An Empirical Cross-Section Analysis of Stock Returns on the Chinese A-Share Stock Market

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By Liu Yaoguang

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This research attempts to test the performance of the Fama-French three-factor model (1993) in explaining the stock portfolio returns on the China A-share Stock Market from 1996 to 2005. In this study, the data are obtained from Chinese stock Market and Accounting Research database. We will follows Drew, Naughton and Veeraraghavan (2003) method, who adopted the Fama and French's (1993) method to test small sample stock markets.

We find the positive relation between book-to-market ratio and stock excess returns, and the negative relationship between size and stock excess returns. And our result demonstrated that the three-factor model is more accurate in predicting stock excess returns than the CAPM, since the adjusted $R^2$ value increased and the intercept are not significantly different from zero. The size effect is stronger than the BTM ratio effect. Moreover, our results present that stock profitability is related to size and BTM ratio in China stock market. However, the relationship between stock profitability and size and BTM ratio are unconditional.

Key words: Asset pricing; cross-section; three-factor; firm size; book-to-market; Chinese A-share
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Chapter 1

Introduction

1.1 Introduction

Financial researchers have attempted to develop robust and meaningful asset pricing models for investors to value asset returns. This includes the traditional Capital Asset Pricing Model (CAPM). However, empirical researchers have pointed out that the CAPM could not explain the portfolio stock returns accurately, and some researchers employed other models to predict portfolio stock returns. For example, Fama and French (1993) used the three-factor model to explain the portfolio stock expected returns and reported that the CAPM had weak explanatory power in predicting asset returns.

The CAPM, 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. 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. Roll (1977) argued that the CAPM is not testable because the test involved a joint hypothesis on the model and the choice of the market portfolio. According to Roll, the real proxies would be highly correlated with each other. The linear relationship between assets return and beta is based solely on the mean-variance-efficient hypothesis of market portfolio, but the real market portfolio did not support the mean-variance-efficient hypothesis. Researchers have identified several factors that could affect asset returns, such as firm size (Banz, 1981; Reinganum, 1981, 1982; Keim, 1983; Fama and French, 1992, 1993, 1995,
1996), and book-to-market equity (BTM) ratio (Statman 1980 and Chan, Hamao and
Lakonishok 1991). 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. The author’s results showed that firm size affected the stock return but the earning price
(EP) ratio could not explain the stock returns. Keim (1983) reported that the relationship
between size and stock returns was significantly negative and that small firms which earned
high returns could be caused by the January effect.

Some studies also indicated that the asset returns might be affected by the book-to-market
equity ratio and argued that the BTM ratio is positively related to stock returns. For example,
Statman (1980) reported a positive relationship between expected stock returns and the BTM
ratio in the U.S. stock market. Chan et al.’s (1991) study showed a significant positive
relationship between the BTM ratio and expected asset returns from 1971 to 1988 in the
Japanese stock market. However, Chen and Zhang (1998) pointed out that the spread of risk is
small between the high and low BTM ratio stocks in high growth markets such as Taiwan and
Thailand. Lakonishok, Shleifer and Vishny (1994) advocated that the BTM ratio effect was
due to market overreaction to the firm’s prospects. Other researchers such as Keim (1990)
reported that there is a positive relationship between the expected returns and EP ratio, and
Bhandari’s (1988) study revealed a positive relationship between debt to equity (DE) ratio and
stock returns.

1.2 Fama and French Three-factor Model

Fama and French (1992) examined the relationship between five factors (beta, firm size, BTM
ratio, DE ratio and EP ratio) and cross-sectional stock returns on the U.S. stock market.
According to the authors, the BTM ratio effect could absorb the DE effect and the relationship
between EP ratio and cross-sectional stock returns could be subsumed by a combination of firm size and the BTM ratio. Fama and French concluded that the beta did not have a significant role in explaining stock returns, including in the long run and firm size, and the BTM ratio was sufficient to explain the variation in stock returns.

Fama and French (1993) presented the three-factor model, where firm size and the BTM ratio were included, together with the market beta as the third factor. The authors argued that the new model could explain the cross-sectional stock returns better than the CAPM. Fama and French contended that firm size and BTM ratio could explain the cross-sectional variation on the U.S. stock markets sufficiently, and firm size and the BTM ratio could be proxies for risk.

1.3 Research Objective

There are three research objectives in this study. The first research objective is to test whether there are firm size and the BTM ratio effects in the Chinese A-share stock market. Drew, Naughton and Veeraraghavan (2003), Wang and Xu (2004) and Wong, Tan and Liu (2006) found that the firm size was negatively related to stock returns in the Chinese stock markets. However, the authors argued that there was no BTM ratio effect in the Chinese stock markets. On the other hand, Chen, Kan and Anderson (2007) tested the risk factors on the Chinese stock markets and reported a positive relationship between the BTM ratio and stock returns. Wang and Iorio (2007) conducted a similar test using the Fama and French (1992) model on the Chinese A-share stock market and confirmed the presence of firm size and BTM ratio effects. This study follows the Drew et al. (2003) framework to re-examine the size and book-to-market effect on the Chinese A-share stock market.
The second research objective is to test whether the Fama and French (1993) three-factor model is applicable to the Chinese A-share stock market and whether the Fama and French model could present a better explanation for stock returns than the CAPM on the Chinese A-share stock market. Drew et al. (2003) indicated that the CAPM could not adequately measure the stock returns in the Shanghai stock market. Wang and Iorio (2007), in their analysis, found that neither the local beta nor the global beta was related to the Chinese A-share stock return. There is no research that examines the application of the original Fama and French (1993) three-factor on the Chinese A-share stock market. Thus, this study will test the applicability of the Fama and French three-factor model to the Chinese A-share stock market and will compare the performance of the three-factor model and the CAPM.

The third research objective is to find out whether there exists size and BTM ratio factors in the stocks’ earnings. Fama and French (1995) claimed a fundamental economic reason for the firm size and BTM ratio effect on the stock returns. The authors reported that the size and BTM ratio were related to stocks’ profitability. The high-BTM ratio stocks were less profitable compared with the low-BTM ratio stocks, and small stocks had lower earning to book value ratio than large stocks. In this study, we follow Fama and French’s (1995) method to find out the economic reason for the size and BTM ratio effect by using Chinese A-share stock market data.

1.4 Significance of Research

Most of the research testing the Fama and French (1993) three-factor model concentrated on the U.S. stock markets. Although there is evidence to support the three-factor model using data from stock markets outside the U.S., there is a lack of empirical evidence to tell whether there are firm size and BTM ratio effects on the Chinese A-share stock market. Several
studies have investigated the Chinese stock markets using the Fama and French three-factor model. They include Drew et al. (2003) and Wong, Tan and Liu (2006). These studies found that there was a size effect in the Chinese stock markets, but the BTM ratio had weak explanatory power in the cross-sectional stock returns. Wang and Xu (2004) tested the stock returns in the Chinese A-share stock market including the Shanghai and Shenzhen A-share stock markets. Their results showed the BTM ratio had no effect in the Chinese stock markets. On the other hand, Wang and Iorio (2007) and Chen, Kan and Anderson (2007) used different methods to examine the risk factors related to stock returns in China and found that the firm size and BTM ratio could be risk factors for stock returns in the Chinese stock markets. In summary, some empirical studies showed a BTM ratio effect in the Chinese stock markets, but there is no direct evidence to support the Fama and French three-factor in the Chinese stock markets.

The CAPM is widely used to predict asset expected returns by both researchers and practitioners in various situations, such as portfolio management, evaluation of asset performance, and capital budgeting. If the CAPM inaccurately predicts stock returns, it will result in sub-optimal resource allocation decisions and negatively affect the investors’ wealth. Our study will show that the Fama and French (1993) three-factor model can better explain the stocks returns than the CAPM model in the Chinese A-share stock market. The findings 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 the capital.

Previous research which tested the stock returns on the Chinese stock markets used data from 1993 to 2002 (see Drew et al. 2003; Wang and Xu, 2004; Wang and Iorio, 2007; Wong et al. 2006). However, the Chinese stock markets had many deficiencies at the beginning. For
example, the market standardisations were inadequate and there were still significant regulatory loopholes (see Lee, Chen and Rui 2001). These deficiencies could affect the stock returns and may cause bias and inaccuracy in the testing models. Our study testing period is from 1996 to 2005, when the standards and regulatory framework of the stock market was more mature, the market was more efficient, and the stocks were not mispriced. Therefore, there were fewer arbitrage opportunities for arbitragers, the data are more reliable and the results will be more robust in predicting stock returns than in prior studies.

1.5. Review of the Chinese Stock Markets

The Chinese stock markets comprise 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 shares are tradeable in two groups, namely A-shares and B-shares. The A-shares were issued at the establishment of the Chinese stock market and the B-shares were issued in 1992. The A-shares are valued in renminbi (Chinese currency) and are tradable only to Chinese citizens, whereas the B-shares, also valued in renminbi, are tradable in foreign currency and originally could be bought or sold only by foreigners. Since 2001, the B-shares may be traded by Chinese citizens who hold foreign currency.

The Chinese stock markets have grown very quickly from 1996 to 2005. The total number of listed firms increased about 1.54 times and the number of A-share firms increased more than 1.75 times from 1996 to 2005. The total market capitalisation was 9842 million renminbi in 1996, compared with 32430 million renminbi in 2005, an increase of about 230 percent.

For two reasons this study will focus only on the A-shares stock market. First, the data in Table 1 show the number of B-share listed firms did not increase significantly compared with
A-shares. Figure 1 shows the number of B-share listed firms was stable from 1996 to 2005. However, the number of A-share listed firms showed a significant increase. Second, the B-shares were tradable domestically from the middle of 2001 but are illiquid. In addition, the number of B-share listed firms is quite small. Therefore, Wang and Xu (2004) used the A-share stock market data to test the three-factor model since the number of firms in the B-share market was less than 8% of the total market.

There is a unique feature in the Chinese A-share market. 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. Wand and Xu (2004) and Drew et al. (2003) pointed out that this special feature may reduce the BTM ratio factor’s explanatory power.

Table 1.1 The number of listed firms and the total market capitalization of the Chinese stock market 1996 to 2005

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Listed Firms</th>
<th>A-Share Firms</th>
<th>B-Share Firms</th>
<th>Total Market Capitalization (million renminbi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>599</td>
<td>514</td>
<td>85</td>
<td>9842</td>
</tr>
<tr>
<td>1997</td>
<td>821</td>
<td>720</td>
<td>101</td>
<td>17529</td>
</tr>
<tr>
<td>1998</td>
<td>931</td>
<td>825</td>
<td>106</td>
<td>19506</td>
</tr>
<tr>
<td>1999</td>
<td>1029</td>
<td>922</td>
<td>108</td>
<td>26471</td>
</tr>
<tr>
<td>2000</td>
<td>1174</td>
<td>1010</td>
<td>114</td>
<td>48091</td>
</tr>
<tr>
<td>2001</td>
<td>1240</td>
<td>1130</td>
<td>110</td>
<td>43522</td>
</tr>
<tr>
<td>2002</td>
<td>1310</td>
<td>1199</td>
<td>111</td>
<td>38329</td>
</tr>
<tr>
<td>2003</td>
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<td>1261</td>
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<td>42458</td>
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<td>2004</td>
<td>1463</td>
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<td>110</td>
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</tr>
<tr>
<td>2005</td>
<td>1467</td>
<td>1358</td>
<td>109</td>
<td>32430</td>
</tr>
</tbody>
</table>


1.6 Outline of the Thesis

Chapter one outlines the general description of the study, including the background, research hypotheses, research importance and the purpose of the research. Chapter two provides an overview of the literature about the CAPM and three-factor model. Chapter three describes the methodology and data used in this research. Chapter four presents the findings and interpretation of the empirical models. Chapter five concludes the research, summarizes the findings and provides recommendations for future research.
Chapter 2

Literature review

2.1 Introduction

This chapter reviews the literature related to the CAPM and Fama and French (1993) three-factor model. Section one introduces the CAPM and the debates surrounding the CAPM. Some studies confirm the validity of the CAPM in predicting the stock returns, whereas others argued that the CAPM cannot explain the portfolio stock returns. Following this, we introduce other types of the CAPM. Section two reviews several factors affecting stock returns, such as firm size, book-to-market (BTM) ratio, debt to equity ratio (DE), and earning price ratio (EP). The third section details the Fama and French (1992, 1993, 1995, and 1998) findings. For example, Fama and French (1992) reported that firm size and the BTM ratio effect could capture abnormal stock returns. Fama and French (1993) presented the three-factor model to explain the portfolios’ stock expected returns. The fourth section reviews the stock market evidence from outside the US in supporting the three-factor model, including some studies of the Chinese stock market. Finally, this chapter presents the three main arguments about the three-factor model, potential sources of bias, the over-reaction hypothesis, and the characteristic hypothesis associate with the Fama and French findings.

2.2 CAPM

The capital asset price model (CAPM) was developed by Sharpe (1964), Lintner (1965), Mossin (1966) and Black (1972). The CAPM model is as follows:

\[
E(R_i) = R_f + \beta_i (R_m - R_f)
\]
Where, $E(R_i)$ is the expected stock return at time $i$;

$R_f$ is the return on the risk-free asset;

$R_m$ is the return on the market portfolio;

$\beta_i$ is the slope for the market risk premium factor;

The $(R_m-R_f)$ term is the market risk premium, which measures the excess market return required by the investor to hold the market portfolio instead of a risk-free asset. According to the CAPM, an asset’s expected return should depend only on its systematic risk, since the unsystematic risk of the asset could be diversified by portfolio selection. Sharpe (1964) and Lintner (1965) used beta to measure the systematic risk and reported a positive linear relationship between beta and asset expected returns. There are certain assumptions embedded in the CAPM. First, investors make the investment decision based on the mean and variance of expected returns. Investors have homogeneous expectations of asset returns in a single period. Second, taxes and transaction costs are absent. Third, the presence of perfectly divisible assets and information are fully available to buyer and sellers. Fourth, there are risk-free assets available, and the ability to borrow and lend unlimited amounts at the risk free rate of interest (Roll 1977).

In the early 1970s, Black, Jensen and Scholes’ (1972) study showed a linear relationship between beta and stock expected return. The authors tested the cross-sectional monthly stock returns on the U.S. stock market from 1926 to 1966 and discovered the beta had a positive trend during the test period, and concluded that the beta was an important determinant of stock returns. Similarly, Ang and Chen (2003) showed that the CAPM performed remarkably well in the long run. They used U.S. stock market monthly data from 1963 to 2001 and developed the conditional CAPM with latent time-varying betas and concluded that the
standard unconditional CAPM could explain the spread between the portfolio returns. Fama and French (2004) pointed out that the CAPM was useful to predict the individual asset return.

2.3 Arguments about the CAPM

There is empirical evidence that supports a linear relationship between beta and stock expected returns (e.g., see Black et al., 1972; Ang and Chen, 2003). However, the empirical evidence showed that the CAPM cannot fully explain the portfolio asset returns, and the beta has little or no explanatory power in predicting the asset returns. Fama and French (2004) pointed out that the application of the CAPM was invalid because the portfolio stocks returns could not be explained by the CAPM.

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. Roll argued that the real proxies would be highly correlated with each other. However, the only testable hypothesis of CAPM was the market portfolio mean-variance-efficient where the linear relationship between asset returns and beta was based solely on the mean-variance-efficient of the market portfolio, but the real market portfolio did not support the hypothesis. Megginson (1996) confirmed Roll’s critique and pointed out that the most damaging critique of the CAPM was Roll’s 1977 criticism. Shanken (1987) showed similar results to Roll’s critique; the unambiguous inference about the validity of the CAPM was not attainable, regardless of whether one used the Centre for Research in Security Prices (CRSP) equal-weighted stock index or the U.S. long term government bond index in a multivariate proxy and multiple correlations between the true market portfolio and proxy assets. Kandel and Stambaugh (1987) focussed on the multiple-correlation between the proxy and the market portfolio and found that if the 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.

Fama and French (2004) disagreed with Roll’s critique. They argued that, in the normal efficient market, the expected returns and beta of the portfolio is the minimum-variance condition (the lowest possible portfolio variances in which certain portfolios contain the risky stocks, and there are no risk-free assets). Fama and French argued that investors under the minimum-variance condition market have the chance to form the mean-variance-efficient portfolio when they contained reasonable proxies.

2.4 Other Types of CAPM

Empirical researchers of the CAPM have shown varied results. Some researchers relaxed the assumption in the original CAPM, and then tested the validity of the theoretical extensions to the CAPM.

Breeden (1979) employed Merton’s (1973) model by extending the CAPM in a multi-goods and continuous-time model known as the consumption-oriented CAPM (CCAPM). The difference between Breeden’s model and the original CAPM is that Breeden used the real consumption rate to calculate the beta. Breeden, Gibbons, and Litzenberger (1989) conducted empirical tests on the CCAPM. The CCAPM basic prediction is that the beta should be significantly positive related to the expected return of assets. However, Breeden, Gibbons, and Litzenberger found that the hypothesis of a positive linear relationship between beta and expected returns was rejected. They presented three reasons for the rejection of the CCAPM hypothesis. First, the data should be monthly, not be quarterly. Second, the Great Depression during 1929 to 1939 had negative effect on the CCAPM. Third, the market portfolio weights
(the percentage of the risk-free assets and the risk assets) contained uncertainty and should be included in the estimation.

Gibbons and Ferson (1985) developed the CAPM with a multiple risk model, namely the conditional CAPM. They argued that previous CAPM studies did not follow the basic theory of conditional information. Gibbons and Ferson conducted the test using the daily stock data of the Dow Jones 30 from 1962 to 1980 and confirmed the hypothesis of the conditional CAPM. Their results showed a linear relationship between the beta and the portfolio expected stock returns.

Tinic and West (1986) presented a four-parameter model that added another two variables, the beta square and standard deviation, and reported that the beta had a significant nonlinear relationship with expected returns in the CRSP index. Furthermore, the adjusted R-squared in their model increased compared with the original CAPM. Their results indicated that the four-parameter model could provide an accurate prediction of portfolio expected returns.

According to the traditional CAPM model, only beta is related to the asset returns. However, Fama and French (2004) argued that the CAPM could not be used to predict portfolio asset returns. The beta was insufficient in explaining the expected returns, and the CAPM model requires other variables to increase the explanatory power of the expected returns (Fama and French, 1992). They argued that firm size and book-to-market ratio could sufficiently explain the cross-sectional variation in average stock returns. Later, Fama and French (1993) presented the three-factor model, which could explain the cross-sectional stock returns better than the CAPM.
2.5 Size Effect

The CAPM hypothesizes a linear relationship between the expected returns and the market risk of the stock returns. There is some evidence that shows that either the CAPM is inaccurate or the beta cannot effectively explain the assets’ expected returns. Other researchers pointed out that size, EP ratio, leverage, and book to market ratio can explain the assets’ expected returns more efficiently.

Banz (1981) was the first researcher to argue that, on average, small firms earned higher returns than large firms. In a sample period of 50 years, stretching from 1926 to 1975, the author used common stocks monthly data on the New York Stock Exchange. Banz applied three stock market indexes to test the firm size effect. The first was the CRSP equal weight index, followed by the CRSP value weight index and the third was a combination of equal weight, value weight and corporate return data, and government bonds return data. The results showed a nonlinear stable relationship between size and stock expected returns in the three market indexes. On average, the small firms’ earnings were 0.4% higher than large firms’ earnings per month. The beta was negatively related to stock returns. Banz concluded that firm size should be a risk proxy for the CAPM. In addition, the author argued that the size effect did not have a theoretical foundation and questioned whether there were unknown factors correlated to firm size. Nevertheless, Banz agreed with Klein and Bawa’s (1977) explanation that there was insufficient information available to investors causing them to limit their portfolio diversification. Investors do not have a desire to hold small firms stock since the small firms might get higher undesirable returns. Reinganum (1981) confirmed Banz’s findings and argued that there was a significant negative relationship between firm size and asset abnormal returns. However, Reinganum’s testing period was short. The author used quarterly return data from 1975 to 1977 from the New York Stock Exchange and American
Stock Exchange stocks. The author asserted that the CAPM was inadequate in predicting the asset expected returns and firm size could be the risk proxy factor. 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 U.S. stock market.

Following the discovery of the small firm effect, researchers have subjected this anomaly to much scrutiny and analysis. They have tried to find the reason for the small firm effect. For example, Stoll and Whaley (1983) confirmed that the size effect existed in a holding period of three months or more on the New York Stock Exchange during 1955 to 1979. They also pointed out that the transaction costs were higher for the investors holding small firms stocks compared with large firms stocks. In order to discover the transaction cost effect, Stoll and Whaley examined the CAPM applied to monthly stock returns the transaction cost deducted. They found small firms received higher returns than large firms. They concluded 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. He applied this to sample stocks listed on the New York Stock Exchange from 1963 to 1979. Keim found that nearly 15% of the size effect premium (small firm returns are smaller than large firm returns on average) was caused by January abnormal returns, and were higher than in the other months.

Roll (1981), Handa, Kothari and Wasley (1989) and Chan and Chen (1988) rejected the size effect and showed the small firm effect was caused by bias or incorrect methods. For example, Roll (1981) argued that small firm effect was caused by infrequent trading and firm size could
not be a risk factor. The author used the Standard & Poor’s 500 index, New York Stock Exchange index, and American listed common stocks data to examine the small firm effect. The sample period was from 1962 to 1977. The author found by comparing the daily and semi-annual results that the beta and the mean returns increased irregularly. The daily mean returns of Roll’s portfolio were slightly larger than the daily mean returns of the index, but the semi-annual mean returns were two times larger than the daily returns. The beta also increased about 50% from daily to semi-annual. Based on these results, the author pointed out investors would be not concerned about firm size whether small or large, when the risk and returns were equal. Roll further found that there was positive correlation between firm size and frequent trading. Therefore, the small firm effect was due to less-frequent trading and the small firm effect was a bias in risk measurement.

According to Handa et al. (1989), 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. The sample included all the stocks monthly data from 1926 to 1982. They formed 20 portfolios by firm size, and then used the buy-and-hold equally weighted return to test the beta and size effect against the return interval. Handa et al. (1989) found that the beta changes could predict the expected return interval and that annual betas are more efficient in explaining stock returns than monthly betas. In addition, Handa et al. used regression to examine monthly and annually firm size coefficients and beta. The results showed that the coefficients of firm size were not statistically significant but the betas had significant explanatory power. Therefore, they concluded that the CAPM was efficient in predicting assets’ expected returns and the size effect could be explained by the beta.
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. The authors found the size effect existed, but was not stable over time. The small firm effect was due to imprecise measurement of beta. Therefore, firm size did not have additional power to explain the returns.

However, Jegadeesh (1992) cast doubt on the assertion of both Chan and Chen (1988) and Handa et al.’s (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. Jegadeesh further argued that neither Handa et al. (1989) nor Chan and Chen (1988)’s findings could satisfactorily explain expected returns’ variations. Fama and French (1992) also stated 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.

### 2.6 Book-to-market (BTM) Ratio Effect

Since firm size is not the only risk factor related to assets’ expected returns, a number of researchers pointed out that the BTM ratio could be an additional risk factor. Stocks with a high BTM ratio earned higher returns than stocks with a low BTM ratio. The difference between the high BTM ratio stocks’ earning and low BTM ratio stocks’ earning is the value premium.

Chan et al. (1991) revealed that there was a significant positive relationship between the BTM ratio and assets’ expected returns for the period 1971 to 1988 in the Tokyo Stock Exchange. Chan et al. used 64 portfolios to test the relationship between four variables (earnings yield,
size, BTM ratio and cash flow yield) and the portfolios’ returns. The evidence showed that the high positive BTM ratio firms were about 1.1% higher than the low positive BTM ratio firms. They further reported that the coefficients of the BTM ratio variable have a significant positive sign. Further, there was no specific effect in January when using the BTM ratio to predict stock returns. Finally, the authors tested the CAPM and found the beta could not explain the cross-section stock returns in the Japanese stock market during their testing period. They concluded that the BTM ratio had a significant impact on the stock expected returns.

Fama and French (1992) tested the relationship between assets’ expected returns and size, BTM ratio, leverage, and EP ratio on the New York Stock Exchange, American Exchange, and National Association of Securities Dealers Automated Quotation System from 1962 to 1989. They reported that the BTM ratio had a strong role in explaining the cross-sectional stock average returns. Fama and French (1993) stated that the BTM ratio, which could explain stock average returns, was related to economic fundamentals. They claimed that 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. However, in the long-term, the high BTM ratio stocks yielded higher profitability than the low BTM ratio stocks.

Daniel, Titman and Wei (2001) investigated the U.S. and Japanese stock markets from 1975 to 1997 and concluded that the cross-section stock returns were directly related to the BTM ratio. The authors reported that the difference between the high BTM ratio stock returns and the low BTM ratio stock returns was 0.99% per month in the Japanese stock market, and
0.35% in the U.S. stock market. Their results showed that the BTM ratio had a stronger power to predict average cross-sectional stock returns in the Japanese stock market than the U.S. market.

Chen et al. (2007) applied a different method to test the BTM ratio effect on the Chinese Stock Market. They ran the cross-sectional stock returns regression by rearranging the risk variable into several principal components. They found that the cross-section stock returns were positively related to the BTM ratio on the Chinese Stock Market. However, the BTM ratio effect could be replaced by other factors that could predict the stock returns more accurately than the BTM ratio. Chen and Zhang (1998) also found that the BTM ratio could explain stock returns. However, they pointed out that the BTM ratio might not be sufficient to explain the stock expected return in a high-growth market.

The literature, in general, supported the BTM ratio as a distress factor, but there exists a number of disagreements about the BTM ratio as a risk proxy. For example, Daniel and Titman (1997) argued that the BTM ratio effect is the firm’s risk characteristics rather than the risk factor in generating stock expected returns. They applied the Fama and French (1993) data and portfolio returns and found that high BTM ratio stocks had high average returns that did not depend on the return patterns. This implies the assets expected returns are related to their firms’ characteristics and have no relationship with the covariance returns of the BTM ratio. Daniel and Titman rejected the CAPM hypothesis. They argued that the beta could not explain the cross-sectional stock returns when either forming the portfolios by size or by the BTM ratio.
Another disagreement of BTM ratio as risk factor came from the Lakonishok et al. (1994) study. They argued that the high BTM ratio anomaly was due to investor overreaction. Lakonishok et al. stated that investors are over-optimistic about well performing stocks and over-pessimistic about stocks with poor performance in the previous year. The BTM ratio captured systematic errors in investors’ expectations about future returns. Therefore, Lakonishok et al. concluded that the BTM ratio should not be proxy for the risk factor.

2.7 Other Factors

Researchers found that the CAPM did not perform as well as multifactor alternatives in predicting the stock portfolios’ expected returns. Besides the firm size and BTM ratio variables, empirical research revealed that there are other factors relating to the stock portfolios’ expected returns. The debt to equity ratio and earning price ratio are the most significant and influential factors.

2.7.1 Debt to Equity Ratio (DE) Effect

Bhandari (1988) used the DE to explain the stock expected returns. The author argued that when a firm’s DE ratio increases, the common equity of the firm also increases, including the risk. There should be a positive relationship between the DE ratio and stock expected returns. The sample of the study was from the CRSP monthly files from 1949 to 1979. The author combined the DE ratio with the CAPM and reported that the coefficient of DE ratio was 0.13% per month and significant. Bhandari concluded that the DE ratio was significant and positively related to stock expected returns.
2.7.2 Earning Price Ratio (EP) Effect

Basu (1977) indicated that the average returns on low EP stocks were higher than the high EP stocks’ returns. The author investigated over 1400 firms listed on New York Stock Exchange from 1956 to 1971. The result demonstrated that the average annual rate of returns on the high EP portfolio was 0.0934 compared with 0.1630 for low EP portfolio average annual returns. The stock expected return was negatively related to the EP. Basu (1983) further investigated the EP effect on the stock expected returns on the New York Stock Exchange from 1963 to 1980 and confirmed Basu’s (1977) findings. Basu reported that the EP effect was significant when the portfolios were formed by size. However, when the portfolios were controlled by EP, there was no size effect. Basu argued that the EP effect should be another variable for the risk proxy in predicting stock expected returns. Keim (1990) tested the EP effect on New York Stock Exchange and American Stock Exchange from 1951 to 1986. The author’s daily stock returns and the monthly returns were calculated by linking the daily stock returns in order to reducing the biases. The author found that the EP had a significant effect on the stock expected returns. Moreover, Keim reported that the EP and size effect were correlated together and pointed out that there was January effect when the portfolio was formed by the EP. The EP coefficient in January was higher than the other months of the year in his model.

However, Fama and French (1992) rejected the DE and EP effects. They argued that, in the U.S. stock market, the explanatory power of the DE and EP on stock expected returns could be absorbed by the size and BTM ratio factors.

2.8 Fama and French Findings and the Three-factor Model

Fama and French (1992) examined the relationship between five factors (beta, firm size, BTM ratio, DE ratio and EP ratio) using cross-sectional stock returns on New York Stock Exchange,
American Stock Exchange, and the National Association of Security Dealers Automated Quotation from 1963 to 1990. The five factors were chosen because they are the most important factors in predicting stock returns according to the literature (Fama and French, 1992). In response to the Chan and Chen (1988) argument (the size effect was caused by firm size highly correlated to beta), Fama and French separated the correlation between beta and size by allocating the sample to 100 portfolios by size and pre-ranked beta. They used the Fama and MacBeth (1973) methods to test their results. They found when the sample portfolio was formed by beta, the two extreme (the largest size and the smallest size) portfolios had similar stock returns, 1.20% and 1.18% per month respectively. As for other portfolios, the relationship between the stock returns and beta was weak and variable. Fama and French pointed out that the stock expected returns were not related to the market beta. On the other hand, when the portfolio was based on firm size only, there was a significant negative relationship between firm size and the stock average returns, which confirmed Banz’s (1981) findings. Fama and French further stated that there was no relationship between firm size and beta.

Fama and French further examined the BTM ratio effect on the cross-sectional stock returns. They reported a strong positive relationship between the BTM ratio and stock returns, which supported Chan et al.’s (1991) findings. In order to test the robustness of the firm size and the BTM ratio effects, Fama and French divided their testing period into three sub-periods. They found that the beta was positive for only one period but was not statistically significant. The firm size effect was weak in one period between 1977 and 1990. However, the average firm size effect was significantly related to stock returns. The BTM ratio was significant and positively related to stock returns in all three sub-periods. Fama and French concluded that the BTM ratio effect was more effective in explaining the stock returns than firm size.
The DE and EP effects were significant during the testing period, but Fama and French showed that the BTM ratio could absorb the DE ratio effect. In addition, they revealed that the relationship between the EP ratio and the cross-sectional stock returns could be subsumed by the combination of firm size and the BTM ratio effects. Based on their findings, Fama and French concluded 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 in the U.S. stock market.

Fama and French (1993) used the three-factor model, firm size factor, BTM ratio factor and the market beta to predict stock returns. They extended the testing period from 1990 to 1991. The three-factor model was tested with three stock portfolios, namely the market stock portfolio, the mimicking stock portfolio by firm size, and the mimicking stock portfolio by the BTM ratio. The firm size and the BTM ratio coefficients were statistically significant, which showed these two factors had strong power in predicting the stock returns. In addition, the intercept of the three-factor model was close to zero, which showed the three-factor model could explain the variation in the excess returns well. Fama and French used time-series data to compare the three-factor model and the CAPM. The results showed that the three-factor model had significantly higher $R^2$ than the CAPM model. 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 to find the fundamental economic reasons why firm size and the BTM ratio affect stock returns. The sample data were similar to those in the Fama and French (1992) study. They extended the one-year testing period from 1963 to 1992. The authors confirmed the Fama and French (1992, 1993) findings that the firm size and BTM ratio do affect the cross-sectional stock
returns. Fama and French argued that the BTM ratio reflects the long term effect of the stocks returns and they revealed that firms with a high BTM ratio has a distressed effect on the stock returns for a longer period. This implies that the stocks have low prices relative to their book value, and the high BTM ratio stocks are less profitable compared with the low BTM ratio stocks. Investors who hold high BTM ratio stocks would suffer high risk but expected to earn high returns. Moreover, the evidence showed that when the sample was formed by the BTM ratio, the larger firms were more profitable than the smaller firms. Fama and French reported that these findings suggest the firm size and BTM ratio could be the risk factors in predicting returns. Finally Fama and French concluded that, for the rational stock price, firm size and BTM ratio corresponded to the behaviour 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.

Fama and French (1998) re-examined the relationship between stock returns and firm size and BTM ratio effects on 13 international stock markets (the U.S., Japan, the U.K., France, Germany, Italy, the Netherlands, Belgium, Switzerland, Sweden, Australia, Hong Kong and Singapore) from 1975 to 1995. In order to reduce the survivor bias, Fama and French used Morgan Stanley’s Capital International Perspectives data, since that data source excluded newly added firms. They confirmed the value stocks outperformed growth stocks. The evidence showed that there were over 3.09% and 5.09% average return premiums for the global value stock portfolios and the global market stock portfolios annually, respectively. In contrast, the average returns premium of the global growth stock portfolios and the global value stock portfolios were 5.56% and 7.65% annually, respectively. Fama and French concluded that the high BTM ratio portfolios had higher returns than the low BTM ratio portfolios.
Fama and French (1998) carried out further investigation on the three-factor model using the global emerging stock markets. They applied it to 16 (Argentina, Brazil, Chile, Colombia, Greece, India, Jordan, Korea, Malaysia, Mexico, Nigeria, Pakistan, the Philippines, Taiwan, Venezuela and Zimbabwe) emerging markets’ data during the period 1987 to 1995. Their results supported the BTM ratio effect in the emerging markets. Fama and French reported that the returns of high BTM ratio portfolios were 14.13% higher than the low BTM ratio portfolios when the portfolios were of equal weight, and the returns of high BTM ratio portfolios were 16.91% higher when the portfolios were of value weight. Fama and French also found evidence to confirm the firm size effect on the emerging markets. When the portfolios were organised according to equal-weight and value-weight, the average return premiums of the small stock and large stocks were 14.89% and 8.70%, respectively. Fama and French also tested the validity of the international CAPM and found that the intercepts of the CAPM were over 20 basis points for the global value and growth portfolios. The F-test and p-value of the intercept indicated that the intercepts did not equal to zero, and the beta could not explain the stock return sufficiently. Therefore, Fama and French confirmed that the international CAPM has no power to predict the stock returns.

2.9 Out-of-sample Studies

Following Fama and French (1992) three-factor model, several studies have tested whether firm size and the BTM ratio could explain the stock returns outside the U.S. 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 but the three-factor model could predict stock returns more accurately.
Aksu and Onder (2000) tested the three-factor model on the Istanbul stock exchange from 1993 to 1998. Their results were consistent with the Fama and French (1993) findings where firm size and the BTM ratio effects were statistically significant. Aksu and Onder revealed that the interval of the small portfolios’ stock returns was 15.0 - 15.81% higher than the large portfolios’ stock returns. The interval of the high BTM ratio portfolios stock returns was 11.5% to 15.06% higher than the low BTM ratio portfolios stock returns. However, they also reported that the beta was highly correlated to the portfolios’ stock returns. Aksu and Onder further compared the explanatory power of the CAPM with the three-factor model. They found the $R^2$ for the CAPM was 0.85 while the $R^2$ for the three-factor model was 0.95. Therefore, they concluded that the three-factor model did a better job than the CAPM in explaining stock returns.

Chen and Zhang (1998) employed the three-factor model to examine the Pacific Rim markets, including Japan, Hong Kong, Malaysia, Taiwan, Thailand, and the U.S. stock markets. They found firm size affected stock returns. The difference between the small size portfolios’ returns and the large size portfolios’ returns were positive and statistically significant in the U.S., Japan, Hong Kong, Malaysia, and Thailand stock markets. Moreover, Chen and Zhang found that the U.S., Japan, Hong Kong, and Malaysia stock markets were affected by BTM ratio effect, where the high BTM ratio portfolios could provide more earnings than the low BTM ratio portfolios. However, the Taiwan stock market was not affected by firm size and the BTM ratio effects. Chen and Zhang argued that for a high-growth stock market, such as Taiwan, firms would captured the profits of an expanding economy, but the high risk might be not related to the high stock returns. This explained why the firm size and BTM ratio factors could not contain sufficient information of the firms’ past performance on stock prices. In addition, the firm size and BTM ratio effects could not accurately predict the investment
opportunities on a high-growth market. Overall, Chan and Zhang indicated that firm size and the BTM ratio had explanatory power on stock returns in the developed countries’ stock markets.

Drew and Veeraraghavan (2002) reported that the three-factor model could explain the stock returns sufficiently for the Malaysia stock market. They used monthly data obtained from DataStream from 1992 to 1999. The authors divided the whole sample into six intersection portfolios by size and BTM ratio. They found that the returns for the small firm stock portfolios were greater than the average returns for the large firm stock portfolios. They found that the coefficients of the size factor were significant at 1% level for all the six portfolios and the coefficients of the small stock portfolios were higher than the large stock portfolios. These results are consistent with the firm size effect hypothesis. The BTM ratio coefficients were statistically significant at the 1% level. The high BTM ratio stock portfolio coefficients were higher than the small BTM ratio stock portfolio coefficients. Drew and Veeraraghavan’s findings showed that the BTM ratio had an effect on stock returns on the Malaysian stock market.

Gaunt (2004) used the three-factor model to test the Australian stock market using monthly data from 1991 to 2000. The author followed the Fama and French (1993) method and formed 25 intersection stock portfolios by size and BTM ratio. Gaunt found that the firm size and BTM ratio were highly correlated to the stock returns. He reported that the interval of the small size portfolios’ coefficients were from 1.41 to 1.87, compared with the interval of the big size portfolios’ coefficients from -0.15 to 0.14. The interval of the high BTM ratio portfolios’ coefficients and the low BTM ratio portfolios’ coefficients were from 0.15 to 1.39 and -0.82 to 0.05, respectively. The findings were consistent with the Fama and French (1993)
results, which showed a negative relationship between firm size and the portfolio stock returns, and a positive relationship between the BTM ratio and the portfolios stock returns. Furthermore, Gaunt compared the explanatory power of the CAPM and the three-factor model by using 25 portfolios’ data and applied $R^2$ to measure the explanatory power. The author showed that the average $R^2$ of the CAPM was 0.35 for the 25 portfolios. In contrast, the average $R^2$ of the three-factor model was 0.67. The average $R^2$ increased about 90 percent. Gaunt concluded that the three-factor model could better explain stock returns than the CAPM on the Australia stock market.

2.10 Evidence on the Chinese Stock Market

Most empirical studies on asset pricing are conducted in the U.S. and other developed countries. 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 from 1993 to 2000. The authors reported that there was a negative relationship between the cross-sectional stock returns and firm size. The coefficient for the firm size variable (small size stock portfolio returns minus large size stock portfolio returns) was 11.12% per year. However, Drew et al. found the coefficient of BTM ratio variable was negative and statistically significant for four of the six portfolios. The authors argued that the Shanghai stock market had a number of non-trading shares held by the government, which were inefficiently valued. Since the shares were mispriced, arbitragers took a premium of the value stocks which outperformed growth stocks. The authors further claimed that the CAPM beta could not be the sole risk measurement.
Wang and Xu (2004) examined the relationship between firm size, the BTM ratio and the stock expected returns on the Shanghai A-share stock market from 1996 to 2002. The authors followed the Fama and French (1992) framework, using logarithms of the variables except beta. Though there was a difference in the Fama and French (1992) model, Wang and Xu added another variable, namely floating equity, to examine the effect on stock returns. The authors found that firm size was highly correlated to the stock returns but the BTM ratio had no effect on the stock returns. Wang and Xu stated that the new model with the floating equity variable had more explanatory power than the original Fama and French (1992) three-factor model.

Wong et al. (2006) extended Wang and Xu’s study to investigate the Shanghai stock market from 1993 to 2002. The authors’ results confirmed the Drew et al. (2003) findings. Their results showed firm size had effect on stock returns and the BTM ratio had a non-explanatory power on the stock returns on the Shanghai market. Nevertheless, Wong et al. rejected the free float effect that is not related to stock returns.

Chen et al. (2007) tested the risk factors on the Chinese A-share stock market. They ran the 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 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, and both the conditional local betas and the global betas were not related to stock returns for the period 1994 through 2002. They extended the Fama and MacBeth (1973) method, which was the basis of the Fama and French (1992) three-factor model. Wang and Iorio tested more factors than Fama and French, including firm size, EP, BTM ratio, dividend yield, DE, the
local beta, the global beta, and the Hong Kong stock market beta. They found that the local beta and the global beta were weak and negatively related to stock returns. The authors reported that the firm size effect was strong and statistically significant; the average slope was -0.039 and the t-statistic was -4.11. In addition, the BTM ratio was positively related to stock returns; the average slope was 0.0154 and the t-statistic was 2.303. Their findings agreed with Fama and French (1992) that the EP was absorbed by the BTM ratio effect.

2.11 The Argument Against the Fama and French Three-factor Model

2.11.1 Potential Sources of Bias

There have been a number of debates about the three-factor model and the Fama and French findings. Some argue that the Fama and French (1992) findings have a potential bias.

Kothari, Shanken and Sloan (1995) argued that the BTM ratio effect was caused by the survivorship bias. They presented two examples of survivorship bias from COMPUSTAT. First, several surviving firms’ historical data were obtained from COMPUSTAT. Second, some stocks data were in the CRSP database but were missing from COMPUSTAT. The authors pointed out that, since these extra data and missing data were related to COMPUSTAT, the sample for the Fama and French (1992) study would contain survivorship bias and the results could be inaccurate because they applied data from COMPUSTAT.

On the other hand, Chan, Jegadeesh and Lakonishok (1995) explained that the data missing from CRSP and not COMPUSTAT were not related to survivorship bias. These missing firms were financial firms, such as closed-end investment companies, REITs, and ADRS. Furthermore, Fama and French (1996) challenged the Kothari et al (1995) findings, reported
there was no survivorship bias in COMPUSTAT and indicated that Kothari et al. reported the firm size effect in their study.

Black (1993) stated that the lack of theory in finding the market anomaly is a sign of data-mining or data-snooping. This statement challenged the Fama and French’s (1992, 1993) findings, because Fama and French (1992, 1993) did not provide the economic reasons for firm size effect and the BTM ratio effect. Kothari et al. (1995) also pointed out that the BTM ratio effect of three-factor model could be a result of data-mining. They applied the Standard and Poor’s Index data from 1949 to 1987 and found that the BTM ratio factor was very weak in explaining the portfolios’ stock returns, which was not consistent with the BTM ratio effect of the three-factor model.

In response to the data-mining hypothesis of Black (1993) and Kothari et al. (1995), Fama and French (1995) provided the fundamental economic reasons, related to profitability, for both the firm size and BTM ratio effects. Moreover, the finding of the anomalies through data-mining was not expected to hold outside the U.S. samples. Fama and French (1998) found support for the three-factor model in 12 international stock markets, including the Japan, UK, France, Germany, Italy, the Netherlands, Belgium, Switzerland, Sweden, Australia, Hong Kong, and Singapore stock markets.

2.11.2 The Overreaction Hypothesis

There are two groups of researchers who do not agree that firm size and BTM ratio should be used as risk factors to predict stock returns. One group applies the stock behavioural principles to explain why small size stock and high BTM ratio stocks outperform the market. For example, Lakonishok et al. (1994) stated that firm size and BTM ratio should not be risk
proxies and the three-factor model could not be used to explain the stock returns. The authors examined long-term stock returns (five years) by using the stocks listed on the New York Stock Exchange obtained from the CRSP and COSTAT. They found the superior returns on value stocks were due to upward revisions in expectations of the future growth rate. They explained that the explanatory power of firm size and the BTM ratio was caused by the systematic error in the way investors formed expectations about future stock returns. They argued investors may misperceive the high BTM ratio stocks (value stock) to be more risky than their ex post performance of the corporate news because the systematic and idiosyncratic risks are difficult to diversify away. Investors would not want to buy or hold the value stocks, therefore it caused the high BTM ratio stocks to be under-priced. However, investors overpriced the low BTM ratio stocks (growth stocks), since they want to buy or hold growth stocks.

Fama and French (1996) conducted a study to test the three-factor model using the Lakonishok et al. (1994) portfolios. They reported that the three-factor model did a good job in predicting stock returns. Fama and French (1995) challenged the Lakonishok et al. (1994) findings and argued that the market could exist that the earnings growth rate for high BTM ratio and low BTM ratio stocks tend to converge when the portfolios formed. Therefore, the three-factor model could be used to forecast the stock returns without bias.

2.11.3 The Characteristics Hypothesis

The other group of researchers argues that the firm size and BTM ratio effects are due to their characteristics in influencing the stock returns. Daniel and Titman (1997) reported that no separate risk factor related to the distress factor in their testing period from 1973 to 1993 in the U.S. stock market. There were no firm size and BTM ratio effects when they controlled
for the firm characteristics. Moreover, the high BTM ratio stocks had similar properties and there should not be any risk premium associated with the BTM ratio factor. They pointed out that the stock characteristics could explain the stock returns better than the firm size and BTM ratio. Daniel Titman and Wei (2001) confirmed the Daniel and Titman (1997) findings by re-examining the characteristic hypotheses in the Japanese stock market from 1975 to 1997.

Davis, Fama and French (2000) contested the Daniel and Titman (1997) characteristics hypothesis. They extended Daniel and Titman’s testing period from 1929 to 1997, and pointed out that Daniel and Titman’s findings were specific for only their testing period. The authors reported that for the long testing period, the characteristic hypotheses were rejected at the 95% level of significance. The three-factor model explained stock returns better than the Daniel and Titman’s model. Lewellen (1999) confirmed the Davis et al. results.

2.12 Conclusion

Researchers, such as Roll (1977) and Fama and French (2004), argued that the CAPM can not explain stock returns accurately. The authors argued that other factors, such as firm size effect, DE effect, EP effect, and BTM ratio effect, have a significant effect on stock returns.

Fama and French (1992) pointed out that firm size and BTM ratio are the most important factors in explaining stock returns, and the DE ratio and EP ratio effect on stock returns could be explained by firm size and BTM ratio. Fama and French (1993) presented the three-factor model and argued that the three-factor model did a better job in explaining the stock returns than the CAPM. Fama and French (1995) reported that the high-BTM ratio stocks were less profitable than the low-BTM ratio stocks and small stocks had lower earnings to book value ratio than the large stocks.
However, some researchers argued that firm size and BTM ratio effects are caused by data bias (Kothari et al. 1995), but others stated that the size and BTM ratio effects were due to investor overreaction or stocks’ characteristics. On the other hand, research also showed the size and BTM ratio effects existed not only in the U.S. stock market, but also in non-U.S. stock markets. For example, the Drew and Veeraraghavan (2002) study showed that the three-factor model could explain the stock returns in the Malaysian stock market. Fama and French (1998) provided evidence of the three-factor model in 12 international stock markets and 11 emerging markets.

For the Chinese stock market, the Fama and French three-factor model showed different results. Some studies reported that the three-factor model could predict the stock returns accurately (Wang and Iorio 2007). In addition, Chen et al. (2007) found that size and BTM ratio could be risk factors for the stock markets. Other researchers argued that there was a size effect but no BTM ratio effect (see Wong et al., 2006; Wang and Xu, 2004; Drew et al. 2003).
3.1 Introduction

Chapter three describes the methodology and data employed in examining the Fama and French (1993) three-factor model and the CAPM in the Chinese A-share stock market. This study follows the Drew et al. (2003) method using the Fama and French (1993) framework to examine the stock return in a small sample stock market. This chapter also presents the hypothesis development and the portfolio formation for testing the three-factor. Data collection is consistent with Drew et al. (2003). Finally, we discuss how to fix the bias related to the Fama and French three-factor model data sources.

3.2 Empirical Model

In this study, we examine the Fama and French three factor model and CAPM on the Chinese A-share stock market. We also compare the explanatory power of these two models to find out which model can predict stock excess returns accurately.

3.2.1 Three-factor Model

This study follows the Drew et al. (2003) method; they adopted the Fama and French (1993) framework to examine small sample stock markets. Fama and French (1993) developed the three-factor asset pricing model as a variant of the CAPM model by adding the firm size factor and the BTM ratio factor and argued that the three-factor model was better in predicting asset returns than the CAPM. The three-factor model is as follows:

\[ R_{it} - R_{ft} = \alpha_i + b_i (R_{mf} - R_{ft}) + s_i \text{SMB}_t + h_i \text{HML}_t + \varepsilon_i \tag{1} \]
Where:

\( R_{it} - R_{ft} \) is the excess stock return at time \( t \);

\( R_{mt} - R_{ft} \) is the excess market return factor at time \( t \);

\( \alpha_i \) 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; and

\( \epsilon_i \) is the error term.

### 3.2.1.1 Forming the BTM-size Portfolios

Following Drew et al. (2003) in forming annual portfolios, 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 whose market value of equity was less than the mid point of the market value of equity. The big size portfolio contains firms whose 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 low BTM ratio portfolio contains one third of the lower BTM ratio stocks. Fama and French (1992) claimed that the BTM ratio has a stronger explanatory power than firm size. The authors formed three BTM ratio portfolios and two size portfolios. The six BTM-size portfolios were formed as follows: 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.
3.2.1.2 Independent Variables

There are three independent variables in the three-factor model. The first independent variable is the firm size factor (SMB), which 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 second variable HML is the BTM ratio factor (HML) 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 forming of six BTM-size portfolios will be described later in this chapter. The third factor in the model is $R_m - R_{ft}$, which is the excess market return factor and $R_m$ is average market return.

3.2.1.3 Dependent Variable

Following Drew et al. (2003), we formed six BTM-size portfolios to obtain the dependent variable of the three-factor model. There are 120 months in our testing 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. Fama and French (1993) sorted their data into 25 portfolios. However, our study differs from Fama and French because the number of listed firms on the Chinese stock market is not as large as the U.S. stock market and in order to ensure the number of firms in each portfolio were reasonable, we divided the data into six portfolios.
3.2.2 The CAPM

We examined whether the Fama and French (1993) three-factor model is superior to the CAPM in explaining stock returns. The CAPM uses beta to value the systematic risk. The model is as follows:

\[ R_{it} - R_{ft} = \alpha_i + b_i (R_m - R_{ft}) + \epsilon_i \]  

Where:

- \( R_{it} - R_{ft} \) is the excess stock return at time t;
- \( R_m - R_{ft} \) is the excess market return factor at time t;
- \( \alpha_i \) is the intercept term;
- \( b_i \) is the slope for the excess market return factor; and
- \( \epsilon_i \) is the error term.

To be consistent, we also used the six BTM-size portfolios returns as the dependent variable in the CAPM and the independent variable is excess market return. The \( R_m \) is the average market return, which uses \( b_i \) to measure the relationship between the excess market return factor and the excess stock return.

3.3 Development of the Hypotheses

There are two hypotheses in our study. First, we test the Fama and French three factor model on the Chinese A-share stock market. We examine whether there is a firm size and BTM ratio effect on the Chinese A-share stock market. The literature shows that there is a negative relationship between firm size and stock return (see Banz, 1981; Wang and Xu, 2004), and that a high BTM ratio stock indicated that the company is under stress, so the stock should be
more risky and the stock may yield high returns to the investor (see Chan et al., 1991; Chen et al. 2007). Therefore, our hypotheses are that all the slopes of market excess factor, firm size factor and the BTM ratio factor are statistically different from zero, and the intercepts are different from zero. If the t-statistics show the slopes are significant and the intercepts are insignificant, then the Fama and French three-factor model is confirmed in the Chinese A-share stock market and the investor can use it to form a stock portfolio.

Secondly, we compare the explanatory power of the three factor model with that of the CAPM. In order to do so, we begin by testing the CAPM model on the Chinese A-share stock market. The hypotheses are the coefficients of market excess factor are significantly different from zero and intercepts are also significantly different from zero. If the null hypotheses of the slopes are accepted and the intercepts null hypotheses are rejected, then the CAPM can be used to predict stock excess return on the Chinese A-share stock market. We then use the adjusted $R^2$ to compare the two models’ explanatory power. If the Fama and French three factor model has larger $R^2$ than the CAPM, then we can conclude that the Fama and French model is better in predicting stock excess returns than the CAPM for the Chinese A-share stock market.

### 3.4 General Testing Methodology

The CAPM claims that there is a positive relationship between stock excess returns and the systematic risk. This means that the beta is statistically significantly greater than zero. Furthermore, the intercept term must be equal to zero and statistically insignificant. Therefore, under these conditions, the CAPM could be used to explain excess asset returns. In contrast, the three-factor model states that the size factor has a negative relationship with stock excess returns and the BTM ratio factor is positively relative to the stock excess returns. The excess
market return factor should be positively related to stock excess returns. The intercept term should also be statistically equal to zero. Fama and French (1993) argued that a well-specified capital asset pricing model’s intercept term should not be statistically different from zero.

We ran the ordinary least squares (OLS) regression using the excess market return (market return minus risk free rate) as the independent variable and the excess stock returns as dependent variable to test the CAPM on the Chinese A-share stock market. Second, to examine the three-factor model, we ran the OLS regression using excess market returns, size factor (SMB) and the BTM ratio factor (HML) as independent variables to examine the excess stock returns. We thus obtain the slopes and intercepts for each portfolio and the t-statistics, which will be used to test whether the slopes and intercepts of the model for the six portfolios are statistically significant for both CAPM and the three-factor model. Cross-sectional data were employed in our regressions. According to Fama and French (1993), cross-sectional regression can show the efficiency of the firm size and the BTM ratio factor relative to the stock returns. The adjusted $R^2$ can be used to compare the explanatory powers of the two models.

3.5 Data

The data for our study include the stock returns of 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 markets 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 on the Chinese stock market regulations when stocks prices were extremely volatile and the market capitalization significantly increased. Therefore, we chose 2005 as the end of our testing period. The data
were obtained from China Stock Market & Accounting Research Database (CSMAR) database. The data satisfy the following requirements:

1. The monthly adjusted closing price adjusted for capital asset changes (such as dividends, share repurchase).
2. The year-end book value at its fiscal year t-1.
3. The market value at the end of December in year t-1.

Table 3.1: Number of listed firms included in the sample for each portfolio from 1996 to 2005

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

The BH portfolio has the largest average number of listed firms and the average SH portfolio has the smallest number of listed firms. The number of listed firms increased dramatically from 1996 to 2005. The number of listed firms in 2005 is four times bigger than the number of listed firms in 1996. As discussed in Chapter 1, the total market capitalisation also had huge increase.

This study examined the three-factor model and the CAPM using both the Shanghai and Shenzhen A-share stock markets from 1996 to 2005. Following the Drew et al. (2003) method, the market value is the value adjusted for the closing price at the end of December times the
number of shares outstanding including the non-tradable shares. The sample of firms in our study includes ordinary common equity and positive book equity firms. The negative book equity firms and financial firms were excluded from the sample. Since financial firms typically have a high debt to equity ratio, it is difficult to compare with non-financial firms. However, the negative book equity firms’ returns were used to calculate the market returns (see Fama and French 1993; Drew, et al., 2003).

The risk-free rate ($R_{ft}$), the market rate of return ($R_{mt}$), the market value of equity (ME), the book value of common equity (BE), and the BTM ratio were used to estimate the CAPM and three-factor model: stock returns ($R_{it}$) in our study.

### 3.5.1 Stock Monthly Returns

We use individual firm stock prices to calculate the stock returns. The data were adjusted for cash payment and dividend payout. The formula for the monthly return is as follows:

\[
R_i = \frac{p_i - p_{i-1}}{p_{i-1}} \quad (3)
\]

Where: $P_i$ is the adjusted closing stock price for stock i at the end of the month t; and $R_i$ is the stock monthly returns.

Following Drew et al. (2003) and Fama and French (1993), the relationships between the stock excess returns and beta, firm size and BTM ratio were examined in our study. We use the stock monthly return minus the monthly risk-free rate as the stock monthly excess returns.
Table 3.2: Yearly stock mean excess returns from 1996 to 2005

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean excess return</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>0.061</td>
<td>0.009772</td>
</tr>
<tr>
<td>1997</td>
<td>0.0211</td>
<td>0.004873</td>
</tr>
<tr>
<td>1998</td>
<td>0.007</td>
<td>0.004041</td>
</tr>
<tr>
<td>1999</td>
<td>0.0194</td>
<td>0.005202</td>
</tr>
<tr>
<td>2000</td>
<td>0.0463</td>
<td>0.004412</td>
</tr>
<tr>
<td>2001</td>
<td>-0.0208</td>
<td>0.002796</td>
</tr>
<tr>
<td>2002</td>
<td>-0.0178</td>
<td>0.002990</td>
</tr>
<tr>
<td>2003</td>
<td>-0.0133</td>
<td>0.002678</td>
</tr>
<tr>
<td>2004</td>
<td>-0.0139</td>
<td>0.003424</td>
</tr>
<tr>
<td>2005</td>
<td>-0.0105</td>
<td>0.002478</td>
</tr>
</tbody>
</table>

The data in Table 3.2 show the yearly mean excess returns from 1996 to 2005. The mean returns are statistically different from zero since the p-values are less than 0.05 at the 5% significance level. The mean excess returns are positive from 1996 to 2000 but negative from 2001 to 2005.

3.5.2 Risk-free Rate

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. The fixed deposit rate was obtained from the People’s Bank of China (see Drew et al. 2003).

3.5.3 Market Rate of Return

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 (see Drew et al. 2003), which were discussed previously. The formula for the monthly market rate of return is as follows:

\[
R_{mt} = \sum_{i=1}^{6} R_{it} + \sum_{j=1}^{6} R_{jt}
\]  

(4)
Where: \( n \) is the number of the negative book value stock returns.

Like Fama and French (1993), the market excess returns were calculated from the market monthly return minus monthly interest free rate.

### Table 3.3: Market monthly excess returns for six BTM-size portfolios

<table>
<thead>
<tr>
<th>Parameter</th>
<th>BH</th>
<th>BM</th>
<th>BL</th>
<th>SH</th>
<th>SM</th>
<th>SL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.0002</td>
<td>0.0004</td>
<td>0.0012</td>
<td>0.0011</td>
<td>0.0008</td>
<td>0.0002</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.0791</td>
<td>0.0788</td>
<td>0.0800</td>
<td>0.0795</td>
<td>0.0797</td>
<td>0.0787</td>
</tr>
<tr>
<td>t-static</td>
<td>0.4165</td>
<td>0.7419</td>
<td>2.0242</td>
<td>1.7227</td>
<td>1.3295</td>
<td>0.2635</td>
</tr>
</tbody>
</table>

The data in Table 3.3 give the summary statistics for the market monthly excess returns for six BTM-size portfolios. The six portfolios mean market excess returns are all positive, but only the BL statistic is significant at the 5% confidence level. The SH statistics is significant at the 10% confidence level. The other portfolios are not statistically significant, which indicates that the four portfolios mean returns are not positive.

### 3.5.4 The BTM Ratio

We obtained the book value of common equity and the market value of equity from the CSMAR. The BTM ratio was computed as the book value of common equity divided by the market value of equity. Like Drew et al. (2003), we first obtained the market value of equity at the end of December in year \( t-1 \). Second, we used the book value of common equity in year \( t-1 \) divided by market value of equity at year \( t-1 \) as the BTM ratio in year \( t \). Following Drew et al. (2003), we used the December market value of equity to calculate the BTM ratio because some firms do not have a December fiscal year since the last day for issuing annual financial reports in China is 30 April.
3.6 Bias Associated with the Fama and French (1993) Data Source

According to Fama and French (1993), the SMB variable reflects the size effect. The SMB factor focuses on the behaviour of big size stock returns and small size stock returns, since the data are sorted independently. SMB is calculated by the big size portfolio returns minus the small size portfolio returns. Similarly, the HML variable emphasises the behaviour of the high stock returns and low stock returns and is the difference between the high BTM ratio stock returns and the low BTM ratio stock returns.

Kothari et al. (1995) argued that there is survivorship bias relative to the data sources of the three-factor model. In our study, we used CSMAR database to test the three-factor model to reduce the survivorship bias, since the bias is controlled by the CSMAE. According to Fama and French (1993), the sample firms must have at least 24 months returns in order to reduce the survival bias and a 6 month lag period is employed before the accounting data are used, which can avoid market volatility. Banz and Breen (1986) claimed that COMPUSTAT also contained the ‘look-ahead’ bias. This bias occurs when the values used are unknown or publicly unavailable when the predictions of expected returns are made. Fama and French (1993) addressed the look-ahead bias since most firms’ fiscal year is 31 December in the U.S, and they also assumed the BTM ratio values could be reported within 6 months of the end of the fiscal year, and they ranked stock based on BTM ratio only on 30 June each year. The authors formed their portfolio based on the BTM ratio using the data at 30 June each year. In our study, because the official fiscal year for Chinese firms is 30 April, 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, and then applied the BTM ratio to rank the stocks in order to mitigate the look-ahead bias.
3.7 Testing the Behaviour of the Stocks Earnings

Fama and French (1995) applied the $\frac{EI_t}{BV_{t-1}}$ (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 $BV_{t-1}$. There is a difference between this study and Fama and French research; Fama and French sorted the data into six BTM-size portfolios at year $t$, $t$ is the year from 1963 to 1991, and calculated the $EI_t/BV_{t-1}$ ratio for year $t + n$, $n = -5, \ldots, 5$, and then showed the 11 years portfolios’ profitability. Since the Fama and French testing period was much longer than the study testing period, we chose 1999, 2000, 2001 and 2002 as year $t$ to form the six BTM-size portfolios, and we calculate the $EI_t/BV_{t-1}$ ratio for year $t + n$, $n = -3, \ldots, 3$, thus, in contrast, we test the 7 years portfolios profitability. The method of forming the six BTM-size portfolios is the same as Chapter 3.2.1.1.

3.8 Conclusion

Chapter 3 discusses the methodology and data used in the study. The chapter addressed the bias in the data source. The data were obtained from CSMAR.

Most studies applied the Fama and French (1993) model to test stock excess returns on the U.S. stock market. For stock markets outside the U.S., researchers followed the Fama and French hypothesis. However, they divided the data into a different number of groups to examine the three factor model based on their sample size. For example, Aksu and Onder (2000) tested the three-factor model on the Istanbul stock exchange by forming 16 BTM-size portfolios; Chen and Zhang (1998) examined the three-factor model in the Pacific Rim Market by dividing the data into 25 BTM-size portfolios, Drew and Veeraraghavan (2002) conducted research on the Hong Kong stock market using 6 BTM-size portfolios, and Drew et
al. (2003) tested the Chinese A-share stock market excess returns by applying 6 BTM-size portfolios. In this study, we follow the Drew et al. (2003) method since the sample size is small compared with the U.S. stock market. Moreover, we also test the CAPM on the Chinese A-share stock market, and compare the explanatory power (adjusted $R^2$ value) of the CAPM and three-factor model.
Chapter 4

Results and Discussions

4.1 Introduction

This chapter presents the summary descriptive statistics of the dependent variable, the stock excess returns, and the independent variable effect including beta, firm size and the BTM ratio. The regression results of the three-factor model and the CAPM are also reported.

The summary statistics of stock excess return show whether the firm size and BTM ratio effect exist on the Chinese A-share stock market. The significant coefficients of the three variables (size factor, BTM ratio factor and market excess return factor) will help determine the rejection or acceptance of the null hypotheses. The intercepts provide the evidence whether the model is well specified. The adjusted $R^2$ determines whether the independent variables in the three-factor model and the CAPM are able to explain the stock returns’ variation.

4.2 Summary Statistics

Table 4.1 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 evidence in the table supports the fact that the firm size and BTM ratio effects exist on the Chinese A-share stock market for the test period.
Table 4.1: Stock monthly excess returns for six BTM-size portfolios from 1996 to 2005

<table>
<thead>
<tr>
<th>Parameter</th>
<th>BH</th>
<th>BM</th>
<th>BL</th>
<th>SH</th>
<th>SM</th>
<th>SL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>0.0086</td>
<td>-0.0033</td>
<td>-0.0101</td>
<td>-0.0006</td>
<td>0.0065</td>
<td>0.0034</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.1204</td>
<td>0.1211</td>
<td>0.1228</td>
<td>0.1216</td>
<td>0.12280</td>
<td>0.1267</td>
</tr>
<tr>
<td>t-statistic</td>
<td>10.1393**</td>
<td>-3.7414**</td>
<td>-11.3606**</td>
<td>-0.6467</td>
<td>6.9358**</td>
<td>3.4694**</td>
</tr>
</tbody>
</table>

Notes:
* Significant at the 0.05 level (2-tailed)
** Significant at the 0.01 level (2-tailed)

The BH, BM, BL, SH, SM and SL terms are the six BTM-size portfolios are discussed in Chapter 3. For example, BH means all the big firms and high BTM ratio stocks in this portfolio.

The data in Table 4.1 show the small size portfolios’ stock excess returns (SM, SL) have a positive mean and the t-statistics for the small size portfolios are significant at the 1% significance level, which means the stock monthly excess returns relationship of the SM and SL portfolios are statistically positive. However, the SH portfolio has a negative mean return and its t-statistic is -0.6467, which is not statistically significant. It shows that the SH portfolio mean of stock excess returns is not statistically negative. The big portfolios’ stock excess returns are statistically different from zero at the 1% significance level. The BM and BL portfolios’ stock excess returns have negative means and the BH portfolio has the positive mean.

In this study, the average mean return for small firm portfolios is 0.0031 and for the large firm portfolios is -0.0016. Although the standard deviations for the six portfolios are very close to each other, our findings reveal that the small firm portfolios stock returns are more volatile than large firm portfolios (the small firm portfolios mean standard deviation is 0.1233, the large firm portfolios mean standard deviation is 0.1218.), moreover the t-static shows there is a significant difference between the standard deviations. This tells us that the small firm stocks have a higher risk than the large firm stocks and the small firm portfolios are more
profitable than the large firm portfolios. Drew et al. (2003) reported that the SM portfolio coefficient of variation is the lowest and the BH portfolio slope of variation is the highest in their six BTM-size portfolios. The average mean return of the small size portfolios in their study was 0.9273% higher than the average mean return of the large size portfolios. The small firm portfolios had higher average higher standard deviations than the large firm portfolios in the Shanghai A-share stock market. Therefore, Drew et al. concluded that the size effect exists on the Chinese A-share stock market. Our results confirm the Drew et al. findings and also support Fama and French’s (1993) BTM ratio effect. In our study, 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.

On the other hand, Drew et al. (2003) study did not find any BTM ratio effect in the Shanghai stock market. They explained their findings were inconsistent with Fama and French’s (1993) because investors overexploited the BTM ratio effect and there were some irrational investors on the Chinese stock market. However, the Drew et al. (2003) data might contain mispriced stock returns since the large amount of non-tradable stocks affected the real value of the stock price. In addition, during their study period, the Chinese stock market was in a high growth stage, which had some abnormal effects on the stock price. Chen and Zhang (1998) argued that the value stocks are less risky in high growth markets since these firms have positive earnings and low leverage and they are not in any financial distress.

Our result is opposite of 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 future 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. Wand 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.

Our standard deviations are lower than those in the Fama and French’s (1993) study, which implies that the stock returns are less volatile, causing a low degree of variation in the stock excess returns. The low volatility of in our stock excess returns may imply that the asset pricing model may lack explanatory power, since the independent variables do not have enough variation to be absorbed.

In summary, the firm size and the BTM ratio affect the Chinese A-share stock market from 1996 to 2005. Both effects have significant statistical support. Therefore we conclude that the mean-variance-efficient investors can choose the small size and high BTM ratio stocks to form their investment portfolios.
4.3 Regression on CAPM

Table 4.2 Regression results on the CAPM from 1996 to 2005

\[ R_{it} - R_{ft} = \alpha_i + b_i (R_m - R_{ft}) + \epsilon_i \]

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<tr>
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</thead>
<tbody>
<tr>
<td>(\alpha)</td>
<td>0.008406</td>
<td>0.006073</td>
<td>0.002267</td>
<td>-0.00181</td>
<td>-0.00411</td>
<td>-0.01024</td>
</tr>
<tr>
<td>(b)</td>
<td>0.995397</td>
<td>0.945</td>
<td>0.890787</td>
<td>1.10401</td>
<td>1.058301</td>
<td>0.985133</td>
</tr>
<tr>
<td></td>
<td>(122.1093)**</td>
<td>(100.0938)**</td>
<td>(88.6155)**</td>
<td>(132.5432)**</td>
<td>(133.5494)**</td>
<td>(112.5324)**</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.4273</td>
<td>0.3681</td>
<td>0.3164</td>
<td>0.5210</td>
<td>0.4856</td>
<td>0.3985</td>
</tr>
</tbody>
</table>

Notes
The number in () stand by t-statistic
* Significant at the 0.05 level (2-tailed)
** Significant at the 0.01 level (2-tailed)

Table 4.2 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 excess market returns were calculated from the market return less the risk-free rate. The excess stock returns were computed from the stock return less the risk-free rate. We followed the Drew et al. (2003) method using the one year deposit rate as the risk-free rate.

![Figure 4.1 Comparison the slopes between size and BM portfolios](image_url)
Drew et al. (2003) reported that the beta result alone could not explain the cross section stock excess returns in the Shanghai A-share stock market. In our study, 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. Our results show the market factor has a significant positive relationship with stock excess returns in the six BTM-size stock portfolios. Figure 4.1 shows 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. Both of these phenomena indicate that when the size factor increases by one unit, the stock return for the small portfolios is 0.1054 higher than the large portfolios on average, and when the BTM ratio factor increase by one unit, the stock return for the high BTM ratio portfolios are 0.1117 higher than the low BTM ratio portfolios on average. 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 the Fama and French (1993) result. 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 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 means 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 all are statistically significant at the 1% level, which indicates that
the intercepts are not equal to zero. Merton (1973) stated that the standard asset pricing models intercept should equal zero and the independent variable could fully explain the dependent variable. According to Fama and French (1993), the intercept provides evidence of how well the model captured the stock return. Therefore, our results suggest that other factors relative to stock excess returns in the Chinese A-share stock market during the test period, such as firm size and BTM ratio.

In summary, our findings agree with Fama and French’s (1993) findings; the beta alone cannot explain the stock excess returns efficiently and much variation in the dependent variable is left unexplained. The variation might be explained by the firm size and the BTM ratio in the equation (5) or equation (6). The adjusted $R^2$ value is lower compared with those reported for the U.S. stock market. The stock standard deviation is relatively low. Moreover, our testing period is also short compared with Fama and French’s sample which spanned 40 years.

### 4.4 Regression on SMB and HML

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. For example, Wang and Xu (2004) tested the stock returns on the Chinese A-share stock market and found that the size was negative relative to the stock returns and the BTM ratio had no effect. Wong et al. (2006) study showed firm size has negative effect on stock returns and the BTM ratio has non-explanatory power on the stock returns in the Chinese stock market. On the other hand, Wang and Iorio (2007) used different methods to examine the risk factors related to stock returns in China and found that the firm size and the
BTM ratio could be risk factors for stock returns on the Chinese stock market. Therefore, we ran the following regressions base on equations (5) and (6) to examine whether the size factor plus the market factor model and BTM ratio factor plus the market factor model could improve the explanatory power of the CAPM.

\[ R_{it} - R_{ft} = \alpha_i + b_i (R_m-R_{ft}) + s_i \text{SMB}_t + \epsilon_i \]  
(5)

\[ R_{it} - R_{ft} = \alpha_i + b_i (R_m-R_{ft}) + h_i \text{HML}_t + \epsilon_i \]  
(6)

Where:

- \( R_{it} - R_{ft} \) is the excess stock return at time \( t \);
- \( R_m-R_{ft} \) is the excess market return factor at time \( t \);
- \( \alpha_i \) 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; and
- \( \epsilon_i \) is the error term.
Table 4.3 Regression results of the six BTM-size portfolios’ excess stock returns against the size factor plus market excess return factor and the BTM ratio factor plus market excess returns factor from 1996 to 2005

\[ R_{it} - R_{ft} = \alpha_i + b_i (R_m - R_{ft}) + s_i SMB_t + \varepsilon_i \]

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<tbody>
<tr>
<td>( \alpha )</td>
<td>0.0024</td>
<td>0.0001</td>
<td>-0.0032</td>
<td>0.0021</td>
<td>0.0008</td>
<td>-0.0030</td>
</tr>
<tr>
<td></td>
<td>(3.5072)**</td>
<td>(0.1379)</td>
<td>(-3.7897)**</td>
<td>(3.0445)**</td>
<td>(1.2332)</td>
<td>(-4.1461)**</td>
</tr>
<tr>
<td>( b )</td>
<td>1.0469</td>
<td>1.0007</td>
<td>0.9413</td>
<td>1.0662</td>
<td>1.0152</td>
<td>0.9215</td>
</tr>
<tr>
<td></td>
<td>(125.7257)**</td>
<td>(103.4594)**</td>
<td>(91.3837)**</td>
<td>(124.4665)**</td>
<td>(125.1873)**</td>
<td>(103.4060)**</td>
</tr>
<tr>
<td>( s )</td>
<td>-0.5132</td>
<td>-0.5384</td>
<td>-0.5054</td>
<td>0.3691</td>
<td>0.4343</td>
<td>0.6238</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.4430</td>
<td>0.3846</td>
<td>0.3305</td>
<td>0.5290</td>
<td>0.4970</td>
<td>0.4206</td>
</tr>
</tbody>
</table>

\[ R_{it} - R_{ft} = \alpha_i + b_i (R_m - R_{ft}) + h_i HML_t + \varepsilon_i \]

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<tbody>
<tr>
<td>( \alpha )</td>
<td>0.0035</td>
<td>0.0060</td>
<td>0.0060</td>
<td>-0.0053</td>
<td>-0.0036</td>
<td>-0.0061</td>
</tr>
<tr>
<td></td>
<td>(5.3739)**</td>
<td>(7.8603)**</td>
<td>(7.3372)**</td>
<td>(-7.9718)**</td>
<td>(-5.6224)**</td>
<td>(-8.7200)**</td>
</tr>
<tr>
<td>( b )</td>
<td>0.9318</td>
<td>0.9442</td>
<td>0.9381</td>
<td>1.0618</td>
<td>1.0644</td>
<td>1.0370</td>
</tr>
<tr>
<td></td>
<td>(113.9124)**</td>
<td>(97.7560)**</td>
<td>(92.2458)**</td>
<td>(127.1145)**</td>
<td>(130.5715)**</td>
<td>(117.2904)**</td>
</tr>
<tr>
<td>( h )</td>
<td>0.5565</td>
<td>0.0087</td>
<td>-0.4713</td>
<td>0.4604</td>
<td>-0.0548</td>
<td>-0.4800</td>
</tr>
<tr>
<td></td>
<td>(32.5674)**</td>
<td>(0.4119)</td>
<td>(-21.2099)**</td>
<td>(24.7055)**</td>
<td>(-3.1741)**</td>
<td>(-25.6685)**</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.4562</td>
<td>0.3681</td>
<td>0.3340</td>
<td>0.5384</td>
<td>0.4859</td>
<td>0.4186</td>
</tr>
</tbody>
</table>

Notes
The numbers in () stand by t-statistic
* Significant at the 0.05 level (2-tailed)
** Significant at the 0.01 level (2-tailed)

The adjusted \( R^2 \) values for the six BTM-size portfolios increase 3% on average (see Table 4.3) when the SMB factor is added into the CAPM. All the coefficients of the market factor are
still positive and statistically significant. Similarly, the coefficients of the size factors are all statistically different from zero at the 1% significance level. The small firm portfolios have a positive slope and the big firm portfolios’ coefficients are negative. This means that there is a negative size effect on the Chinese stock market. According to Banz (1981) and Reinganum (1981) study, there is a significant negative relationship between firm size and asset abnormal returns. Compared with the regressions for the CAPM, although the adjusted $R^2$ value does not increase much, the intercepts provide evidence that the market factor plus the firm size factor model increases the explanatory power. However, the data in Table 4.3 show the SM and BM portfolio intercepts are statistically insignificant, and the other four portfolios’ intercepts are significant, therefore, we conclude that the size factor and the market factor are not enough to capture all the variation of the stock excess returns.

Since equation (5) could explain the abnormal returns more efficiently than the CAPM, we tested whether equation (6) could make good predictions on stock abnormal returns.

The data in Table 4.3 show the slopes of the market excess returns and the BTM ratio factor are statistically significantly different from zero. Moreover, on average, the high BTM ratio portfolios coefficients are higher than the low BTM ratio portfolios slopes. This finding is consistent with Fama and French (1993) who reported that the BTM ratio had a positive relationship with stock abnormal returns. The adjusted $R^2$ values for the six BTM-size portfolios have a 3% increase on average compared with the CAPM regression. However, the intercepts in all the portfolios are statistically different from zero, which indicates that adding the BTM ratio alone into the CAPM cannot predict stock excess returns efficiently. This result shows that there might be other variables that can explain the stock returns.
In general, the combination of the size factor with market factor and the BTM ratio factor with market factor did not effectively explain the stock abnormal returns. These two models do not have high adjusted $R^2$ values and most intercepts are statistically significant. However, the beta is positively related to the stock abnormal returns.

On the other hand, Table 4.3 provides evidence that the firm size factor is negatively related to stock returns and the BTM ratio factor has a positive relationship with stock abnormal returns. Therefore, we ran the regression using market factor, size factor and BTM ratio factor to examine whether the Fama and French three-factor model is superior to the CAPM.
4.5 Regression Results of the Three-factor Model

Table 4.4 Regression results of excess returns on the three-factor model from 1996 to 2005

\[ R_{it} - R_{ft} = \alpha_i + b_i (R_m - R_f) + s_i SMB_t + h_i HML_t + \varepsilon_i \]

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<th>SL</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\alpha)</td>
<td>-0.0006</td>
<td>0.0005</td>
<td>0.0001</td>
<td>-0.0009</td>
<td>0.0008</td>
<td>-0.0007</td>
</tr>
<tr>
<td></td>
<td>(-0.8582)</td>
<td>(0.6321)</td>
<td>(0.0790)</td>
<td>(-1.3112)</td>
<td>(1.1770)</td>
<td>(-0.9262)</td>
</tr>
<tr>
<td>(b)</td>
<td>0.9782</td>
<td>1.0085</td>
<td>1.0039</td>
<td>1.0114</td>
<td>1.0146</td>
<td>0.9741</td>
</tr>
<tr>
<td></td>
<td>(115.0156)**</td>
<td>(101.0495)**</td>
<td>(96.0903)**</td>
<td>(117.5026)**</td>
<td>(120.4347)**</td>
<td>(106.4030)**</td>
</tr>
<tr>
<td>(s)</td>
<td>-0.3928</td>
<td>-0.5518</td>
<td>-0.5922</td>
<td>0.4481</td>
<td>0.4352</td>
<td>0.5282</td>
</tr>
<tr>
<td>(h)</td>
<td>0.4954</td>
<td>-0.0672</td>
<td>-0.5378</td>
<td>0.5101</td>
<td>0.0045</td>
<td>-0.3973</td>
</tr>
<tr>
<td></td>
<td>(28.6727)**</td>
<td>(-3.1800)**</td>
<td>(-24.3301)**</td>
<td>(27.4873)**</td>
<td>(0.2601)</td>
<td>(-21.1229)**</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.4650</td>
<td>0.3849</td>
<td>0.3531</td>
<td>0.5501</td>
<td>0.4970</td>
<td>0.4338</td>
</tr>
</tbody>
</table>

Notes
The numbers () stand by t-statistic
* Significant at the 0.05 level (2-tailed)
** Significant at the 0.01 level (2-tailed)

Table 4.4 shows the regression results of the excess stock returns for the six BTM-size portfolios in the Chinese A-share stock market from 1996 to 2005. Different to Tables 4.3, the t-statistics of all the portfolio intercepts in Table 4.4 are insignificant at the 1% significance level.
level. The BM, BL and SM portfolios have positive intercepts. The three-factor model performs well in explaining the cross-section stock excess returns on the Chinese A-share stock market. This result is consistent with the Drew et al. finding.

All the market factor slopes in Table 4.4 are positive and significant at the 1% level. The average slope is 0.9984, which is close to 1. Drew et al. (2003) also reported significant market factor slopes. This indicates that the market factor is also highly related to stock excess return, 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 4.4. 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. It 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 five of the six portfolios (see Table 4.4). On the other hand, the Fama and French (1993) study showed that 24 of their 25 portfolios were significant. Drew et al. (2003) found that four of their six portfolios were significant. 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 on 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 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, the arbitragers took the advantage of the value stocks which out performed the growth stocks. During our test period there were still a large number of non-tradable shares. 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 low BTM effect.

In our study, the three portfolios’ coefficients were negative. The irrational investor may be one of the reasons in the negative coefficients. 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. 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. The SH portfolio mean return is -0.0101 and the BL portfolio mean return is -0.0006. We then applied the F-test to examine whether these two samples are different. The p-value is 0.0035, so we reject the null hypothesis. 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 U.S stock market for the sample period tested.

4.5.1 Comparison of the Three-factor Model and the CAPM

In order to show whether the Fama and French (1993) three-factor model could present a better explanation for stock returns than the CAPM on the Chinese A-share stock market, we need to compare the adjusted $R^2$ value and the intercept term of each model.

Drew et al. (2003) showed the three-factor model had significantly higher $R^2$ values than the CAPM model in the Shanghai stock market. Figure 4.2 shows that our portfolios’ adjusted $R^2$
values of the three-factor model are higher than the portfolios adjusted $R^2$ value of the CAPM. The three-factor model can explain the stock excess returns better than the CAPM, which confirms the Fama and French and Drew et al. findings.

Our results show that when we run the regression on the CAPM, all of the six BTM-size portfolios’ intercepts are significant at the 1% level. This indicates that other factors are affecting the stock excess returns such as size factor and BTM ratio. On the other hand, all the portfolios’ intercepts are not significant at the 10% level for the three-factor model. Therefore, our results are consistent with Fama and French’s (1993) findings that the three-factor model can explain excess stock returns better the CAPM.

In summary, the significant coefficients $s_i$ and $h_i$ in the three-factor model confirm that the small firm effect and the BTM ratio effect existed in the Chinese A-share stock market from 1996 to 2005. In addition, the non-significant intercepts of the three-factor model reveal that the three-factor model is able to capture the variation of the stock excess returns. Compared
with the CAPM, the adjusted $R^2$ value also increased by about 6.6% on average, indicating that the three-factor model predicts stock returns better than the CAPM.

4.6 Testing the Behaviour of the Stock Earnings

Fama and French (1995) found the fundamental economic reasons why firm size and the BTM ratio affect stock returns. Fama and French reported that these findings reflect that the firm size and BTM ratio could be the risk factors in predicting returns. The rational stock price, firm size and BTM ratio correspond to the behaviour of the stock earnings and they could help explain returns and the economic fundamental reasons why firm size and the BTM ratio effects were related to profitability of the firms. We tried to support the fundamental economic reasons of size and the BTM ratio effects in the Chinese A-share stock market.

Figure 4.3 shows that stock profitability is not related to size in the Chinese A-share stock market. The average EI/BV of the big stock portfolios is 0.1422, and the average EI/BV of the small stock portfolios is 0.09704. 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. Conversely, the average EI/BV of high BTM ratio stock portfolios is 0.1416, and the average EI/BV of low BTM ratio stock portfolios is 0.0977. When size is controlled, the mean EI/BV of the BH portfolio is 32.57% higher than the BL portfolio. Similarly, the mean EI/BV of the SH portfolio is 65.72% higher than the SL portfolio. This result reveals that stock profitability is also related to the BTM ratio.

Fama and French (1995) pointed out that the BTM ratio was persistent. Our result confirms their finding. Figure 4.4 shows that the low BTM ratio stock portfolios have a high BTM ratio for at least three years before and 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 have an upward trend BTM ratio from the t-3 year to t+3 year. This finding is not consistent with Fama and French findings.

Fama and French (1995) 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 of supply shock stage, and therefore they had increased earnings. After the portfolio was formed
the EI/BV had 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 forming the portfolios (at year t), and then increased.

However, Figure 4.3 the relationship between stock profitability and size and BTM ratio is unconditional, since the four lines cross each other during the test period. This indicates the EI/BV of big portfolios was not always higher than the small portfolios during the test period, and the high BTM ratio is also not always higher than the low BTM ratio portfolios. Moreover, all of them show a decreasing trend. Three possible explanations exist for the unexpected result. First, the test period is too short compared with Fama and French’s (1995) study, so the results of this study can not fully reflect the relationship between EI/BV and size and BTM ratio. We can form the portfolio only at 1999, 2000, 2001 and 2002 to obtain the 7-year evolution of EI/BV_{t-1} ratio. In contrast, Fama and French had 29 testing periods and they formed the portfolios 21 times to get the 10-year evolution of EI/BV_{t-1} ratio. Second, as Table 3.2 shows that 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 argued that firm size and BTM ratio were related to long-term profit. We applied the F-test to examine whether the big portfolios and small portfolios and the high BTM ratio and low BTM ratio EI/BV means are equal. The P-values of the F-test are 0.499 and 0.0576, respectively, which indicates the big portfolios and small portfolios and the high BTM ratio and low BTM ratio EI/BV means are not different. We tested the evolution of the EI/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.
4.7 Conclusion

The summary statistics show that 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 four regressions to find out whether the market factor alone is enough to predict the stock excess returns, and to compare the CAPM and three-factor model explanatory power in predicting stock excess returns. First, we used only the excess market returns factor as the independent variable to predict the stock excess returns. Our results show that there is large amount of variation that cannot be explained by the beta term. The second regression applied the market factor plus the size factor as the independent variable and the third regression used the market factor plus the BTM ratio factor as the independent variable to test stock excess returns. The slopes of the market factor, firm size and BTM ratio were significantly different from zero. However, the significant intercept of the second and third regressions revealed that these two models are not well-specified asset-pricing models. Both models imply that other factors exist in explaining the stock excess returns. The final regression demonstrated that the three-factor model is more accurate in predicting stock excess returns than the CAPM, since the adjusted $R^2$ value increased and the intercept are not significantly different from zero. The size effect is stronger than the BTM ratio effect.

The results suggest that the three-factor model is generally able to capture the cross-sectional variation in the Chinese A-share stock market from 1996 to 2005. Moreover, the evidence from this study shows that there are firm size and BTM ratio effects in the Chinese A-share stock market.
Chapter 5

Conclusion

This chapter presents the summary of the findings and draws conclusions based on the hypotheses of our study. The findings of our study are subject to a number of limitations. These limitations do have some effects on the results. Possible future research directions are presented in this chapter.

5.1 Main Findings

Table 5.1 shows the expected sign for the three-factor model and the CAPM. The table is the summary of the regressing results of both models. The results are most consistent with the Fama and French (1993) study.

Table 5.1 Summary the finding on the three-factor model and the CAPM

<table>
<thead>
<tr>
<th></th>
<th>Signs of the intercept/ slope</th>
<th>Do all portfolios have the expected value of intercept/slope?</th>
<th>Are all the parameter significance?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Three-factor model</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>α</td>
<td>Mixed</td>
<td>Yes</td>
<td>Insignificance</td>
</tr>
<tr>
<td>β</td>
<td>Positive</td>
<td>Yes</td>
<td>Significance</td>
</tr>
<tr>
<td>s</td>
<td>Mixed</td>
<td>NO</td>
<td>Significance</td>
</tr>
<tr>
<td>h</td>
<td>Mixed</td>
<td>NO</td>
<td>Significance</td>
</tr>
<tr>
<td><strong>The CAPM</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>α</td>
<td>Mixed</td>
<td>Yes</td>
<td>Significance</td>
</tr>
<tr>
<td>β</td>
<td>Positive</td>
<td>Yes</td>
<td>Significance</td>
</tr>
</tbody>
</table>

The three-factor model regression results demonstrate that this model can be used in the Chinese A-share stock market to predict stock return. The insignificant intercepts indicate that the three-factor model is well specified. Although not all portfolios have the expected sign of the size and BTM ratio factor slopes, the average value of the slopes reveal that there are size
and BTM ratio effects in the Chinese A-share stock market during the testing period. Moreover, the betas are positive and significant playing important roles in explaining the stock returns.

However, three the size and BTM ratio factor coefficients have the negative sign. This implies that for some portfolios size and BTM ratio factor are negatively related to stock excess returns. According to Fama and French (1993), the size factor and BTM ratio factor are proxies for sensitivity to an underlying risk factor, and both are expected to be positively related to stock excess returns. The Drew et al. (2003) and Fama and French (1993) studies also showed significant negative slopes. The significantly negative size factor slopes in the Fama and French (1993) study belonged to the large firm portfolios, and the negative BTM ratio factor slopes were concentrated on the low-BTM ratio portfolios. In this study, the BM and BH portfolios have two negative size factor slopes and the BL and SL portfolio factor have two negative BTM ratio factor slopes. There is no theory or argument in the existing literature that explains the negative relationships. It may be caused by data bias or it might due to incorrect specification.

On the other hand, the coefficients of the market factor have a significant positive relationship with stock excess returns. However, the intercepts are also significantly different from zero, which indicates that beta only cannot fully capture the variation of the portfolio stock excess returns. Not only the intercept results indicate that the three-factor model is better than the CAPM, but also the explanatory power (adjusted $R^2$ value) of the three-factor model is also higher than the CAPM.
In testing the null hypotheses, the three-factor model regression results show that the size and BTM ratio coefficient for all the six BTM-size portfolios are significant (see Chapter 4). It reveals that the size, BTM ratio and market excess return factor play important roles in predicting stock excess returns. Moreover, we cannot reject the null hypothesis of the intercept equal to zero which indicates that the three-factor model is well-specified. On the other hand, for the CAPM, we reject the null hypotheses. This provides evidence that the CAPM cannot predict stock excess return accurately in the Chinese A-share stock market from 1996 to 2005. Therefore, we conclude that the three-factor model is able to capture the size and BTM ratio effect on the Chinese A-share stock market and is superior to the CAPM.

5.2 Limitations

5.2.1 Computing the BTM Ratio

There are two limitations in computing the BTM ratio in our study. First, we followed the Drew et al. (2003) method to obtain the BTM ratio, which used book value of common equity at December year t-1 divided by market value of equity at December year t-1 as the BTM ratio at year t. Moreover, we examined stock excess return from January to December of each year. However, Fama and French (1993) used book value of common equity at fiscal year ending t-1 divided by market value of equity at fiscal year ending t-1 to calculate the BTM ratio at year t. They tested stock returns from July of year t to June of year t+1. These differences might affect the relationship between firm size and BTM ratio and average returns.

Second, we apply both tradable and non-tradable shares in testing the three-factor model. However, the large number of non-tradable shares might not reflect the true market value of the firm. If the non-tradable shares could be traded then the stock price should be different
from the present stock price. Drew et al. (2003) also argued that the large number of non-tradable shares is the main reason of weak BTM ratio effect in the Chinese stock market.

5.2.2 Length of the Sample Period and the Number of Stocks

The sample period for our study is only 10 years from January 1996 to December 2005. Since the Chinese stock market was established in 1990 there were a few listed firms at the start and the original data source is limited. The Fama and French (1993) study had 38 test periods. 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.

The other limitation is that the number of stocks in our study is lower than in Fama and French (1993). The number of listed firms ranges from a minimum of 306 companies to as many as 1281 companies per year. Fama and French (1993) reported that there was an average of 3100 listed firms per year in their sample. Therefore, Fama and French were able to sort their data into 25 portfolios compared with only six portfolios in our study. The smaller number of stocks may be the reason of the low degree of variation of the stock excess returns. The low adjusted $R^2$ value suggests that the three-factor model can only explain a limited amount of variation of stock return.

5.3 Future Research Directions

5.3.1 The Fundamental Economic Reason of the Three-factor Model

Fama and French (1995) claimed the size factor and BTM ratio are related to stocks’ profitability. However, there is no study to test the whether the firm size and BTM ratio are related to profitability in the Chinese A-share stock market. There are two reasons our results cannot fully support Fama and French (1995) findings. First, the length of the test period in
our study is short, only 10 years. Second, the large number of non-tradable shares affects the
cash flow of the listing firm and then affects the earning of the firms. Future researchers can
examine whether the size and BTM ratio are related to stocks’ profitability in the Chinese
stock market to find out whether the high-BTM ratio stocks are less profitable compared with
the low-BTM ratio stocks and whether small stocks have lower earning to book value ratio
than large stocks.

5.3.2 The Length of Sample Period

Future researchers can use a long sample period in examining the three-factor model in the
Chinese stock market. As discussed in section 5.3.2, the short test period in our study may be
the reason why the three-factor does not work efficiently, and during the short test period the
stock price is stable, which also affects the explanatory power of the three-factor model.
Therefore, future studies should attempt to employ longer sample periods in the analysis.

5.3.3 Characters of the Chinese A-share stock market

The three-factor model is successful in predicting stock excess return in the US stock market.
However, there is no strong evidence to support this model in China. The Chinese stock
market is still in the growing stage and there are several differences between it and the U.S.
stock market. For example, the Chinese stock market is smaller than the U.S. stock market. In
the early stage of the Chinese stock market, the stock price is not as volatile as the U.S. stock
prices. Moreover, the large amounts of non-tradeable shares cause the stock to be mispriced
and the BTM ratio effect is ambiguous. On the other hand, future researchers can employ
other variables beside the BTM ratio to predict the stock returns. For example, Wong et al.
(2006) reported that the floating rate could affect Chinese stock returns. Chen et al. (2007)
stated that the company’s intangible asset ratio is positively related to stock returns in the Chinese stock markets.

5.4 Further Examination of the Findings of this Study

As we discussed in section 5.2, significant negative slopes were found for some of the size and BTM ratio portfolios tested. However, there is no theory or argument in the existing literature that explains the significant negative relationship. Future studies can attempt to further investigate the nature of the relationships. We found that the big size and low BTM ratio portfolios have negative slopes for the size and BTM ratio factors. Future researchers could examine in detail these aspects of the findings and possible reasons for their occurrence.

5.5 Conclusion

In our study, we compare the explanatory power of the three-factor model and the CAPM. Our results suggest that the small firm and high BTM ratio firms do generated higher returns than large firms and low BTM ratio firms in the Chinese A-share stock market from 1996 to 2005. The slopes of the size factor and BTM ratio factor are significant for all the portfolios and the intercepts are all insignificant in testing the three-factor model. Compared with the CAPM, the market factor can capture some variation of the stock returns, but the intercept is significantly different from zero. Therefore, we conclude that the three-factor model can predict stock returns better than CAPM. Our findings are consistent with the Fama and French (1993) study.

However, there are some limitations that impact our results. The large number of non-tradable shares causes that the BTM ratio effect on the Chinese A-share stock market to be weak compared with the U.S. stock markets. The stable stock returns may be result in the
explanatory power of the three-factor to be weak. Therefore, future researchers should focus on these limitations when they re-test the three-factor model in the Chinese stock markets.
Appendix

1. Merton (1973) presented the CAPM in a continuous-time model. He stated that there are multi-beta to reflect the expect return of assets. The multi-beta is the different variables that relate to different characters of the market portfolio.

2. The pre-ranking betas for individual stock are computed by 24 to 60 monthly returns in the five years, and applied for value-weight Index (see Fama and French, 1992).

3. The high BTM ratio portfolio stock returns minus the low BTM ratio portfolio stock returns call mimicking stock portfolio by BTM ratio, and the small size portfolio stock returns minus large size portfolio stock returns call mimicking stock portfolio by firm size (see Fama and French, 1993).

4. Value stocks are stocks with low prices relative to historical prices, earnings, dividends, book assets or sales, and growth stock are high price relative to historical prices, earnings, dividends, book assets or sales. The measurement of value stock and growth stock include BTM ratio effect, cash flow effect, size effect, and dividend effect. (see Fama and French, 1998).

5. Out-of-sample studies means the studies of testing Fama and French three-factor model applying sample data outside of the U.S.

6. The difference in U.S. is 0.60% (t=1.81), in Japan is 0.79% (t=1.90), in Hong Kong is 3.15% (t=3.55), in Malaysia is 2.23% (t=4.46), and in Thailand is 1.30% (t=2.72) (see Chen and Zhang, 1998).

7. There is a different economic investment environment in China. The large number of market capitalization control by the government, and these shares are non-tradable. The ratio of the available shares to the total firm shares is called free float rate (see Wang and Xu, 2004).
References


