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Full text available at: http://dx.doi.org/10.1561/1400000076

Foundations and Trends® in Accounting

Published, sold and distributed by:
now Publishers Inc.
PO Box 1024
Hanover, MA 02339
United States
Tel. +1-781-985-4510
www.nowpublishers.com
sales@nowpublishers.com

Outside North America:
now Publishers Inc.
PO Box 179
2600 AD Delft
The Netherlands
Tel. +31-6-51115274

The preferred citation for this publication is

J. Zhang and X.-J. Zhang. *Uncertainty-Embedded Financial Data and Stock Returns*. Foundations and Trends® in Accounting, vol. 19, no. 1, pp. 1–115, 2024.

ISBN: 978-1-63828-439-0
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Full text available at: http://dx.doi.org/10.1561/1400000076

Foundations and Trends® in Accounting

Volume 19, Issue 1, 2024

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Foundations and Trends® in Accounting, 2024, Volume 19, 4 issues. ISSN paper version 1554-0642. ISSN online version 1554-0650. Also available as a combined paper and online subscription.

Contents

Uncertainty-Embedded Financial Data and Stock Returns

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ABSTRACT

This monograph investigates the role of conservative accounting in capturing various types of uncertainty in a firm's operations and assesses how the resulting financial data can be harnessed to gauge risk and forecast stock returns. It challenges the conventional approach of employing cross-sectional return regression for empirically identifying financial ratios as "risk factors," suggesting this methodology is fundamentally unsound. An accounting measure may help estimate the expected stock return of a firm, but it does not necessarily reflect any inherent risk in the firm's operations. The study differentiates between conditional and unconditional conservative accounting practices, highlighting how they capture different facets of uncertainty and thereby lead to varying relationships between financial data and expected stock returns. The monograph further substantiates its claims with empirical evidence based on dissecting the market-to-book premium according to the accounting principles employed.

Jasmine Zhang and Xiao-Jun Zhang (2024), "Uncertainty-Embedded Financial Data and Stock Returns", Foundations and Trends® in Accounting: Vol. 19, No. 1, pp 1–115. DOI: 10.1561/1400000076.

1

Introduction and Overview

Many financial ratios have been documented to correlate with future stock returns, resulting in the creation of numerous “risk factors” and a somewhat chaotic “factor zoo” (Fama and French, 1992; Cochrane, 2011; Novy-Marx, 2014; Harvey *et al.*, 2016; Harvey and Liu, 2019). However, are they really risk factors?

In this monograph, we perform a series of accounting-based analyses to explore the question of whether the financial ratios in question truly reflect fundamental business risks. We argue that having a correlation with future stock returns, as evidenced by a significant “beta” in cross-sectional return regression, is neither necessary nor sufficient for an accounting measure to convey any fundamental business risk. In analyzing the result of a multi-variate return regression, it is important to interpret the estimated coefficient of one regressor *conditional* on the other regressors. Accounting is a well-articulated measurement system. Any measurement error inadvertently introduced into one component, such as earnings, inevitably affects other components, such as the book value. As a result, an accounting measure could show significant predictive power of future stock returns simply because it is correlated with the measurement error contained in the conditioning variable(s).

In Section 2, we demonstrate that an accounting measure can show significant conditional correlation with future stock returns but have no relationship with business risk. More generally, because of measurement errors in the accounting numbers, several related financial measures may be required to fully capture the effect of even one risk factor. In other words, the number of accounting measures with significant estimated coefficients in a cross-sectional return regression could far exceeds the actual underlying risk factors.

Differentiating between two closely related reasons why an accounting measure may correlate with expected stock returns is also crucial: (1) The accounting measure proxies for the expected stock return itself; or (2) the accounting measure proxies for something more fundamental, namely, certain business risks of a firm, which, in turn, determine the expected stock return. If an accounting measure shows no significant conditional correlation (i.e., a significant "beta") with future stock returns, such a result should be interpreted with caution. The conditioning variable could be a proxy for the expected stock return, in which case, concluding the accounting measure in question is a less effective indicator of a particular type of risk than the conditioning variable would be erroneous. The conditioning variable may just be mirroring the overall risk profile of the firm, rather than indicating the firm's exposure to any specific underlying risk factor.

Instead of relying on empirically estimated "betas" to identify risk factors, research should focus on the fundamental connection between accounting data and the properties of future investment payoffs. Towards that goal, we propose a framework centered on two key accounting principles: *articulation* and *conservatism*. While conservative accounting introduces a systematic bias into the data, often seen as undesirable, this bias contains crucial information about the uncertainty of projected future payoffs from a firm's operations. Consequently, financial data incorporating this uncertainty is intrinsically linked to the risk and return of the underlying business operation.

Our analysis distinguishes between conditional and unconditional conservative accounting practices (Beaver and Ryan, 2000). These two types of conservative accounting policies capture different facets of uncertainty and thereby can lead to different relationship between financial data and expected stock returns. Unconditional accounting conservatism refers to the rapid expensing of long-term assets and investments such as research and development (R&D) and advertising.[1] This type of conservatism is typically applied at the outset of a transaction cycle, particularly when investments are made. By contrast, conditional conservatism involves the asymmetric accounting of unrealized gains and losses based on information acquired during a transaction cycle. A prime example is the set of accounting rules governing the recognition of asset impairment.[2] Both types of conservative accounting reflect uncertainties related to firm operational payoffs, but with a crucial distinction. As demonstrated in Section 3, conditional conservatism additionally encapsulates the skewness in the distribution of relatively large potential payoffs. This is attributed to its asymmetrical measurement approach to significant potential gains and losses: it delays the recognition of potential gains to future periods while recognizing potential losses in a timelier manner.[3] Consequently, conditional accounting conservatism is influenced by the degree of asymmetry in a firm's potential payoffs, especially concerning relatively extreme upside potential and downside risk.

The distinction between conditional and unconditional accounting conservatism, particularly in the nature of uncertainty they capture, can result in variations in their relationship with expected stock returns. In Section 4, we show how higher moments of the payoff distribution, including skewness and relative extremeness, can influence expected stock returns. In the traditional mean-variance asset-pricing model by Sharpe (1964) and Lintner (1965), risk is fully captured by "beta" of the capital asset pricing model (CAPM), representing the covariance or the undiversifiable portion of a stock's return distribution. In this model, higher moments of the payoff distribution, such as skewness, are

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[1] Financial Accounting Standards Board (FASB) Statement No. 2 Accounting for Research and Development Costs (FASB, 1974).

[2] FASB Statement No. 144 Accounting for the Impairment or Disposal of Long-Lived Assets (FASB, 2001). International Accounting Standards (IAS) 36 Impairment of Assets (IAS, 1998).

[3] FASB Accounting Standards Update (ASU) 2014-09 (Topic 606) Revenue from Contracts with Customers (FASB, 2014). International Financial Reporting Standards (IFRS) 15 Revenue from Contracts with Customers (IFRS, 2014).

irrelevant for the pricing of assets. However, when we move beyond the simplistic mean-variance framework, the significance of skewness and other moments of the payoff distribution emerges.

Exploring scenarios beyond the mean-variance framework is essential. The common practice of individuals purchasing both insurance and lottery tickets indicates a mix of risk-averse and risk-seeking behaviors, contradicting the predictions of the mean-variance utility function. To address this inconsistency, Kahneman and Tversky (1979) introduced prospect theory as a more accurate representation of human behavior in uncertain situations. Differing from the traditional expected utility assumption proposed by von Neumann and Morgenstern (1953), prospect theory suggests that individuals' utility function is kinked and that people use a transformed probability approach which tends to overweight the tails of the payoff distribution.

Similar observations regarding human behavior under uncertainty also led Friedman and Savage (1948) to propose a step-shaped utility function. As discussed in Section 4.3, this function is designed to capture the dual nature of human behavior, encompassing both risk-seeking and risk-avoidance tendencies. The crucial feature of the step-shaped utility function is its combination of concave and convex segments. This design allows it to account for risk-seeking behavior in certain scenarios and risk-avoidance in others, depending on the nature of the uncertain payoffs involved. The step-shaped utility function of Friedman and Savage (1948) leads to some intriguing predictions about human behavior under uncertainty. First, it suggests human attitudes toward risk are influenced by the higher moments of the payoff distribution. In scenarios where a gamble offers limited upside, risk-averse behavior is more prevalent. Conversely, when a gamble presents a substantial upside potential—enough to potentially elevate an individual's socio-economic status (akin to a "step-up")—people tend to exhibit risk-loving behavior. Second, the step-shape utility function implies attitudes toward risk are also contingent on an individual's wealth or current socio-economic status. People at a lower socio-economic level, or "at the bottom of a step," may be more inclined to gamble, because potential losses won't significantly worsen their situation, but a win could lead to substantial improvements. Wealthier individuals, by contrast, might be less prone to gambling, because the gains may not significantly enhance their lifestyle, but substantial losses could result in a severe downward shift in their living standards.

The adoption of a step-shaped utility function, as well as the transformed utility function suggested by prospect theory, carries interesting implications for asset pricing. According to Friedman and Savage (1948) and Kahneman and Tversky (1979), investors are drawn to uncertain payoffs that offer substantial upside potential. Building on this insight, Barberis and Huang (2008) show stocks exhibiting more significant extreme skewness in their returns are more appealing to speculative investors. This preference, in equilibrium, results in these stocks having lower expected returns.

Overall, investors' preferences for extreme payoffs affect asset pricing in equilibrium. Conditional and unconditional accounting conservatism capture different types of uncertainty and respond differently to the asymmetry in firms' extreme payoffs. Consequently, these two types of accounting conservatism are expected to have distinct relationships with both the likelihood of extreme payoffs and expected stock returns.

We conduct a series of empirical tests of the aforementioned predictions. Specially, in Section 5, we dissect the market-to-book premium (i.e., the difference between the market value and the book value of equity) into two components based on the accounting principles that govern the measurement of net assets. The first component reflects the effect of unconditional conservatism, namely, the expensing of R&D and advertising. The second component is indicative of the effects of conditional conservatism. Our tests reveal these two components exhibit differing relationships with extreme future payoffs. Moreover, the unconditional conservatism reserve shows a negative correlation with future stock returns whereas the conditional conservatism reserve exhibits a positive correlation with future stock returns. These findings underscore how distinguishing between the two forms of accounting conservatism can enhance the predictive capacity of accounting measures for future stock returns.

In Section 6, we further explore whether the book-to-market ratio predicts future stock returns simply because it mirrors the expected return, rather than capturing fundamental business risk via conservative accounting. Ball *et al.* (2020) show that the book-to-market ratio's ability to explain the cross section of stock returns is effectively subsumed by the retained earnings-to-price ratio. They infer the predictive power of the book-to-market ratio for future stock returns lies in its retained earnings component, which acts as a proxy for firms' earnings yield. Our analysis indicates this conclusion is limited to firms with positive retained earnings. For firms with negative retained earnings, which account for more than 30% of our sample, the result reverses. Additionally, even for firms with positive retained earnings, the book-to-market ratio maintains significant predictive power for stock returns when the effect of unconditional accounting conservatism is properly adjusted for. These results suggest the assertion by Ball *et al.* (2020)—that the book-to-market ratio explains stock returns solely due to retained earnings representing earnings yield—might be premature. Instead, our findings suggest the market-to-book premium reflects the fundamental risks of firms as captured by conservative accounting.

In summary, this monograph addresses the question of why and how accounting measures can capture fundamental business risks. In doing so, the monograph takes a "measurement-information" perspective of accounting research. Historically, theoretical accounting discourse has produced two seemingly distinct traditions: the measurement school and the information school. Pre-1960 mainstream accounting scholars seemed to agree accounting serves a measurement function (i.e., income determination and asset valuation). The approach was to derive a measurement basis (e.g., historical cost basis) from some self-evident postulates (e.g., entity, continuity, and periodicity). Although the debate has not reached a consensus on what constitutes the best measure, it has consistently focused on key accounting concepts such as income, asset, relevance, and reliability. The classic work of Paton and Littleton (1940), along with a collection of articles debating the desirability of various measurement principles (e.g., Sterling, 1971), provides great examples of this highly influential line of research.

With the rise of modern economic theory of information during the 1960s, the new information paradigm acknowledges demand for (and thus the value of) information is derived from improved decision-making under uncertainty (e.g., Demski, 1973). Compared with the measurement worldview, the distinctive change is the explicit focus on users. Accounting, in turn, is treated as one of many information sources. As a result, the explicit measurement view has been much deemphasized (e.g., Beaver and Demski, 1979). Arguably, the shift toward the information school comes at the price of less explicit attention to measurement issues.

A series of research in accounting seeks to blend the two perspectives. Such an approach can be seen as a "measurement-information" or a "measure-to-inform" perspective (e.g., Ohlson, 1987; Demski and Sappington, 1990; Feltham and Ohlson, 1995; Ohlson and Zhang, 1998; Gjesdal and Antle, 2001; Dutta and Reichelstein, 2005; Liang and Zhang, 2006; Liang and Wen, 2007; Zhang, 2012; Fan and Zhang, 2012; Glover and Xue, 2023; Penman and Zhang, 2020). Accounting measurement structures are considered as centrally important as user preferences and market structures. This monograph continues the "measurement-information" approach of research, with an emphasis on risk measurement. Our analysis focuses on the accounting principles of articulation and conservative revenue-recognition/expense-matching. We present a theoretical framework, supported by empirical evidence, that elucidates how various forms of accounting conservatism capture distinct facets of risk. These variations in the payoff distribution influence investors' risk preferences, subsequently affecting stock pricing in equilibrium.

This study aligns with the broad literature of assessing risk using financial-statement information. Early accounting research in this area has illustrated the utility of accounting information in assessing credit risk and various accounting betas (e.g., Beaver *et al.*, 1970; Ohlson, 1980; Nekrasov and Shroff, 2009; Konstantinidi and Pope, 2016). In these studies, accounting numbers are generally viewed as a fair representation of the underlying economic constructs. Other research acknowledges the presence of noises and biases in accounting data. By using accounting-based valuation models, researchers have demonstrated how the required rate of return can be reverse-engineered from observed price and analysts' forecasted future earnings, effectively adjusting for measurement errors in observed historical accounting ratios, such as the book rate of return (Gebhardt *et al.*, 2001; Easton *et al.*, 2002; Easton and Monahan, 2005; Easton, 2007; Nekrasov and Ogneva, 2011).

More recent studies focus explicitly on understanding the accounting principles underlying the observed biases in accounting (Penman and Reggiani, 2013; Penman and Zhang, 2020, 2021, 2022, 2024; Penman, 2021; Zhang and Zhang, 2022, 2023). Central to this discourse is the idea that so-called "measurement errors" in accounting are not arbitrary. Rather, specific accounting principles, such as conservatism, are deliberately employed in response to the perceived risks in a firm's operations. Accounting data thus convey information about firm risk. Penman (2021) provides a comprehensive review of this body of literature, demonstrating how a meticulous examination of financial statements can effectively reveal risk information.

This monograph builds upon Penman (2021) by extending the discussion in two ways. First, we examine two types of accounting conservatism: conditional accounting conservatism and unconditional accounting conservatism. These types of conservatism capture varying uncertainties and have distinct implications for future stock returns. Second, we distinguish between two types of relationships between financial data and future stock returns: one where accounting data may mechanically serve as a proxy for the expected stock return, and another where they are linked to more fundamental aspects, such as the operational risks of firms, which consequently dictate the expected stock return. Understanding the former helps clarify that predictable stock returns based on accounting data do not necessarily imply market mispricing (Ball, 1978; Penman and Zhu, 2014). Understanding the latter provides insights into how accounting data can be used as a measurement of risk. Our analysis focuses on the latter.

Appendices

Appendix A

Proofs

Proposition A.1. Substitute (2.4) into (2.9) we get

$$E_t[\tilde{r}_{t+1}] = \frac{E_t[\tilde{E}_{t+1}]}{M_t} + g\frac{(M_t - B_t)}{M_t} = g + \frac{E_t[\tilde{E}_{t+1}]}{M_t} - g\frac{B_t}{M_t}.$$

Assumptions (2.4) implies that

$$\frac{\tilde{B}_{\mathrm{it}}}{\tilde{M}_{\mathrm{it}}} = 1 - \sum_{\tau=0}^{t}(1+g)^{\tau}\frac{\tilde{\varepsilon}_{\mathrm{it}-\tau}}{\tilde{M}_{\mathrm{it}}}.$$

Assumption (2.5) implies that $\mathrm{Cov}(\tilde{\varepsilon}_{i\tau}, \frac{1}{\tilde{M}_{\mathrm{it}}}) = 0$, $\mathrm{Cov}(\tilde{\varepsilon}_{i\tau}, \beta_i) = 0$, and $E[\tilde{\varepsilon}_{i\tau}] = 0$ for all $\tau = 0, 1, \ldots t$. Therefore,

$$\mathrm{Cov}\left(\frac{B_{\mathrm{it}}}{M_{\mathrm{it}}}, \beta_i\right) = 0.$$

Corollary A.1. We know from Proposition 2.1 that

$$E_t[\tilde{r}_{it+1}] = a + b_1\frac{E_t[\tilde{E}_{it+1}]}{M_{\mathrm{it}}} + b_2\frac{B_{\mathrm{it}}}{M_{\mathrm{it}}},$$

where $a = g$, $b_1 = 1$, $b_2 = -g$. Suppose $c_j = k$ where k is a constant. Then,

$$E_t[\tilde{r}_{it+1}] = \gamma_{ijt}g + \gamma_{ijt}\frac{E_t[\tilde{E}_{it+1}]}{M_{\mathrm{it}}} - \gamma_{ijt}g\frac{B_{\mathrm{it}}}{M_{\mathrm{it}}} + k\beta_{ij}X_{jt}, \tag{A1}$$

where $\gamma_{ijt} = \frac{E_t[\tilde{r}_{it+1}] - k\beta_{ij}X_{jt}}{E_t[\tilde{r}_{it+1}]}$. Because $\frac{\beta_{ij}X_{jt}}{E_t[\tilde{r}_{it+1}]}$ varies across firm i, factor j, and time t, γ_{ijt} would vary with i, j, and t except for the case when $k = 0$. Therefore, for Equation (A1) to hold with coefficients $\gamma_{ijt}g$ and γ_{ijt} being constants, k equals 0.

Proposition A.2.

$$\begin{aligned}\frac{\partial(1-\beta^0\theta)E_0[TE]}{\partial\beta^1} &= (1-\beta^0\theta)\beta^0\left[\frac{E_0[C_1]}{1+r_1^{RF}} + \frac{E_0[C_2]}{(1+r_1^{RF})(1+r_2^{RF})}\right]\\ &= (E_0[C_1]+E_0[C_2])\frac{\beta^0(1-\beta^0\theta)(1+r_2^{RF}(1-\theta))}{(1+r_1^{RF})(1+r_2^{RF})}. \qquad \text{(A2)}\end{aligned}$$

Note $\beta_0\beta_1 > r_2^{RF}$ implies $\frac{1}{\beta_0} < \frac{1+r_2^{RF}}{r_2^{RF}}$ and $\theta < \frac{1+r_2^{RF}}{r_2^{RF}}$. Because $\frac{\partial \frac{E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{E_0[C_1]+E_0[C_2]}}{\partial\beta} > 0$ and $\frac{\partial^2 \frac{E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{E_0[C_1]+E_0[C_2]}}{\partial\beta\partial\theta} > 0$, it follows from (A2) that $\theta^A > 0$ exists such that when

$$\theta > \theta^A, \quad \frac{\partial \frac{E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{E_0[C_1]+E_0[C_2]}}{\partial\beta^1} > \frac{\beta^0(1-\beta^0\theta)(1+r_2^{RF}(1-\theta))}{(1+r_1^{RF})(1+r_2^{RF})}.$$

That is, $\frac{\partial E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{\partial\beta^1} > \frac{\partial(1-\beta^0\theta)E_0[\mathrm{TE}]}{\partial\beta^1}$.

Note also that

$$\begin{aligned}\frac{E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{E_0[\mathrm{TE}]} &= \frac{E_0[E_1^{HCUM}] - E_0[E_1^{HC}]}{E_0[TE]}\\ &= \frac{(1-\beta^0\theta)E_0[TE] - E_0[E_1^{HC}]}{E_0[TE]} = 1 - \beta^0\theta - \frac{E_0[E_1^{HC}]}{E_0[TE]}.\end{aligned}$$

Therefore, when $E_0[E_1^{HC}] > 0$, $\frac{\partial E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{\partial\beta^1} > (1-\beta^0\theta)\frac{\partial E_0[\mathrm{TE}]}{\partial\beta^1}$ implies $\frac{\partial E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{\partial\beta^1} > \frac{E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{E_0[\mathrm{TE}]}\frac{\partial E_0[\mathrm{TE}]}{\partial\beta^1}$. That is, $\frac{\partial \frac{E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{E_0[\mathrm{TE}]}}{\partial\beta^1} > 0$. Therefore, $\mathrm{Corr}(\frac{B_1}{M_1}, \beta^1) < 0$.

Note $\frac{\partial \frac{E_0[E_1^{HC}]}{E_0[M_0]}}{\partial \beta^1} < 0 \Leftrightarrow \frac{\partial E_0[E_1^{HC}]}{\partial \beta^1} E_0[M_0] - E_0[E_1^{HC}] \frac{\partial E_0[M_0]}{\partial \beta^1} < 0$

$$\begin{aligned}
&\Leftrightarrow \frac{\partial((1-\beta^0\theta)E_0[\mathrm{TE}] - E_0[\mathrm{EXP}_1^{\mathrm{CB}}])}{\partial \beta^1}(E_0[C_1] + E_0[C_2] - E_0[\mathrm{TE}]) \\
&\quad + E_0[E_1^{HC}]\frac{\partial E_0[\mathrm{TE}]}{\partial \beta^1} < 0 \\
&\Leftrightarrow \frac{\partial E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{\partial \beta^1}(E_0[C_1] + E_0[C_2] - E_0[\mathrm{TE}]) \\
&\quad > (1-\beta^0\theta)\frac{\partial E_0[\mathrm{TE}]}{\partial \beta^1}(E_0[C_1] + E_0[C_2] - E_0[\mathrm{TE}]) \\
&\quad + E_0[E_1^{HC}]\frac{\partial E_0[\mathrm{TE}]}{\partial \beta^1} \\
&\Leftrightarrow \frac{\partial E_0[\mathrm{EXP}_1^{\mathrm{CB}}])}{\partial \beta^1} > \left[1 - \beta^0\theta + \frac{E_0[E_1^{HC}]}{E_0[C_1] + E_0[C_2] - E_0[\mathrm{TE}]}\right]\frac{\partial E_0[\mathrm{TE}]}{\partial \beta^1} \\
&\Leftrightarrow \frac{\partial E_0[\mathrm{EXP}_1^{\mathrm{CB}}])}{\partial \beta^1} \\
&\quad > [1 - \beta^0\theta + E_0[\mathrm{ROE}_1^{HC}]]\frac{\partial E_0[\mathrm{TE}]}{\partial \beta^1} \\
&\Leftrightarrow \frac{\partial(E_0[\mathrm{EXP}_1^{\mathrm{CB}}]/(E_0[C_1] + E_0[C_2]))}{\partial \beta^1} \\
&\quad > \frac{\beta^0(1 - \beta^0\theta + E_0[\mathrm{ROE}_1^{HC}])(1 + r_2^{RF}(1-\theta))}{(1 + r_1^{\mathrm{RF}})(1 + r_2^{\mathrm{RF}})}. \qquad \text{(A3)}
\end{aligned}$$

Note $\beta_0\beta_1 > r_2^{RF}$ implies $\frac{\beta_0}{(1-\beta_0\theta)} > \frac{r_2^{RF}}{\rho[1+r_2^{RF} - r_2^{RF}\theta])}$, which then implies $\frac{\partial E_0[\mathrm{ROE}_1^{HC}]}{\partial \theta} < 0$. Therefore, it follows from (A3) that $\theta^E > 0$ exist such that when $\theta > \theta^E$, condition (A3) holds such that $\frac{\partial \frac{E_0[E_1^{HC}]}{E_0[M_0]}}{\partial \beta^1} < 0$. Similarly, we can prove the result with respect to β^0.

Proposition A.3. Note transaction-cycle-conformity assumption (3.4) implies

$$E_0[E_1^{CRUM}] + E_0[E_2^{CRUM}] = E_0[E_1^{FV}] + E_0[E_2^{FV}].$$

Therefore, from Proposition A.2, we conclude $\frac{E_0[E_1^{HCUM}]}{E_0[E_2^{HCUM}]} < \frac{E_0[E_1^{FV}]}{E_0[E_2^{FV}]}$.[1]

Note also that

$$\begin{aligned}\frac{E_0[E_1^{CRUM}]}{E_0[E_2^{CRUM}]} &= \frac{\frac{E_0[C_1]}{E_0[C_1]+E_0[C_2])}E_0[TE]}{\frac{E_0[C_2]}{E_0[C_1]+E_0[C_2])}E_0[TE]}\\ &= \frac{E_0[C_1]}{E_0[C_2]};\end{aligned}$$

hence, $\frac{\partial(E_0[E_1^{CRUM}]/E_0[E_2^{CRUM}])}{\partial\beta} = 0$.

Under historical-cost accounting with accrual revenue and conservative expense matching (HC),

$$E_0[E_2^{HC}] = [E_0[C_{2a}] - \frac{E_0[C_{2a}]}{E_0[C_1]+E_0[C_2]}B_0] + E_0[\mathrm{EXP}_1^{\mathrm{CB}}].$$

Note that $E_0[TE] = E_0[E_1^{HC}] + E_0[E_2^{HC}] = E_0[C_1] + E_0[C_2] + C_0$. Hence $\frac{E_0[E_1^{HC}]}{E_0[E_2^{HC}]} = \frac{E_0[TE]}{E_0[E_2^{HC}]} - 1$. Therefore $\frac{E_0[E_1^{HC}]}{E_0[E_2^{HC}]}$ is decreasing in $\frac{E_0[E_2^{HC}]}{E_0[TE]}$.

$$\begin{aligned}\frac{E_0[E_2^{HC}]}{E_0[TE]} &= \frac{[\beta^0 E_0[C_2] - \frac{\beta^0 E_0[C_2]}{E_0[C_1]+E_0[C_2]}(-C_0)] + E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{E_0[C_1]+E_0[C_2]+C_0}\\ &= \left[\frac{\beta^0 E_0[C_2]}{E_0[C_1]+E_0[C_2]}\right] + \frac{E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{E_0[TE]}.\end{aligned}$$

Therefore, $\frac{\partial\frac{E_0[E_2^{HC}]}{E_0[TE]}}{\partial\beta} > (=,<)0$ if and only if $\frac{\partial\frac{E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{E_0[TE]}}{\partial\beta^1} > (=,<)0$ and $\frac{\partial\frac{E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{E_0[TE]}}{\partial\beta^0} > (=,<) - \frac{E_0[C_2]}{E_0[C_1]+E_0[C_2]}$, that is,

$$\frac{\frac{\partial E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{\partial\beta^1}}{E_0[\mathrm{EXP}_1^{\mathrm{CB}}]} > (=,<)\frac{\frac{\partial E_0[TE]}{\partial\beta^1}}{E_0[TE]}$$

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[1] In all proofs, we examine the inverse of the growth rate of expected earnings, that is, with the earnings in period 2 as the denominator, or the ratio of earnings in period 2 to total expected earnings, to avoid the negative-denominator problem when earnings in period 1 become negative due to conservative accounting.

and

$$\frac{\frac{\partial E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{\partial \beta^0}}{E_0[\mathrm{EXP}_1^{\mathrm{CB}}]} > (=,<) \frac{\frac{\partial E_0[TE]}{\partial \beta^0}}{E_0[TE]} - \frac{E_0[C_2]E_0[TE]}{(E_0[C_1] + E_0[C_2])E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}.$$

Note that $\frac{E_0[\mathrm{EXP}_1^{\mathrm{CB}}]}{\partial \beta^1} > (1-\beta^0\theta)\frac{\partial E_0[TE]}{\partial \beta^1}$

$$\Leftrightarrow \frac{\partial((1-\beta^0\theta)E_0[TE] - E_0[\mathrm{EXP}_1^{\mathrm{CB}}])}{\partial \beta^1} < 0$$

$$\Leftrightarrow \frac{\partial E_0[E_1^{HC}]}{\partial \beta^1} < 0.$$

Therefore $\frac{\partial \frac{E_0[E_1^{HC}]}{E_0[C_1]}}{\partial \beta^1} < 0$.

Results with respect to β^0can be proven in a similar way.

Proposition A.4. When $x = C$ at $t = 1$, assumption (3.5) implies $\frac{B_1}{M_1} = 1$. Because $\mathrm{p}^{\mathrm{C}} < 1/2$, we have $\mathrm{SKEW}_1(C_{2a}) < 0$. When $x =$ E at $t = 1$, there is no impairment such that $\frac{B_1}{M_1} < 1$. Similarly, because $p^E < 1/2$, $\mathrm{SKEW}_1(C_{2a}) > 0$. Therefore, $\frac{B_1}{M_1}|_{x=C} > \frac{B_1}{M_1}|_{x=E}$ and $\mathrm{SKEW}_1(C_{2a})|_{x=C} > \mathrm{SKEW}_1(C_{2a})|_{x=E}$. That is, $\mathrm{Corr}(\frac{B_1}{M_1}, \mathrm{SKEW}_1 (C_{2a})) < 0$.

Appendix B

Table B.1: Calculation of variables

BM	Book-to-market ratio, calculated as the book value of common equity (BV) divided by the market value of common equity (MV). BV is Compustat item CEQ at the end of the fiscal year ending at least three months prior to June 30 of the sample year. MV is the market value of common equity from CRSP at the end of the third month after the same fiscal year.
$\mathrm{CG}^{\mathrm{REV}}$	Competitive revenue growth, calculated by subtracting the growth rate of industry total revenue from $\mathrm{G}^{\mathrm{REV}}$. Industry classification is based on the 3-digit SIC code.
$\mathrm{RESV}^{\mathrm{C}}$	Component of reserve (RESV) that is due to delayed recognition of unrealized abnormal economic income from future operations, calculated by subtracting $\mathrm{RESV}^{\mathrm{U}}$ from RESV.
$\mathrm{G}^{\mathrm{CREV}}$	Growth rate of cash revenue. Cash revenue is estimated based on reported total revenue (Computat item SALE), adjusted for changes in trade receivables (Compustat item RECCH) and deferrals (changes in Compustat items DRC and DRLT)
$\mathrm{G}^{\mathrm{REV}}$	Growth rate of revenue (Compustat item SALE).
INV	The amount of net investment, estimated based on the growth rate of total assets (Compustat item AT).
$\mathrm{INV}^{\mathrm{OA}}$	The amount of net investment in operating assets, estimated based on the change in operating assets (Computat item AT minus Compustat items CHE and IVAO) deflated by total assets at the end of the previous fiscal year. See Penman and Zhang (2024) for more details.

Continued.

Table B.1: Continued

DRSKEW	Decile rank based skewness measure calculated according to 5.3.
MKTSHR	Market share, calculated by dividing a firm's revenue by the total revenue of all firms in the same industry. Industry classification is based on the three-digit SIC code.
RESV	The difference between the market value and the book value of common equity.
RESV^{U}	Unconditional conservative accounting reserve. See Section 5 for detailed description of the estimation.
Return	One-year buy-and-hold stock return calculated using CRSP monthly returns, starting on July 1 of each sample year. For firms that are delisted during the 12-month period, the return for the remaining months is calculated by first applying the CRSP delisting return and then reinvesting any remaining proceeds at the risk-free rate. Firms that are delisted for poor performance (delisting codes 500 and 520–584) frequently have missing delisting returns (Shumway, 1997). We control for this potential bias by applying delisting returns of -55% for NASDAQ firms and -30% for NYSE/AMEX firms (Shumway and Warther, 1999).
ROA	Return on assets, calculated as the after-tax operating income (Compustat item OIADP) divided by the amount of total assets (Compustat item AT) at the end of the previous fiscal year. Tax rate is estimated based on the prevailing federal tax rate plus 2% for state tax. The top statutory federal tax rate was 50% in 1964, 48% in 1965–1967, 52.8% in 1968–1969, 49.2% in 1970, 48% in 1971–1978, 46% in 1979–1986, 40% in 1987, 34% in 1988–1992, 35% in 1993-2017, and 21% in 2018–2021.
ROA^{CBOP}	Cash-based return on assets, calculated as the amount of cash-based operating income (CBOP) divided by the amount of total assets at the end of the previous fiscal year. CBOP is estimated as the amount of operating income before depreciation and amortization (Compustat item OIBDP) plus R&D expenses (Compustat item XRD) minus change in net working capital other than cash (changes in Compustat items DCR, DRKT, AP, XACC minus changes in Compustat items RECT, INVT, and XPP). See Ball *et al.* (2016) for more details.
SIZE	The logarithm of market capitalization at the end of June of each sample year.

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