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## An empirical cross-section analysis of stock returns on the Chinese A-share stock market

### Abstract

This study applied the Fama-French three-factor model (1993) and CAPM to examine A-shares in Chinese equity market from 1996 to 2005. The authors find a positive relation between book-to-market ratio and stock excess returns, and negative between size and stock excess returns. The results demonstrate that the Fama-French three-factor model is more accurate in predicting stock excess returns than the CAPM. The size effect is stronger than that of the book-to-market ratio (BTM). The results also suggest that stock profitability is related to size and BTM ratio in China's stock market.

**Keywords:** asset pricing, cross-section analysis, three-factor model, firm size, book-to-market, Chinese A-share.

**JEL Classification:** G10, G11, G12.

### Introduction

Financial researchers have attempted to develop robust and meaningful asset pricing models for investors to value asset returns. The Capital Asset Pricing Model (CAPM hereafter), developed by Sharpe (1964), Lintner (1965) and Black (1972), is widely used by portfolio managers, institutional investors, financial managers, and individual investors to predict asset returns. The beta is used to measure the systematic risk in the CAPM model and is assumed to be positively related to asset returns. However, several researchers have demonstrated that other variables exist that could significantly explain the expected asset returns and the beta showed either no relationship or a weak relationship with the expected asset returns. For example, Banz (1981) discovered that small firms' average returns were higher than large firms' average returns on the New York Stock Exchange from 1926 to 1975. Chan et al.'s (1991) study showed a significant positive relationship between the book-to-market (BTM) ratio and expected asset returns from 1971 to 1988 in the Japanese stock markets. Other researchers such as Keim (1990) reported that there is a positive relationship between the expected returns and earning price (EP) ratio, and Bhandari's (1988) study revealed a positive relationship between debt to equity (DE) ratio and stock returns. Fama and French (1993) presented the three-factor model, and contended that firm size and BTM ratio could explain the cross-sectional variation on the US stock markets sufficiently, and firm size and the BTM ratio could be proxies for risk.

Most of the research testing the Fama and French (1993) three-factor model concentrated on the US stock markets. There is a lack of empirical evidence as to whether there are firm size and BTM ratio

effects on the Chinese A-share stock market, which is becoming increasingly important in the global capital market. Due to differences in political and cultural practice, the investment environment in China differs from the US stock market. Therefore, the price formation process and risk factors could be different. For example, one unique feature of the Chinese market is the transferability of shares. About two thirds of the shares outstanding could not be freely traded on the secondary market prior to 2006 due to the share transferability restriction. The illiquidity may affect the BTM effect in portfolio returns. Although some empirical studies showed a BTM ratio effect in the Chinese stock markets, there is no direct evidence to support the Fama and French three-factor model in the Chinese stock markets.

This paper investigates which asset pricing model, CAPM or Fama French three-factor model, can better explain the portfolio stock return in China's A-share stock market. We adopt Fama and French's (1995) method to identify the economic reason for the size and BTM ratio effects. The finding of this research can help investors to select their investment portfolio and supply the benchmark model to evaluate the stock portfolio returns and the cost of capital in China.

The remainder of the paper is organized as follows. Section 1 introduces the background of the Chinese stock markets. Section 2 provides an overview of the literature about the CAPM and three-factor model. Section 3 describes the method and data used in this research. Section 4 presents the findings and interpretation of the empirical models, and the final section concludes the paper.

### 1. Review of the Chinese stock markets

The Chinese stock markets are comprised of the Shanghai and Shenzhen stock markets. The Shanghai stock market was established on December 19, 1990

and the Shenzhen stock market on July 3, 1991. The Chinese A-share market has grown very quickly from 1996 to 2005. The number of A-share firms increased from 306 firms to 1281 firms from 1996 to 2005. The total market capitalization was 9.842 billion renminbi in 1996, compared with 32.430 billion renminbi in 2005, an increase of about 230 percent.

The A-shares are almost equally divided into three categories based on different ownership. The first category is the state-owned shares, which are not tradable, the second category is legal corporation shares, which are also not tradable, and the third category is the private shares, which are publicly tradable. This means more than 60% of the A-shares are non-tradable. Wang and Xu (2004) and Drew Naughton and Veraraghavan (2003) pointed out that this special feature may reduce the BTM ratio factor's explanatory power.

## 2. Literature review

Sharpe (1964), Lintner (1965), Mossin (1966) and Black (1972) used the beta in their CAPM to measure the systematic risk and reported a positive linear relationship between the beta and the asset expected returns. In the early 1970s, Black, Jensen and Scholes' (1972) study showed a linear relationship between beta and stock expected return.

However, other empirical studies showed that the beta has little or no explanatory power in predicting the asset returns. The early challenges to the CAPM validity came from Roll (1977), who argued that the CAPM test could not be constructed theoretically unless there was an exact composition of the true market portfolio with certainty. Kandel and Stambaugh (1987) focussed on the multiple-correlation between the proxy and the market portfolio and found that if two market portfolios returns were highly correlated, the central assumption of the mean-variance-efficient of CAPM was reversed. They, therefore, rejected the validity of the CAPM.

Other researchers pointed out that size, EP ratio, leverage, and BTM ratio can explain the assets' expected returns more efficiently than beta. Banz (1981) was the first researcher to argue that on average the small firms' earnings were 0.4% higher than large firms' earnings per month. Banz concluded that firm size should be a risk proxy for the CAPM. Following the discovery of the small firm effect, researchers have subjected this anomaly to much scrutiny and analysis. Fama and French (1995) presented the economic fundamental reason of the firm size effect and they reported that small firms earned higher returns than large firms in the US stock market. Stoll and Whaley (1983) pointed out that the transaction cost could explain size

effect. Keim (1983) claimed that the small firms earning high returns could be caused by the January effect and that the relationship between the size factor and expected returns was significantly negative. Roll (1981) argued that small firm effect was caused by infrequent trading and firm size could not be a risk factor. Handa, Kothari and Wasley (1989) found that the small firm effect is correlated with the return interval (daily, monthly and annual) used to estimate beta. The beta changes with the asset expected return interval since the variance of the return on the market portfolio did not change proportionately as the asset expected return interval changed. Chan and Chen (1988) stated that the size effect was related to the beta if beta is measured accurately and there is no size effect. However, Jegadeesh (1992) cast doubt on the assertion of both Chan and Chen (1988) and Handa, Kothari and Wasley (1989) conclusions. The author argued that if the portfolios were formed by size then the beta could not explain the cross-section returns appropriately. The author further reported that firm size had statistically significant effect on assets' returns, where small firms had higher return on average than large firms. Fama and French (1992) also conclude that the beta cannot absorb the size effect. They formed their portfolio by size and found a strong relationship between the size factor and assets' expected returns.

A number of researchers pointed out that the BTM ratio could be an additional risk factor. Chan, Hamao and Lakonishok (1991) study revealed a significant positive relationship between the BTM ratio and assets' expected returns for the period 1971 to 1988 in the Tokyo Stock Exchange. They reported that the BTM ratio had a significant impact on the stock expected returns. Fama and French (1993) stated that the BTM ratio, which could explain stock average returns, was related to economic fundamentals. They claimed that a firm with a high BTM ratio had a low stock price relative to book value, which means low earnings on assets for the firm. Fama and French (1995) discussed the fundamental economic reason for the BTM ratio effect where high BTM ratio firms were distressed. The high BTM ratio stocks were less profitable compared with low BTM ratio stocks in the short term. Daniel, Titman and Wei (2001) investigated the US and Japanese stock markets from 1975 to 1997 and concluded that the cross-section stock returns were directly related to the BTM ratio. Chen, Kan and Anderson (2007) applied a different method to test the BTM ratio effect on the Chinese stock market. They found that the cross-section stock returns were positively related to the BTM ratio on the Chinese stock market.

Besides the firm size and BTM ratio variables, empirical researches also revealed there are other factors relating to the stock portfolios' expected returns.

Fama and French (1992) examined the relationship between five factors (beta, firm size, BTM ratio, DE ratio (Debt/Equity ratio) and EP ratio (Earning/Price ratio)) using the US stock market data. The authors conclude that the beta did not have significant role in explaining the stock returns. For longer periods, firm size and the BTM ratio are sufficient to explain the variation in the stock returns. Moreover, the DE and EP effects could be absorbed by the BTM and size factor. Fama and French (1993) used the three-factor model, firm size factor, BTM ratio factor and the market beta to predict stock returns. They argued the new model could explain the cross-sectional stock returns better than the CAPM. Fama and French (1995) conducted further tests on the three-factor model and pointed out that firm size and BTM ratio corresponded to the behavior of the stock earnings and they could help explain returns and the economic fundamental reasons why firm size and the BTM ratio effects are related to the profitability of the firms.

Following Fama and French (1993) three-factor model, several studies have tested whether firm size and the BTM ratio could explain the stock returns outside the US stock market. Most of the studies showed mixed results regarding the Fama and French hypothesis but the majority rejected the CAPM in predicting stock returns. Firm size and the BTM ratio have significant power to explain stock returns and the three-factor model could predict stock returns more accurately (see Aksu and Onder, 2000; Chen and Zhang, 1998; Drew and Veeraraghavan, 2002; Gaunt, 2004).

There are few studies that focused on Asian stock markets, including the Chinese stock markets. Drew et al. (2003) provided evidence supporting the Fama and French three-factor model in the Shanghai stock market. Wang and Xu (2004) revealed that firm size was highly correlated to the stock returns but the BTM ratio had no effect on the stock returns. Wong, Tan and Liu (2006) extended Wang and Xu's study to investigate the Shanghai stock market from 1993 to 2002. The authors' results confirmed Drew et al. (2003) findings. Chen et al. (2007) tested the risk factors on the Chinese A-share stock market. They ran a cross-sectional stock returns regression. Their results showed the cross-section stock returns were positively related to the BTM ratio and negatively related to firm size in the Chinese stock markets. Similarly, the Wang and Iorio (2007) study of the Chinese A-share market showed the firm size and BTM ratio had sufficient power to explain the cross-sectional stock returns.

### 3. Data and method

**3.1. Data.** The data includes the stock returns of the firms listed on the Chinese A-share stock market from January 1996 to December 2005. The Chinese stock market was established in 1990 and the poor standards and regulations of the stock market did not truly reflect the data value of the stock returns for the first few years. Therefore, we chose 1996 as the starting year for our analysis. After 2005, there was a significant change in the Chinese stock market regulations that resulted in stocks prices becoming extremely volatile and the market capitalization increasing significantly. Therefore, we chose 2005 as the end of our sample period. The data were obtained from China Stock Market & Accounting Research Database (CSMAR) database and include the following variables:

1. The monthly closing price adjusted for capital asset changes (such as dividends, share repurchase).
2. The year-end book value.
3. The year-end market value.

Since China did not have a one month government bond before 2004, we used the fixed deposit rate of the first month of each year as the risk-free rate, which was obtained from the People's Bank of China (see Drew et al., 2003). The monthly market rates of return were obtained from the six BTM-size portfolios, excluding the negative book value stock returns used in the formation of the six BTM-size portfolios. Similar to Fama and French (1993), the market excess returns were calculated from the market monthly return minus monthly interest free rate. The sample of firms includes ordinary common equity and positive book equity firms. The negative book equity firms and financial firms were excluded from the sample.

**3.2. Methodology.** This study follows Drew et al. (2003) method to examine the Fama and French three factor model and CAPM on the Chinese A-share stock market from 1996 through 2005.

We formed six BTM-size portfolios to obtain the dependent variable for the three-factor model. There are 120 months in our sample period, and we calculated the monthly returns for each stock. The portfolio return was calculated by taking the average of all stock returns in the portfolio. Since the number of listed firms on the Chinese stock market is not as large as the US stock market and in order to ensure the number of firms in each portfolio were reasonable, we divided the data into six portfolios. Following Drew et al.'s (2003) method, we divided the whole sample into two groups by firm size (market value). Using the mid point of the market value of the sample stocks at

the end of December, the small size portfolio contains firms which market value of equity was less than the mid point of the market value of equity. The big size portfolio contains firms which market value of equity was bigger than the mid point of the market value of equity. Then, we divided the sample equally into the three BTM ratio portfolios independently. The BTM ratio for year  $t$  was calculated using the book value for the fiscal year in year  $t - 1$  divided by the market equity at the end of December of year  $t - 1$  because the official fiscal year for Chinese firms is 30 April. The low BTM ratio portfolio contains one third of the lower BTM ratio stocks and vice versa. The final portfolios are the six intersections of the two size and the three BTM groups (SL, SM, SH, BL, BM, and BH). For example, the BH portfolio contained stocks that are in the large-size portfolio and also in high-BTM ratio stock portfolio. These six stock portfolios were reorganized at the end of December each year, since both market value and BTM ratio change at the end of the year.

The firm size factor (SMB) is the difference between the monthly average returns of the small-size stock portfolios (SL, SM, and SH) and the monthly average returns of the large-size stock portfolios (BL, BM, and BH). The BTM ratio factor (HML) is defined as the difference between the portfolios' average returns on the two high-BTM ratio stock portfolios (SH and BH) and the portfolios' average returns on the two low-BTM ratio stock portfolios (SL and BL). Fama and French (1993) stated the size factor and BTM ratio factor are proxies for sensitivity to an underlying risk factor, and both of them are expected to be positively related to stock excess returns.

The three-factor model is given as follows:

$$R_{it} - R_{ft} = \alpha_i + b_i(R_{mt} - R_{ft}) + s_iSMB_t + h_iHML_t + \varepsilon_{it}, \tag{1}$$

Table 2. Stock monthly excess returns for six BTM-size portfolios (1996-2005)

Parameter	BH	BM	BL	SH	SM	SL
Mean	0.0086	-0.0033	-0.0101	-0.0006	0.0065	0.0034
Std. dev.	0.1204	0.1211	0.1228	0.1216	0.12280	0.1267
t-statistic	10.1393**	-3.7414**	-11.3606**	-0.6467	6.9358**	3.4694**

Notes: \* Significant at the 0.05 level (2-tailed). \*\* Significant at the 0.01 level (2-tailed). The six-BTM portfolios (BH, BM, BL, SH, SM, SL) are the intersections of the two size and the three BTM groups.

The data in Table 2 show the average mean return for small firm portfolios is 0.0031 and for the large firm portfolios is -0.0016. The small firm portfolios stock returns are more volatile than large firm portfolios. The  $t$ -statistic shows there is a significant difference between the standard deviations. This implies that the small firm stocks have a higher risk than the large firm stocks and the small firm portfolios

where  $\alpha_i$  is the intercept term;  $b_i$  is the slope for the excess market return factor;  $s_i$  is the slope for the SMB;  $h_i$  is the slope for the HML;  $\varepsilon_i$  is the error term.

We used the heteroskedasticity and autocorrelation consistent (HAC) estimator to account for heteroskedasticity and autocorrelation (Hirukawa and Hodoshimay, 2012).

Table 1. Number of listed firms included in the sample for each portfolio (1996-2005)

Year	BH	BM	BL	SH	SM	SL	Total
1996	64	44	45	38	58	57	306
1997	74	83	91	95	86	74	509
1998	110	114	133	128	124	105	714
1999	150	125	133	122	147	139	816
2000	171	147	135	131	155	167	906
2001	209	164	146	137	182	201	1039
2002	226	177	150	143	191	219	1106
2003	249	180	151	138	207	236	1161
2004	203	203	200	201	201	205	1213
2005	211	202	227	216	225	200	1281
Average	166.7	143.9	141.1	134.9	157.6	160.3	

Note: The six-BTM portfolios (BH, BM, BL, SH, SM, SL) are the intersections of the two size and the three BTM groups.

Table 1 presents the number of sample firms in each of the portfolio groups. The number of listed firms in 2005 increased dramatically and is four times bigger than the number of listed firms in 1996. The BH portfolio has the largest average number of listed firms and the average SH portfolio has the smallest number of listed firms.

#### 4. Results and discussions

**4.1. Summary statistics.** Table 2 presents the stock monthly mean returns of the six BTM-size portfolios and the standard deviations and  $t$ -statistics of the mean returns from 1996 to 2005 for Chinese A-share stock market. The data in the table shows that the firm size and BTM ratio effects exist on the Chinese A-share stock market for the study period.

are more profitable than the large firm portfolios. As for BTM, the high BTM ratio portfolio stock mean return is 0.004 and the low BTM ratio portfolio stock mean return is -0.0034. This implies the high BTM ratio portfolios have higher mean returns than low BTM ratio portfolios mean returns. Our results confirm Drew et al.'s findings and also support Fama and French's (1993) BTM ratio effect.

Our result is opposite to Fama and French (1993) where the BH portfolio has positive average returns and the SH portfolio has negative average returns. Moreover, the high BTM ratio portfolios' average standard deviation is 0.1210, and the low BTM ratio portfolios' average standard deviation is 0.1248. This implies the high BTM ratio stocks are less risky than the low BTM ratio stock. This may be due to the specific feature of the Chinese A-share stock market. Hu (1999) stated that there are large blocks of non-tradable shares on the Chinese stock market and, before 2001 investors could trade only in A-shares. Wang and Xu (2004) pointed out that this special feature may reduce the BTM ratio factor's explanatory

power. The non-tradable shares were held by the government. As a result, the company could not directly control the cash flow and stock price, so the market value of a stock does not reflect the real value. Therefore, the BTM ratio effect was weak.

**4.2. Regression analysis.** Table 3 presents the regression results for the CAPM. We regressed the excess stock returns on the excess market returns, the only explanatory variable for the six BTM-size portfolios. The coefficients of the six BTM-size portfolios excess market returns are all positive and statistically significant at the 1% level. The average beta for the six portfolios is 0.9964.

Table 3. Regression results on the CAPM (1996-2005)

	BH	BM	BL	SH	SM	SL
$\alpha$	0.008406 (4.666)**	0.006073 (2.935)**	0.002267 (0.945)	-0.00181 (-1.067)	-0.00411 (-2.436)**	-0.01024 (-5.202)**
$b$	0.995397 (27.312)**	0.945 (24.50)**	0.890787 (21.638)**	1.10401 (31.90)**	1.058301 (35.978)**	0.985133 (38.159)**
$R^2$	0.4273	0.3681	0.3164	0.5210	0.4856	0.3985

Notes: HAC standard errors and covariance are used and the number in parentheses are Newey-West  $t$ -statistics. \* Significant at the 0.05 level (2-tailed). \*\* Significant at the 0.01 level (2-tailed). The six-BTM portfolios (BH, BM, BL, SH, SM, SL,) are the intersections of the two size and the three BTM groups.

The results show the market factor has a significant positive relationship with stock excess returns in the six BTM-size stock portfolios. The coefficients of the small firm portfolios are higher than those of the large firm portfolios; and there is a difference of 0.1054 between the average small firm portfolios slope and the average large firm portfolios slope. Similarly, the average slope for the high BTM ratio portfolios market factor is 0.1117 higher than that for the low BTM ratio portfolios market factor. These findings reveal the firm size and BTM ratio effects exist on the Chinese A-share stock market.

The adjusted  $R^2$  value in our study is lower than Fama and French (1993) results. In our study, the average adjusted  $R^2$  is 0.4195, the SH portfolio has the highest adjusted  $R^2$  (0.5210), and the BL portfolio has the lowest adjusted  $R^2$  (0.3164). The adjusted  $R^2$  for the large firm stock portfolios is 26% lower than that of the small firm portfolios. This indicates that the market factor for the small firm portfolios can explain the excess stock returns

variation better than the big firm portfolios. We also found that the high BTM ratio portfolios had a higher adjusted  $R^2$  than the low BTM ratio portfolios.

The intercepts of the big firm portfolios are positive whereas the intercepts of the small firm portfolios are negative and two of three are statistically significant at the 1% level. Merton (1973) stated that the standard asset pricing models intercept should equal zero and the independent variable could fully explain the dependent variable. Therefore, Table 3 suggests that CAPM model is not sufficient to explain the stock returns in China.

Both Drew et al. (2003) and Fama and French (1993) found that beta alone could not explain the stock returns sufficiently. Several studies have shown there was a size effect on the Chinese stock market, but the BTM ratio had a weak explanatory power in the cross-sectional stock returns. Thus we include beta, size and BTM ratio to explain the stock return. The regression results are presented in Table 4.

Table 4. Regression results of excess returns on the three-factor model (1996-2005)

	BH	BM	BL	SH	SM	SL
$\alpha$	-0.0006 (-0.417)	0.0005 (0.294)	0.0001 (0.032)	-0.0009 (-0.643)	0.0008 (0.539)	-0.0007 (-0.375)
$b$	0.9782 (33.709)**	1.0085 (26.334)**	1.0039 (21.451)**	1.0114 (37.314)**	1.0146 (35.493)**	0.9741 (32.45)**
$s$	-0.3928 (-10.884)**	-0.5518 (-10.340)**	-0.5922 (-8.202)**	0.4481 (11.796)**	0.4352 (10.995)**	0.5282 (12.323)**

Table 4 (cont.). Regression results of excess returns on the three-factor model (1996-2005)

	BH	BM	BL	SH	SM	SL
$h$	0.4954 (8.035)**	-0.0672 (-1.452)	-0.5378 (-11.686)**	0.5101 (6.756)**	0.0045 (0.1)	-0.3973 (-11.646)**
$R^2$	0.4650	0.3849	0.3531	0.5501	0.4970	0.4338

Notes: HAC standard errors and covariance are used and the number in parentheses are Newey-West  $t$ -statistics. \* Significant at the 0.05 level (2-tailed). \*\* Significant at the 0.01 level (2-tailed). The six-BTM portfolios (BH, BM, BL, SH, SM, SL) are the intersections of the two size and the three BTM groups.

The  $t$ -statistics for all the portfolio intercepts in Table 4 are insignificant at the 1% significance level, which suggests that the three-factor model performs well in explaining the cross-section stock excess returns on the Chinese A-share stock market. The BM, BL and SM portfolios have positive intercepts. The market factor slopes in Table 4 are positive and significant at the 1% level. The average slope is 0.9984, which is close to 1. This indicates that the market factor is also highly related to stock excess returns, which plays an important role in explaining stock excess returns.

The six portfolios' coefficients of the size factor are highly significant at the 1% level of significance. The firm size effect is shown in Table 4. The slopes of the three small firm portfolios are positive and significant. In contrast, all the big firm portfolios' coefficients are negative. Our result shows that the small firm portfolios have positive slope coefficients, whereas those for the big firm portfolios are negative. The result also reveals that the coefficients of the big portfolios decrease from BH to BL. Fama and French (1993) pointed out that the small firm portfolios' returns were higher than those of big firm portfolios when they formed the portfolios by the BTM ratio. The firm size affects the returns on the Chinese A-share stock market and the high coefficient of size factor implies a high return for small firms' stock.

The slopes of the BTM ratio factor are significant at the 1% level of significance for four of the six portfolios (see Table 4). Furthermore, our results show the average high BTM ratio portfolios' slopes are higher than the average low BTM ratio portfolios' slopes. This provides the evidence that the BTM ratio effect exists in the Chinese stock market. When the portfolios are formed by size, the BTM ratio factor slopes increase monotonically from lower portfolios to higher portfolios. However, our results reveal that the BTM ratio effect is not as strong as the firm size effect on the Chinese A-share stock market during the testing period. The SM portfolio slope is insignificant. Drew et al. (2003) reported that the BTM ratio effect is weak in their study. They argued that the Chinese A-share stock market had a number of non-trading shares held by the government. This caused the shares to be poorly valued. As the shares were mispriced, arbitrageurs

took the advantage of the value stocks which outperformed the growth stocks. During our test period there were still a large number of non-tradable shares, where more than 60 percent of the A-shares are non-tradable. This may result in the company manager having less power to control the firm's tradable stock price, which may make the value of the firm less risky than that of growth firms. Therefore, our result reveals the weak BTM effect.

In our study, the three portfolios' BTM coefficients were negative. The irrational investor may be one of the reasons why the coefficients were negative. Kang, Liu and Ni (2002) pointed out that the Chinese stock market was relatively new to Chinese investor and, most of the individual investors did not have experience on stock investment. We suggest that the Chinese investors tried to make money on the stock market, but took the wrong investment strategy. They may believe that strong firms with high earnings could generate high return on stocks, and weak firms with low earnings generate low return on stocks. However, Fama and French (1995) reported that the weak firms with low earnings in general have a high BTM ratio, and strong firm with high earning has low BTM ratio. Drew et al. (2003) stated that the Chinese investors thought the low BTM ratio stock could generate high returns. The Chinese stock market is in the high growth stage, which may be another reason why the BTM ratio effect is weak. Chen and Zhang (1998) claimed that the fast growing market such as Taiwan and Thailand had a small BTM ratio effect. Their study showed the SH portfolio risk is lower than the BL portfolio. Our result is consistent with Chen and Zhang's finding. We then applied the F-test to examine whether these two samples are different. The  $p$ -value is 0.0035, this indicates that the two sample means are not different. Therefore, the high BTM ratio stock portfolio does not have the noticeably higher return than the low BTM ratio stock portfolio in the Chinese A-share stock market from 1996 to 2005.

The significant difference between our results and those of Fama and French (1993) and Drew et al. (2003) is the lower adjusted  $R^2$  value. Fama and French presented adjusted  $R^2$  values between 0.83 and 0.99 in their 25 portfolios. Drew et al. (2003) reported adjusted  $R^2$  values between 0.79 and 0.92. In contrast, the adjusted  $R^2$  values reported in our

study are below 0.60. The low adjusted  $R^2$  values imply the explanatory power of the three-factor model in the Chinese A-share stock market is not as good as the US stock market for the sample period tested. However, our results shows three-factor model predicts stock returns better than the CAPM model, which confirms Fama and French (1993) and Drew et al.'s (2003) findings.

#### 4.3. Testing the behavior of the stock earnings.

Fama and French (1995) found the fundamental economic reasons why firm size and the BTM ratio affect stock returns. We tried to examine the fundamental economic reasons of size and the BTM ratio effects in the Chinese A-share stock market as well.

To do this, we applied the  $EI_t/BV_{t-1}$  (earning to book value) ratio to measure the profitability of stocks.  $EI_t$  is the stock's net profit before extraordinary items

at the fiscal year  $t$ .  $BV_{t-1}$  is the book value of the stocks at the fiscal year  $t-1$ .  $EI_t/BV_{t-1}$  is the total of  $EI_t$  for all stock in a portfolio divided by the total  $BV_{t-1}$ . Since our sample period is not as long as Fama and French's (1995), we can only test 7 years portfolios profitability. We chose 1999, 2000, 2001 and 2002 as year  $t$  to form the six BTM-size portfolios. We calculate the  $EI_t/BV_{t-1}$  ratio for year  $t + n$ ,  $n = -3, \dots, 3$ .

Figure 1 shows that stock profitability is related to size in the Chinese A-share stock market. When the BTM ratio is controlled, the mean  $EI/BV$  of the BH portfolio is 33.94% higher than the SH portfolio, and the mean  $EI/BV$  of BL portfolio is 1.2 times higher than the SL portfolio. Figure 1 also reveals that stock profitability is related to the BTM ratio. When size is controlled, the mean  $EI/BV$  of the BH portfolio is 32.57% higher than the BL portfolio.

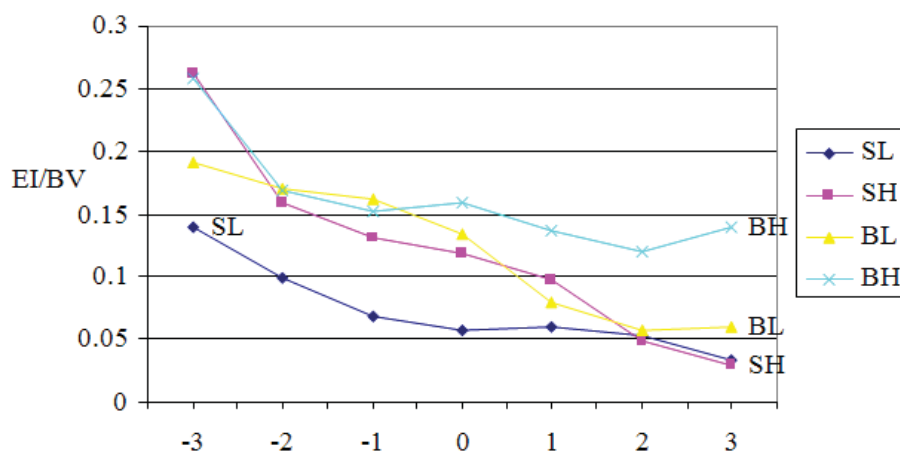


Fig. 1. Seven-year evolution of  $EI_t/BV_{t-1}$  ratio

Similarly, the mean  $EI/BV$  of the SH portfolio is 65.72% higher than the SL portfolio. This result, however, is not consistent with Fama and French (1995), which reported that for the low BTM ratio stocks, before the portfolio formed, the  $EI/BV$  had an increasing trend, which implied that the firms were in a demand or supply shock that exhibited increased earnings. After the portfolio was formed the  $EI/BV$  exhibited a downward trend, which revealed that in order to maximize the profit, firms expand output and investment, until they reached the margin when the earnings return to the equilibrium level. On the other hand, for the high BTM ratio stock the  $EI/BV$  started to decrease until the portfolios are formed (at year  $t$ ), and then increased.

Three possible explanations exist for the unexpected result. First, our test period is too short compared to Fama and French's (1995) study, so our results cannot fully reflect the relationship between  $EI/BV$  and size and BTM ratio. Second, as the average market return is negative from 2001 to 2005, this results in the downward trend of the  $EI/BV$  lines.

Third, Fama and French (1995) argued that firm size and BTM ratio were related to long-term profit. We applied the  $F$ -test to examine whether the  $EI/BV$  means in big portfolios and small portfolios and the high BTM ratio and low BTM ratio are equal. The  $p$ -values of the  $F$ -test are 0.499 and 0.0576, respectively, which indicates  $EI/BV$  means in the big and small portfolios and the high BTM ratio and low BTM ratio are not different. We tested the evolution of the  $EI_t/BV_{t-1}$  ratio before three years and after three years when the portfolio was formed. Three years may be not long enough for testing the long-term effect on profitability.

Figure 2 shows the low BTM ratio stock portfolios have a low BTM ratio for at least three years before and a high BTM ratio three years after the portfolios were formed. The low BTM ratio firms are not distressed, and they can then have sustained high profit. However, the high BTM ratio stock portfolios exhibited an upward trend BTM ratio from the  $t - 3$  year to  $t + 3$  year. This finding is not consistent with Fama and French's (1995) findings.

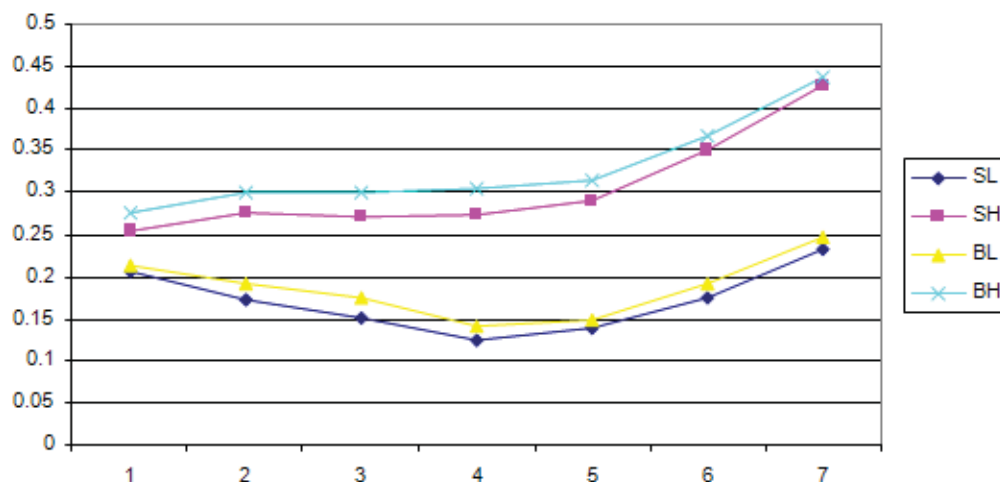


Fig. 2. Seven-year evolution of BTM ratio

## Conclusion

Significant statistical evidence was found for the presence of firm size and BTM ratio in the Chinese A-share stock market from 1996 through 2005. All the portfolios' returns were significantly different from zero, except the SH portfolio, which may have been caused by the Chinese government's regulations. The low standard deviation may imply that there is inadequate variation to be absorbed by the independent variable in the asset pricing model.

We ran two regressions in this study. First, we used only the excess market returns factor as the explanatory variable to explain the stock excess returns. Our results showed that there was a large amount of variation that could not be explained by the beta. The second regression model demonstrated that the Fama-French three-factor model was more accurate in predicting stock excess returns than the CAPM, since the adjusted  $R^2$  value increased and the intercept was not significantly different from zero. The size effect was stronger than the BTM ratio effect. Although not all portfolios had the expected sign for the size and BTM ratio slopes, the average value of the slopes revealed that there were size and BTM ratio effects in the Chinese A-share stock market during the testing period. Moreover, the betas were positive and significant in explaining the stock returns.

Both tradable and non-tradable shares were used in our estimation. However, the large number of non-tradable shares might not reflect the true market value of the firm. Drew et al. (2003) also argued that the large number of non-tradable shares was the main reason for weak BTM ratio effect in the Chinese stock market. If the non-tradable shares could be traded then the stock price should differ significantly. This is one reason why our sample ended in 2005 when a major reform took place to float non-tradable shares.

The sample period for our study was only 10 years from January 1996 through December 2005. Lakonishok and Shapiro (1986) argued that even sample periods of 20-30 years may not be sufficiently long to enable the use of ex post returns as proxies for expectations. Moreover, the number of stocks in our study was lower than in Fama and French (1993) study. The number of listed firms ranged from a minimum of 306 companies to as many as 1281 companies per year. Fama and French (1993) study has an average of 3100 listed firms per year in their sample. Therefore, the authors were able to sort their data into 25 portfolios compared to only six portfolios in our study. The smaller number of stocks may be the reason for the low degree of variation of the stock excess returns. The low adjusted  $R^2$  value suggested that the three-factor model could only explain a limited amount of variation of stock returns in China for the study period.

Our results show that Chinese investors are concerned about three separate risk factors instead of a single risk factor. To issuers of stocks, this means that small firms must pay more for capital when issuing securities. Distressed firms (high book-to-market), those that have poor prospects, bad financial performance, irregular earnings and/or poor management must also pay more for capital.

For portfolio construction, investors must decide how much of each of the three risk factors they are willing to absorb when they construct their portfolios. They must manage the tradeoffs between the three risk factors to suite their own appetite for various risks. The good news is that investors can now build their portfolios with expected returns significantly higher than the market portfolio. By identifying the true sources of risk, and managing their exposure to fundamental risk factors through passive structural portfolio engineering techniques they can obtain additional benefits at dramatically lower costs.



These increased expected returns do not depend on any specific performance by an active manager as shown by the insignificant coefficient on the alpha in our results. They can be economically achieved by building a portfolio of index funds that rely solely on exposure to risk factors that over time

have demonstrated persistent strong positive premiums. For example, in our results, a big and high book-to-market portfolio will generate a moderate return for investors while a small and low book-to-market portfolio will generate superior returns.

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