests whether the coefficient on the fair value of derivatives is significantly different from one. Differences between the estimated and predicted values are often interpreted as evidence of measurement error in the accounting number." However, to interpret the coefficients on financial variables in a value-relevance regression as informative about those variables' relevance and reliability requires that either (i) confounding factors that might influence the coefficient magnitudes are absent, or (ii) their effects are adequately controlled for. Previous research recognizes that the relation between share prices and financial variables in a cross-section might be biased due to correlated omitted variables. For example, Skinner (1996, p. 394) observes: "In cross-sectional valuation studies a fundamental challenge facing the researcher is to convince the reader that the results (significant coefficient on the variables of interest) are evidence in favor of the idea that the market is attaching value to the information variables of interest, rather than being due to econometric problems. The most likely alternative explanation is correlated omitted variables and the associated measurement error bias." Others echoing a similar concern include Christie (1987), Holthausen (1994), Lambert (1996), Shevlin (1996), Easton (1998), and Holthausen and Watts (2001).

1.1. Summary of results

We analyze randomly selected samples of 500 stocks each year. We find that the time series of estimated coefficients on book values of assets and liabilities from annual cross-sectional value-relevance regressions are significantly correlated with aggregate growth and expected return proxies. Similar results are obtained using two sets of industry-clustered samples. Later, we argue that the significant relations for the estimated coefficients on liabilities, in particular, suggest that interpreting value-relevance regression coefficients as the market's "valuation" of assets and liabilities might be inappropriate.

The estimated coefficients on the balance sheet variables from value-relevance regressions vary considerably through time. For example, in annual cross-sectional regressions of prices on book values of assets and liabilities, the estimated coefficient on assets ranges from 0.40 to 1.32, with an average value of 0.86. The range of values is similar for the coefficients on liabilities. Because of the large variation in the coefficient estimates, relative to standard errors from cross-sectional regressions, researchers should find it tenuous to make definitive statements about the market's "valuation" of a tangible or intangible asset, or a liability that appears on a balance sheet or is disclosed in financial footnotes (see, for example, Barth and McNichols, 1994; Barth and Clinch, 1996; Muller III, 1998).

We find that coefficients on earnings from value-relevance regressions are significantly negatively correlated with the aggregate growth and expected rate of return proxies. This result is consistent with findings in previous research on the temporal relation between interest rates and earnings response coefficients (e.g., Collins and Kothari, 1989; Kothari and Zimmerman, 1995). The temporal relation between the earnings response coefficient and variables proxying for future profitability and investment opportunities extends similar previous results on earnings response coefficients' cross-sectional variation related to growth opportunities and discount rates (e.g., Easton and Zmijewski, 1989; Collins and Kothari, 1989).

While some variation in coefficients is to be expected due to rationally based aggregate discount rate or growth effects, the observed variation seems too great to be completely explained in this manner. In this sense, the evidence suggests that the coefficients are influenced by omitted expected growth or expected return variables whose cross-sectional relation to the observed earnings measure varies through time with aggregate economic conditions.

Section 2 summarizes the reasons for potential biases in the estimated coefficients from value-relevance levels regressions. Section 3 discusses empirical results. Section 3.1 describes the data. Section 3.2 discusses descriptive statistics for the estimated coefficients from value-relevance regressions. Section 3.3 presents evidence on the relation between these coefficients and proxies for aggregate growth and discount rates. We conclude in Section 4.

2. Bias due to correlated omitted variables and changing aggregate growth expectations and discount rates

We now discuss in detail the logical basis for concerns about bias due to correlated omitted variables in value-relevance regressions. Researchers frequently estimate the following cross-sectional regression (time subscript t and firm subscript i are omitted for simplicity):

$$P = \alpha + \beta_1 E + \beta_2 \mathrm{BVA} + \beta_3 \mathrm{BVL} + \varepsilon, \tag{2}$$

where P is share price, E is earnings per share, BVA is the book value of assets per share, and BVL is the book value of liabilities per share, all measured at the end of fiscal period t. Instead of separately including BVA and BVL, following Ohlson (1995), it is also common to estimate the model using the book value of equity (BVE or net assets) as an independent variable (e.g., Collins et al., 1997; Francis and Schipper, 1996).

Share price, P, is the present value of future net cash flows including economic rents. This means that the market value of equity differs from the aggregate market value of separable net assets (i.e., assets minus liabilities) and the difference is rents or goodwill (see Holthausen and Watts, 2001; Lo and Lys, 2000, for a thorough discussion). Since current earnings and cash flows from the individual assets and liabilities are unlikely to contemporaneously capture a large portion of the rents (and changes in the rents), the firm's rents are omitted from Eq. (2).

If the rents are correlated with the separable net assets in the cross-section, then estimated coefficients on BVA and BVL will be biased away from a value of one that is typically hypothesized in the value-relevance literature.[3] Similar considerations apply to the earnings variable. More formally, bias depends on the slope coefficients from an ‘‘auxiliary regression’’ of the omitted variables on the included variables. We see no obvious reason why the relevant slopes should have any particular magnitude or even sign. However, spurious relations cannot be ruled out in any given period.[4] The value of rents changes unpredictably through time. If its in-sample relation to the separable net assets changes as well, the sign and magnitude of the bias in the estimated coefficients on BVA and BVL cannot be accurately determined in any single cross-section. Therefore, definitive inferences about the market's valuation of a financial statement asset or liability are not possible.

Although correlated omitted variables are likely to have substantial firm or industry-specific components, as do earnings themselves, we emphasize that even *aggregate* growth and discount rate effects can influence the levels regression slope coefficients through a correlated omitted variable effect. To see this most simply, consider a constant earnings growth valuation model (ignoring future investment outlays) with expected growth and risk identical for firms at each point in time. In this case, the slope coefficient in the cross-sectional regression of price on earnings per share is inversely proportional to $r-g$, the difference between the expected return and the expected growth rate. As r and g vary over time, so will the slope coefficient.

[3] This hypothesized value is based on an underlying valuation relation that is, under minimal assumptions, a tautology, rather than a relation with free parameters to be empirically determined. If one were able to control for all variables omitted from this relation then, apart from measurement errors, the coefficients on assets and liabilities would have to be one—it is not an empirical question. On the other hand, without controlling for correlated omitted variables, almost anything is possible. Thus, it is not clear what can be inferred about value relevance in this framework.

[4] Even if the variables are orthogonal in a population sense, there is likely to be some correlation in any given cross-section.

Here, the omitted variable is the present value of future cash flows, which is perfectly correlated cross-sectionally with current earnings in a constant earnings growth valuation model. We provide evidence consistent with this sort of influence by correlating the time series of estimated levels regression coefficients with variables that previous research suggests proxy for temporal variation in the investment opportunity set, future profitability, and the expected market rate of return. The commonly used proxy variables include earnings yield, dividend yield, and a book-to-market ratio, each for the aggregate market, and the yield on long-term government bonds.

The relation between these aggregate factors and the correlated omitted-variables depends on whether and how the *cross-sectional relation* between the variables included in value-relevance regressions, and those omitted, varies over time with the changes in aggregate expected growth and expected return. It is well known that stocks display considerable variation in their betas or sensitivities to movements in broad market indices. Thus, a range of individual-firm responses will likely accompany changes in aggregate expected growth. Similarly, asset-pricing models like the CAPM imply that shifts in the market risk premium will generate differential shifts in the expected returns of stocks, depending on their betas. However, what matters is the extent to which these firm-level shifts in omitted growth and discount rate variables will be cross-sectionally correlated with the firm-level independent variables. Even if there is no systematic correlation on average, a changing in-sample relation from one year to the next will induce corresponding changes in the value-relevance regression coefficients. Our time-series analysis below *indirectly* reflects this sort of coefficient variation. Similar time-series effects can result from purely firm-specific omitted variables if their cross-sectional relations to the included variables change from year to year.

Value-relevance research recognizes the potential for correlated omitted variable bias, scale bias in particular, and often attempts to mitigate it econometrically. As discussed in the literature, "scale effects" or "scale biases" refer to "scale differences … resulting in a correlated omitted variable related to scale" (Barth and Clinch, 1999, pp. 3–4). To reduce this bias as well as heteroskedasticity in estimating a value-relevance regression, accounting research often uses the book value of equity as a deflator in Eq. (2). For example, Easton (1998, p. 243) observes that "…. inferences from a regression of price-to-book on return on equity will not be due to spurious scale effects." Similar motivation underlies the use of the book value of equity as a deflator in Core et al. (2003), Easton et al. (1993), Nelson (1996), Trueman et al. (2000), and many others. On the other hand, Barth and Kallapur (1996) caution that using book value of equity as a deflator can exacerbate scale bias. Instead, they prefer that a scale proxy be used as an additional independent variable in a levels regression. Barth and Clinch (1999, p. 24) also question the Easton (1998) conclusion that book-value deflated regression specifications "are superior to price levels" specifications. In light of the popularity of the book value of equity as a deflator in levels regressions, and the conflicting claims in the literature about its consequences, we present evidence on the relation between growth proxies and coefficients from cross-sectional value-relevance regression Eq. (2) estimated with all the variables deflated by the book value of equity.

3. Data and results

This section describes the data and main results. We begin by summarizing the selection of random and industry-clustered samples used to estimate levels regressions. Section 3.2 presents descriptive statistics for the estimated annual cross-sectional value-relevance regression coefficients. Section 3.3 contains results of regressing the estimated coefficients on proxies for aggregate growth and discount rates.

3.1. Data

We use random and industry-clustered samples to estimate value-relevance regressions. Previous research uses both random (e.g., Amir et al., 1997) and industry-clustered samples (e.g., Barth, 1994) in studies employing levels regressions. We draw a random sample of 500 firms each year from 1967 to 2000. All NYSE, Amex, and NASDAQ stocks with data available in a given year have equal probability of being selected for that year. We obtain two industry-clustered samples each year consisting of all firms in the financial services industry (2-digit SIC codes from 60 to 69) and in the machinery and computer equipment industry (SIC code 35). We select the financial services industry because it offers a stark contrast to the traditional manufacturing sector. Somewhat arbitrarily, we select the machinery and computer equipment industry because it contains the largest number of Compustat firms outside of the financial services industry.

In all samples, in order to be included the firms must have a positive book value of equity and share price between \$2 and \$200. Previous research frequently excludes negative book value of equity firms in estimating levels regressions. The share price restrictions in our samples are intended to mitigate potential scale effects on the coefficients and are designed primarily to avoid penny stocks from the samples. We also exclude firms with earnings below \$–10 per share and earnings in excess of \$20 per share. The purpose is to avoid including extreme values of earnings that are probably dominated by transitory components. Our data restrictions are: (i) in line with procedures employed in previous research (e.g., Chang, 1998; Collins et al., 1997); and (ii) a low-cost substitute for identifying potential data errors, or a substitute for influential-observation or outlier analysis that empirical researchers typically carry out. Because we use a large number of samples, we favor a crude and simple technique that likely eliminates most influential observations and outliers, but the procedure might also exclude non-outliers. However, we believe the data restrictions are unlikely to bias results in any particular fashion. Experimentation with variations in data restrictions does not alter the tenor of the findings reported below.

Table 1
Descriptive statistics for annual cross-sectional levels regression coefficients

Mean, standard error, t-statistic, and selected percentiles of the distribution of 34 (1967–2000) annualcross-sectional levels regression coefficients in panels A and B and 30 (1967–1996) annual regression coefficients in panel C. The regressions are estimated using samples of 500 randomly selected stocks each year from Compustat.

Coefficient	Mean	Newey–West std. error/ uncorrected std. error	t-statistic	Min	$Q1$	Median	$Q3$	Max
Panel A: $P_{it} = a_{0,t} + a_{1,t}X_{it} + a_{2,t}\,\mathrm{BV}_{it} + \mathrm{err}_{it}$								
a_0	8.27	0.97/0.60	8.49	2.64	6.02	8.00	9.86	16.82
a_1	4.01	0.45/0.35	8.88	1.05	2.74	3.95	4.90	12.32
a_2	0.50	0.07/0.04	7.41	−0.26	0.30	0.48	0.72	1.04
Adj. R^2, %	48.91			5.34	46.20	52.37	58.65	69.36
Panel B: $P_{it} = a_{0,t} + a_{1,t}\,\mathrm{Assets}_{it} + a_{2,t}\,\mathrm{Liab}_{it} + \mathrm{err}_{it}$								
a_0	8.53	1.10/0.73	7.72	2.83	5.82	7.35	10.19	22.86
a_1	0.86	0.07/0.05	12.66	0.40	0.63	0.83	1.07	1.32
a_2	−0.86	0.07/0.05	−12.59	−1.35	−1.09	−0.83	−0.63	−0.40
Adj. R^2, %	38.93			5.73	30.99	40.77	47.56	63.59
Panel C: $P_{it} = a_{0,t} + a_{1,t}X_{it} + a_{2,t}\,\mathrm{BV}_{it} + a_{3,t}\,\mathrm{FX}_{it} + a_{4,t}\,\mathrm{FR}_{it} + \mathrm{err}_{it}$								
a_0	8.98	0.79/0.53	11.38	3.57	6.67	8.99	10.90	17.48
a_1	4.51	0.50/0.39	9.08	1.39	2.82	4.13	5.36	12.04
a_2	0.44	0.07/0.05	6.27	−0.19	0.26	0.39	0.66	0.96
a_3	2.94	0.57/0.48	4.93	−1.95	1.03	2.79	4.65	10.75
a_4	−1.89	0.39/0.38	−4.61	−7.78	−3.19	−1.59	−0.37	1.21
Adj. R^2, %	52.29			33.84	47.22	53.07	59.36	70.32

Annual levels regressions are estimated using random samples of 500 firms that meet the following data requirements (subscript i is suppressed): P_t is price per share at the end of year t. Samples exclude firms with share prices less than \$2 and greater than \$200. X_t is earnings per share before extraordinary items and discontinued operations for year t. Samples exclude firms with earnings per share less that \$−10 and greater than \$20. BV_t is book value of equity at the end of year t. Samples exclude negative book value of equity firms. Assets_t is the book value of assets per share at the end of year t. Liab_t is the book value of liabilities in dollars per share at the end of year t. FX is three-year average growth in earnings defined as the ratio of $(X_{t+3} - X_t)/(3X_t)$. FX greater than 0.50 is set equal to 0.50 and FX less than −0.50 is set equal to −0.50. If X_t is negative and X_{t+3} is positive, then FX is set equal to 0.5. FR is average annual return in years $t+1$ to $t+3$. Standard error is the usual standard error of the sample mean, multiplied by the Newey and West (1987) correction for autocorrelation up to three lags in the time series of estimated coefficients.

3.2. Value-relevance regression coefficients

3.2.1. Descriptive statistics

Panels A and B of Table 1 report descriptive statistics for the time series of 34 annual cross-sectional regression coefficients estimated from 1967 to 2000 using the 500 stock random samples. The first two models are:

$$\text{Panel A}: \quad P_{it} = \alpha_{0,t} + \alpha_{1,t}X_{it} + \alpha_{2,t}\mathrm{BV}_{it} + \varepsilon_{it}. \tag{3}$$

$$\text{Panel B}: \quad P_{it} = \alpha_{0,t} + \alpha_{1,t}\,\mathrm{Assets}_{it} + \alpha_{2,t}\,\mathrm{Liab}_{it} + \varepsilon_{it}. \tag{4}$$

where P_t is share price, X_t and BV_t are per share values of earnings and book value of equity, and Assets_t, and Liab_t are per share values of assets and liabilities, all at the end of fiscal year t for firm i. We also estimate models (3) and (4) using BV_{it} as the deflator. In model (3), since BV itself is an independent variable, the deflated model is

$$P_{it}/\text{BV}_{it} = \alpha_{0,t}(1/\text{BV}_{it}) + \alpha_{1,t}X_{it}/\text{BV}_{it} + \alpha_{2,t} + \varepsilon_{it}, \tag{3a}$$

where the estimated intercept is the "valuation" of a firm's book equity. Thus, we still estimate model (3) except that the book value of equity is used as deflator in the hope that it addresses econometric problems encountered in using the levels specification. Finally, we also estimate a deflated version of Eq. (4) as follows:

$$P_{it}/\text{BV}_{it} = \alpha_{0,t}(1/\text{BV}_{it}) + \alpha_{1,t}\,\text{Assets}_{it}/\text{BV}_{it} + \alpha_{2,t}\,\text{Liab}_{it}\,\text{BV}_{it} + \varepsilon_{it}. \tag{4a}$$

In Table 1, the standard errors of the mean coefficients are calculated by correcting for the effect of autocorrelation in the estimated annual regression coefficients and the t-statistics are calculated using these Newey and West (1987) corrected standard errors. Autocorrelation in the estimated coefficients is expected because successive cross-sections of the levels of prices, earnings, and book values are correlated due to both persistent macro-economic and firm-specific factors. The residuals of the model capture the measurement errors in the proxies for expected future cash flows as well as discount rate effects, and are thus likely to be positively autocorrelated as well. Some autocorrelation is expected in spite of the fact that we randomly select 500 stocks each year from the universe of several thousand stocks on Compustat, and the universe of stocks itself changes considerably through the years because of initial public offerings, mergers, acquisitions, bankruptcies, going-private transactions, etc. We make the Newey and West (1987) correction for autocorrelation up to three-to-five lags depending on the number of lags for which autocorrelations are non-trivial for each coefficient. Correction for autocorrelations beyond three-to-five lags makes little difference empirically.

The estimated coefficients' means in panel A, Table 1 are in line with those reported in previous research (see, for example, Collins et al., 1997, Table 3). The average coefficient on earnings is 4.01 (standard error = 0.45) and that on book value of equity is 0.50 (0.07). The variation in the estimated coefficients on book value of equity is striking relative to a typical cross-sectional regression standard error. The coefficient estimates range from a minimum of –0.26 to a maximum of 1.04. This suggests that there may be considerable variation in the true coefficients from year to year in addition to the estimation error in any given cross-sectional regression estimate. The notion of a true coefficient is less than straightforward in this context, however. As discussed earlier, it reflects (is conditional on) the in-sample relation between omitted and included variables, which can vary randomly over time. In this sense, we are dealing with a sort of random coefficients model.

Untabulated results of estimating the book value deflated model (3a) show that the average coefficient on earnings is 3.98, which is close to that from the undeflated levels model (3). However, the average coefficient on book value (i.e., the estimated intercept from the book value deflated model), at 0.82, is significantly higher than the undeflated estimate, 0.50, with the time-series standard error for the difference between the two coefficients just 0.04. The minimum estimated coefficient is no longer negative as in the undeflated setting (see Table 1, panel A); the minimum is now 0.26 and the maximum is 1.51. Thus, regardless of whether a deflated or undeflated specification is employed, there is considerable variation in the estimated coefficients.

Perhaps more surprising is the range of the coefficient values on liabilities reported in panel B for the regression model (4). The market's "valuation" of a dollar of book liability ranges from \$−1.29 to \$−0.40, with a mean of \$−0.86 (standard error = 0.07). In fact, more than a quarter of the coefficients are below −1. Insofar as this is indicative of time-varying true coefficients that sometimes fall below −1, it is inconsistent with the usual valuation interpretation. A portion of the variation in the estimated coefficient on liabilities might be related to changes in interest rates affecting the market values of corporations' obligations that carry a fixed interest rate. However, a non-trivial fraction of corporate liabilities is short-term non-interest bearing liabilities (e.g., accounts payables) or short-term interest-bearing loans, and for many of the long-term liabilities corporations typically enjoy the option to pre-pay bank loans at face value in a declining interest-rate environment. These factors should mitigate time variation in the market's valuation of corporate liabilities. Finally, we observe that the coefficients on assets and liabilities are almost perfectly negatively correlated (correlation coefficient of −0.996) and virtually identical in absolute magnitude each year because the standard error of the time series of differences between the coefficient on assets and −1 times the coefficient on liabilities is only 0.004. Thus, taken at face value, the value-relevance regressions suggest that the market valuations of assets and liabilities change in lock step, which seems economically implausible.

Untabulated results for the deflated specification of Eq. (4) show that the average coefficient on assets is 1.29 (standard error = 0.11) and that on liabilities is −1.38 (standard error = 0.11) and that the coefficients are almost perfectly negatively correlated.[5] The range of estimated coefficients is larger than that observed when the levels specification is estimated. Specifically, the minimum coefficient on liabilities is –2.61 and the maximum 0.19.[6] Thus, if the coefficient estimates were to be interpreted as the market's valuation of a firm's book liabilities, then in at least 1 year, the liabilities are valued positively!

Overall, the regression results in panels A and B and the untabulated results for the deflated model suggest that it is tenuous to make definitive statements about the market's "valuation" or reliability of book values of equity, assets, or liabilities from the value-relevance regressions. The wide range in the estimated coefficient values can arise for a number of reasons. First, as several researchers suggest, and as

[5] The standard error of the time series of differences between the coefficient on assets and minus one times the coefficient on liabilities is only 0.011.

[6] In estimating the deflated model, we excluded more observations than in the case of the level regressions to reduce their impact on estimated coefficients. Thus, the observed wide range of estimated coefficients is despite generous truncation of data. When the data truncation rules were similar to those in effect for the levels model, the estimated coefficients are far more dispersed than those we discuss here.

discussed above, correlated omitted variables can bias the coefficients on book value of equity, assets, and liabilities. Second, the variation in the market's "valuation" reflects temporal changes in the reliability of the book values of corporate assets and liabilities. However, we find it hard to believe that the reliability of liabilities reported in corporate financial statements has fluctuated so much through time as to account for the variation in the estimated coefficients. Even if the reliability of reported financial statement numbers changes over time, we cannot think of economic reasons why such changes would be correlated with macroeconomic growth prospects.

We also note that the substantial differences observed in coefficients from deflated and undeflated specifications suggest that deflation is doing more than just adjusting for heteroskedasticity. In a standard regression context, an adjustment for heteroskedasticity should provide a more precise estimate of the *same* coefficient. However, deflation actually *increased* the standard errors of our estimates. In this more complicated random coefficients context, deflation can alter the cross-sectional relation between correlated omitted variables and the included variables and thus affect the so-called "true" coefficients in each year. The differences across specifications found above may thus be another (in addition to the large time-series coefficient variation) reflection of such omitted-variable influences.

Of course, some differences in estimated coefficients from levels regressions might simply be due to sampling variation. Again we emphasize that standard errors obtained from individual cross-sectional regressions are much smaller than the time-series standard errors in Table 1. If the former are rough indications of sampling variation around the true coefficients, then the much larger time-series standard errors imply considerable variation in the true coefficients. On the other hand, if the true sampling variation in individual cross-sections is severely understated as a result of ignoring correlation in the cross-sectional regression residuals, then the usual interpretation of coefficients in value-relevance regressions based on these standard errors is misleading for purely statistical reasons.

3.2.2. Regression models with future earnings growth

Our first attempt to examine whether correlated omitted variables bias the value-relevance regression coefficients entails expanding the model in panel A to include future earnings growth (FX) and future stock returns (FR). The resulting model is

$$\text{Panel C}: \; P_{it} = \alpha_{0,t} + \alpha_{1,t}X_{it} + \alpha_{2,t}\,\text{BV}_{it} + \alpha_{3,t}\,\text{FX}_{it} + \alpha_{4,t}\,\text{FR}_{it} + \varepsilon_{it}. \tag{5}$$

We measure FX and FR over 3 years following year t. FX is 3-year average growth in earnings, defined as $(X_{t+3} - X_t)/(3X_t)$. To mitigate outlier influences on the estimated regression models, FX greater than 50% per year is set equal to 0.50 and FX less than -50% is set equal to -0.50. If X_t is negative and X_{t+3} is positive, then FX is set equal to 0.5. FR is average annual stock return in years $t+1$ to $t+3$.

We select future earnings growth because investment opportunities forecast earnings growth, and investment opportunities are commonly argued to be an omitted variable in levels regressions (e.g., Nelson, 1996; Eccher et al., 1996). Econometrically, the inclusion of *realized* earnings growth is problematic because price capitalizes expected, not realized, future earnings growth. To reduce the errors-in-variable problem that arises from using realized growth, we also include future return in the model (see Collins et al., 1994, for econometric details).

The results in panel C indicate that FX and FR are significantly related to price with the expected signs, positive and negative, respectively. However, the average values of the coefficients on earnings and book value of equity are both statistically and economically similar in magnitude to those in panel A. More importantly, the variation in the coefficient estimates through time is also largely unaffected. For example, the coefficient on book value of equity in panel C ranges from −0.19 to 0.96, compared to −0.26 to 1.04 in panel A. The tenor of the results is unchanged when the model in panel C is estimated without earnings. We also obtain results similar to those in Table 1 using the financial services and machinery and computer equipment industry samples of firms instead of random samples.

This evidence in panel C does not support the interpretation of future growth as a *correlated* omitted variable if we adopt a pure rational expectations framework. Suppose, however, that the forecasts of growth implicit in prices do not always reflect a rational assessment of actual firm growth prospects. This premise underlies the behavioral finance perspective, e.g., Lakonishok et al. (1994). In this context, the presence of an influential correlated omitted growth variable, i.e., investor perceptions, cannot be ruled out.

Overall, a naïve interpretation of the results, ignoring omitted variables, is that there is considerable variation in the market's valuation of income statement and balance sheet variables. We have argued that shifts in aggregate expected growth and discount rates can be one source of changing coefficients through a correlated omitted variables effect. Next, we examine the relations between the value-relevance regression coefficients and several proxies for aggregate growth and discount rates.

3.3. Value-relevance regression coefficients' association with proxies for aggregate growth and discount rates

Table 2 reports results of estimating the following time-series regression model using data from 1967 to 2000:

$$a_{k,t} = \gamma_0 + \gamma_1 \text{ State Variable}_{t-1} + \gamma_2 \text{ Time} + \varepsilon_{k,t}, \qquad (6)$$

where $a_{k,t}$ is the estimated slope coefficient in year t from a cross-sectional value-relevance regression estimated using a sample of 500 randomly selected stocks each year; State Variable$_{t-1}$ is dividend yield, book-to-market ratio, or earnings yield for the market portfolio, or the yield on a 10-year Government bond, all at the beginning of year t; and time is calendar year $t-1966$ so that time = 1 for year $t = 1967$. Time is included as an independent variable because prior research (e.g., Ramesh and Thiagarajan, 1995; Collins et al., 1997) suggests that the value-relevance regression coefficients on earnings and book values exhibit a time trend. Inclusion of time thus helps reduce the standard error on all coefficients in (6). In addition, to the extent that there is a correlation between the growth proxies and the time trend, inclusion of a time trend reduces the likelihood of a spurious association between the value-relevance regression coefficients and growth proxies. Dividend

Table 2
Results of time series regressions of estimated slope coefficients from cross-sectional regressions on state variables proxying for time variation in the investment opportunity set, future profitability, and expected market rate of return

The four separate time-series regressions using data from 1967 to 2000 are

$$a_{k,t} = \gamma_0 + \gamma_1\ \text{State Variable}_{t-1} + \gamma_2\ \text{Time} + \text{err}_{k,t},$$

where $a_{k,t}$ is the estimated slope coefficient from a cross-sectional levels regression in year t estimated using a sample of 500 randomly selected stocks each year (see Table 1 for details); State variable$_{t-1}$ is either dividend yield (model 1), or book-to-market ratio (model 2), or earnings yield for the market (model 3) or yield on a 10-year Government bond (model 4), all at the beginning of year t; and Time is calendar year—1966 so that Time = 1 for year 1967. Dividend yield, book-to-market ratio, and earnings yield are calculated as the ratio of average dividend or earnings or book value of equity to average market capitalization of all NYSE-Amex stocks for which data are available on the Compustat or CRSP tapes at the beginning of each year.

	Model 1		Model 2		Model 3		Model 4	
	Dividend yield		Book-to-market		Earnings yield		10-yr bond yield	
	γ_1	t-stat	γ_1	t-stat	γ_1	t-stat	γ_1	t-stat
Panel A: Slope coefficients from the cross-sectional levels model $P_{it} = a_{0,t} + a_{1,t}X_{it} + a_{2,t}\,\text{BV}_{it} + \text{err}_{it}$								
$a_{1,t}$	−57.36	−1.98	−2.42	−2.19	−14.53	−2.00	−16.22	−1.61
$a_{2,t}$	−6.20	−1.46	−0.30	−1.84	−2.74	−2.79	−1.16	−0.78
Panel B: Slope coefficients from the cross-sectional levels model $P_{it} = a_{0,t} + a_{1,t}\,\text{Assets}_{it} + a_{2,t}\,\text{Liab}_{it} + \text{err}_{it}$								
$a_{1,t}$	−7.63	−1.75	−0.34	−2.04	−2.93	−2.88	−2.37	−1.59
$a_{2,t}$	7.26	1.62	0.33	1.91	2.89	2.76	2.42	1.58
Panel C: Slope coefficients from the cross-sectional levels model $P_{it} = a_{0,t} + a_{1,t}X_{it} + a_{2,t}\,\text{BV}_{it} + a_{3,t}\,\text{FX}_{it} + a_{4,t}\,\text{FR}_{it} + \text{err}_{it}$								
$a_{1,t}$	−99.84	−2.74	−3.51	−1.41	−21.37	−2.34	−33.08	−2.57
$a_{2,t}$	−6.85	−1.42	−0.31	−1.75	−2.65	−1.10	−1.54	−0.90

yield, book-to-market ratio, and earnings yield are calculated as the ratio of average dividend, earnings, or book value of equity to average market capitalization of all NYSE-Amex stocks for which data are available on the Compustat or CRSP tapes at the beginning of each year.

Since the value-relevance regression coefficients are serially correlated, this is likely to be true for the residuals from regression model (6) as well. Under these conditions the OLS estimates are unbiased, at least in a standard regression context, but less efficient than generalized least squares estimates (Maddala, 1990). Therefore, when the Durbin–Watson statistic indicates significant autocorrelation in the errors, we report results of estimating model (6) using the Cochrane and Orcutt (1949) procedure assuming that the residuals of this model follow a first-order autoregressive process.

The first row in Table 2, panel A reports results of regressing the levels regression earnings-response coefficients, $a_{1,t}$ from Eq. (3), individually on dividend yield, book-to-market ratio, earnings yield, or the 10-year government bond yield. The results reveal a strong negative association between $a_{1,t}$ and dividend yield, book-to-market ratio, and earnings yield, with varying degrees of statistical significance. The negative relation means that the earnings response coefficient, $a_{1,t}$, tends to be low in periods when discount rates are high and growth opportunities are poor. For example, if earnings yield increases by five percentage points, which is slightly greater than one standard deviation of annual earnings yield for the CRSP equal-weight portfolio, the estimated earnings coefficient drops by 0.73 (the mean in Table 1 is 4.0). Previous research (e.g., Easton and Zmijewski, 1989; Collins and Kothari, 1989) documents a cross-sectional relation between earnings response coefficients and discount rates and growth. The evidence in Table 2 extends those findings to a time-series setting.

The second row in panel A shows that the coefficient on book equity is also negatively correlated with market ratios. We compare the average coefficients on earnings and book value, as reported in Table 1, with their sensitivities to market ratios in Table 2. The comparison reveals that coefficients on both earnings and book value from the value-relevance regressions are about equally sensitive to growth proxies. To reach this conclusion, we begin with the ratio of the coefficients on earnings and book value in Table 1, panel A, which is about 8 (= 4.01/0.50). Since the ratio of the γ_1 coefficients in Table 2, panel A under the column book-to-market (as a growth proxy) is also approximately 8 (= −2.42/−0.30), the similar sensitivities to book-to-market follows. The ratio of the γ_1 coefficients in Table 2, panel A using earnings yield is a bit lower at 5.3. It is 14 in the case of the 10-year government bond yield.

Untabulated results of regressing the coefficients on earnings and book value from model (3a) on proxies for aggregate growth expectations and discount rates consistently indicate a highly significant negative relation. For example, the coefficients on deflated earnings are negatively related to dividend yield with a slope of −93.2 (t-statistic = −3.03) and the coefficients on book value of equity (i.e., the estimated intercept from model (3a) have a slope of −14.78 (t-statistic = −3.87). Thus, the use of book value of equity as a deflator also yields a significant negative relation between the value-relevance regression coefficient estimates and growth and discount rate proxies.

Results in panel B show that the levels regression coefficients on assets and liabilities are also associated with proxies for macroeconomic growth and discount rates, at similar levels of significance. For example, when the annual levels regression coefficients on assets are regressed on earnings yield, the estimated slope coefficient is −2.93 with a t-statistic of −2.88. This means that if the earnings yield rises by 1%, the market's "valuation" of assets decreases by 2.9%. In the case of liabilities, the second row shows that the market's "valuation" of liabilities rises by 2.89% for every 1% increase in earnings yield; in other words, the negative valuation of liabilities becomes less negative or smaller in magnitude. The coefficients on assets and liabilities are almost perfectly negatively correlated with a time-series standard error of the difference in magnitudes equal to 0.01. Thus, each coefficient is about equally sensitive to earnings yield, the independent variable. While this is consistent with a rational valuation story that changing discount rates move assets and liabilities values, an equal and offsetting relation between the aggregate variables and the coefficients on assets and liabilities is puzzling. Growth and discount rate effects are expected to impact equity values included in the assets more than liabilities, especially in light of the fact that corporations' liabilities are largely short term. That is, we expect, but do not observe, a highly asymmetric impact on assets and liabilities. Again, this could be a manifestation of correlated omitted variable effects.

Untabulated results of correlating the coefficients on deflated assets and liabilities from Eq. (4a) with proxies for growth and discount rates fail to show any significant association. While this is consistent with deflation eliminating the correlated omitted variables problem, we caution the reader that the estimated coefficients from the deflated balance sheet value-relevance model, as discussed above, are highly dispersed, which makes it difficult to interpret the coefficients as the market's valuation of liabilities in particular.

Panel C reports results of using coefficients on earnings and book equity as in panel A, except that the regression model is expanded to include future earnings and future returns (see Eq. 5). The time variation in the estimated coefficients on earnings exhibits a stronger association with growth and discount rate proxies than in panel A.

We perform analysis similar to that in Tables 1 and 2 using financial services and machinery and computer equipment industry samples. Results for the financial services industry are similar to those reported for the random samples, whereas results for the machinery and computer industry samples are mixed. In particular, the estimated annual coefficients on earnings exhibit a strong negative association with aggregate growth and discount rate proxies, but the coefficients on assets and book values are not always significantly related to these proxies. Nevertheless, the time-series variation in the estimated coefficients on assets and liabilities is just as large for the computer and machinery industry as it is for the financials services industry samples or the random samples.

Although we find significant relations in our time-series regressions, the adjusted R^2 values are generally less than 10%, so much of the variation in the coefficients remains unexplained. The challenging task of identifying the determinants of this variation is left to future research.

4. Summary

Core et al. examine whether equity valuation using financial variables in the New Economy Period, i.e., 1995–2000, differs from that in other time periods. Their research is motivated by the widespread belief among researchers and practitioners that financial statements' value relevance in the New Economy Period has declined. Core et al. find that, whereas the financial variables' ability to explain stock prices is significantly lower in the New Economy Period, the magnitude of out-of-sample prediction errors for the New Economy Period is not unusual compared to those in other time periods. These observations are based on value-relevance regression analysis that accounting research frequently employs to infer the relevance and reliability of financial statement numbers.

Neither Core et al., nor prior accounting research, examines the economic determinants of the (changing) magnitudes of the coefficients on financial variables and of the financial variables' changing explanatory power through time. We have focused on these issues because we believe they are important for interpreting the results from value-relevance regressions, particularly in the context of standard setting.

Holthausen and Watts (2001) offer a comprehensive critique of conceptual and econometric problems of inference from value-relevance regressions estimated with a motivation of guiding standard setters. We complement their analysis by presenting evidence that is helpful in interpreting the coefficient magnitudes from value-relevance regressions. Like Holthausen and Watts (2001), we are skeptical that unambiguous inferences about the relevance and reliability of financial statement variables are feasible on the basis of value-relevance regressions. This position is based on the evidence summarized below.

We find considerable time-series variation in the value-relevance regression coefficients on income statement and balance sheet variables. The coefficients on earnings as well as assets and liabilities are significantly associated with proxies for aggregate growth and discount rates. These observations suggest that a simple interpretation of the value-relevance regression coefficients as the market's valuations of assets and liabilities and/or as indicative of reliability and measurement error in financial statement variables would be too strong and possibly erroneous. Using book value of equity as a deflator in estimating value-relevance regressions does not eliminate the association between the coefficients on earnings and book values with proxies for aggregate growth expectations and discount rates. Moreover, the estimated coefficients on assets and liabilities exhibit much wider variation than in the case of levels (i.e., undeflated) regressions.

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