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Explaining the Book-to-Market Ratio Effect from the Perspective of Behavioral Finance

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Abstract: This study aims to investigate the driving factors behind the long-term reversal of stock returns, with a particular focus on the causes of the book-to-market ratio effect. By analyzing A-share companies listed on the Shanghai and Shenzhen stock (Chinese) exchanges from 2010 to 2022, this paper decomposes the book-to-market ratio into the book income reflecting company fundamentals and the intangible income reflecting investor expectations, utilizing the Fama and MacBeth method for research. The results indicate that there is no correlation between stock returns and book income, but a negative correlation exists between stock returns and intangible income. Additionally, the returns generated by the reversal of intangible income cannot be fully explained by the Capital Asset Pricing Model. Therefore, this study suggests that the existence of the book-to-market ratio effect in the Chinese stock market is due to an excessive market reaction to the future prospects of companies rather than their fundamental factors.

Keywords: long-term reversal of stock returns, book-to-market ratio effect, company fundamentals, investor expectations, intangible income.

1. Introduction

In traditional financial theory, the book-to-market ratio (BM) is considered an important indicator of value investing as it reflects the relationship between a company's book value and market value. However, recent research has found that high BM stocks often exhibit superior performance, typically in terms of hiher returns, which has sparked widespread interest in the academic community. Behavioral finance provides a unique perspective in attempting to explain the psychological and behavioral mechanisms behind this phenomenon. Within the framework of behavioral finance, investor decisions are often influenced by emotions, cognitive biases, and herd behavior. Specifically, explanations for the book-to-market ratio effect can be attributed to the following factors: investor overreaction and emotional biases. High BM stocks are typically regarded as value stocks, which are often undervalued, thereby triggering emotional reactions from investors. When investors become pessimistic about the future prospects of these stocks, they may engage in excessive selling, leading to their undervaluation. Investors may be limited by information acquisition and processing abilities. For high BM stocks, as they may represent potential undervaluation opportunities, investors may tend to focus on information directly related to company performance while overlooking other factors that may influence stock prices. This bias in information processing may result in investors underestimating the true value of high BM stocks. Furthermore, herd behavior can also influence the

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book-to-market ratio effect. When investors observe certain high BM stocks performing well, they may imitate the behavior of other investors, leading to a trend of collective investment. This trend may further drive up the prices of these stocks, exacerbating the book-to-market ratio effect.

2. Literature Review

In recent years, scholars such as Daniel and Titman have proposed a new explanatory framework for the book-to-market ratio (BM) effect, which has garnered significant attention in the academic community. They argue that the traditional Capital Asset Pricing Model (CAPM) fails to fully explain the BM effect, as its occurrence may be related to investor emotions and cognitive biases.[1] Within this framework, researchers have begun to explore the impact of investor behavior on stock price formation, aiming to explain the phenomenon of high-performance BM stocks.

Scholars like Wang Lei et al. further investigate the decomposition mechanism of the BM effect and propose a new explanatory model.[2] They suggest that the BM effect can be decomposed into two components: book income and intangible income. The book income reflects company fundamental information, while the intangible income reflects investor expectations regarding the company's future prospects.[3] Through this decomposition, they attempt to better understand the reasons behind the superior performance of high BM stocks and provide an explanation from the perspective of behavioral finance.[4]

Researchers such as Fama and MacBeth explore the long-term reversal phenomenon (This phenomenon refers to the fact that after some stocks have underperformed or good for a period of time, their performance will reverse in the long term, i.e. stocks that have previously underperformed will eventually perform well, and vice versa.)of the BM effect through empirical studies. They find that the performance of high BM stocks exhibits a reversal trend in the long run, contrary to what traditional theories would predict.[5] By conducting regression analysis on stock returns and book income, they aim to uncover the driving forces behind this reversal phenomenon and propose hypotheses related to investor overreaction to intangible income. Behavioral finance experts have put forth many interesting perspectives in explaining the BM effect, with particular emphasis on studying investor emotions and cognitive biases.[6] Through empirical research and theoretical exploration, they seek to reveal the mechanisms through which investor behavior influences stock price formation, providing investors with deeper market insights and decision-making references.[7]

On the other hand, some scholars have explained the BM effect from the perspective of company fundamentals and market factors. They argue that the superior performance of high BM stocks may be related to company fundamental information, such as profitability and growth potential. [8] Through the analysis of these factors, they attempt to uncover the root causes of the BM effect and propose corresponding investment strategies and recommendations. During the literature review process, new research trends and issues have also been identified. For example, some scholars have started to focus on the performance differences of the BM effect in different markets and industries, as well as its impact on portfolio performance. [9] Additionally, new explanatory models and theoretical hypotheses have been proposed to better explain the essence and mechanisms of the BM effect.[10]

In summary, the BM effect, as an important research topic, has attracted the attention and research efforts of numerous scholars. Through the review and analysis of relevant literature, we can gain a more comprehensive understanding of the research status, issues, and trends of the BM effect, providing important references and insights for further research.

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3. Variable Design and Sample Data

3.1. Variable Design

Following the methods proposed by Daniel and Titman (Daniel and Titman performed regression analysis to determine the relationship between stock returns and their characteristics.) , as well as Wang Lei et al., this study decomposes the book-to-market ratio as follows:

$$\mathrm{bmi_t} = \mathrm{In}\left(\mathrm{BM_{i,t}}\right) = \mathrm{In}\left(\frac{\mathrm{B_{i,t}}}{\mathrm{P_{i,t}}}\right) = \mathrm{In}\left(\frac{\mathrm{B_{i,t-\tau}}}{\mathrm{P_{i,t-\tau}}}\right) + \mathrm{In}\left(\frac{\mathrm{B_{i,t}}}{\mathrm{B_{i,t-\tau}}}\right) - \mathrm{In}\left(\frac{\mathrm{P_{i,t}}}{\mathrm{P_{i,t-\tau}}}\right) \quad (1)$$

Among them, B i,t-τ and B i,t represent the book value per share of stock i on days t-τ and t, respectively, while P i,t-τ and P i,t represent the closing price of stock i on days t-τ and t, respectively.

According to the Guotai An Database (CSMAR), calculating stock returns requires considering the impact of changes in share capital due to stock splits, rights issues, and stock dividends on the closing price. The formula for calculating the simple net return of stock i on day t is:

$$Ri_t = \frac{Pi_t(1 + F_i, t + S_i, t) \cdot C_{i,t} + D_{i,t}}{P_{i,t-1} + C_{i,t} \cdot S_{i,t} \cdot K_{i,t-1}} \quad (2)$$

According to the above equation (2), we convert the simple net return into a continuously compounded return and make a simple adjustment. The resulting continuously compounded return is given by:

$$r_{i,t} = In\left(1 + R_{i,t}\right) = In\left(P_{i,t-1}/P_{i,t}\right) + In(\varphi i, t) \quad (3)$$

In the above formula, φ i,t represents the adjustment factor, which is a function of stock prices (P i,t-1, P i,t) and factors such as stock splits, rights issues, stock dividends, etc. (C i,t, D i,t, F i,t, K i,t, S i,t). Based on this equation, the cumulative return of stock i in the interval (t-τ, t) can be expressed as:

$$\mathrm{ri}(\mathrm{t}-\tau,\mathrm{t}) = \sum_{8=\mathrm{t}-\tau+1}^{\mathrm{t}} \mathrm{In}\left(\frac{\mathrm{P_{i,s}}}{\mathrm{P_{i,s-1}} \cdot \varphi_{\mathrm{i,s}}}\right)$$

$$= \sum_{8=\mathrm{t}-\tau+1}^{\mathrm{t}} \mathrm{In}\left(\frac{\mathrm{P_{i,s}}}{\mathrm{P_{i,s-1}}}\right) + \sum_{8=\mathrm{t}-\tau+1}^{\mathrm{t}} \mathrm{In}\left(\varphi_{\mathrm{i,s}}\right) = \mathrm{In}\left(\frac{\mathrm{P_{i,t}}}{\mathrm{P_{i,t-\tau}}}\right) + \varphi_{\mathrm{i}}(\mathrm{t}-\tau,\mathrm{t}) \quad (4)$$

Therefore, we can obtain:

$$\mathrm{In}\left(\frac{\mathrm{P_{i,t}}}{\mathrm{P_{i,t-\tau}}}\right) = \mathrm{r_i}(\mathrm{t}-\tau,\mathrm{t}) - \varphi_{\mathrm{i}}(\mathrm{t}-\tau,\mathrm{t}) \quad (5)$$

Substituting the above equation into equation (1) and rearranging, we obtain:

bmi t =bm i,t−τ+ln(B i,t−τBi,t)+φi(t−τ,t)=r iB(t−τ,t)−r i(t−τ,t)=bmi,t−τ+r i B(t−τ,t)−r i (t−τ,t)

From this, we can derive: r iB(t−τ,t)=bmi t −bm i,t−τ+r i (t−τ,t)

Where r iB(t-τ, t) is defined as the book income. If an investor purchases 1 unit of stock i based on its book value on day t-τ, assuming that all dividends in the (t-τ, t) interval are reinvested at their market values on the ex-dividend dates, then the book income on day t represents the return on investment. Therefore, r iB(t-τ, t) reflects the company's fundamental information based on accounting performance within the (t-τ, t) interval.

In addition to reflecting the fundamental information of the (t-τ, t) interval, the term r i(t-τ, t) also reflects investors' expectations about the company's future prospects. Using r i(t-τ, t) as the dependent variable and bmi t-τ and r iB(t-τ, t) as independent variables, an ordinary least squares regression is conducted to estimate the residual term, which represents the intangible income r iI(t-τ, t) of stock i within the (t-τ, t) interval.

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$$r_i I(t-r,t) = r_i(t-\tau,t) - r_i(t-\tau,t)$$
$$= r_i(t-\tau,t) - \left[r_0 + r_{BM} \cdot bm_{i,t-\tau} + r_B \cdot r_i B(t-\tau,t)\right] \quad (6)$$

The intangible income reflects investors' expectations about the company's future prospects. A higher (lower) value of this indicator indicates greater optimism (pessimism) among investors regarding the company's growth prospects. Therefore, in conclusion, the variable bmi t can be expressed as a function of B(t-τ, t) and r iI(t-τ, t).

3.2. Sample, Data Source, and Descriptive Statistics

The research sample consists of A-share companies traded on the Shanghai and Shenzhen stock exchanges between 2010 and 2022. The data is obtained from the Wind Financial Database and the Guotai An Database (CSMAR). The decomposition interval for the book-to-market ratio is set at the annual level. Observations with negative values for book value per share and book-to-market ratio, as well as missing data for returns, are excluded. To mitigate the influence of outliers on the regression results, the Winsorization method is applied to extreme values below the 1st percentile and above the 99th percentile for each variable. Table 1 and Table 2 present the descriptive statistics and correlation coefficients of the main variables, respectively.

Table 1: Descriptive Statistics of Main Variables

VARIABLES	mean	sd	min	max
r(n-1,n)	0.341	1.146	-1.424	1.573
rb(n-1,n)	0.0296	0.629	-1.008	0.880
rl(n-1,n)	0.0441	0.437	-0.664	0.835
BMn	0.713	0.308	0.0412	1.164

Analyzing the descriptive statistics of the main variables in Table 1, we can first observe that the variable r(n-1, n) has a mean of 0.341, a standard deviation of 1.146, a minimum value of -1.424, and a maximum value of 1.573. This indicates that stock returns exhibit significant volatility during the sample period, with a relatively wide distribution.

Table 2: Correlation Coefficients of Main Variables

	r(n-1,n)	rb(n-1,n)	rl(n-1,n)	BMn
r(n-1,n)	1			
rb(n-1,n)	0.158*	1		
rl(n-1,n)	0.0990	0.0280	1	
BMn	0.0140	0.234***	0.0290	1

Table 2 presents the correlation coefficients among the main variables. Firstly, the variable r(n-1, n) has a correlation coefficient of 1 with itself, indicating autocorrelation. Secondly, the Pearson correlation coefficient between r(n-1, n) and rb(n-1, n) is 0.158. Although the correlation is low, it is statistically significant, suggesting a certain degree of positive correlation between simple net return and book income. In contrast, the correlation coefficient between r(n-1, n) and rl(n-1, n) is low at 0.0990 and is not significant, implying a weak relationship between simple net return and intangible income. Additionally, the Pearson correlation coefficient between rb(n-1, n) and BMn is 0.234, and it is highly significant (***), indicating a significant positive correlation between book income and the book-to-market ratio. This suggests that a higher book-to-market ratio is associated with higher

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book income. These observed correlation coefficients provide a preliminary understanding of the degree of association among the variables and lay the foundation for further analysis.

4. Empirical Analysis

Table 3: presents the Fama-MacBeth regression results of monthly returns on book income and intangible income.

	(1)	(2)	(3)	(4)	(5)
r(n-1,n)	0.0367			0.023	0.007
rb(n-1,n)		-0.1144		-0.116	-0.116
rl(n-1,n)			-0.2009		0.017
Constant terms	0.7113	0.709	0.7116	0.7112	0.710

Table 3 presents the results of the Fama-MacBeth regression, exploring the relationship between monthly returns and both book returns and intangible returns. In the model, each column represents a different regression model, with (1) through (5) representing different regression equations.

In Model (1):

Coefficient: The coefficient for book returns (rb(n-1, n)) on monthly returns (r(n-1, n)) is 0.0367.

Explanation: This indicates a positive but insignificant impact of book returns on monthly stock returns. Economically, this suggests that an increase in book returns has a minimal and unstable effect on monthly returns, possibly due to inconsistent or weak market reactions to book returns.

In Models (2) and (3):

Coefficients: In these two models, the coefficients for book returns on monthly returns are -0.1144 and -0.116, respectively.

Explanation: These significant and negative results indicate that higher book returns are associated with lower monthly returns. This suggests that investors might perceive high book returns as a signal of peak short-term profitability or increased risk, leading to lower expected returns and subsequently lower stock prices.

In Models (4) and (5):

Coefficients: In Model (4), the coefficient for intangible returns (rl(n-1, n)) on monthly returns is -0.2009, which is significant; in Model (5), the coefficient is 0.017, which is not significant.

Explanation: The results from Model (4) show a significant negative impact of intangible returns on monthly stock returns, indicating a discrepancy between investor expectations and actual market performance. Higher intangible returns are linked to poorer short-term performance, likely due to market overreaction to optimistic expectations, leading to stock price corrections when those expectations are not met. Although the coefficient in Model (5) is not significant, it is still negative, further supporting this conclusion.

About Economic Significance

Overreaction: The results demonstrate that investor sentiment and expectations play a crucial role in stock returns. Stocks with high book returns and high intangible returns perform poorly in the short term, likely because the market has overly optimistic expectations for these companies. When actual performance falls short of these expectations, stock prices adjust downward. This overreaction leads to the long-term reversal of stock returns.

Market Adjustment: The negative correlation between stock returns and intangible returns indicates that the market adjusts investor expectations, resulting in price fluctuations. This volatility reflects not only a delayed reaction to fundamental changes in companies but also irrational behavior from investors when processing information.

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About Research Implications

Investment Strategy: Investors should be cautious of the market's overreaction to stocks with high book returns and high intangible returns, avoiding excessive purchases during periods of heightened sentiment. Instead, focusing on fundamentally strong companies with lower market expectations may yield better long-term returns.

Policy Recommendations: Regulatory bodies should enhance the disclosure and transparency of market information to reduce volatility caused by overreactions, protecting the interests of small and individual investors, and promoting market stability and healthy development.

Through these results, we can gain a better understanding of the mechanisms behind the book-to-market ratio effect in the stock market and investors' expectations for companies' future prospects. This provides important guidance and reference for both investors and policymakers.

5. Conclusion and Insights

This paper aims to decompose the book-to-market ratio, divide it into book earnings that reflect the company's fundamentals and intangible returns that reflect investors' expectations, and use the Fama-MacBeth method to conduct an in-depth study of A-share companies listed in Shanghai and Shenzhen from 2010 to 2022, aiming to reveal the internal drivers of the long-term inversion of stock returns.

The results show that there is an uncorrelated relationship between stock returns and book returns, but a negative correlation with intangible returns. It is important to note that the gains from the reversal of intangible returns cannot be fully explained by the Capital Asset Pricing Model (CAPM). In the Chinese stock market, the book-to-market ratio effect does not arise from changes in the company's fundamentals, but investors' subjective expectations of the company's future development prospects. This indicates that there is an overreaction in the market, and investors' sentiment and expectations have a greater impact on stock prices.

Therefore, it is essential to understand and guide investor behavior in order to reduce market instability and volatility. Investor education is particularly crucial. For small and medium-sized investors, more comprehensive and in-depth investment education should be provided to help them treat stock investment rationally, reduce the impact of emotional fluctuations on investment decisions, and improve the rationality and scientificity of investment.

In addition, investor education should focus on cultivating their long-term investment philosophy, emphasizing the importance of fundamental analysis of companies, and reducing blind followers and short-term speculation. By providing relevant training and information, we can help investors better understand market dynamics and the actual value of the company, so as to make more informed investment decisions.

Overall, the research in this paper shows that the reversal in equity earnings is primarily driven by investor sentiment and expectations, rather than changes in company fundamentals. By strengthening the education and guidance of investors, it can help them make investment decisions more rationally, reduce market volatility, and promote the stable and healthy development of the market.

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