Effects of Accounting Bias and Market Mispricing on Book-to-Market Ratio*

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This paper aims to identify the effect that accounting bias and economic goodwill have on the variation of the book-to-market ratio (BTM). Using an empirical valuation model to measure the fair value of net assets, I divide the BTM into two components that capture accounting bias and economic goodwill. Accounting bias (BIAS) measures the deviation of a firm's book value (BV) from the fair value of its net assets (FV) under biased accounting. Economic Goodwill (GW) indicates the difference between a firm's market value (MV) and its FV. BIAS reflects the effect of both accounting conservatism and historical cost basis on BV. With GW, the effect of growth can be included in MV, which FV fails to include, or GW may simply reflect how biased accounting numbers lead to market mispricing. Empirical results support my hypothesis that accounting bias and economic goodwill, under the mispricing, can explain most of the BTM anomaly. BIAS ((BV-FV)/MV) has a strong negative relation to future ROE over a nine-year period (the approximate median depreciation period), while GW ((FV-MV)/MV) has a less negative (even positive) relation over shorter terms. When one controls the effect of accounting bias, GW as the growth measure shows a positive relation to future returns for as long as a five-year period. In contrast, BIAS shows a positive relation only temporarily to short-term returns. These results provide two implications. The BTM anomaly for ROE cannot be an equilibrium phenomenon. Rather it is related closely to accounting bias and its effect upon market pricing. Ultimately, the BTM's short-term relation to returns is primarily attributed to accounting bias, whereas its long-term relation to returns is primarily influenced by economic goodwill, which captures growth.

Key-words: book-to-market ratio; market mispricing; accounting bias; economic goodwill.
Data Availability: All data are publicly available from the source indicated in the paper.

Ⅰ. Introduction

Fama and French (1995) report that the current book-to-market ratio (BTM) has a strong negative association with future returns on book equity (ROE), and a positive association with future returns. In opposition to the mispricing hypothesis of Lakonishok et al. (1994), they interpret the BTM's association with ROE and returns as the market equilibrium phenomenon. Yet, many researchers have reported empirical findings that support the mispricing hypothesis. Billings and Morton

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(2001) provide some evidence that the market's mispricing for the temporary earnings change actually drives the BTM anomaly. They find that the earnings forecast revision has a significant positive effect upon both BTM and return. Penman and Zhang (2002) show a strong association between accounting conservatism and earnings reversal, which they see as lowering the quality of earnings, leading to the BTM's negative relation to future ROE. Both Billings and Morton's and Penman and Zhang's findings provide evidence of market mispricing, and thus could give an explanation on the BTM anomaly.

Recently, Beaver and Ryan (2000) suggest the idea that both accounting conservatism and the economic environment that reflects a firm's growth jointly affect the variation of BTM. They divide BTM into two major components based on its statistical relation to current and lagged returns, and find that each one has a different persistence in relation to future ROE. As do Feltham and Ohlson (1995), they define conservatism broadly enough to capture all accounting methods that deviate the firm's book value (BV) from its market value (MV). Some of them (e.g., the lower of cost or market valuation and LIFO adoption for inventories) induce the temporary variation of BTM, while others (e.g., non-capitalization of R&D expenditure and other intangibles) along with the economic environment cause more persistent variations.

This paper extends the ideas of Beaver and Ryan by using an empirical valuation model that measures the fair value of the firm's net assets (FV). This model divides BTM into two conceptually distinct components, according to their sources of variation. One component represents accounting bias as related to both conservatism and historical cost basis, and the other represents either economic goodwill or the market's irrational pricing. I define accounting bias (BIAS) as the accounting treatment, *independent of the market's reaction to it*, that incurs the temporary difference between BV and MV. Economic goodwill (GW) is then defined as the market's possible reaction to accounting bias and growth opportunity, and it results in the persistent difference between BV and MV. The market could react either rationally capturing the growth opportunity omitted from BV or irrationally to the biased BV and earnings. As Beaver and Ryan have fundamentally understood, the omission of growth opportunities such as R&D intangibles can be examples of accounting bias (conservatism). However, it is difficult to actually distinguish accounting bias from economic goodwill. More restrictive definitions are therefore required to keep accounting bias isolated from market reaction, in order to separate the effect of market's potential mispricing from that of accounting bias, both of which could affect BTM. By separating these two factors, one can evaluate the competing theories regarding the market's reaction to accounting bias. Under rational pricing, economic goodwill, independent of accounting bias, should actually capture the effect of growth on BTM. On the other hand, under irrational pricing, economic goodwill is unlikely to capture the effect of growth, and would simply indicate the market's mechanical reaction to accounting bias. Specifically, the valuation model incorporates accounting bias' effect upon earnings into FV, so that FV can effectively estimate the pro-forma BV under unbiased accounting. This model helps to measure BIAS and GW in forms of (BV - FV)/MV and (FV - MV) /MV respectively from (BTM - 1).

I develop two hypotheses in order to judge the competing theories regarding market pricing, and to provide a descriptive explanation of the BTM anomaly. The first hypothesis predicts that BTM (GW) has a less negative or even positive relation to future ROE, when BIAS has been controlled. The second hypothesis predicts that BTM (GW) would have more persistent relations to future return when BIAS is controlled. The former prediction is derived from the descriptive theory underlying the valuation model. This particular model claims that the negative relation between BTM and ROE is a result of accounting bias, and sustains itself over the depreciation period. Therefore, the BTM's relation to ROE can become less negative by controlling BIAS. The latter prediction expects that market pricing will become rational in the long-term, as presumed by the mispricing hypothesis as well. However, this would not guarantee the market's rational reaction to accounting bias even in the short-term. None of my hypotheses provide a prediction regarding the market's temporary reaction to BIAS, as this should remain an empirical question.

Empirical results support both of my hypotheses. First of all, the regression result on both conservatism and growth variables confirms that BIAS and GW respectively capture each of these variables efficiently. In particular, the positive association between GW and any growth variable can be considered as evidence of market's temporary mispricing for accounting bias. Market mispricing can also explain GW's positive relation to conservatism variables. GW increases as the market value deceases because of a mechanical reaction to more conservative, mispriced earnings. Secondly, median ROE analyses over a fourteen-year period reveal that BIAS has a negative relation to future ROE over a nine-year period, which is approximately the sample's median depreciation period. At the same time, GW has a less negative relation over shorter periods. This finding also coincides with the result of ROE regressions on BIAS and GW. The negative relation between BIAS and ROE, over nine years, conforms to the theory constructing the valuation model. Finally, analysing the return regressions on BIAS and GW, GW is seen to have a positive relation to future return, which persists for five years, whereas BIAS experiences only a temporary relation to short-term returns.

These findings provide two major implications. Both accounting bias and market mispricing cause the long-term negative relation between BTM and ROE. Next, the BTM's temporary relation to return is attributed most to accounting bias' mispricing, and its persistent relation to return is mainly subject to goodwill's ability to reflect growth. The *persistent* relation between return and GW as *the BTM after BIAS* represents the market's rational reaction to the long-term growth. In the meantime, their *positive* relation reflects the market's temporary mispricing because of accounting bias. When the market irrationally prices based on biased accounting numbers, a high growth (return) firm may show greater GW than a low growth firm because the firm's MV would fail to reflect its FV that is greater than BV. Therefore, the *persistent and positive* relation to return can simultaneously be evidence of both the market's long-term rationality and its short-term mispricing.

The next section of the paper constructs a valuation model that divides BTM into two components, adding a descriptive theory. Section III develops testable hypotheses on each component's relation to future ROE and return. Section IV provides presentations and discussions of the sample and empirical results. Section V concludes the paper.

II. BTM Decomposition: Accounting Bias and Economic Goodwill

Focusing on historical cost accounting, Ryan (1995) confines goodwill to the difference between fair and book values of the firm's fixed assets. He argues that these differences are gradually incorporated into future accounting earnings, and affect neither current earnings nor the book value of the asset. This difference represents the measurement error in the book value under biased accounting (*accounting bias*). In subsequent years, the current accounting bias changes into abnormal earnings through less depreciation charge and more disposition gain on the asset. The abnormal earnings due to accounting bias sustain over the asset's useful life. To illustrate, one can assume a firm with one asset.[1] The firm only

1) APPENDIX provides an illustration of the relation between bias and abnormal earnings. For simplicity, I address a one-asset case. However, the whole analyses can be extended to any multi-asset cases, while maintaining this model's theoretical and empirical properties discussed in this section.

has zero-NPV projects with a constant equity cost (k_e) over time. This 'no growth' assumption is consistent with Ryan's idea of confining goodwill to accounting bias. The firm buys an asset at its fair value (FV) with T-years of useful life and a zero salvage value for straight-line depreciation. Though FV subsequently increases because of economic change, the firm still carries the asset at its book value (BV), based on its acquisition cost. The FV and BV difference reflects accounting bias or the holding gain in the economic-earnings perspective. However, currently, historical cost accounting does not recognize the gain. Instead, the gain can be recognized in future accounting earnings, as there would be less depreciation charges than economic earnings. Yearly balances of FV and BV decrease monotonically through the straight-line depreciation. Any depreciation method resulting in a systematic allocation of the asset value can replace the straight-line method. During all future periods, economic depreciation will be greater than accounting depreciation, according to the current bias' exact amount.

If accounting bias currently incurs the FV and BV difference, as explained above, future abnormal earnings ($X^a_{t+\tau}$) are also determined at that moment. They are gradually realized through a systematic allocation of the current bias ($FV_t - BV_t$) with depreciation rate of $D_{t+\tau}$. Then, future earnings ($X_{t+\tau}$) are the sum of the annual depreciation charge for bias ($D_{t+\tau}(FV_t - BV_t)$) and expected earnings ($k_eFV_{t+\tau-1}$).[2)]

$$X^a_{t+\tau} = D_{t+\tau}(FV_t - BV_t) \quad (1)$$

$$X_{t+\tau} = k_eFV_{t+\tau-1} + D_{t+\tau}(FV_t - BV_t) \quad (2)$$

In Equation (1), $D_{t+\tau}$ can either be constant or vary over time, according to the firm's depreciation method. However, the sum of $D_{t+\tau}$ for all future periods of $\tau(\tau=1,T)$ always equals one ($\Sigma_{\tau=1,T}D_{t+\tau}=1$), regardless of the depreciation method. Consequently, the sum of future abnormal earnings equals the accounting bias incurred at the end of current year (B_t), under the 'no growth-reinvestment' assumption.

$$B_t = \Sigma_{\tau=1,T}X^a_{t+\tau} = \Sigma_{\tau=1,T}D_{t+\tau}(FV_t - BV_t) = FV_t - BV_t \quad (3)$$

Fixed assets are usually held for shorter periods than their economic life. Yet, the early disposition would not change the relation between bias and abnormal earnings.

2) Most valuation models (e.g., Feltham and Ohlson 1995) define actual and expected earnings first, and abnormal earnings as their difference, employing the operating assumption that abnormal earnings capture both accounting bias and future growth. However, in my valuation model, which confines abnormal earnings to accounting bias, the logical sequence should be reversed. Since future abnormal earnings are currently determined only by accounting bias, and there is no growth opportunity affecting future earnings, I define the predetermined abnormal earnings first, and next the actual earnings as the sum of expected and abnormal earnings.

For example, the asset can be disposed at the end of the current year. If this is so, current accounting earnings increase according to its disposition gain ($FV_t - BV_t$), which is otherwise recognized as abnormal earnings during subsequent years ($\Sigma_{\tau=1,T}D_{t+\tau}(FV_t - BV_t)$). Furthermore, in practice, changes in estimated useful life and salvage value frequently happen. Neither of these changes affect the result of my analysis because accounting earnings also reflect them as *prospectively* as economic earnings do.

In Equation (4), actual earnings ($X_{t+\tau}$) are easily transformed into $ROE_{t+\tau}$ simply divided by the beginning balance of book equity ($BV_{t+\tau-1}$). However, expected ROE ($k_eFV_{t+\tau-1}/BV_{t+\tau-1}$) needs careful interpretation. When goodwill is confined to fixed asset's bias, future abnormal earnings are only the delayed recognition of its current holding gain. No factors other than the current bias affect future abnormal earnings, and they are totally independent of the market's expectation. This means that k_e for ROE expectation will not vary over time. Further, the FV to BV ratio ($FV_{t+\tau-1}/BV_{t+\tau-1}$) for each subsequent year is identical to that of current year because future balances of both FV and BV decrease proportionally, with the same depreciation rate. As for the acquisition year, the ratio becomes 'one' since the asset price reflects its fair market value. This model is constructed to measure the year-end bias, such that it can be identified as having been acquired during that year. This calculation requires the constant k_e for every year-end bias to be the ROE for the acquisition year incurring the bias. That is, it must be the ROE for the current year. Thus, the expected earnings for all future periods should be transformed into the current ROE (ROE_t) as in Equation (5).

$$X^a_{t+\tau} = (X_{t+\tau}/BV_{t+\tau-1} - k_eFV_{t+\tau-1}/BV_{t+\tau-1})BV_{t+\tau-1} \quad (4)$$

$$X^a_{t+\tau} = (ROE_{t+\tau} - ROE_t)BV_{t+\tau-1} \quad (5)$$

Relaxing the 'no reinvestment' assumption, to make the model more empirically valid, the discount rate for future abnormal earnings must be specified. The discount rate would be the rate of return on reinvested abnormal earnings. When abnormal earnings are determined only by the *ex-post* allocation of accounting bias, the actual reinvestments accompanying cash flows do not happen in any future period before the asset's replacement.[3) This explains why either k_e or ROE *for the future period* may not be applied to the reinvestment. The reinvestment return on abnormal earnings is closely related with the

3) This replacement includes the asset's early disposition as well as the normal replacement at the end of its useful life. However, it ultimately makes no difference because both will terminate the depreciation. As long as there is a depreciation period, length being negligible, this model suffices.

opportunity cost of the current bias (*the cost of investment on the asset*). During the acquisition year, the asset price (*the investment on the asset*) becomes both the BV (BV_{t-1}) and FV (FV_{t-1}) beginning balance, the expected ROE for the year ($k_e FV_{t-1}/BV_{t-1}$) then equals *the cost of the investment* (k_e). Therefore, the acquisition year's ROE (ROE_t) would be the rate of return on the reinvestment. This determines that the discount rate for future abnormal earnings is ROE_t. Moreover, ROE_t should be the current realized ROE, instead of the expected one, as abnormal earnings reflect the bias currently realized, regardless of the market's expectation. In consequence, the current bias (B_t), which indicates the present value of future abnormal earnings over the depreciation period (T), can be expressed as below.

$$B_t = FV_t - BV_t = \Sigma_{\tau=1,T}(ROE_{t+\tau} - ROE_t)BV_{t+\tau-1}(1+ROE_t)^{-\tau} \quad (6)$$

This theory leads the valuation model for FV_t (hereafter the FV model) in Equation (7) to be constructed only with *ex-post* ROE and BV variables.

$$FV_t = BV_t + B_t = BV_t + \Sigma_{\tau=1,T}(ROE_{t+\tau} - ROE_t)BV_{t+\tau-1}(1+ROE_t)^{-\tau} \quad (7)$$

For the practical purpose of empirical measurement, one needs to explicitly specify a measurement period that has an estimated terminal value after that period. Following Lee et al. (1999), I use a two-stage approach to measure FV_t. First, I compute ROEs explicitly for the next three years.[4] Second, I implicitly estimate ROEs beyond the third year by assuming that ROE_{t+3} equals the average ROE of three explicit measurement periods (t ~t+2), and that it remains stationary through all future periods (t+3~t+T). The terminal value beyond the third year is estimated by taking ROE_{t+3} as a perpetuity without growth. Since the expected growth of ROE does not affect B_t, which already has been determined by current bias, Equation (8) ignores the ROE growth in the terminal value computation.

$$FV_t = BV_t + (ROE_{t+1} - ROE_t)BV_t(1+ROE_t)^{-1} + (ROE_{t+2} - ROE_t)BV_{t+1}(1+ROE_t)^{-2} + TV \quad (8)$$

where, $TV = (FROE - ROE_t)BV_{t+2}\Sigma_{\tau=3,T}(1+ROE_t)^{-\tau}$
$FROE = (ROE_t + ROE_{t+1} + ROE_{t+2})/3$
$ROE_{t+\tau} = X_{t+\tau}/BV_{t+\tau-1}$
$X_{t+\tau}$ = earnings per share in $t+\tau$
$BV_{t+\tau}$ = book value per share at the end of $t+\tau$

Owing to the FV model, both accounting bias (BIAS) and economic goodwill (GW) are

4) I also estimate FV_t using an eight-year measurement period – approximately the sample's median depreciation period. FV_t estimates for the eight-year measurement period are almost identical to those for three-year one, simply with a drastic reduction in observations.

measured using casual calculations of (BV - FV) and (FV - MV) respectively. They can be expressed in ratio forms, as well. The ratio expression in Equation (9) is convenient for the development of hypotheses and the interpretation of empirical results in the following sections.[5)]

$$
\begin{aligned}
(BTM - 1) &= (BV - MV)/MV \\
&= (BV - FV)/MV + (FV - MV)/MV \\
&= BIAS + GW \qquad (9)
\end{aligned}
$$

III. Development of Hypotheses

The FV model embodies a descriptive theory regarding the relation between accounting bias and ROE in the BTM decomposition. The theory claims that the current bias for fixed assets turns gradually into future abnormal earnings through less depreciation charges and more disposition gains. If the FV model is empirically valid, the BTM's negative relation caused by the bias will persist over the depreciation period. Specifically, BIAS captures accounting bias and its earnings effect, thus driving the systematic reversal between current and future earnings. The reversal process sustains over the fixed asset's depreciation period. The bias for assets other than fixed assets would be reversed in early years of the depreciation. As a result, the magnitude of earnings reversal during early years will be greater than that of later years. The negative relation caused by BIAS is then expected to decay over the depreciation period.[6)]

This theory also predicts that the BTM's negative association with ROE would be weakened after eliminating the effect of accounting bias (BIAS) from BTM. In other words, the economic goodwill (GW) in BTM would have a less negative or even a positive relation to ROE *under the market's mispricing.* If the market prices the firm value rationally, even in the presence of accounting bias, the bias control will not make any difference in the BTM's relation to ROE. Fama and French (1995) argue that the association between BTM and ROE is an equilibrium phenomenon resulting from the market's rational pricing of the firm's long-term profitability. According to their argument, the effect of bias on the BTM's variation is limited only to short-term earnings reversal. If that is the case, controlling the bias effect will not weaken, but rather it

5) The FV model intends to measure the book-to-market difference (BV-MV), instead of the book-to-market ratio (BV/MV). Theoretically, the book-to-market difference has the same implications for the BTM anomaly as any other variants of book-to-market measure. Technically, however, this difference may cause some inconveniences, i.e., skewing the comparison of results with other studies.

6) BIAS for other assets (mostly, current assets) would be counter-balanced over two or more years, within the fixed asset's useful life. BIAS as a whole would persist, at most, for the fixed asset's depreciation period, thus accounting for the FV model's concentration on fixed asset.

will strengthen BTM's negative relation to ROE. Without the bias, low BTM firms that have above-average ROEs during past and current years, even with a bias present, would show higher ROE during subsequent years. This phenomenon would happen, as the earnings reversal would be cancelled. However, most empirical findings succeeding their study have evidenced the market's mispricing. At least, they have in the short-term (Penman and Zhang 2002; Billings and Morton 2001; Penman 1996). Based on both the theory underlying the FV model and the mispricing hypothesis of Lakonishok et al. (1994), I develop my first hypothesis regarding BTM's relation to ROE.

H1: BTM (GW) would have a less negative or even a positive relation to future ROE, after controlling for BIAS and its effect.

According to Penman and Zhang (2002), conservative accounting reduces current earnings and BV by increasing unrecorded reserves. Those reserves are liquidated in subsequent years, thus increasing future earnings. If conservative accounting currently produces reserves by reducing earnings and BV, then future earnings will automatically increase due to future allocations of those reserves. This reversal of earnings under conservative accounting can also explain the negative association of current BIAS with future ROE. On the contrary, current GW may have a positive relation to future ROE because GW will capture the sustainable growth of earnings instead of temporary earnings reversal. Likewise, future ROEs are positively related to growth. At least, current GW should have a less negative association with future ROE than BIAS does, if the FV model is empirically valid. One may expect a negative relation between current GW and future return under the presumption of market's all-time rational pricing, even in the short-term. Firms with lower GW would show higher returns in subsequent years if higher future ROEs result from currently lower GW, and if the market properly prices them at the same time. Yet, the relation between current GW and future ROE has not been explored, and the market's (at least, short-term) mispricing for ROEs has been numerously documented in finance and accounting literature. The less negative relation between GW and ROE in H1 also consists with the findings in ⟨Table 2⟩ which reports the GW's significantly positive association with growth proxy.[7)]

7) Under rational pricing, the current GW could have a negative relation to future ROE in a theory that ROE also reflects the abnormal earnings from economic rents as well as those from conservatism. Unfortunately, the return's association with abnormal ROE due to economic rents is not predictable with the FV model, which is fundamentally based on actual (*not forecasted*) ROE data. This limitation requires a careful interpretation for the result of H1 test, and provides an opportunity for further research. I thank an anonymous referee for pointing this out.

The second hypothesis extends the mispricing hypothesis by measuring the effect of BIAS on BTM. It also examines the change in BTM's relation to return, after controlling for BIAS effects. Lakonishok et al. insist that the market undervalues high BTM stocks that have low current earnings because it fails to reflect subsequent earnings growth that can be brought on by earnings reversal. This mispricing generates a temporary positive relation between BTM and return. The FV model attributes the temporary relation to BIAS, and thus captures the earnings reversal. This model also predicts that BIAS would have a short-term positive relation to future return under the mispricing. In contrast, GW is free from this temporary earnings change caused by accounting bias, and it is immune to the mispricing. Further, the FV model expects that GW would capture the earnings growth, which accounting literature has repeatedly documented to be positively associated with return. Thus, GW is also predicted to have a positive relation to future return. Though both components are commonly expected to have positive relations to return, their drivers and persistence are quite different. Since GW reflects the long-term growth in sustainable earnings, it would have a more persistent relation than would BIAS. BIAS may only have a temporary relation, driven by the reversal of unsustainable earnings. This idea leads H2 to predict that BTM (GW), without bias, would have a more persistent relation to return.

H2: BTM (GW) would have more persistent relations to future return, after controlling for BIAS and its effect.

H2 simultaneously predicts the short-term mispricing and the long-term rational pricing of the market, consistently with the findings of recent studies on BTM anomaly. Empirical studies following Fama and French (1995) have documented that most abnormal returns of high BTM firms are centered around the subsequent year's earnings announcement or forecast revision date. They find that the market misprices BIAS only in the short-term, and shows rational behavior in the long-term (e.g., Desai et al. 2004; Gleason and Lee 2003; Doukas et al. 2002; Griffin and Lemmon 2002). Most studies support the fact that the market temporarily misprices the firm's future profitability through the over/under-reaction to its past and current performance which is largely affected by accounting bias. This is why H2 attributes the temporary positive relation to BIAS. However, there are few studies which explore and successfully answer the long-term positive relation between BTM and return. Griffin and Lemmon (2002) have tried a *risk-explanation* on this long-term relation, only to find no significant relation between BTM and distress risk. This is quite different from what Fama and French (1995) have expected. H2 aims to provide an alternative answer for the long-term relation, namely, a *growth explanation*. By eliminating the temporary effect of BIAS from BTM, GW, capturing the long-term growth as reported in ⟨Table 2⟩, will show more persistent relation to returns.[8)]

Ⅳ. Samples and Empirical Results

Samples and Descriptive Statistics

All data are obtained from the 2001 Standard and Poor's Research Insight *Compustat (North America)* CD covering 1981~2000. MV, FV and BV are per share estimates of the firm's fiscal-year-end market value, the fair and book value of its common equity, respectively. BTM, BIAS and GW are measured respectively as BV, (BV-FV) and (FV-MV) over MV. ROE is measured as annual basic earnings per share excluding extraordinary items over BV at the beginning of the fiscal year. R measures the fiscal year's percentage market returns on common equity, adjusted for stock distributions. The depreciation period (T) is estimated by annual depreciation expense, dividing the average cost of depreciable fixed assets (the sum of beginning and ending balance of gross plant, property and equipment over two).

For a more pertinent interpretation of results, I exclude the firms with T of less than two years and more than fourteen years. The lower bound (2) is the minimum measurement period required by the FV model, and the upper bound (14) is the maximum sample period for the analysis of BTM's relation to both future ROE and return. In spite of the sample reduction, the upper bound is required for two reasons. First, the bound is essential for the effective control of BIAS' effect on BTM. The FV model predicts that BIAS affects ROE, and that the affecting period is the depreciation period. Therefore, if the sample's depreciation period exceeds the longest possible period of the analysis, BIAS' effect upon BTM cannot be eliminated entirely. This would bother the effective examination of the changes in the BTM anomaly after controlling for BIAS. Yet, this paper's main aim is to examine just that. Second, the bound will detail the difference between each

8) In unreported analyses, GW shows strong positive associations with future growth variables. The correlation coefficients between current GW and average retention ratio (one minus dividend payout ratio) for three, five and seven years ahead are 0.238 (t=3.105), 0.242 (t=3.277) and 0.168 (t=1.906), respectively. Additional analysis with sales growth ratio as an alternative growth variable shows similar results. GW's correlation coefficients with average sales growth ratio for three, five and seven years ahead are, respectively, 0.201 (t=2.533), 0.225 (t=2.748) and 0.185 (t=2.049).

〈TABLE 1〉
Descriptive Statistics for BTM, BIAS, GW, ROE, R and T Estimates: 1982~1998

Panel A: Pooled Sample Quantiles

	Quantiles						
	1%	*5%*	*25%*	*Med*	*75%*	*95%*	*99%*
MV	0.36	1.00	3.50	7.50	15.00	33.13	52.68
FV	0.10	0.37	1.55	3.43	6.84	16.55	31.46
BV	0.18	0.47	1.68	3.57	6.76	16.33	29.52
BTM	0.06	0.120	0.292	0.500	0.813	1.601	2.578
BIAS	-1.885	-0.569	-0.060	0.010	0.098	0.442	1.046
GW	-0.975	-0.911	-0.733	-0.521	-0.189	0.795	2.151
ROE	-0.640	-0.336	0.012	0.113	0.193	0.350	0.525
R	-0.741	-0.553	-0.191	0.087	0.423	1.250	2.226
T	2.324	3.293	5.833	8.418	11.086	13.358	13.881

Panel B: Selected Yearly Medians

	Years					
	1983	*1986*	*1989*	*1992*	*1995*	*1998*
BTM	0.523	0.521	0.587	0.497	0.426	0.525
BIAS	0.003	0.007	0.036	0.003	0.011	0.013
GW	-0.500	-0.487	-0.463	-0.518	-0.583	-0.512
ROE	0.143	0.105	0.111	0.102	0.118	0.095
R	0.396	0.208	0.104	0.225	0.067	0.086
T	10.060	9.305	8.778	8.497	8.066	7.312

All data are obtained from the 2001 *Compustat* CD covering 1981~2000. The pooled quantiles in Panel A are all from 18,645 firm-year observations for the FV's longest sample period: 1982~1998. Panel B provides annual medians for all observations of each variable in the selected year. MV, FV and BV are per share estimates of the firm's fiscal-year-end market value, the fair and book value of its common equity, respectively. BTM, BIAS and GW, respectively, denote BV, (BV - FV), (FV - MV) over MV. ROE denotes basic earnings per share excluding extraordinary items divided by beginning-of-year BV. R denotes the fiscal year's percentage market returns on common equity adjusted for stock distributions. T denotes annual depreciation expense dividing the sum of beginning and ending balance of gross plant, property and equipment over two. T is winsorized at 2 and 14 years. MV, FV and BV are all winsorized at 0 and 100, BTM at 0 and 4, both BIAS and GW at -4 and 4, ROE at -1 and 1, and R at 3. FV is estimated by the following model.

$FV_t = BV_t + (ROE_{t+1} - ROE_t)BV_t(1+ROE_t)^{-1} + (ROE_{t+2} - ROE_t)BV_{t+1}(1+ROE_t)^{-2} + TV$

where, $TV=(FROE - ROE_t)BV_{t+2}\Sigma_{\tau=3,T}(1+ROE_t)^{-\tau}$, $FROE=(ROE_t+ROE_{t+1}+ROE_{t+2})/3$,

$ROE_{t+\tau}=X_{t+\tau}/BV_{t+\tau-1}$, $X_{t+\tau}$=earnings per share in $t+\tau$,

$BV_{t+\tau}$= book value per share at the end of $t+\tau$

component's persistence by the length of affected sample period. This can then facilitate the intuitive comparison of not only the magnitude, but also the length of each component's relation to future ROE and return.[9]

〈Table 1〉 reports the descriptive statistics for the major variables during 1982~1998. MV, FV and BV estimates are all winsorized at 0 and 100. Like Beaver and Ryan (2000, hereafter **BR**), I exclude the BTM, ROE and R observations outlying the ranges of 0.0~4.0, −1~1, and 3, respectively. I also winsorize both BIAS and GW at −4 and 4. The outliers are less than one and a half percent of total observations. The pooled quantiles in Panel A are all from 18,645 firm-year observations of the FV's longest sample period (1982~1998). Panel B provides each variable's annual medians for all observations in the selected year.

In Panel A, the median BTM for 1982~1998 is 0.50, which indicates 50% decrease from 0.75 for 1974~1993 in **BR**. This is consistent with the BTM's decreasing trend for 1991~1997. The uprising of Internet stocks in those years may give an explanation for this trend. Most Internet stocks in NASDAQ were overpriced relative to NYSE stocks, showing a much lower BTM, particularly for those years. The medians of BIAS and GW are 0.01 and -0.52 respectively. It is interesting to note that the median BIAS is positive (i.e., BV is higher than FV for the median sample). An unreported analysis also reveals that lower quantiles of MV have the positive BIAS, in contrast with the negative BIAS for its upper quantiles. These numbers might be indirect evidence that high-priced firms practice more conservative accounting than low-priced firms. BIAS (-1.89~1.05) as well as GW (-0.98~2.15) has substantial spread, and their spread is quite similar in its construction.

ROE and R show the medians of 0.11 and 0.09 respectively, which are lower than **BR**'s (0.13 and 0.15). In Panel B, however, the medians of both ROE and R during the corresponding years differ little from **BR**'s. The median T is 8.4 years, and the decreasing figures of yearly median indicate that the fixed asset's depreciation period has considerably reduced for the past 16 years from 10.1 (1983) to 7.3 (1998) years. Probably, this reduction has taken place due to rapid progress in production and information technology during recent decades.

9) I also perform the entire analyses without the upper bound excluding only one-percent outliers for FV. The overall results of both analyses still show similarity in the direction and relative persistence of each component's relation to ROE and return. However, as anticipated, the distinction of their relation to both ROE and return become considerably diluted in the analysis without upper bound because the analysis controls the BIAS effect incompletely. For example, the negative relation between BIAS (GW) and ROE continues significant even in the fourteenth (twelfth) year due to the over-ranging depreciation period of 2.0~67.7 with 12.4 years median. This seriously spoils the comparability of their relation to ROE in both persistence and magnitude.

Empirical Validity of BIAS and GW

⟨Table 2⟩ reports the regression result of BTM, BIAS and GW on growth and conservatism variables. For the purpose of comparison, I perform similar regressions as in **BR**. Except for BIAS and GW, all variables are measured identically to **BR**, using data available on the *Compustat* CD. LEV denotes total liabilities divided by the fiscal-year-end market value, winsorized at 0 and 10. GROW denotes one minus average dividend payout ratio for the current and past three years, winsorized at 0 and 1. LIFO and RDAD

⟨TABLE 2⟩

Regressions of BTM, BIAS and GW on Growth and Conservatism Measures: 1984~1998

	a	*b*	*c*	*d*	*f*	*g*	*h*
	Intercept	*BTM*	*LEV*	*GROW*	*ACCDEP*	*RDAD*	*LIFO*
Panel A: $BTM_{it} = a + bIBTM_{it} + cLEV_{it} + dGROW_{it} + fACCDEP_{it} + gRDAD_{it} + hLIFO_{it} + e_{it}$							
coefficient	-0.366	0.838	0.193	0.175	0.428	0.045	0.309
t-value	-6.484	26.291	19.421	3.435	8.079	1.000	0.900
p-value	0.000	0.000	0.000	0.001	0.000	0.317	0.368
Adjusted R^2	34.8%						
Panel B: $BIAS_{it} = a + bIBIAS_{it} + cLEV_{it} + dGROW_{it} + fACCDEP_{it} + gRDAD_{it} + hLIFO_{it} + e_{it}$							
coefficient	0.143	0.950	-0.048	-0.043	-0.135	-0.142	-0.259
t-value	2.731	15.256	-5.212	-0.877	-2.684	-3.353	-0.790
p-value	0.006	0.000	0.000	0.380	0.007	0.001	0.429
Adjusted R^2	9.4%						
Panel C: $GW_{it} = a + bIGW_{it} + cLEV_{it} + dGROW_{it} + fACCDEP_{it} + gRDAD_{it} + hLIFO_{it} + e_{it}$							
coefficient	-0.698	0.790	0.247	0.226	0.570	0.182	0.559
t-value	-9.834	21.458	19.988	3.588	8.707	3.314	1.318
p-value	0.000	0.000	0.000	0.000	0.000	0.001	0.187
Adjusted R^2	31.2%						

All panels are from 2,832 observations for 1984~1998.
P-values in each panel indicate two-tail significance.
Denotations and winsorizations for BTM, BIAS and GW are the same as described in the footnote of ⟨Table 1⟩.
LEV denotes total liabilities over market value at fiscal year end, winsorized at 0 and 10.
GW denotes one minus average dividend payout ratio for current and past three years, winsorized at 0 and 1.
ACCDEP denotes total accumulated depreciation over gross plant, property and equipment, winsorized at 0 and 1.
LIFO denotes LIFO reserve over total assets, winsorized at 0 and 1.
RDAD denotes R&D and advertising expense over net sales, winsorized at 0 and 3.
LMV denotes natural log of market value at fiscal year end, winsorized at 0.
IBIAS (IGW) denotes the average of BIAS (GW) for the firm's four digit SIC code industry in current year.

respectively denote the LIFO reserve over total assets, and annual R&D and advertising expense over net sales. LIFO is winsorized at 0 and 1, and RDAD at 0 and 3. IBIAS (IGW) is the current BIAS (GW) average for the firm's four digit SIC code industry. ACCDEP is measured as the total accumulated depreciation over gross plant, property and equipment, ignoring a 0-1 accelerated depreciation indicator that **BR** have timed to ACCDEP. Unreported regressions with ACCDEP, multiplied by the indicator, do not change the sign and magnitude of its coefficient, but somewhat reduce the coefficient's statistical significance and the regression's R^2.

The regression results in ⟨Table 2⟩ clarify the descriptive differences between BIAS and GW, and empirically confirm their validity as the proxy of conservatism and growth. In Panel A, BTM has significant positive relations to the growth and conservatism variables except for RDAD and LIFO. Panel B and C reveal that the positive relations are mainly a result of GW, while BIAS has an explicitly negative relation to conservatism variables, especially ACCDEP and RDAD. As a growth measure, GROW has a strong positive association with GW (d=0.226, t=3.59), in opposition to its insignificant negative association with BIAS (d= -0.043, t= -0.88). The positive relation between GW and GROW is consistent with the claim of Beaver and Ryan (1997) that growth drives the BTM toward 'one'. The results using ACCDEP and RDAD are more decisive. Both ACCDEP and RDAD as conservatism measures have significant negative relations to BIAS (f= -0.135, t= -2.68 and g= -0.142, t= -3.35 respectively), unlike their positive relations to GW (f= 0.570, t=8.71 and g=0.182, t=3.31 respectively). Similarly, although insignificant, LIFO shows an opposite relation to GW (h=0.559, t=1.32) and BIAS (h= -0.259, t= -0.79). The contrary results between GW and BIAS effectively show their difference in the descriptive property.

GW's positive relations to both variables could be interpreted as evidence of the market's temporary mispricing. Under this mispricing, GW should increase proportionate to the market value deceasing, thanks to a mechanical reaction to more conservative earnings. Further, the GW of a high growth firm that has greater MV than FV will show a negative relation to the firm's growth proxy under rational pricing. However, under irrational pricing, the market fails to reflect the firm's high FV (unbiased BV) onto MV. In this case, high growth firms would have greater GWs than low growth firms. These mispricings lead to GW's positive relation to both conservatism and growth variables. The result in ⟨Table 2⟩ suggests two implications in comparison with **BR**'s. First, each BTM component obviously shows the opposite relation to the growth and conservatism variables, while BR's components have similar relations to them. This difference is earned by separating the effect of conservatism from that of growth, both of which **BR** have believed to affect the BTM's variation. This separation highlights this paper's extension of **BR**'s ideas. Second, the negative relation between LEV and BIAS is in accordance with the prediction of Beaver and Ryan (1997) that leverage drives the BTM below 'one'. This also offers counter-evidence for the positive relation between LEV and their BTM components, which has confused **BR**.

Regarding the opposite results on RDAD, it cannot be determined confidently which one is empirically more valid. Since RDAD can either be considered as the measure of conservatism (e.g., **BR**) or growth (e.g., Lev 2001), the positive relation of RDAD to GW is as predictable as its negative relation to BIAS. In an unreported regression, I replace the current RDAD with the average RDAD over the past five years. Lev and Sougiannis (1996) have documented such an average as a growth measure. The average RDAD has a stronger positive relation to GW and an insignificant negative relation to LAG.

Median ROE for BIAS and GW Quintiles

〈Table 3〉 provides evidence of the changes in the relation between BTM and ROE after controlling for BIAS effect. Current BTM, BIAS and GW are estimated from the observations in 1982~1986, and future ROE is forecasted over 14 subsequent years from the observations in 1983~2000. As explained earlier, 14 years is the longest forecast period possible for future ROE, as well as the upper bound of the FV estimates. The upper bound helps to exhaust the BIAS effect from BTM, and to examine the possible changes in the length and magnitude of its relation to ROE, after controlling for BIAS, by comparing the period affecting ROE with BIAS and GW.

Like **BR**, the observations in each five quintile (1 for lowest, 5 for highest) are pooled across years. 〈Table 3〉 reports the median ROE for each quintile over the subsequent 14 years. All Panels in 〈Table 3〉 provide similar results to those of **BR**, in that the BTM and its components have strong negative relations to future ROE. However, 〈Table 3〉 presents several new findings regarding the persistence and magnitude of ROE's relations to the BTM and its components. In Panel A partitioning on BTM, the ROE difference between lowest and highest quintiles decreases sharply during the subsequent five years (from 0.135 to 0.040), and then continues gradually until the ninth year (from 0.041 to 0.022). The nine years approximates the sample's median depreciation period (8.42 years). Overall, decreases in the ROE differences over nine years vary considerably according to the component on

〈TABLE 3〉

Median ROE for Next Fourteen Years for Quintiles of BTM, BIAS and GW in 1982~1986

Years Ahead of Quintile Formation	*Quintiles*						*Mann-Whitney Z-statistic*
	1(Low)	*2*	*3*	*4*	*5(High)*	*1 - 5(all)*	
Panel A: BTM predicting ROE							
1	0.200	0.166	0.138	0.105	0.065	0.135	41.292
2	0.165	0.153	0.134	0.107	0.078	0.087	41.982
3	0.148	0.141	0.126	0.109	0.080	0.068	42.403
4	0.142	0.127	0.121	0.103	0.088	0.054	42.638
5	0.129	0.119	0.104	0.106	0.089	0.040	42.661
6	0.126	0.110	0.107	0.095	0.085	0.041	42.796
7	0.122	0.112	0.105	0.097	0.082	0.040	42.914
8	0.123	0.101	0.108	0.098	0.085	0.038	42.892
9	0.115	0.121	0.117	0.108	0.093	0.022	42.890
10	0.115	0.129	0.126	0.119	0.092	0.023	42.809
11	0.123	0.137	0.132	0.126	0.103	0.020	42.587
12	0.130	0.142	0.130	0.122	0.107	0.023	42.400
13	0.125	0.144	0.128	0.123	0.102	0.023	42.197
14	0.126	0.130	0.136	0.125	0.095	0.031	39.532
No. of Obs.	518	517	517	517	517		
Panel B: BIAS predicting ROE							
1	0.129	0.175	0.156	0.105	0.028	0.101	17.622
2	0.136	0.167	0.148	0.095	0.029	0.107	16.588
3	0.117	0.153	0.138	0.097	0.067	0.050	16.143
4	0.116	0.144	0.130	0.094	0.075	0.041	16.040
5	0.107	0.137	0.121	0.097	0.065	0.042	15.867
6	0.098	0.126	0.116	0.096	0.079	0.019	15.680
7	0.092	0.119	0.121	0.094	0.072	0.020	15.257
8	0.091	0.122	0.120	0.087	0.071	0.020	15.476
9	0.094	0.128	0.120	0.108	0.090	0.005	16.999
10	0.110	0.130	0.128	0.111	0.091	0.019	17.182
11	0.121	0.135	0.132	0.109	0.111	0.010	18.430
12	0.116	0.143	0.136	0.117	0.110	0.005	18.169
13	0.115	0.135	0.139	0.122	0.101	0.014	17.975
14	0.117	0.142	0.135	0.112	0.104	0.013	16.042
No. of Obs.	518	517	517	517	517		
Panel C: GW predicting ROE							
1	0.163	0.161	0.140	0.112	0.086	0.076	34.112
2	0.128	0.148	0.140	0.111	0.102	0.026	34.171
3	0.132	0.138	0.126	0.111	0.089	0.043	34.187
4	0.121	0.131	0.121	0.105	0.099	0.022	34.212
5	0.117	0.119	0.111	0.099	0.099	0.019	34.106
6	0.113	0.110	0.111	0.094	0.096	0.017	33.941
7	0.107	0.118	0.107	0.093	0.092	0.015	33.919
8	0.101	0.114	0.112	0.092	0.092	0.010	33.953
9	0.112	0.123	0.119	0.106	0.094	0.018	34.220
10	0.115	0.127	0.129	0.112	0.102	0.013	34.385
11	0.121	0.130	0.137	0.124	0.103	0.018	34.574
12	0.130	0.136	0.138	0.117	0.110	0.021	34.519
13	0.118	0.134	0.138	0.122	0.108	0.010	34.331
14	0.122	0.131	0.138	0.122	0.107	0.016	31.486
No. of Obs.	518	517	517	517	517		

All panels are from 2,586 observations for 1982~1986. Each panel reports the median ROE for fourteen years subsequent to quintile formation. ROE data for all subsequent years are winsorized at - 1 and 1. BTM, BIAS and GW are also winsorized at the same levels described in the footnote of 〈Table 1〉. Mann-Whitney Z-statistic denotes the normal approximation to the Mann-Whitney rank test comparing quintile 1 to quintile 5.

which ROE is partitioned (83.7%, 95% and 76.3% partitioning on BTM, BIAS and GW respectively). Panel B and C respectively, partitioning on BIAS and GW, indicate that the ROE difference is greater, and shows steeper decrease, when partitioning on BIAS rather than on GW leading up to the ninth year (0.101~0.005 and 0.076~0.018 respectively). This comes as no surprise of the FV model's construction, and thereby verifies the model's empirical validity.

More specifically, the partitioned difference of BIAS, in Panel B, decays 58.4% (0.101~0.042) for the first five years and 88.1% over the next four years (0.042~0.005). In contrast, the partitioned difference of GW, in Panel C, dominantly reduces by 75.0% (0.076~0.019) in early five years and only by 5.3% (0.019~0.018) in later four years. This result suggests two important implications on each component's role in the BTM's association with ROE. First, both BIAS and GW evenly share the early (i.e., first five years) negative relation between BTM and ROE. Second, BIAS plays an exclusive role in the later (i.e., next four years) negative relation. The result in ⟨Table 3⟩, as a whole, confirms the fact that the BTM's negative relation is substantially weakened by eliminating the BIAS effect, both in its persistence and magnitude.

ROE Regressions on BIAS and GW

Following **BR**, I perform three multivariate regressions to test the ability of BTM and its components to predict ROE. Regression models are identical to **BR**'s, with the exception of some variable changes. Regression (9b), by construct, includes only two components of BTM as explanatory variables. Regression (9c) has the average ROE forecasted over 14 years as the dependent variable, as compared to four BTM components and the five-years average ROE in **BR**.

$$ROE_{it+\tau} = a + bROE_{it} + dBTM_{it} + e_{it+\tau},\quad 1 \le \tau \le 14 \qquad (9a)$$

$$ROE_{it+\tau} = a + bROE_{it} + cBIAS_{it} + dGW_{it} + e_{it+\tau},\quad 1 \le \tau \le 14 \qquad (9b)$$

$$1/14\Sigma_{\tau=1,14}ROE_{it+\tau} = a + bROE_{it} + cBIAS_{it} + c_g(BIAS_{it}xGROW_{it}) + dGW_{it} + d_g(GW_{it}xGROW_{it}) + e_{it+\tau} \qquad (9c)$$

In ⟨Table 4⟩, the coefficient *b* on the current ROE is significantly positive over all forecasting horizons, and attenuates over time, as in **BR**. However, the coefficient *d*, commonly on BTM (Panel A) and GW (Panel B), is significantly negative for only two years. GW shows a weak and inconsistent relation to future ROE, and even has a positive associations with the fourth and fifth years (0.0038, t=0.52 and 0.0036, t=0.48 respectively). On the contrary, the BIAS coefficient *c* is

〈TABLE 4〉
Regression of ROE in Subsequent Fourteen Years on ROE, BTM, BIAS and GW in 1982~1986

Panel A: $ROE_{it+\tau} = a + bROE_{it} + dBTM_{it} + e_{it+\tau},\ 1\le\tau\le14$

Year Ahead	a (t-value)	b (t-value)	d (t, p-value)	adjusted R^2
1	0.067 (11.40)	0.500 (29.76)	-0.0308 (-4.76, 0.000)	30.9%
2	0.088 (13.00)	0.285 (14.66)	-0.0313 (-4.19, 0.000)	10.9%
3	0.077 (11.53)	0.233 (12.04)	-0.0089 (-1.19, 0.234)	6.4%
4	0.076 (11.53)	0.184 (9.67)	-0.0004 (-0.06, 0.951)	3.9%
5	0.075 (11.33)	0.161 (8.39)	-0.0004 (-0.06, 0.954)	3.0%
6	0.079 (11.82)	0.107 (5.56)	-0.0043 (-0.57, 0.566)	1.4%
7	0.087 (12.67)	0.056 (2.85)	-0.0126 (-1.65, 0.099)	0.5%
8	0.087 (13.12)	0.053 (2.78)	-0.0117 (-1.59, 0.113)	0.5%
9	0.086 (12.75)	0.089 (4.57)	-0.0042 (-0.55, 0.579)	0.9%
10	0.095 (14.03)	0.102 (5.24)	-0.0102 (-1.36, 0.175)	1.4%
11	0.106 (15.28)	0.070 (3.50)	-0.0077 (-1.00, 0.316)	0.6%
12	0.101 (14.36)	0.105 (5.19)	-0.0072 (-0.93, 0.355)	1.3%
13	0.104 (14.51)	0.096 (4.64)	-0.0105 (-1.32, 0.187)	1.1%
14	0.084 (11.61)	0.089 (4.30)	-0.0029 (-0.37, 0.715)	0.8%

Panel B: $ROE_{it+\tau} = a + bROE_{it} + cBIAS_{it} + dGW_{it} + e_{it+\tau},\ 1\le\tau\le14$

Year Ahead	a (t-value)	b (t-value)	c (t, p-value)	d (t, p-value)	adjusted R^2
1	0.036 (10.50)	0.562 (35.03)	-0.1420 (-16.91, 0.000)	-0.0135 (-2.21, 0.027)	39.5%
2	0.056 (13.79)	0.334 (17.32)	-0.1180 (-11.77, 0.000)	-0.0178 (-2.43, 0.015)	16.0%
3	0.069 (16.46)	0.255 (13.00)	-0.0486 (-4.75, 0.000)	-0.0027 (-0.36, 0.719)	7.5%
4	0.076 (18.42)	0.200 (10.29)	-0.0279 (-2.76, 0.000)	0.0038 (0.52, 0.605)	4.5%
5	0.075 (18.10)	0.175 (8.98)	-0.0261 (-2.57, 0.010)	0.0036 (0.48, 0.631)	3.4%
6	0.075 (17.94)	0.116 (5.91)	-0.0202 (-1.97, 0.049)	-0.0018 (-0.24, 0.812)	1.5%
7	0.074 (17.37)	0.060 (2.98)	-0.0194 (-1.85, 0.065)	-0.0115 (-1.50, 0.135)	0.5%
8	0.076 (18.23)	0.063 (3.22)	-0.0289 (-2.84, 0.005)	-0.0090 (-1.21, 0.225)	0.7%
9	0.082 (19.44)	0.090 (4.55)	-0.0066 (-0.64, 0.523)	-0.0038 (-0.50, 0.619)	0.9%
10	0.085 (20.10)	0.113 (5.69)	-0.0298 (-2.88, 0.004)	-0.0071 (-0.94, 0.347)	1.7%
11	0.098 (22.72)	0.076 (3.76)	-0.0196 (-1.85, 0.064)	-0.0058 (-0.75, 0.452)	0.7%
12	0.093 (21.38)	0.109 (5.30)	-0.0152 (-1.41, 0.159)	-0.0060 (-0.76, 0.448)	1.3%
13	0.094 (20.92)	0.102 (4.82)	-0.0210 (-1.91, 0.056)	-0.0089 (-1.10, 0.270)	1.2%
14	0.081 (17.96)	0.091 (4.26)	-0.0049 (-0.44, 0.659)	-0.0026 (-0.32, 0.747)	0.8%

Panel C: $1/14\Sigma_{\tau=1,14}ROE_{it+\tau} = a + bROE_{it} + cBIAS_{it} + c_g(BIAS_{it}xGROW_{it}) + dGW_{it} + d_g(GW_{it}xGROW_{it}) + e_{it+\tau}$

	a	b	c	c_g	d	d_g	adjusted R^2
coefficient	0.067	0.198	-0.282	0.249	-0.162	0.162	18.5%
t-value	20.79	12.03	-5.52	4.62	-7.38	7.05	
p-value	0.000	0.000	0.000	0.000	0.000	0.000	

Total observations for both Panel A and B are 2,571, and Panel C is from 1,296 observations. Panel A and B report regression results from five-years observations for 1982-1986, while Panel C reports the result only from three-years observations for 1984~1986 because GROW data are not available for 1982~1983. P-values in each panel indicate two-tail significance. Each variable denotes the same as described in the footnote of 〈Table 1〉 and 〈Table 2〉. Variables are truncated as follow. T: 2~14, BTM: 0~4, BIAS and GW: -4~4, ROE: -1~1, GROW: 0~1.

consistently negative and significant, except for during three of the forecasting horizons (ninth, twelfth and fourteenth years). In addition, the coefficient c increases persistently for the first seven years, from -0.1420 (t= -16.91) to -0.0194 (t= -1.85), and carries a similar pattern to that of the BIAS partitioned ROE difference in ⟨Table 3⟩.

This result confirms the findings in ⟨Table 3⟩ that BTM's negative association with ROE is largely attributed to BIAS, rather than to GW. In Panel B, one can easily see that the GW coefficient d attenuates by 80% for the first three years, from -0.0135 to -0.0027, during which time the BIAS coefficient c attenuates only by 65.8%, from -0.1420 to -0.0486. BIAS requires five years for it to reach 81.6% attenuation (from -0.1420 to -0.0261), which is two more years than for GW's 80% attenuation. Panel C provides additional evidence of BIAS and GW's empirical properties. Theoretically, as **BR** have explained, the coefficient d_g on GWxGROW should be $-d$, the coefficient on GW if GW properly captures the growth. Likewise, the coefficient c_g on BIASxGROW is expected to be zero if BIAS is independent of growth, purely reflecting conservatism. The coefficient d_g (0.162, t=7.05) is exactly equal to $-d$ (-0.162, t= -7.38), as predicted. The perfect sign reversal between the two coefficients provides further evidence of the FV model's empirical validity. Unexpectedly, however, the coefficient c_g (0.249, t=4.62) does not approximate zero, but rather shows a sign reversal of c (-0.282, t= -5.52) by 88.3%. The sign reversal between c_g and c can be interpreted as evidence that BIAS captures growth, as well as conservatism. Additionally, its negative association with ROE (otherwise stronger than that reported in ⟨Table 3⟩) might lessen with growth.

In summary, ⟨Table 3⟩ and ⟨Table 4⟩ report the same result. BIAS has a significant negative association with future ROE that persists over nine years, whereas GW has a weaker association than BIAS with ROE, and it persists for only two years. In fact, the result in ⟨Table 4⟩ is precisely consistent with my hypothesis (H1) that the BTM's relation to ROE would be less negative, or even positive, after controlling for the BIAS effect. Thus, it is implied that the BTM anomaly for ROE could not actually be the equilibrium phenomenon, which refers to the market's rational pricing on the long-term profitability, as has been argued by Fama and French. Rather, this anomaly seems to really reflect the effect of accounting bias on BV and market mispricing.

Return Regressions on BIAS and GW

Finally, I examine the association of BTM, BIAS and GW with future return. Also for comparison, I follow the regressions in Billings and Morton (2001). With some structural exceptions. Regression (10a) and (10b) are almost identical to those of Billings and Morton who followed Fama and French (1992). Regression (10c) shall review the attribute of GW and BIAS by testing whether they capture the growth reflected in future return. LMV denotes the natural log of market value at fiscal-year-end, and other variables denote the same as described earlier.

$$R_{it+\tau} = a + bLMV_{it} + dBTM_{it} + e_{it+\tau},\quad 1 \le \tau \le 14 \tag{10a}$$

$$R_{it+\tau} = a + bLMV_{it} + cBIAS_{it} + dGW_{it} + e_{it+\tau},\quad 1 \le \tau \le 14 \tag{10b}$$

$$1/14\Sigma_{\tau=1,14}R_{it+\tau} = a + bLMV_{it} + cBIAS_{it} + c_g(BIAS_{it}xGROW_{it}) + dGW_{it} + d_g(GW_{it}xGROW_{it}) + e_{it+\tau} \tag{10c}$$

Panel A in ⟨Table 5⟩ reports similar results to those of Billings and Morton, but it adds an enhanced explanatory power (R^2=4.7%). Panel A shows that both LMV and BTM have strong positive relations to one-year-ahead return (b=4.930, t=7.93 and d=22.874, t=9.02). While the LMV's positive relation to return does not persist for years, BTM has a persistent positive association with return that decays over five years. Panel B shows a strong positive relation between return and GW, as well as BIAS. Panel B also depicts that the positive relation to the next year's return is more attributable to BIAS (c=38.127, t=11.44) than to GW (d=20.574, t=8.12). Conversely, GW is the main contributor to the positive relation to returns, from the second year onwards. The coefficient *d* on GW for the second year is 16.536 (t=7.37) and 7.672 (t=3.40) for the fifth year, which is much greater and more significant than the coefficient *c* on BIAS for the corresponding years (c= -1.388, 3.933 and t= -0.47, 1.32 respectively). This result supports my hypothesis (H2) that BTM (GW) would have a more persistent relation to future return after controlling for the BIAS effect.

Because the coefficient d_g (-5.304, t= -1.57) on GWxGROW almost reverses the coefficient *d* (5.518, t=1.73) on GW, Panel C reaffirms GW to be an efficient measure of growth. However, the coefficients c_g and *c*, on BIASx GROW and BIAS respectively, are not statistically significant even though c_g (-5.721) over-reverses *c* (3.231). This is consistent with the result in Panel C of ⟨Table 4⟩, and confirms the FV model's empirical validity. In Summary, ⟨Table 5⟩ renders two crucial findings. First, the BTM's positive relation to the short-term return should attribute more to BIAS, as it can capture the BTM's temporary variation affected by accounting bias. Second, BTM's persistent positive relation to long-term return is mostly subject to GW, and its reflection of the sustainable earnings growth. These findings provide an answer to the BTM puzzle, whereby there is a *persistent* positive relation to return rather than a *temporary*

〈TABLE 5〉

Regression of Return in Subsequent Fourteen Years on LMV, BTM, BIAS and GW in 1982-1986

Panel A: $R_{it+\tau} = a + bLMV_{it} + dBTM_{it} + e_{it+\tau},\ 1 \le \tau \le 14$

Year Ahead	a (t-value)	b (t-value)	d (t, p-value)	adjusted R^2
1	18.183 (7.05)	4.930 (7.93)	22.874 (9.02,0.000)	4.7%
2	8.117 (2.68)	-1.068 (-1.93)	14.187 (6.30,0.000)	1.7%
3	8.314 (2.81)	-0.649 (-1.20)	13.225 (6.01,0.000)	1.5%
4	11.177 (3.80)	-1.046 (-1.95)	8.875 (4.06,0.000)	0.8%
5	6.049 (2.01)	0.256 (0.47)	7.182 (3.21,0.001)	0.3%
6	15.764 (4.75)	-0.192 (-0.32)	0.801 (0.32,0.746)	-0.1%
7	29.212 (8.71)	-1.920 (-3.14)	-2.277 (-0.91,0.361)	0.3%
8	17.946 (5.47)	-0.700 (-1.17)	4.094 (1.68,0.094)	0.1%
9	23.676 (7.23)	-0.032 (-0.05)	-5.493 (-2.25,0.024)	0.1%
10	35.195 (10.58)	-1.987 (-3.28)	-4.458 (-1.80,0.072)	0.4%
11	28.172 (8.87)	-1.245 (-2.15)	-1.841 (-0.78,0.436)	0.1%
12	22.596 (7.18)	-0.041 (-0.07)	-2.877 (-1.23,0.219)	0.0%
13	16.289 (5.12)	0.431 (0.74)	-0.967 (-0.41,0.683)	0.0%
14	16.364 (4.88)	-0.152 (-0.25)	0.564 (0.23,0.821)	-0.1%

Panel B: $R_{it+\tau} = a + bLMV_{it} + cBIAS_{it} + dGW_{it} + e_{it+\tau},\ 1 \le \tau \le 14$

Year Ahead	a (t-value)	b (t-value)	c (t, p-value)	d (t, p-value)	adjusted R^2
1	15.906 (5.51)	4.762 (7.72)	38.127 (11.44, 0.000)	20.574 (8.12, 0.000)	6.4%
2	22.914 (9.01)	-0.897 (-1.64)	-1.388 (-0.47, 0.638)	16.536 (7.37, 0.000)	4.1%
3	21.637 (8.60)	-0.621 (-1.15)	10.721 (3.67, 0.000)	13.603 (6.13, 0.000)	1.5%
4	19.987 (8.00)	-1.064 (-1.98)	8.530 (3.63, 0.000)	8.625 (3.91, 0.000)	0.8%
5	13.359 (5.22)	0.292 (0.53)	3.933 (1.32, 0.186)	7.672 (3.40, 0.001)	0.4%
6	16.612 (5.89)	-0.179 (-0.30)	-0.415 (-0.13, 0.899)	0.984 (0.40, 0.693)	-0.1%
7	26.916 (9.45)	-1.925 (-3.15)	-1.812 (-0.55, 0.584)	-2.347 (-0.93, 0.351)	0.3%
8	21.787 (7.83)	-0.771 (-1.29)	10.573 (3.27, 0.001)	3.118 (1.27, 0.205)	0.4%
9	18.064 (6.49)	-0.066 (-0.11)	-2.453 (-0.76, 0.448)	-5.952 (-2.42, 0.015)	0.2%
10	30.605 (10.84)	-2.024 (-3.34)	-1.087 (-0.33, 0.740)	-4.966 (-1.99, 0.047)	0.5%
11	26.436 (9.81)	-1.216 (-2.10)	-4.506 (-1.44, 0.150)	-1.439 (-0.61, 0.546)	0.1%
12	19.535 (7.31)	-0.093 (-0.16)	1.822 (0.59, 0.557)	-3.586 (-1.52, 0.129)	0.2%
13	15.354 (5.68)	0.440 (0.76)	-1.798 (-0.57, 0.567)	-0.842 (-0.35, 0.724)	-0.1%
14	16.930 (5.94)	-0.151 (-0.25)	0.503 (0.15, 0.879)	0.573 (0.23, 0.820)	-0.1%

Panel C: $1/14\Sigma_{\tau=1,14}R_{it+\tau} = a + bLMV_{it} + cBIAS_{it} + c_g(BIAS_{it}\text{x}GROW_{it}) + dGW_{it} + d_g(GW_{it}\text{x}GROW_{it}) + e_{it+\tau}$

	a	b	c	c_g	d	d_g	adjusted R^2
coefficient	20.603	-0.729	3.231	-5.721	5.518	-5.304	2.3%
t-value	22.03	-3.55	0.57	-0.93	1.73	-1.57	
p-value	0.000	0.000	0.572	0.354	0.084	0.116	

Total observations for both Panel A and B are 2,551, and Panel C is from 1,260 observations. Panel A and B report regression results from five-years observations for 1982~1986, while Panel C reports the result only from three-years observations for 1984~1986 because GROW data are not available for 1982~1983. P-values in each panel indicate two-tail significance. Each variable denotes the same as described in the footnote of 〈Table 1〉 and 〈Table 2〉. Variables are truncated as follow. R < 3, LMV > 0, T: 2~14, BTM: 0~4, BIAS and GW: -4~4, ROE: -1~1, GROW: 0~1.

relation, as has been only partially explained by other studies. Neither the mispricing hypothesis nor the results of Billings and Morton (2001) can explain the persistent association between BTM and return. The mispricing hypothesis traces the short-term positive relation only to the market's mispricing on the temporary earnings reversal. According to my findings, that short-term positive relation is captured by BIAS, not GW. Billings and Morton (2001) attribute the inverse relation between BTM and long-term growth forecasts to its LAG portion, which reflects the temporary difference between BV and MV. Such an explanation fails to explain BTM's persistent relation to return.

The *persistent* relation between return and GW, as *the BTM after BIAS*, represents the market's rational reaction to long-term growth. Their *positive* relation reflects the market's temporary mispricing due to accounting bias, as explained previously. Therefore, the *persistent and positive* relation would be evidence of both the market's long-term rationality and its short-term mispricing, at the same time. This conclusion is in accordance with the general belief that a firm's market value will gradually converge with its intrinsic value over time. Factors such as accounting bias contribute to temporary mispricing, and restless market fluctuations. However, as these temporary factors balance each other out, its intrinsic value becomes apparent.

V. Conclusion

This paper constructs the FV model in order to measure the fair value of the firm's net assets. The model divides BTM into two components, according to their descriptive natures. One component represents accounting bias, including both conservatism and historical cost basis, and the other includes goodwill that captures economic growth. I measure accounting bias (BIAS) as the difference between BV and FV, and economic goodwill (GW) as that between FV and MV. The FV model incorporates the earnings effect of accounting bias into FV so that FV can estimate the pro-forma BV under unbiased accounting. This model aids in measuring BIAS and GW as (BV - FV)/MV and (FV - MV)/MV respectively from (BTM - 1).

I develop two hypotheses to suggest a descriptive explanation for the BTM anomaly, and to judge the competing theories regarding the market's pricing based upon biased accounting. H1 predicts that the BTM (GW) would have a less negative, or even positive, relation to future ROE after controlling for the BIAS effect. H2 also predicts that BTM (GW) would have more persistent relations to future return after BIAS is controlled. Empirical results are consistent with my predictions. First, the regression result on conservatism and growth variables confirm that BIAS and

GW, respectively, are the efficient proxy of each variable. GW's positive relation to the growth variable could be evidence of the market's temporary mispricing for accounting bias. The market's mispricing also explains the positive relation between GW and conservatism variables. Second, median ROE analyses reveal that BIAS has a negative relation to future ROE over nine-year periods (approximately the median depreciation period), and GW has a less negative relation over shorter horizons. This evidence also aligns with ROE regression results on BIAS and GW. The negative relation of nine-years, between BIAS and ROE, conforms to the FV model's theories. Finally, return regressions show that GW has a positive relation to future return that persists for five years. BIAS merely has a temporary relation to short-term returns.

These findings provide two important implications. First, both accounting bias and the market's irrational reaction to the bias are seen as instigating the long-term negative relation between BTM and ROE. Second, BTM's temporary relation to return should be attributed most to accounting bias and its mispricing. Any persistent relation to return is primarily subject to economic goodwill, as it is able to reflect growth. These findings suggest a solution to the puzzle of BTM, and account for BTM and return's *long-term* positive relation with one another. The results of this paper propose the theory that both the long-term rationality and the short-term mispricing of the market jointly determine the BTM's *persistent and positive* relation to return. Prior studies have failed to explain this phenomenon. The mispricing hypothesis of Lakonishok et al., along with the findings of Billings and Morton, has provided answers only to their *short-term* relation. Future researchers may identify even better measures of growth in BTM, allowing them to completely explain the BTM puzzle.

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APPENDIX
An Illustration of Relation between Bias and Abnormal Earnings

	t	*t+1*	*t+2*	*t+3*	*t+4*	*Total*
Panel A: Beginning Balance of the Asset (FV, BV) and Bias (FV - BV)						
FV	\$1,000	\$1,200	\$900	\$600	\$300	\$4,000
BV	\$1,000	\$800	\$600	\$400	\$200	\$3,000
Bias (FV−BV)	-	\$400	\$300	\$200	\$100	\$1,000
Panel B: Economic Earnings and Accounting Earnings						
Economic earnings	\$100	\$520	\$90	\$60	\$30	\$800
- Holding gains	-	\$400	-	-	-	\$400
- Expected earnings (k_eFV)	\$100	\$120	\$90	\$60	\$30	\$400
Accounting earnings (X)	\$100	\$220	\$190	\$160	\$130	\$800
- Economic depreciation (a)	\$200	\$300	\$300	\$300	\$300	\$1,400
- Accounting depreciation (b)	\$200	\$200	\$200	\$200	\$200	\$1,000
- Abnormal earnings (a - b)	-	\$100	\$100	\$100	\$100	\$400
- Expected earnings (k_eFV)	\$100	\$120	\$90	\$60	\$30	\$400
Panel C: Return on Book Equity (ROE) and Present Value of Abnormal Earnings ($X^a_{t+\tau}$)						
$ROE_{t+\tau}$ ($X_{t+\tau}/BV_{t+\tau-1}$)	10%	27.5%	31.66%	40%	65%	-
ROE_t (cost of equity, discount rate)	10%	10%	10%	10%	10%	-
PV of $X^a_{t+\tau}$ $(ROE_{t+\tau} - ROE_t)BV_{t+\tau-1}(1+ROE_t)^{-\tau}$	-	\$127.27	\$107.44	\$90.16	\$75.13	\$400

Assumptions: The firm has one asset, no liabilities and only zero-NPV projects that carry a 10 percent cost of equity, constant over time. At the beginning of year t, the firm buys its asset at \$1,000. A five-year useful life and zero salvage value are estimated for the asset's straight-line depreciation. At the beginning of year t+1, the asset's fair market value increases to \$1,200.