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Biases and Lags in Book Value and Their Effects on the Ability of the Book-to-Market Ratio to Predict Book Return on Equity

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1. *Introduction*

In this paper, we distinguish two sources of variation in the book-to-market ratio—bias and lags in book value (hereafter, bias and lags)—with different implications for the book-to-market ratio's ability to predict future book return on equity. Specifically, we hypothesize and find that the bias component of the book-to-market ratio has a more persistent cross-sectional association with future book return on equity than does the lag component. This investigation is motivated both by the central role of expectations of book return on equity in the discounted residual income valuation model (e.g., see Feltham and Ohlson [1995]) and by prior empirical research that finds that the book-to-market ratio is correlated with future book return on equity (e.g., see Fama and French [1992; 1995], Penman [1992], and Bernard [1994]).

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By bias, we mean that book value is persistently higher (lower) than market value, so that the book-to-market ratio is persistently above (below) one. Bias results from joint effects of the accounting process (e.g., conservatism and historical cost) and the economic environment (e.g., expected positive present value projects and inflation). By lags, we mean that unexpected economic gains (losses) are recognized in book value over time rather than immediately, so that the book-to-market ratio is temporarily lower (higher) than its mean (one in the absence of bias) but tends to its mean over time. As with bias, lags result from joint effects of the accounting process and the economic environment.

We use empirical methods developed by Ryan [1995] to distinguish the bias and lag components of the book-to-market ratio. Specifically, in pooled cross-sections over the prior period, we regress the book-to-market ratio on the current and six lagged security returns with fixed firm and time effects. The bias (or persistent) component is measured as the firm effect, i.e., the mean of the firm's book-to-market ratio that is not explained by the time effects or the means of the current and lagged returns. We show that the bias component is associated with measures of accounting conservatism. The lag (or transitory) component is measured as the portion of the book-to-market ratio explained by the current and lagged returns, i.e., a proxy for currently unrecognized economic gains and losses. Ryan [1995] provides evidence that the lag component results from historical cost accounting; we show that it is not associated with measures of conservatism.

We hypothesize that the bias and lag components of the book-to-market ratio both have negative implications for future book return on equity,[1] but the bias component's implications are persistent while the lag component's implications decay on average over the period during which the firm's currently unrecognized economic gains or losses are recognized. We test this hypothesis over forecast horizons from one to five years and find results generally consistent with our hypotheses. Similarly, we predict and find that the bias component has a stronger association than does the lag component with the terminal value in the discounted residual income valuation model (essentially, the market-to-book ratio) at the end of a five-year horizon. Consistent with the well-known fact that bias interacts with growth (e.g., see Greenball [1969]), we also predict and find that the association between the bias (but not the lag) component of the book-to-market ratio and future book return on equity is less negative for higher-growth firms.

In decomposing the book-to-market ratio into its bias and lag components, we extend prior research relating the book-to-market ratio to future book return on equity (Fama and French [1992; 1995], Penman

[1] In theory, this association between the bias component and future book return on equity is positive for firms that grow at a rate above their internal rate of return (see equation (2) and Greenball [1969]), but we are not able to identify a sample of such firms.

[1992], and Bernard [1994]). In particular, Bernard finds that the book-to-market ratio does not add much beyond current book return on equity to the prediction of future book return on equity. In contrast, we find that the book-to-market ratio predicts book return on equity beyond current return on equity; this difference in results is attributable to our use of multivariate regression methods rather than the grouping methods used by Bernard. We find that our decomposition of the book-to-market ratio significantly increases this incremental predictive power by indicating the horizon over which future book return on equity decays. Although our approach provides modest incremental R^2 for the representative *Compustat* firm used in our tests, our approach would considerably alter the valuation of a given firm that is predominantly subject to either bias or lags.

Section 2 develops hypotheses about the relation between the bias and lag components of the book-to-market ratio and future book return on equity. Section 3 describes the data set and estimates the bias and lag components. Section 4 reports the associations of the bias and lag components with future book return on equity and shows that the association of the bias component with future book return on equity depends on firm growth. Section 5 reports the association of the bias and lag components with the terminal value in the discounted residual income valuation model. Section 6 concludes.

2. *Bias and Lag Components of the Book-to-Market Ratio*

In this section, we develop hypotheses about the relation between the bias and lag components of the book-to-market ratio (hereafter *BTM*) and future book return on equity (hereafter *ROE*). These components might be viewed either as a purely statistical decomposition of persistent and transitory variation in the *BTM* or, more ambitiously, as reflecting the joint effects of the accounting system and economic environment. While we favor this accounting/economic interpretation, we emphasize that attributes of the accounting system and economic environment can and do affect both components of the *BTM*. For example, while historical cost depreciation schedules that are more accelerated than economic depreciation yield a conservative bias, they also induce lags since they generally do not reflect unexpected changes in the fair value of fixed assets. And while historical cost methods yield lags, they also induce bias because they understate values when prices are rising or when positive present value projects exist.

2.1 BIAS AND LAGS DEFINED

We define a more conservative (anticonservative) bias as a persistently lower (higher) *BTM*. We intend bias to reflect aspects of both the accounting system and the economic environment. Aspects of the accounting system that yield bias (but not necessarily only bias) include the lower of cost or market rule for inventories, the recording of loss but not gain contingencies under *FAS No. 5*, and the immediate expensing of advertising and most research and development expenditures. Aspects of the economic environment that yield bias include a continuous flow of positive present value projects, say due to market power or regulatory restraints on competition. Our definition of bias follows Feltham and Ohlson's [1996] definition of conservatism as an asymptotic difference between book and market value.

Following Ryan [1995], we say that lags exist if unexpected economic gains and losses are not fully recognized in net income in the period they occur, but they are fully recognized over a well-defined number of subsequent periods (e.g., the remaining life of the firm's assets, liabilities, or current projects). Aspects of the accounting system that yield lags (but not necessarily only lags) include the valuation of held-to-maturity debt securities and the firm's own debt at amortized cost and historical cost depreciation of fixed assets. Aspects of the economic environment that cause unexpected changes in the flow of positive present value projects also yield lags.

Both bias and lags are subject to the cash conservation relation; i.e., the sum of income over the life of the firm (or a defined set of transactions) is the same regardless of accounting choice. However, bias and lags differ in that the "day of reckoning" imposed by the cash conservation relation can be delayed indefinitely for a going concern with biased accounting that continues to reinvest or to have positive net present value investment opportunities. Another difference is that bias can exist under certainty, while lags require uncertainty.

2.2 BIAS HYPOTHESES

We demonstrate the effects of bias on the relation between the *BTM* and future *ROE* using the discounted residual income valuation model. In this model, the reciprocal of the *BTM* is equal to one plus expected discounted abnormal *ROE* (*ROE* less a constant normal return on equity capital, *r*), taking into account growth in the book value of common equity, *BV*:

$$\frac{1}{BTM_t} = 1 + E_t\left\{\sum_{s=1}^{\infty}\frac{(ROE_{t+s} - r)\dfrac{BV_{t+s-1}}{BV_t}}{(1+r)^s}\right\}. \tag{1}$$

To simplify the characterization of bias, we assume certainty, but all our results hold on average under uncertainty. We also assume perpetual steady-state growth, *g*, in all valuation variables (*BV*, the market value of common equity, *MV*, and net income, *NI*), which implies constant *BTM* and *ROE* over time. While *g* must be less than *r* if the firm has positive net present value projects, Beaver and Ryan [1997] show that *g* can exceed r if investments are zero present value (net dividends will be negative if $g > r$, however).[2] This finding is important given that some firms do grow at a rate above r for extended periods and the well-known interaction of bias with growth. To simplify the discussion of *ROE*, *BV* is assumed to be positive.

Under these assumptions, it is easy to show that (1) simplifies to:

$$\frac{r-g}{BTM} = ROE - g. \tag{2}$$

Equation (2) implies the *BTM* is inversely related to *ROE* for the usual case of $r > g$. Holding *MV* constant, a smaller *BTM* (more conservative bias) implies a smaller *BV* in the denominator of *ROE*, which increases *ROE* as long as its numerator *NI* is not decreased by as much as *BV* proportionally. This is the case if $r > g$. For example, in the special case of $g = 0$, it is well known that bias has no effect on *NI*, and so the smaller *BV* works in isolation to increase *ROE*.

In contrast, equation (2) implies that there is no (a positive) relation between the *BTM* and *ROE* if $r = g$ ($r < g$). As discussed below, as g increases above r, conservative (anticonservative) bias reduces (increases) both *NI* and *BV*, but the proportional effect is larger for *NI* than *BV*. We emphasize that the role of r as the cutoff value of g results from the infinite period derivation of equation (2). In a finite-period model, Greenball [1969] shows that the cutoff value of g is the internal rate of return (which exceeds r if projects have positive net present value). In an infinite-period model, g can equal or exceed the internal rate of return only if the internal rate of return equals r.

A simple way to see the joint effects of bias and growth is to substitute NI_t/BV_{t-1} for *ROE* and BV_{t-1}/MV_{t-1} for *BTM* in equation (2), multiply through by BV_{t-1}, and rearrange:

$$NI_t - rMV_{t-1} = g(BV_{t-1} - MV_{t-1}). \tag{2'}$$

The left-hand side of equation (2′) is net income in year t less economic income under certainty (rMV_{t-1}), i.e., the bias in net income. The right-hand side is growth times the bias in year $t-1$ book value. If growth is zero, then net income is always unbiased. As growth increases, the bias in net income becomes larger in absolute value for a given bias in book value. As growth exceeds r, the bias in net income becomes proportionally larger than the bias in book value.

[2] Beaver and Ryan [1997] employ the modeling device of vintages of investments to deal with the explosion of the power series in equation (1) when $g > r$. With zero net present value investments, future investments do not affect firm value, which equals the sum of the value of currently held investments. In practice, if $g > r$, it would be necessary to develop a mechanism to pay off old shareholders and simultaneously raise capital from new shareholders for a market in the firm's shares to function, since individuals presumably would not purchase securities for which they would never be paid.

If bias varies across firms so that we can calculate cross-sectional covariances, then equation (2) provides the basis for the following testable hypotheses: (1) the bias component of the *BTM* covaries negatively with *ROE* when $r > g$; (2) the covariance of the bias component with *ROE* increases with g and becomes positive when $r < g$; and (3) both of these effects persist for as long as accounting bias and firm growth remain around current levels (we test this hypothesis only for horizons from one to five years).

2.3 LAGS HYPOTHESES

The effect of lags on the relation between the *BTM* and future *ROE* is demonstrated using Ryan's [1995] model of historical accrual measurement. With a minor generalization to allow for steady-state growth, Ryan's equation (4) represents the *BTM* as:

$$BTM_t = 1 - \sum_{s=0}^{K-2} F(s) \frac{MV_{t-s} - (1+g)\, MV_{t-s-1}}{MV_t}, \qquad (3)$$

i.e., one minus a moving average process with coefficients $F(s)$ on the current and $K-2$ lagged market value surprises, $MV_{t-s} - (1+g)MV_{t-s-1}$, where K is the useful life of assets. Intuitively, an economic gain (loss) decreases (increases) the *BTM* as long as it is not fully recognized, which in Ryan's model is $K-2$.[3] Since we allow for positive present value projects and other sources of bias not considered by Ryan, we interpret K more generally as the maximum life of assets, liabilities, or current projects. The coefficient $F(s)$ is the unrecognized proportion of the s year lagged economic gain or loss. Ryan provides mild regularity conditions under which economic gains and losses are gradually recognized over time, so that $F(s)$ declines with the lag s, i.e., $F(0) \geq F(1) \geq F(2) \geq \ldots \geq F(K-2) \geq 0$. We also assume these regularity conditions.

Ryan's model incorporates lags but not bias, so that the *BTM* tends back to a mean of one over $K-1$ years.[4] We use (3) to support our hypotheses about the effect of lags on the relationship between the *BTM* and *ROE*, since bias does not qualitatively affect our hypotheses about lags.

If the clean surplus relation holds, so that all changes in book value from operations flow through the income statement, equation (3) implies that lags in recognizing unexpected economic gains (losses) decrease (increase) accounting net income relative to economic net income

[3] Ryan's [1995] model is discrete-time, so that an unexpected holding gain or loss does not occur until an asset is one year old. Therefore, a difference between the book and market value of an asset exists for at most $K-2$ years (by the $K-1$th year both the book and market value of the asset are zero).

[4] Beaver and Ryan [1997] model both bias and lags and show that the *BTM* tends back to a mean different from one if the accounting is biased.

in the period the gains (losses) occur, but increase (decrease) accounting net income relative to economic net income in $K-1$ subsequent periods as the gains (losses) are recognized. Thus unexpected economic gains (losses) increase (decrease) *ROE* in $K-1$ subsequent periods, both because book value is understated (overstated) relative to market value and because accounting net income is overstated (understated) relative to economic net income. Accordingly, lags imply a negative association between the *BTM* and future *ROE* that decays over $K-1$ years. Beyond this period, *ROE* is expected to equal its unconditional mean (r in the absence of bias).

In summary, equation (3) yields the following testable hypotheses: (1) the lag component of the *BTM* is negatively associated with future *ROE* and (2) this association decays over the period unexpected economic gains and losses are recognized.

3. *Data and Estimation of Bias and Lag Components*

3.1 SAMPLE DATA

All data are obtained from *Compustat's Annual PST* tape covering 1974–93. *MV* is measured at the end of the fiscal year and *NI* is measured as annual net income available for common shareholders. Fiscal-year security returns adjusted for stock dividends and splits are denoted *R*. When necessary, time subscripts precede firm subscripts, though both are suppressed when feasible. ROE_t is defined as NI_t/BV_{t-1}. To mitigate the effects of outliers, *BTM* is winsorized at 0 and 4, *ROE* is winsorized at −1 and +1, and *R* is winsorized at 3. These rules affect approximately 1% in each of the corresponding tails of these variables. Descriptive statistics are reported in panels A and B of table 1. The median *BTM* trends downward since 1974, reflecting a rising stock market and perhaps more conservative accounting during this period. Median *ROE* trends upward from 1975 to 1979 and downward thereafter, roughly tracking interest rates.

Our reported results reflect the survivorship biases in the *Compustat Annual PST* sample. While we are uncertain how these biases affect our results, some insight might be gained from Breen and Korajczyk's [1993] finding that the *BTM*'s ability to predict future security returns is approximately halved after controlling for survivorship. Our method of estimating the bias and lag components essentially precludes any ability to deal with *Compustat* dropping troubled firms (but not backfilling data), since we require a firm to have eight contiguous time-series observations. Indeed, when we include the *Compustat Research Tape* firms, we add very few observations to our sample, with no effect on our results.

3.2 ESTIMATION OF BOOK-TO-MARKET RATIO COMPONENTS

Following Ryan [1995] and motivated by equations (2) and (3), we extract the bias and lag components of the *BTM* using a regression of the

TABLE 1

Descriptive Statistics for Pooled Sample and Selected Years: 1974–93

Panel A: Pooled Sample Quantiles

	Quantile							
	1%	5%	25%	Med.	75%	95%	99%	No. of Obs.
BTM	.00	.15	.46	.75	1.17	2.23	4.00	36,980
ROE	−1.00	−.27	.06	.13	.19	.40	1.00	35,987
R	−.68	−.42	−.06	.15	.40	1.10	2.33	37,599
Size-Adjusted *R*	−.72	−.48	−.18	.00	.22	.89	2.14	37,599

Panel B: Selected Yearly Medians

	Year						
	1975	1978	1981	1984	1987	1990	1993
BTM	1.24	1.09	.96	.76	.74	.83	.58
ROE	.12	.16	.15	.14	.13	.11	.11
R	.45	.08	.07	.01	−.05	−.16	.15

BTM denotes the book value of common equity divided by the end of fiscal-year market value of common equity. *ROE* denotes net income available for common shareholders divided by beginning-of-year book value of common equity. *R* denotes percentage market returns on common equity over the fiscal year adjusted for stock distributions. Size-adjusted *R* denotes *R* minus the median of *R* that year for the corresponding market value decile in the sample (described below).

BTM is winsorized at 0 and 4. *ROE* is winsorized at −1 and +1. *R* is winsorized at 3.

All sample data are obtained from the 1993 *Compustat Annual PST Tape*, which covers the period 1974–93. In panel A, pooled quantiles are provided for all cross-sectional observations and the longest period possible for each variable: 1974–93 for the *BTM* and 1975–93 for *ROE, R*, and size-adjusted *R*. In panel B, annual medians are provided for all observations of each variable in that year.

BTM on the current and six lagged annual security returns with fixed firm and time effects:[5]

$$BTM_{t,i} = \alpha_t + \alpha_i + \sum_{j=0}^{6} \beta_j R_{t-j,i} + \varepsilon_{t,i}. \qquad (4)$$

We include the time intercepts, α_t, to capture the year-by-year variation in the *BTM* common to the sample firms. We focus on the explained firm-specific variation in the *BTM*, decomposing this variation into the firm effect (our measure of bias) and the portion associated with cur-

[5] Equation (4) differs from Ryan's [1995] regression equation in two respects. First, the independent variables in his regression are price changes deflated by current price, not returns. The inclusion of dividends in the numerator and use of lagged price in the denominator have relatively little effect on the results, however. We use returns due to their prevalence in market-based accounting research. Second, Ryan shows that at least four further lagged returns would have been significant if included in (4). Since further lagged returns have much smaller coefficients and add relatively little to the R^2, we omit them to avoid exacerbating the survivorship problem and losing critical time-series observations for subsequent results. Time-series observations are especially precious in this analysis. Out of the 20 annual time-series observations available on *Compustat*, we currently lose seven years in the estimation of (4). Since we forecast book return on equity five years ahead, our reported results span a maximum of eight years.

rent and lagged returns (our measure of lags).[6] The time intercepts affect this decomposition by substantially changing the β_j coefficients. Unreported analysis shows that the time effects are strongly associated with past average returns for the sample (i.e., they capture the average lags for the sample); consistent with this finding, we report in table 5 that the time effects and the lag component have a similar association with future *ROE*.

The firm effect, α_i, is expected to equal the *BTM* under bias alone (see (2)). Equation (3) shows that the slope coefficients, β_j, are expected to be negative, since an unrecognized positive (negative) market value change decreases (increases) the *BTM*. The β_j are expected to rise toward zero with the lag j, since further lagged market value changes are more fully recognized. The β_j should also be more negative for firms subject to greater lags, ceteris paribus. In this regard, Ryan [1995] finds that the β_j are more negative for firms with a higher proportion and longer useful life of fixed assets. For simplicity, we assume that the β_j are constant across firms, which can only weaken our results. When we allow the coefficients in equation (4) to vary across the fixed asset/useful life groupings employed by Ryan [1995], there is only a second-order effect on our results.

The usual specification checks indicate minimal multicollinearity and some cross-sectional correlation due to industry; approximately 8% of the variance in the book-to-market ratio is explained by four-digit *SIC* code dummy variables. The variation in the *BTM* associated with industry mainly appears to capture bias; our results are substantially identical if we estimate (4) including industry effects and include these effects in our measure of bias. Hence, for simplicity, we omit industry effects. Even with deflation, there is residual heteroscedasticity, so we report White's [1980] heteroscedasticity-adjusted *t*-statistics.

We estimate the bias and lag components in a given year using the time-series observations up to that year, requiring a minimum of four time-series observations to allow reasonable estimation of the firm effects. Table 2 reports the fixed effects estimation of equation (4) for three time-series partitions of the sample: (1) the shortest period that we use to estimate the bias and lag components (observations of the *BTM* from 1981–84); (2) the longest period that allows the estimated bias and lag components to be used to predict *ROE* over the subsequent five years (observations of the *BTM* from 1981–88); and (3) the longest period that allows estimation of the bias and lag components (observations of the *BTM* from 1981–93). Results for the three samples are generally similar, although the further lagged β_j coefficients are more significantly negative

[6] Our focus on firm-specific variation in the book-to-market ratio components would reduce the power of our tests if the goal of these tests was simply to document significant relations between these components and book return on equity. Our goal, however, is to demonstrate firm-specific variation in these relations.

TABLE 2

Fixed Effects Regressions of the Book-to-Market Ratio on Current and Six Lagged Annual Returns: 1981–84, 1981–88, 1981–93

	Estimation Period		
	1981–84	1981–88	1981–93
β_0	–.454	–.409	–.353
	(–27.5)	(–31.0)	(–39.0)
β_1	–.312	–.291	–.269
	(–22.0)	(–27.6)	(–33.0)
β_2	–.214	–.214	–.197
	(–17.0)	(–22.1)	(–25.9)
β_3	–.116	–.149	–.162
	(–9.0)	(–16.5)	(–21.0)
β_4	–.071	–.107	–.127
	(–4.5)	(–11.3)	(–16.2)
β_5	–.032	–.073	–.098
	(–2.4)	(–8.2)	(–12.9)
β_6	–.024	–.046	–.079
	(–2.8)	(–5.2)	(–10.8)
R^2 (with Fixed Effects)	.85	.73	.64
R^2 (without Fixed Effects)	.36	.30	.25
No. of Observations	5,230	10,980	19,575

Estimation equation (4) is:

$$BTM_{t,i} = \alpha_t + \alpha_i + \sum_{j=0}^{6} \beta_j R_{t-j,i} + \varepsilon_{t,i}.$$

The notes to table 1 describe the variable definitions and notation and the sample.

The fixed firm and time effects, which capture the mean of *BTM* for each firm across years and for each year across firms, respectively, are not reported in this table.

White's [1980] heteroscedasticity-adjusted *t*-statistics are in parentheses.

in the longer samples, probably because the fixed effects absorb more of the variation in the *BTM* due to factors other than bias, such as lags, in shorter estimation periods. Still, the R^2 attributable to the current and lagged returns is greater in the shorter than in the longer samples, and the β_j coefficients are significantly negative at all lags in all samples.

Since the estimation results for the three samples are generally similar, we discuss those for the whole panel of available data. As expected, all seven slope coefficients are significantly negative, and they rise almost monotonically toward zero with the lag of the market value change. Similar to the results in Ryan [1995], the R^2 ignoring the fixed effects is 25% and with the fixed effects is 64%. These results indicate that the *BTM* is a lagged function of past returns, i.e., market value reflects information on a more timely basis than book value.

The bias component is measured as the firm effect, denoted $BC_i = \alpha_i$. *BC* represents the persistent firm-specific variation in the *BTM*.

TABLE 3

Descriptive Statistics and Support for Estimates of Bias and Lag Components Based on 1981–88 Fixed Effects Regressions of the Book-to-Market Ratio on Current and Six Lagged Annual Returns

Panel A: Pooled Sample Quantiles of the Bias and Lag Components (10,980 Observations)

	Quantile						
	1%	5%	25%	Med.	75%	95%	99%
BC	−.72	−.54	−.24	.01	.22	.68	1.23
LC	−.45	−.25	−.10	−.02	.09	.31	.51

Panel B: Regressions of Bias and Lag Components on Measures of Accounting Conservatism (Equations (5*BC*) and (5*LC*))

BC_t = −.005	+1.014 IBC_t	+ .128 LEV_t	+ .143 $GROW_t$
(−.8)	(23.6)	(15.4)	(8.2)
	−.070 $ACCELDEPN_t$	−.908 $RNDADV_t$	+.881 $LIFORES_t$
	(−2.1)	(−7.1)	(5.3)
No. of Obs. = 3,941		R^2 = .31 (.18 without *IBC*)	
LC_t = .000	+.947 ILC_t	+.026 LEV_t	+.026 $GROW_t$
(.3)	(27.9)	(7.3)	(3.3)
	−.015 $ACCELDEPN_t$	+.150 $RNDADV_t$	−.045 $LIFORES_t$
	(−.9)	(1.6)	(−.6)
No. of Obs. = 3,941		R^2 = .19 (.05 without *ILC*)	

This table analyzes the bias and lag components derived from the 1981–88 estimation of equation (4) reported in table 2. *BC* denotes the firm effect (bias component) and *LC* denotes the variation in the book-to-market ratio explained by current and lagged returns (lag component).

[b]In the estimation equations (5*BC*) and (5*LC*) in panel B, *IBC* (*ILC*) denotes the mean of *BC* (*LC*) for the firm's four-digit *SIC* code industry that year. *LEV* denotes the book value of total liabilities divided by the market value of owners' equity. *GROW* denotes one minus the ratio of the sum of dividends over the current and past three years to the sum of earnings over the current and past three years. *ACCELDEPN* denotes a 0–1 accelerated depreciation indicator variable times accumulated depreciation divided by gross property, plant, and equipment. *RNDADV* denotes the sum of research and development and advertising expense divided by total sales. *LIFORES* denotes the *LIFO* reserve divided by total assets. All the variables in the estimation equations are measured contemporaneously.

In panel B, White's [1980] heteroscedasticity-adjusted *t*-statistics are in parentheses.

The notes to table 1 describe the sample.

The lag component is measured as the projection of the *BTM* from the estimation of equation (4) ignoring the fixed effects, denoted $LC_{t,i} = \sum_{j=0}^{6} \beta_j(R_{t-j,i} - R_{t-j,.} - R_{.,i} + R_{.,.})$ for firm *i* in year *t*, where $R_{t-j,.}$, $R_{.,i}$, and $R_{.,.}$ denote the time, firm, and overall means of $R_{t-j,i}$, respectively. *LC* represents the variation in the *BTM* due to unrecognized past market returns.

3.3 SUPPORT FOR THE MEASURES OF BIAS AND LAGS

Descriptive statistics for *BC* and *LC* are reported in table 3, panel A. In panel A, the medians of *BC* and *LC* are approximately zero by construction; *BC* and *LC* do not include the average bias or lags across firms, respectively. There is considerable spread on both *BC* and *LC* as measured by the interquartile range, though *BC* has the greater spread. We perform a variety of analyses to check that *BC* and *LC* reflect bias and lags, respectively.

First, we show that *BC* is associated with proxies for bias while *LC* is not. Specifically, we regress *BC* and *LC* on three contemporaneous proxies for accounting conservatism that apply to a broad set of firms and are available on the *Compustat* tape: (1) an accelerated depreciation indicator variable times accumulated depreciation divided by gross property, plant, and equipment, denoted *ACCELDEPN*, (2) *R&D* plus advertising expense divided by sales, denoted *RNDADV*, and (3) the *LIFO* reserve divided by total assets, denoted *LIFORES*. The ratio of accumulated depreciation to gross property, plant, and equipment is included in *ACCELDEPN* to capture the fact that depreciation method choice matters only as depreciation accumulates.[7] *RNDADV* is a proxy for unrecorded intangible assets. The *LIFO* reserve rather than a *LIFO* indicator variable is used to capture the magnitude of the effect of the choice of *LIFO*. We also include several control variables. Beaver and Ryan [1997] show that growth drives the *BTM* under bias toward one, so we include *GROW*, one minus average dividend payout over the current and past three years. Beaver and Ryan also show that financial leverage drives the *BTM* away from one, so we include *LEV*, the ratio of the book value of total liabilities to *MV* in the current period. Since this is an incomplete set of the factors that yield bias—for example, we include no proxy for positive net present value investment opportunities—we also include as an explanatory variable the average of *BC* (*LC*) for the firm's four-digit *SIC* code industry in the current period, denoted *IBC* (*ILC*).

To summarize, we estimate the following regressions:

$$BC_{t,i} = a + bIBC_{t,i} + cLEV_{t,i} + dGROW_{t,i} + fACCELDEPN_{t,i} + gRNDADV_{t,i} + hLIFORES_{t,i} + e_{t,i}, \text{ and} \qquad (5BC)$$

$$LC_{t,i} = a + bILC_{t,i} + cLEV_{t,i} + dGROW_{t,i} + fACCELDEPN_{t,i} + gRNDADV_{t,i} + hLIFORES_{t,i} + e_{t,i}. \qquad (5LC)$$

Insofar as *ACCELDEPN*, *RNDADV*, and *LIFORES* reflect accounting conservatism, the coefficients *f*, *g*, and *h* should be negative in (5*BC*) but zero in (5*LC*)

We report the estimation of (5*BC*) and (5*LC*) in table 3, panel B. The coefficients *b* on *IBC* and *ILC* are approximately one by construction and positive ($p = .001$). Approximately 13% (14%) of the 31% (19%) R^2 in (5*BC*) ((5*LC*)) is due to *IBC* (*ILC*); therefore, the other variables have about three times as much explanatory power in (5*BC*) as in (5*LC*). The

[7] The effect of depreciation method choice should diminish as assets become close to fully depreciated under all depreciation methods. We observed no evidence that this is a problem for the specification of *ACCELDEPN* for the *Compustat* firms, which typically reinvest and grow.

coefficients *c* on *LEV* are positive (p = .001) in both equations, consistent with leverage driving the *BTM* toward one on average. This result is inconsistent with the implication of Beaver and Ryan's [1997] model that leverage should drive the *BTM* further below one for the average firm in the sample (which has a *BTM* well below one). In unreported analysis, we find that firms with high leverage tend to operate in mature, relatively unprofitable markets during our sample period, so *LEV* proxies for investment prospects. The coefficients *d* on *GROW* are positive (p = .001) in both equations, consistent with the implication of Beaver and Ryan's model that growth drives the *BTM* toward one on average.

Consistent with *BC* reflecting bias while *LC* does not, in (5*BC*) the coefficients on *ACCELDEPN* and *RNDADV* are negative (t = −2.1 and −7.1, respectively). Unexpectedly, the coefficient *h* on *LIFORES* is positive (t = 5.3). In unreported analysis, we find that firms with large *LIFO* reserves typically operate in mature, relatively unprofitable markets during the sample period, so *LIFORES* proxies for investment prospects.[8] In contrast, the coefficients on all three accounting conservatism variables are insignificant in (5*LC*).

Second, in unreported analysis similar to that reported in table 4 (discussed later), we compared the ability of measured *BC* versus the predicted value of *BC* from (5*BC*) to predict *ROE*. The predicted value of *BC* achieves only about 85% of the spread on *ROE* as does *BC*, though both are associated with similarly persistent variation in *ROE*. The use of the predicted value of *BC* also causes us to lose about 35% of our observations. Thus, using observable accounting methods, even in conjunction with leverage, growth, and industry, does not provide as powerful a test of the effect of bias as does our approach.

Third, we asked whether the implications of lags are greater for firms with more assets subject to historical cost accounting and for firms with assets whose effective periods of recognition are longer. In unreported analysis, we replicated on our sample Ryan's [1995] finding that the coefficients in equation (4) increase in absolute magnitude as the proportion of fixed assets with long useful lives increases. These results are consistent with *LC* reflecting lags. In contrast, we found that *BC* does not vary with these variables.

Fourth, consistent with the intuition that *LC* reflects transitory lags while *BC* reflects persistent bias, we documented that the value of *LC* reverts 76% of the way to zero over five years while *BC* reverts only 9% of the way to zero over five years (results not tabulated). *LC* mean reverts as lagged market value surprises are gradually recognized while *BC* persists because it reflects bias.

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[8] Unreported analysis suggests that the unexpected coefficients on both *LEV* and *LIFORES* in equation (5*BC*) are related; high leverage firms with large *LIFO* reserves tend to operate in mature, unprofitable markets.

TABLE 4

Median Book Return on Equity for the Next Five Years for Quintiles of the Book-to-Market Ratio and Its Bias and Lag Components: Quintiles Formed in 1984–88

Quintile	Years Ahead of Quintile Formation 1	2	3	4	5	No. of Obs.
Panel A: *BTM* Predicting *ROE*						
1 (Low)	.212	.204	.196	.178	.161	1,219
2	.158	.153	.142	.126	.110	1,225
3	.136	.132	.125	.119	.110	1,232
4	.118	.114	.112	.106	.105	1,242
5 (High)	.053	.068	.071	.074	.069	1,233
1–5	.159	.136	.125	.104	.092	
MW Z-statistic	27.8	23.4	20.5	18.0	16.4	
Panel B: *BC* Predicting *ROE*						
1 (Low)	.178	.176	.167	.160	.145	1,229
2	.135	.134	.127	.114	.108	1,216
3	.137	.133	.128	.118	.112	1,236
4	.125	.122	.118	.114	.109	1,236
5 (High)	.101	.102	.094	.089	.084	1,234
1–5	.077	.074	.073	.071	.061	
MW Z-statistic	14.7	13.6	12.6	12.4	11.3	
Panel C: *LC* Predicting *ROE*						
1 (Low)	.158	.152	.142	.127	.114	1,229
2	.146	.143	.134	.127	.119	1,236
3	.132	.132	.125	.118	.114	1,240
4	.116	.114	.114	.106	.097	1,238
5 (High)	.064	.071	.082	.083	.077	1,208
1–5	.094	.081	.060	.044	.037	
MW Z-statistic	19.6	16.2	11.1	7.1	6.0	

The notes to tables 1 and 3 describe the variable definitions and notation and the sample.

In panels A, B, and C, approximately equal-sized quintiles based on the rank of the *BTM*, *BC*, and *LC*, respectively, are formed in each year from 1984–88, with the quintiles pooled across years. The same 6,151 observations are included in each panel.

Median *ROE* is reported for each quintile for the five years after quintile formation requiring that *ROE* is available for all five years.

1–5 denotes the median *ROE* for quintile 1 minus the median *ROE* for quintile 5 in that year. *MW Z*-statistic denotes the normal (large sample) approximation to the Mann-Whitney rank test comparing quintile 1 to quintile 5.

4. *Prediction of Book Return on Equity*

In this section, we provide evidence on the association of the *BTM* and its bias and lag components with *ROE* over the subsequent five years, both bivariately and controlling for current *ROE*.[9] We also show that the association of the bias component with future *ROE* depends on firm growth.

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[9] Joos [1996] includes industrial organization variables such as industry concentration as well as our measures of bias and lags in the prediction of book return on equity. He finds that the inclusion of the industrial organization variables does not substantially affect the implications of our accounting variables.

As described earlier, the bias and lag components in 198*X*, $4 \leq X \leq 8$, are estimated using observations from 1981–8*X*. *ROE* is forecasted over 1985–93, a period when median *ROE* for the sample decreased from .14 to .11, as reported in panel B of table 1.

We first report grouping analyses to provide a sense of the spread on *ROE* associated with the *BTM* and its components. The joint observations of *BTM*, *BC*, and *LC* are each partitioned each year into quintiles (1 denotes low, 5 denotes high). The observations in each quintile are pooled across years. Median *ROE* for each quintile over the subsequent five years is reported in table 4, panel A (partitioning on the *BTM*), panel B (partitioning on *BC*), and panel C (partitioning on *LC*). The results reflect the requirement that each observation has *ROE* available for each of the five subsequent years.

When we partition on the *BTM* (panel A), our results are comparable to those in Fama and French [1992], Penman [1992], and Bernard [1994]. We find that the *BTM* has a strong negative association with *ROE* over each of the five subsequent years. For example, the difference between median *ROE* for quintiles 1 and 5 one year after portfolio formation is .159, with the Mann-Whitney rank test yielding a *Z*-statistic of 27.8. This difference decays about 42% after five years, however, to .092, with a Mann-Whitney *Z*-statistic of 16.4.

When we partition on *BC* (panel B), our results are consistent with *BC* capturing persistent bias in the *BTM*. We find a strong negative association between *BC* and future *ROE* which decays only about 21% over five years. For example, the difference between median *ROE* for quintiles 1 and 5 one (five) years after portfolio formation is .077 (.061), with a Mann-Whitney *Z*-statistic of 14.7 (11.3).

When we partition on *LC* (panel C), our results are consistent with *LC* capturing transitory lags in the *BTM*. We find a strong negative association between *LC* and future *ROE*; this association declines by about 61% over five years, implying that 61% of the difference between market and book value is recognized over this period. For example, the difference between median *ROE* for quintiles 1 and 5 one (five) years after portfolio formation is .094 (.037), with a Mann-Whitney *Z*-statistic of 19.6 (6.0).

In summary, the results in table 4 show that the ability of *LC* to predict *ROE* decays about three times more over a five-year horizon than does the ability of *BC* to predict *ROE*. These results are consistent with *BC* capturing persistent bias and *LC* capturing transitory lags.

We now use multivariate regression to test the ability of *BC* and *LC* to predict *ROE* beyond current *ROE*. We focus on *incremental* explanatory power, because Penman [1992], Bernard [1994], and others have shown that current *ROE* is a strong predictor of future *ROE*. Specifically, we regress *ROE* in each of the five subsequent years on current *ROE*, *BC*, *LC* and, to include a complete decomposition of *BTM* in the model, the time effect α_t and residual $\varepsilon_{t,i}$ from the estimation of equation (4).

$$ROE_{t+j,i} = a + bROE_{t,i} + cBC_{t,i} + dLC_{t,i} + f\alpha_t + g\varepsilon_{t,i} + e_{t+j,i}, \quad 1 \leq j \leq 5. \quad (6)$$

To evaluate the importance of the *BTM* decomposition, we also estimate (6) replacing the book-to-market ratio components with the *BTM*.

Based on prior research, we expect the coefficient *b* on current *ROE* to be positive and to tend toward zero (attenuate) with the forecasting horizon. Based on our prior analysis, we expect the coefficient *c* on *BC* to be negative and to attenuate relatively little with the forecasting horizon. In contrast, we expect the coefficient *d* on *LC* to be negative and to attenuate substantially with the forecasting horizon. We make no predictions about the coefficients *f* and *g* on the equation (4) time effect α_t and residual $\varepsilon_{t,i}$, respectively.

The results of estimating equation (6) are reported in table 5. We focus on the model with the *BTM* components (panel B). As expected, the coefficient *b* on *ROE* is positive for all forecasting horizons, although it is insignificant (t = .5) at the three-year horizon. The coefficient *c* on *BC* is negative at all horizons, increasing from −.096 (t = −8.6) at the one-year-ahead horizon to −.060 (t = −5.7) at the five-year-ahead horizon, a 37% attenuation. The coefficient *d* on *LC* is also negative at all horizons, increasing from −.231 (t = −8.8) at the one-year horizon to −.056 (t = −2.2) at the five-year horizon, a 76% attenuation. As expected, the coefficient *d* on *LC* attenuates by approximately twice as much proportionally as the coefficient *c* on *BC* over the five-year forecasting horizon. This finding is consistent with the threefold difference in the grouping results in table 4. The difference of the coefficients *c* on *BC* and *d* on *LC* is significantly positive at the .01 level or better for the first three years ahead, and then essentially zero. We expect the difference of the coefficients to become significantly negative for longer horizons than we examine, as the coefficient *d* on *LC* decays to zero.

The R^2 decreases from 14.8% forecasting *ROE* one year ahead to 2.2% forecasting *ROE* five years ahead, in contrast to 13.4% and 2.0% if the bias and lag components are replaced by the *BTM* only (panel A). On average across the forecasting horizons, there is about a 10% improvement in the R^2 associated with *ROE* forecasting when the *BTM* is decomposed; the *F*-test reported in panel B indicates that this improvement is significant at the 5% level or better at all horizons, but strongest for the first three years ahead. This relatively modest R^2 improvement may reflect the possibility that many firms are subject to a similar extent to bias and lags; for a sample of such firms, future *ROE* should be accurately predicted by the *BTM*. We emphasize that this R^2 improvement does not reflect the implications of our results for future *ROE* of firms in industries predominantly subject to bias (e.g., pharmaceuticals) or lags (e.g., traditional retail banking), however; these implications are reflected in the sizable differences of the coefficients on *BC* and *LC*. For example, a *BTM* of .5 rather than 1 that is attributable solely to *BC* (*LC*) implies that next year's *ROE* is .048 (.116) higher.

TABLE 5

Regression of Book Return on Equity in Subsequent Five Years on Book Return on Equity and the Book-to-Market Ratio or Its Components: 1984–88

Panel A: *BTM* Predicting *ROE* (Benchmark Model)

$$ROE_{t+j,i} = a + bROE_{t,i} + cBTM_{t,i} + e_{t+j,i}, \quad 1 \leq j \leq 5$$

Years Ahead	a	b	c	R^2
1	.193	.183	−.119	.134
	(30.2)	(9.0)	(−15.4)	
2	.177	.122	−.089	.066
	(16.6)	(4.0)	(−8.2)	
3	.184	.030	−.088	.040
	(18.1)	(1.1)	(−8.9)	
4	.154	.053	−.077	.027
	(16.8)	(2.1)	(−7.5)	
5	.125	.092	−.048	.020
	(13.7)	(3.4)	(−5.3)	

Panel B: *BTM* Components Predicting *ROE* (Equation (6))

$$ROE_{t+j,i} = a + bROE_{t,i} + cBC_{t,i} + dLC_{t,i} + f\alpha_t + g\varepsilon_{t,i} + e_{t+j,i}, \quad 1 \leq j \leq 5$$

Years Ahead	a	b	c	d	f	g	$c–d$	$R^2(F)$
1	.218	.165	−.096	−.231	−.149	−.127	.135	.148
	(11.5)	(4.5)	(−8.6)	(−8.8)	(−6.9)	(−5.4)	(4.3)	(37.6)
2	.215	.095	−.081	−.211	−.134	−.061	.130	.077
	(11.3)	(2.9)	(−7.4)	(−7.9)	(−6.1)	(−2.8)	(3.9)	(33.0)
3	.194	.016	−.086	−.160	−.099	−.075	.074	.044
	(10.4)	(.05)	(−8.1)	(−6.0)	(−4.5)	(−3.5)	(2.3)	(10. 3)
4	.150	.053	−.077	−.075	−.062	−.051	−.020	.028
	(8.1)	(1.8)	(−7.6)	(−2.9)	(−2.8)	(−2.6)	(−0.1)	(2.7)
5	.126	.087	−.060	−.056	−.048	−.021	−.004	.022
	(7.2)	(3.0)	(−5.7)	(−2.2)	(−2.3)	(−1.2)	(−0.2)	(5.1)

The notes to tables 1 and 3 describe variable definitions and notation and the sample. α_t denotes the time effects and $\varepsilon_{t,i}$ denotes the residuals from the estimation of equation (4) reported in table 2.

Year t in the benchmark model and equation (6) covers the years 1984–88. Accordingly, *ROE* is forecasted over the years 1985–93.

ROE is required to be available for each of the next five years for an observation to be included in any of the five regressions. Accordingly, the same 6,044 observations are included in each regression.

White's [1980] heteroscedasticity-adjusted t-statistics are in parentheses, except reported under the R^2 in panel B is an F-statistic testing the incremental explanatory power of the full model in panel B versus the benchmark model in panel A. The .05 (.01) significance level for an F-statistic with 3 and 6,065 degrees of freedom is 2.61 (3.78).

In contrast to Bernard's [1994] finding that the *BTM* does not have much explanatory power over future *ROE* after controlling for current *ROE,* the coefficients on the bias and lag components are individually and collectively more significant than the coefficient on current *ROE.* We emphasize that this is also true when the *BTM* is not decomposed; this result is explained by our use of regression rather than grouping methods as in Bernard; with book value in its denominator, *ROE* is a noisier variable than the *BTM* and thus is subject to greater attenuation bias in a regression framework.

We also show that the implications of *BC* for future *ROE* depend on growth, while this is not true for *LC*. As previously discussed, the correlation of *BC* with *ROE* becomes less negative and then positive as growth increases and then exceeds r, respectively. To test this hypothesis, we modify equation (6) to interact growth with *BC* and *LC*. For simplicity, we use average *ROE* over the subsequent five years as the dependent variable.

$$\frac{1}{5}\sum_{j=1}^{5} ROE_{t+j,i} = a + bROE_{t,i} + cBC_{t,i} + c_g(BC_{t,i} \times GROW_{t,i}) + dLC_{t,i} + d_g(LC_{t,i} \times GROW_{t,i}) + f\alpha_t + g\varepsilon_{t,i} + e_{t,i}. \qquad (6g)$$

We use one minus the ratio of sum of dividends over the current and past three years to the sum of earnings over the past four years (one minus an average dividend payout variable) as our measure of growth, denoted *GROW*. *GROW* is constrained to be between zero (full payout, low growth) and one (zero payout, high growth).[10] We use dividend payout to measure growth both because it is consistent with our characterization of growth in terms of reinvestment and because unreported results indicate that it is a significant predictor of future growth in sales and book value over the whole five-year horizon. In contrast, past growth in sales and book value is not a significant predictor of sales and book value beyond two years. We average dividend payout to mitigate the effect of transitory earnings. A limitation of our approach is that low payout may indicate a distressed firm; our results are substantially identical if we use a combination of dividend payout and past sales growth variable as our measure of growth, to mitigate this concern.

We expect the coefficient c_g on $BC \times GROW$ to be positive. In theory, c_g should be exactly equal to $-c$, since a firm with zero net dividends ($GROW = 1$) is expected to grow at rate r, and since equation (2) implies that bias has no effect on *ROE* when $g = r$. In contrast, we expect the coefficient d_g on $LC \times GROW$ to be zero.

The results of estimating (6*g*) are reported in table 6. The coefficients on the variables are approximately the average of the corresponding coefficients from equation (6) over the five-year horizon reported in table 5. The coefficient c_g on the interactive $BC \times GROW$ variable is positive as predicted ($t = 4.3$). Thus higher growth works to diminish the effect of bias on *ROE*. The coefficient c_g is only about 55% of $-c$, however, and the difference between $-c$ and c_g is significant ($t = 5.3$). This could be due either to measurement error in the growth variable discussed above

[10] If the sum of dividends over the three-year period is zero, then dividend payout is defined as zero regardless of the sum of net income. If the sum of dividends is positive and the sum of net income is negative, then dividend payout is defined as one.

TABLE 6

Regression of Average Book Return on Equity over Subsequent Five Years on Book Return on Equity and the Book-to-Market Ratio Components Allowing for Interaction of Growth: 1984–88

a	b	c	c_g	d	d_g	f	g	R^2	No. of Obs.
.181	.075	−.109	.061	−.169	.034	−.096	−.057	.143	6,128
(18.0)	(4.6)	(−12.1)	(4.3)	(−6.8)	(1.0)	(−8.3)	(−5.1)		

Estimation equation (6g) is:

$$\frac{1}{5}\sum_{j=1}^{5} ROE_{t+j,i} = a + bROE_{t,i} + cBC_{t,i} + c_g(BC_{t,i} \times GROW_{t,i}) + dLC_{t,i} + d_g(LC_{t,i} \times GROW_{t,i}) + f\alpha_t + g\varepsilon_{t,i} + e_{t,i}.$$

The notes to tables 1, 3, and 5 describe the variable definitions and notation and the sample.

Year t in equation (6g) covers the years 1984–88. Accordingly, average *ROE* is forecasted over the five-year periods from 1985–89 and 1989–93.

White's [1980] heteroscedasticity-adjusted t-statistics are in parentheses.

or to limitations of the theoretical or empirical models. In contrast, the coefficient d_g on $LC \times GROW$ variable is insignificant ($t = 1.0$).

In summary, consistent with our characterizations of bias and lags, we find that *BC* has a more persistent negative association with future *ROE* than does *LC* and that *BC*'s association with future *ROE* attenuates with higher growth while *LC*'s association with future *ROE* does not. These results imply that our approach allows for improved forecasts of *ROE* compared to models that do not distinguish these sources of variation in the *BTM* for firms predominantly subject to bias or lags.

5. Prediction of Terminal Values in the Discounted Residual Income Valuation Model

To assess further whether decomposing *BTM* facilitates better valuations, we apply the same analysis used to forecast *ROE* to the terminal value in the discounted residual income valuation model. As a practical matter, the discounted residual income valuation model must be implemented by forecasting *ROE* and growth in book value over a finite horizon and also the terminal value at the horizon. The finite horizon version of equation (1) is:

$$\frac{1}{BTM_t} = 1 + E_t\left\{\sum_{s=1}^{n} \frac{(ROE_{t+s} - r)\dfrac{BV_{t+s-1}}{BV_t}}{(1+r)^s} + \frac{MV_{t+n} - BV_{t+n}}{BV_t(1+r)^n}\right\}, \quad (1')$$

where the last term in the brackets on the right-hand side is the discounted terminal value.

Unfortunately, the application of this model over a finite horizon raises a number of currently unresolved issues. Most importantly, it is unclear why since 1980 the median *BTM* is much less than one while the median *ROE* is close to, if not below, the appropriate discount rate r. For example, in 1993 the median *BTM* was .58, the median *ROE* was .11, and investment-grade corporate bonds yielded about 7.75% on average (*Moody's Bond Record* [1993]). Historically, the premium of corporate equities over investment-grade corporate debt is about 5% (Ibbotson Associates [1988]), implying a discount rate of about 12.75% in 1993. However, the contemporaneous medians of *BTM* and *ROE* in our sample imply a discount rate of about 5%.[11] Since it is not clear how to apply this model to explain the average level of stock prices, we believe it is premature to apply the model to cross-sectional variation in stock prices.

We conduct a more limited application, asking whether the bias and lag components help explain terminal values. Superior explanatory power for the terminal value plus the previously demonstrated superior explanatory power for *ROE* over the horizon should equate to superior valuations if the discounted residual income valuation model is correct.

We regress the undiscounted five-year-ahead terminal value on the same explanatory variables as in equation (6) plus the cumulative return over the valuation horizon, $RET_{t,t+5}$:

$$\frac{MV_{t+5,i} - BV_{t+5,i}}{BV_{t,i}} = a + bRET_{t,t+5,i} + cROE_{t,i} + dBC_{t,i} + fLC_{t,i} + g\alpha_t + h\varepsilon_{t,i} + e_{t+5,i}. \qquad (7)$$

We include $RET_{t,t+5}$ in part to increase the explanatory power of the model and in part to control for the association of the bias and lag components with future returns.[12] To evaluate the importance of the *BTM* decomposition, we also estimate equation (7) with the *BTM* only. Since the dependent variable is essentially a market-to-book ratio, we expect the coefficient c on *ROE* to be positive and the coefficients d on *BC* and f on *LC* to be negative. We expect the coefficient d on *BC* to be more negative than the coefficient f on *LC*, since the ability of *BC* to predict future *ROE* decays less as the horizon lengthens than does that of *LC*.

The results of estimating (7) are reported in table 7. To mitigate the effect of outliers, the dependent variable is winsorized at its 1st and 99th percentiles. Unexpectedly, the coefficient c on *ROE* is insignificantly negative ($t = -1.0$). As expected, the coefficients d on *BC* and f on *LC* are negative ($t = -14.7$ and -5.3, respectively). Thus, *BC* and *LC* help predict the terminal value in the discounted residual income valuation model

[11] Three possible explanations for this are: (1) the market is expecting *ROE* to increase markedly above the discount rate r, (2) the equity risk premium has declined markedly over time, or (3) there is systematic and huge market mispricing.

[12] In a prior version of this paper, we showed that *BC* has a strong positive association with one-year-ahead raw and size-adjusted returns that decays almost entirely over a five-year forecasting horizon. In contrast, *LC* has an insignificant association with one-year-ahead raw and size-adjusted returns that strengthens to a very significant positive association over a five-year forecasting horizon. Thus the nature of the association of *BC* and *LC* with future returns is not likely to be their association with future *ROE* examined in this paper.

TABLE 7

Regression of Terminal Value in Abnormal Earnings Valuation Model on Security Return over the Forecast Horizon, Book Return on Equity, and the Book-to-Market Ratio or Its Components: 1984–88

Panel A: Predicting Terminal Value Using *BTM* (Benchmark Model)

$$\frac{MV_{t+5,i} - BV_{t+5,i}}{BV_{t,i}} = a + bRET_{t,t+5,i} + cROE_{t,i} + dBTM_{t,i} + e_{t+5,i}$$

a	b	c	d	R^2	No. of Obs.
2.813	1.289	−1.086	−2.753	.272	6,068
(13.0)	(14.0)	(−1.6)	(−14.8)		

Panel B: Predicting Terminal Value Using *BTM* Components (Equation (7))

$$\frac{MV_{t+5,i} - BV_{t+5,i}}{BV_{t,i}} = a + bRET_{t,t+5,i} + cROE_{t,i} + dBC_{t,i} + fLC_{t,i} + g\alpha_t + h\varepsilon_{t,i} + e_{t+5,i}$$

a	b	c	d	f	g	h	d–f	$R^2(F)$	No. of Obs.
5.305	1.264	−.653	−2.938	−2.136	−2.586	−1.518	−.803	.283	6068
(6.0)	(13.4)	(−1.0)	(−14.7)	(−5.3)	(−5.1)	(−5.5)	(−2.4)	(22.5)	

The notes to tables 1, 3, and 5 describe the variable definitions and notation and the sample. $RET_{t,t+5}$ denotes the cumulative security return from the end of year t to the end of year $t + 5$. The terminal value (dependent variable) is winsorized at its 1st and 99th percentiles.

Year t in the benchmark model and equation (7) covers the years 1984–88. Accordingly, the terminal value is forecasted over the years 1989–93.

White's [1980] heteroscedasticity-adjusted t-statistics are in parentheses, except reported under the R^2 in panel B is an F-statistic testing the incremental explanatory power of the full model in panel B versus the benchmark model in panel A. The .01 significance level for an F-statistic with 3 and 6,065 degrees of freedom is 3.78.

beyond the current *ROE*. As expected, the difference of the coefficients d on *BC* and f on *LC* is significantly negative, with $t = -2.4$. Thus the terminal value is significantly more sensitive to *BC* than *LC*.

In the full model (panel B), the R^2 is 28.3%, in contrast with 27.2% when the *BTM* is not decomposed (panel A). Thus, there is about a 4% improvement in the R^2 associated with *ROE* forecasting when the *BTM* is decomposed; the F-test reported in panel B indicates that this improvement is significant at the .01 level. As with the *ROE* prediction results, this relatively modest R^2 improvement may reflect the possibility that many firms are subject to a similar extent to both bias and lags. We emphasize that this R^2 improvement does not reflect the implications of our results for the terminal values of firms in industries predominantly subject to bias or lags; these implications are reflected in the sizable differences of the coefficients on *BC* and *LC*. For example, a *BTM* of .5 rather than 1 that is attributable solely to *BC* (*LC*) implies that the terminal value is 1.469 (1.068) higher.

6. *Conclusion*

In this paper, we decompose the book-to-market ratio into two components which capture persistent bias and transitory lags, and show that their associations with future book return on equity differ in predictable ways that facilitate the forecasting of book return on equity. We find that the bias and lag components of the book-to-market ratio have significantly different implications for the pattern of decay of book return on equity, and that the association between the bias component becomes less negative as growth increases, consistent with the well-known fact that bias and growth interact. We also show that the two components provide incremental information beyond current book return on equity for predicting the terminal value in the discounted residual income valuation model.

While our approach has sizable implications for the valuation of firms that are predominantly subject to either bias or lags, the incremental R^2s that result from decomposing the book-to-market ratio are modest. While this may reflect the possibility that many firms are subject to a similar extent to both bias and lags, it may also reflect limitations in our approach to estimating the bias and lag components. In our view, an important task for future research on accounting-based valuation is to develop more powerful methods for distinguishing bias and lags.

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