Emerging Markets Finance & Trade, 52:1092–1105, 2016

ISSN: 1540-496X print/1558-0938 online
DOI: 10.1080/1540496X.2016.1143250

The Three-Factor Model and Size and Value Premiums in China's Stock Market

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ABSTRACT: Using monthly data from China's Shanghai Stock Exchange (SSE) A-share market between 2005 and 2012, this article performs an empirical study on the applicability of the three-factor model to China's stock market. After testing twenty-five size-BE/ME stock portfolios and four stock sector portfolios, we found that the three-factor model, adjusted for the unique features of China's stock market, generally fits the SSE A-share market well. The results show that size and value premiums are significant in China's stock market, although there exist modest differences among industrial sectors. In addition, our empirical results are robust to factor sorting and construction methods.

KEY WORDS: three-factor model, cross-sectional stock returns, size premium, value premium

Introduction

The Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1965) and Mossin (1966) implies that there exists a positive relationship between the expected return on a stock and market systematic risk. This is measured by β (the slope when you regress the return on a stock on the market return), which is the only factor in this model that can explain cross-sectional variations in expected returns on stocks. Nevertheless, much empirical research demonstrates that the CAPM, a single factor model that takes the excess return on a broad market portfolio as the only explanatory variable, cannot satisfactorily explain a number of market anomalies, for example, the long-term reversals in stock returns found by DeBondt and Thaler (1985) and the short-term momentum of returns discovered by Jegadeesh and Titman (1993). Previous works by Banz (1981), Basu (1983), and Lakonishok, Shleifer, and Vishny (1994) also show that average stock returns are closely related to firm size (market value, ME), book-to-market equity (BE/ME), earnings/price (E/P), cash flow/price (C/P), and historical sales growth. Variations in average returns associated with these factors cannot be explained by the CAPM, and hence are documented as asset pricing anomalies.

Compared to the Capital Asset Pricing Model (CAPM), it has been argued that the Fama-French Three-Factor Model provides a better explanation for cross-sectional variations in stock returns in many countries. According to Fama and French (1992) research on nonfinancial sector stocks in the three major stock exchanges in the United States from 1963 to 1990, β cannot fully explain variations in cross-sectional expected returns. To address this problem, Fama and French (1993) incorporate firm size and the book-to-market equity ratio as an extension of the initial CAPM model. They find that this new model has better explanatory power and that significant size and value premiums exist in the U.S. stock markets. Moreover, Fama and French (1996) show that, except for the momentum of average short-term stock returns, their new three-factor model can effectively capture most of the asset pricing anomalies previously left unexplained by the CAPM. More recently, Fama and French (2015) propose a five-factor model by introducing the profitability and investment factors into the three-factor model, but the new model cannot capture the low average returns on small stocks whose returns have similar

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patterns with those of firms with high investment and low profitability. Besides, the role of value factor in explaining the average returns is significantly undermined by the two new factors.

The effectiveness of the three-factor model has been illustrated by a lot of empirical studies. While Daniel and Titman (1997) suggest that, compared with the covariance matrix of stock returns, firm specific characteristics can better explain cross-sectional variations in average stock returns, Davis, Fama, and French (2000) find that the three-factor model is more efficient than Daniels' characteristics model in explaining the cross-sectional stock returns. Chui and Wei (1998) investigate five major emerging capital markets in the Asia-Pacific region and confirm that the three-factor model can reliably explain cross-sectional stock returns. They also find that the degree of correlation between average stock returns and the BE/ME ratio within a country is closely related to the average BE/ME of that country. Drew and Veeraraghavan (2001) provide additional evidence to support the applicability of the three-factor model by focusing on several major stock exchanges in Asia during the 1990s. In the context of China, Gan et al. (2013) show that the three-factor model can be well applied to the Chinese stock market from 1996 to 2005, just before the reform of the split-share structure. Xu and Zhang (2014) use a wider range of data from 1991 to 2011 to argue that several special features of Chinese stock market, such as the high percentage of nontradable shares, and different factor formation methods may significantly affect the performance of the three-factor model.

To adjust for structural changes and unique features of the Chinese market, especially the overwhelming proportion of nontradable components in the stock market before the 2005 reform of the split-share structure, this article uses monthly data from China's Shanghai Stock Exchange (SSE) A-share market between January 2005 and December 2012 and it performs an empirical study on the applicability of the three-factor model to China's stock market. Specifically, this article investigates: (1) the goodness of fit and explanatory power of the three-factor model in explaining cross-sectional variations in stock returns on twenty-five size-book-to-market (size-BE/ME) portfolios and four stock sectors (industrial, commercial, real estate, and utility) in SSE A-share market; (2) the existence and significance of size and value premiums throughout the whole SSE A-share market, especially in the four sectors mentioned above; (3) the influence of different variable sorting and construction methods on the robustness of the three-factor model.

Our test results show that: (1) the Fama-French three-factor model is applicable to the SSE A-share market as the model can satisfactorily explain the cross-sectional variations of stock returns; (2) size premiums exist in the SSE A-share market, i.e., small-company stocks tend to have higher returns than big-company stocks, although different sectors exhibit different premium levels; (3) value premiums exist in the SSE A-share market, i.e., high BE/ME stocks tend to have higher returns than low BE/ME stocks, although there are significant discrepancies among the four sectors; (4) the regression coefficients in the three-factor model are fairly stable and various model construction methods impact insignificantly on the estimation results.

The rest of this article is organized as follows. The next section introduces the model and data used in this article. Following that, we present the summary statistics and the empirical results of the twenty-five size-BE/ME portfolios, and the fourth section shows the summary statistics and empirical results of the four sector portfolios. The final section concludes the article.

Model and Data

Model Specification

The three-factor model of Fama and French in this article takes the following form:

$$E(R_i) - R_f = b_i\left[E(R_M) - R_f\right] + s_i E(SMB) + h_i E(HML). \quad (1)$$

As shown in Equation (1), the expected risk premium, $E(R_i)$-R_f, on portfolio i can be explained by three factors: (a) the market factor, measured by the difference between the market portfolio return

R_M and risk-free asset return R_f; (b) the size factor, SMB, measured by the difference between the return on a portfolio of small stocks and the return on a portfolio of large stocks; and (c) the value factor, HML, measured by the difference between the return on a portfolio of stocks with high book-to-market ratios and the return on a portfolio of stocks with low book-to-market ratios. $E(*)$ denotes the expectation of premiums and the factor sensitivities. b_i, s_i, and h_i, are the slopes or sensitivities of expected risk premium of portfolio i to the market factor, size factor, and value factor in the regression.

There are various reasons for incorporating two additional risk factors into the three-factor model instead of only using the market factor, as in CAPM. Fama and French (1995) specify a simplified model to explain why the BE/ME ratio serves as a suitable risk factor. To better understand the model, we first provide an explanation of the model's components and their respective meanings. EI_t represents a firm's return on equity at period t after depreciation, and tax, interest, preferred stock dividend, and abnormal income have been deducted and BE_{t-1} denotes the book value, or shareholders' equity at period $t-1$. Therefore, EI_t/BE_{t-1} shows the relative profit a firm earns, with the return on equity being measured by a weighted average market cap. Suppose equity constitutes all a firm's assets, its increment D_t at period t comprises retained earnings and depreciation of fixed assets, and the ratios of retained earnings and depreciation of fixed assets to the return on equity are k_1 and k_2, then we have

$$E_t[D_{t+i}] = E_t[EI_{t+i} + DP_{t+i} - I_{t+i}] = E_t[EI_{t+i}(1 + k_1 - k_2)] \tag{2}$$

where EI_t is the return on equity, DP_i is depreciation, and I_t is reinvested capital. Moreover, if the term structure of interest rates is flat, the stock market value at the period t will be

$$ME_t = (1 + k_1 - k_2)\sum_{i=1}^{\infty}\frac{E_t[EI_{t+i}]}{(1+r)^i}. \tag{3}$$

Therefore, the book-to-market ratio is

$$\frac{BE_t}{ME_t} = \frac{1}{(1 + k_1 - k_2)\sum_{i=1}^{\infty}\frac{1}{(1+r)^i} \times \frac{E[EI_{t+i}]}{BE_t}}. \tag{4}$$

In Equation (4), the denominator on the right-hand side is the sum of the discounted value of the return on investment. A high rate of return on investment results in a relatively low BE/ME ratio and, thus, the BE/ME ratio can be an indicator of a firm's ability to generate earnings for shareholders. The fact that a high BE/ME ratio indicates low future growth corresponds to the results identified by Fama and French (1995). Since the BE/ME ratio acts as a proxy for risk and indicates whether a firm is undervalued or overvalued, book-to-market equity and the slope on the value factor, HML, can measure the relative distress of firms. Weak firms with persistently low earnings tend to have a high BE/ME ratio and a positive slope on HML, while strong firms with persistently high earnings have a low BE/ME ratio and a negative slope on HML.

Similarly, variations in average returns that are not fully explained by the market risk factor could be explained by the size factor, SMB. According to an investigation conducted by Fama and French (1996) on the U.S. stock markets between 1963 and 1993, there was no significant difference in the stock performance of large firms with higher market value and small firms with lower market value before 1981. However, small firms found themselves unable to generate earnings while large firms quickly rebounded and began to earn profits again during the mid-1980s. Therefore, a size premium can be partially explained by the fact that small firms are more affected than large firms by business cycles.

In addition, behavioral finance tries to explain these cross-sectional anomalies from the perspective of investor sentiment. Due to the relatively low participation of informed and rational investors, the stock prices of small firms are much more susceptible to market sentiment than the stock prices of large firms and can deviate more easily from their intrinsic values. Therefore, investors require additional compensation from small stocks, which ultimately induces a size premium in the market. In terms of a value premium, as Lakonishok, Shleifer, and Vishny (1994) claim, it may arise as the result of an investor's overreaction to the past performance of firms with low book-to-market ratios. Investors tend to be either too pessimistic about firms that have performed poorly recently or too optimistic about firms that have performed well recently, which leads to higher or lower book-to-market ratios, respectively.

Since this article focuses on the stock market in China, we need to adjust for unique features of the Chinese market. Most important, there is a high percentage of nontradable shares in the secondary market, including state shares, state-owned corporate shares, and other nontradable components. Before 2005 when the reform of the split-share structure started, nontradable shares totaled over 65 percent of the whole market. Despite that the proportion of nontradable shares has fallen sharply, nontradable shares still occupy about 20 percent of the market.

Consequently, to accommodate the specific features of China's stock market, we replace "total market value" in the Fama-French three-factor model with "market value in circulation," which is the product of the number of shares outstanding and the market price of the stock. The rationale behind this replacement is that nontradable and tradable shares have contradictory effects on stock returns, due to the different dividend and voting rights they afford shareholders. Nontradable shareholders tend to show less concern over stock price movements since they cannot liquidate their shares. This may lead to poor corporate governance and operational practices, which often has an adverse effect on the income of tradable shareholders. Moreover, since nontradable shares consist mostly of state shares and state-owned corporate shares, this suggests a higher degree of nationalization and relatively lower economic efficiency within these firms, which often has a negative effect on the firm's operating performance.

Therefore, when constructing the SMB factor and size-BE/ME portfolios, we sort all the stocks in the SSE A-share market according to market value in circulation. However, when calculating the HML factor, we still use the ratio of book value to total market value. There are two reasons for using different calculations: first, the modified SMB factor can reflect the impact of tradable shares proportionally; second, by using two different market values in the SMB and HML factors, we can avoid multi-collinearity among the independent variables. The test results reveal a low correlation between SMB and HML, thus the explanatory power of the model is not compromised.

Data and Variables

This article conducts empirical tests using the three-factor model on China's SSE A-share stock market. The sample period is from January 2005 to December 2012 and it is chosen for three reasons. First, to ensure the consistency of the regression data, the sample period is relatively more recent and avoids the structural changes that occurred in the stock market before 2000 (i.e., the SSE suspended the listings of companies with two consecutive years of losses on their stocks and changed the regulations for the upper and lower bound on the margin of special treatment stocks). Second, the period covers a timespan of ninety-six months over eight years, which is long enough to ensure stability and effectiveness when testing the model. Third, the sample period includes the bear market in 2005, super bull market in early 2006, and the bear market after 2008, covering a comparatively all-round market performance. The data used in this article is obtained from the CSMAR (China Stock Market and Accounting Research) database.

The variables incorporated in the three-factor model include risk-free return, R_f, the size factor, SMB, the value factor, HML, the monthly stock returns on twenty-five size-BE/ME portfolios and four industry-sector portfolios, R_i, and market portfolio returns, R_M. They are defined as follows:

a. Risk-free return, R_f, is the monthly rate of return calculated from the annual interest rate on a time deposit (lump-sum deposit) observed at the beginning of each month.
b. The size factor, SMB, is calculated by the following procedure. First, we classify all the stocks on the SSE A-share market into five groups in descending order according to their market value in circulation at the end of December of each t–1 year (t is from 2005 to 2012). As previously clarified, market value in circulation rather than total market value of each stock is employed here to allow for the impact of the split share reform from 2005 to 2007. In addition, we classify all the stocks into five groups in descending order according to the stockholders' BE/ME ratio. Consequently, twenty-five stock portfolios are obtained from the product of these groups, which are specified by $Size(p)\_BE/ME(q)$ (p, q = 1, 2, 3, 4, 5). Smaller values of p (q) indicate smaller size and lower BE/ME ratio. For example, p = 1 indicates that this group consists of the first 20 percent of the stocks in the market with the smallest size, while p = 5 means that the stocks in this group are the 20 percent with the largest size. We designate the group with the 20 percent largest stocks in size as the big stock portfolio (B) and the group with the 20 percent smallest in size as the small stock portfolio (S). Finally, as defined in Equation (5), SMB is calculated as the average monthly yield gap between the portfolio S and the portfolio B. Note that on December 31 of each year from 2004 to 2011, we adjust the SMB groups to reconstruct the S and B portfolios for the next year.

$$SMB_t = r_{Samll,t} - r_{Big,t} = 1/5\sum_{q=1}^{5} Size(1)\_BE/ME(q)_t - 1/5\sum_{q=1}^{5} Size(5)\_BE/ME(q)_t. \tag{5}$$

c. The value factor, HML, is calculated by the following procedure. Based on the twnety-five stock portfolios delineated by $Size(p)\_BE/ME(q)$, we designate the 20 percent of stocks with the highest BE/ME ratio as the high BE/ME value portfolio (H), the 20 percent with the lowest BE/ME ratio as the low BE/ME value portfolio (L), and the rest as the middle BE/ME value portfolio (M). To calculate the BE/ME ratio, the book value and market value of the stocks are used. The book value of stockholders' equity is the owner's equities in the balance sheet of listed companies minus deferred tax liabilities, plus deferred tax assets, minus the book value of preferred stock by the end of each year. Market value, on the other hand, is weighted directly by total market value. Note that stocks with negative book values are excluded from the sample. As defined in Equation (6), HML is the average yield gap between the high value portfolio (H) and the low value portfolio (L). Similar to SMB, on December 31 of each year from 2004 to 2011, we adjust the classification of the stocks to form a new high BE/ME portfolio (H) and low BE/ME portfolio (L) for the next year to calculate the new HML. Additionally, in order to examine the robustness of the model, we adopt four different threshold ratios, 10 percent, 20 percent, 30 percent, and 50 percent, to sort the stocks and construct the HML factor when testing the four stock sector portfolios. For each ratio, the basic construction and calculating methods remain unchanged.

$$HML_t = r_{Value,t} - r_{Growth,t} = 1/5\sum_{p=1}^{5} Size(p)\_BE/ME(5)_t - 1/5\sum_{p=1}^{5} Size(p)\_BE/ME(1)_t. \tag{6}$$

d. The monthly stock portfolio return, R_i, is constructed differently from Fama and French (1996). We first construct the twenty-five size-BE/ME stock portfolios and calculate the weighted average monthly portfolio return for each group. The adjustment of all the stock portfolios is made on December 31 of each year. Second, in order to test for anomalies in specific sectors and verify the robustness of the results, we select four SSE mixed stock sector indexes (the industrial stocks index, commercial stocks index, real estate stocks index, and utility stocks index) as the dependent variables. Theoretically, the three-factor model should fit the data well regardless of the methods or standards used to construct dependent variables. Therefore, by adopting the method of sector division, we are able to verify the applicability of the three-factor model and the existence and significance of size and value premiums in different sectors.

e. The market portfolio return, R_M , is obtained from the database. Since the market portfolio covers all the stocks in the SSE A-Share market, including the negative-book-value stocks, which are excluded while calculating the HML factor, and the stocks' weighted average monthly returns, we adopt the monthly return on the SSE A-Share Index as the market portfolio return.

Test Results of the Twenty-Five Size-BE/ME Portfolios

Summary Statistics

Table 1 presents summary statistics of the three factors in the three-factor model. It is clear from the results that the statistics are essentially consistent with the results of Fama and French (1996). From January 2005 to December 2012, the monthly returns of the three explanatory variables are all positive. The monthly average returns of the market factor $R_M - R_f$, the size factor SMB, and the value factor HML are approximately 0.79 percent, 1.17 percent, and 0.40 percent, respectively (these results are using the 30 percent HML threshold ratio). The monthly standard deviations are 9.24 percent, 6.58 percent, and 3.41 percent, and the coefficients of variation (CV) are 11.63, 5.61, and 8.57, respectively. This means that the average returns on small stocks are higher than those on big stocks and the average returns on high BE/ME stocks are higher than those of low BE/ME stocks.

To better describe the variations in the returns on stocks with different sizes and BE/ME ratios, we present additional summary statistics in Tables 2 and 3. Table 2 shows the summary statistics of the returns on different size stocks. It is evident that the average monthly returns on stock portfolios decline as their market value in circulation increases. Specifically, the big stock portfolio has an average monthly return of 1.69 percent, while the small stock portfolio has an average monthly return of 2.86 percent. Correspondingly, the standard deviation of the stock portfolios also increases as the size of the stock decreases. The standard deviation of monthly returns on the big portfolio is 10.13 percent, whereas that of the small portfolio is 12.14 percent. The results presented above indicate that the smaller the market value of stocks, the higher the risks and returns. This is intuitive since small stocks are inherently more volatile and more sensitive to macroeconomic fluctuations and investors require higher compensation for bearing higher risk.

Table 1. Summary statistics of independent variables (factors)

Factors	Average (%)	Standard Deviation (%)	CV
R_M-R_f	0.7942	9.2364	11.6293
SMB	1.1729	6.5798	5.6099
HML			
10%	0.5340	5.0138	9.3898
20%	0.4717	3.8039	8.0640
30%	0.3979	3.4101	8.5704
50%	0.2714	2.4292	8.9508

Table 2. Summary statistics of the monthly returns of stocks with different sizes

Size (From Big to Small)	Average (%)	Standard Deviation (%)	CV
Big (50%)	1.6874	10.1317	6.0044
Small (50%)	2.8603	12.1415	4.2449

Table 3. Summary statistics of the monthly returns of stocks with different BE/ME ratios

BE/ME (From High to Low)		Average (%)	Standard Deviation (%)	CV
BE/ME 10	H (10%)	2.4233	11.5290	4.7575
	M (80%)	2.2260	11.1573	5.0122
	L (10%)	1.8894	10.4677	5.5402
BE/ME 20	H (20%)	2.4464	11.4791	4.6923
	M (60%)	2.2434	11.2913	5.0332
	L (20%)	1.9747	10.4151	5.2744
BE/ME 30	H (30%)	2.3938	11.5383	4.8200
	M (40%)	2.2297	11.2954	5.0659
	L (30%)	1.9959	10.4903	5.2559
BE/ME 50	H (50%)	2.3741	11.4475	4.8219
	L (50%)	2.1027	10.7561	5.1154

Table 3 presents the summary statistics for the returns on stocks with different BE/ME ratios. It is clear that the average monthly returns on stock portfolios increases substantially with the increase of the BE/ME ratio. For instance, the portfolio of stocks with the highest 10 percent of BE/ME ratios, H, has an average return of 2.42 percent, while the corresponding low portfolio, L, only has an average return of 1.89 percent. Similarly, the standard deviation of the stock portfolios increases with the increase of the BE/ME ratio. As for the CV, it declines with the increases of BE/ME ratio. The above results mean that the higher the book-to-market equity of stocks, the higher the risks and the higher the required returns. This is because high BE/ME companies are probably having recent problems and they are more likely to suffer from financial crises and economic cycles. Therefore, investors of such stocks require higher risk premiums as compensation.

Regarding the dependent variables, we use the monthly returns of twenty-five size-BE/ME portfolios in our empirical analysis. As shown in Table 4, the monthly average returns of the twenty-five size-BE/ME portfolios are all positive from January 2005 to December 2012. Holding group size constant, the average return and standard deviation of the portfolios increase with the portfolio's BE/ME ratio. For example, consider the group with the smallest size ($size(1)$). The stock portfolio with the lowest BE/ME ratio ($size(1)\_BE/ME(1)$) has an average return of 2.55 percent and a standard deviation of 11.98 percent, whereas the stock portfolio with the highest BE/ME ratio ($size(1)\_BE/ME(5)$) has an average return of 3.02 percent and a standard deviation of 12.46 percent. Conversely, when holding the BE/ME ratio constant, the average return and standard deviation of the portfolios decrease with the increase in the portfolio's size.

Table 4. Summary statistics of the monthly returns of twenty-five size-BE/ME portfolios

	Book-to-Market Equity Value Quintile Groups									
Size	**Low**	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Statistical Characteristics										
			Average					Standard Deviation		
Small	2.5532	2.5986	2.8628	3.2661	3.0205	11.9812	12.7686	12.1116	12.2115	12.4604
2	1.9007	2.1486	2.4779	2.7603	2.6359	11.6072	11.5348	12.2065	12.6538	12.6080
3	1.9767	2.2131	2.1568	2.1771	2.6334	11.1379	11.2668	11.4536	11.8752	12.1225
4	1.6269	1.7599	2.1769	2.2556	2.1177	10.7925	10.6655	11.4483	12.6000	11.4543
Big	1.8158	1.6995	1.6933	1.4040	1.8243	9.1950	10.6304	11.2887	11.2681	10.8234

Empirical Results and Analysis of the Twenty-Five Size-BE/ME Portfolios

In this section, we test the three-factor model using the monthly returns of the twenty-five size-BE/ME portfolios from the SSE A-share market from January 2005 to December 2012. However, we first present the test results from testing the conventional CAPM in Table 5, in order to make a reasonable comparison with the three-factor model later.

The results in Table 5 show that the majority of the R^2 values are above 50 percent, implying that the CAPM does explain cross-sectional variations in returns. Interestingly, there is a monotonically increasing trend in the explanatory power of the CAPM from the smallest to the biggest size portfolios, which is in line with the results of Gaunt (2004). However, of primary interest in the CAPM regressions is the intercept term. The abnormal returns on the smallest stock portfolio are significant both in the economic and statistical sense, while in the other four quintile regressions abnormal returns do not exist. Therefore, the results of the CAPM regressions appear to provide some preliminary evidence for a size premium.

For comparison, Table 6 presents the three-factor model regression results. As we can see, the R^2 of the twenty-five regressions, with an average of 87.36 percent, are much higher than those of the CAPM regressions. It is not surprising to find an increase in the R^2 value when more independent variables are introduced into the regression. Nonetheless, if the change in magnitude is very large, there is good reason to believe that incorporating the previously omitted independent variables is a significant improvement to the model. In our case, the R^2 values for the smallest size group increase from around 50 percent to over 90 percent, suggesting that the three-factor model provides a vast improvement in explanatory power over the CAPM for cross-sectional variations in returns. In addition, when we control for the two additional factors in the three-factor model, SMB and HML, the previously mentioned increasing trend in the R^2 value disappears. Therefore, so far our regression results all support the argument that the three-factor model is a much better fit for China's stock market than the CAPM.

Table 5. CAPM time series regressions on monthly excess returns of portfolios formed on size and BE/ME ratio (2005–12, ninety-six months)

	Book-to-Market Equity Value Quintile Groups									
Size	**Low**	**2**	**3**	**4**	**High**	**Low**	**2**	**3**	**4**	**High**
Regression Equation: $R_i - R_f = \alpha_i + \beta_i(R_M - R_f) + \varepsilon_i$										
			α					t(α)		
Small	0.0159	0.0155	0.0185	0.0226	0.0198	1.8069	1.7373	2.2105	2.6365	2.3165
2	0.0091	0.0116	0.0145	0.0170	0.0158	1.1611	1.4886	1.7528	1.9883	1.8545
3	0.0097	0.0119	0.0115	0.0115	0.0158	1.4151	1.7531	1.5557	1.4745	2.0397
4	0.0064	0.0077	0.0112	0.0115	0.0106	0.9792	1.2239	1.7007	1.4814	1.6328
Big	0.0089	0.0062	0.0056	0.0031	0.0075	1.9358	1.4889	1.2758	0.5743	1.5527
			β					t(β)		
Small	0.9162	1.0198	0.9778	0.9748	1.0113	9.6442	10.5661	10.8199	10.5530	10.9522
2	0.9583	0.9472	1.0028	1.0401	1.0374	11.3936	11.2502	11.2597	11.2787	11.3042
3	0.9720	0.9948	0.9711	0.9943	1.0362	13.1405	13.6009	12.1664	11.7866	12.4318
4	0.9537	0.9512	1.0313	1.0992	1.0411	13.6301	14.0130	14.4711	13.1469	14.9163
Big	0.8751	1.0683	1.1353	1.0861	1.0590	17.7171	23.9094	24.0951	18.8345	20.3534
			R^2					s(e)		
Small	0.4974	0.5429	0.5547	0.5423	0.5606	0.0860	0.0873	0.0818	0.0836	0.0836
2	0.5800	0.5738	0.5742	0.5751	0.5762	0.0761	0.0762	0.0806	0.0835	0.0830
3	0.6475	0.6631	0.6116	0.5964	0.6218	0.0669	0.0662	0.0722	0.0763	0.0754
4	0.6640	0.6763	0.6902	0.6477	0.7030	0.0633	0.0614	0.0645	0.0757	0.0632
Big	0.7696	0.8588	0.8607	0.7905	0.8151	0.0447	0.0404	0.0426	0.0522	0.0471

Table 6. Three-factor time series regressions on monthly excess returns of portfolios formed on size and BE/ME ratio (2005–12, ninety-six months)

	Book-to-Market Equity Value Quintile Groups									
Size	Low	2	3	4	High	Low	2	3	4	High
Regression Equation: $R_i - R_f = \alpha_i + b_i(R_M - R_f) + s_i SMB + h_i HML + \varepsilon_i$										
			α					t(α)		
Small	0.0023	0.0009	0.0046	0.0080	0.0054	0.6078	0.2243	1.3153	2.3531	1.3651
2	−0.0010	−0.0001	0.0022	0.0036	0.0018	−0.2234	−0.0314	0.4423	0.7534	0.4160
3	0.0031	0.0032	0.0012	0.0003	0.0035	0.6378	0.7177	0.2649	0.0635	0.7931
4	0.0013	0.0017	0.0031	0.0004	0.0005	0.2650	0.3460	0.6375	0.0693	0.1338
Big	0.0098	0.0050	0.0032	−0.0011	0.0043	2.8241	1.2453	0.7467	−0.2164	1.0705
			b					t(b)		
Small	1.0233	1.0963	1.0469	1.0359	1.0473	23.9929	25.6204	26.9802	27.4402	23.8048
2	1.0661	1.0171	1.0625	1.0835	1.0741	20.9693	21.4495	19.7499	20.4077	22.9556
3	1.0810	1.0720	1.0479	1.0438	1.0541	20.2355	21.9376	21.2668	18.8143	21.9351
4	1.0641	1.0360	1.0860	1.1157	1.0419	20.0139	19.5622	20.3798	19.2713	24.1773
Big	0.9703	1.1075	1.1383	1.0463	0.9873	25.2459	25.0192	23.8798	19.4135	22.0856
			s					t(s)		
Small	1.1998	1.1956	1.1234	1.1456	1.0706	20.3055	20.1678	20.8966	21.9041	17.5663
2	0.9650	0.9800	0.9918	1.0210	1.0470	13.7006	14.9170	13.3067	13.8811	16.1522
3	0.7329	0.7922	0.9012	0.8901	0.8822	9.9036	11.7025	13.2015	11.5812	13.2513
4	0.6320	0.6310	0.6964	0.7978	0.6839	8.5801	8.5998	9.4334	9.9466	11.4557
Big	0.1819	0.1817	0.1670	0.1766	0.0277	3.4155	2.9623	2.5294	2.3656	0.4479
			h					t(h)		
Small	−0.2879	0.0094	0.0363	0.1288	0.3279	−2.7404	0.0890	0.3799	1.3848	3.0263
2	−0.4434	−0.0624	0.0443	0.2237	0.3057	−3.5406	−0.5343	0.3342	1.7107	2.6523
3	−0.6030	−0.2533	−0.1804	0.0803	0.3857	−4.5829	−2.1044	−1.4860	0.5876	3.2587
4	−0.6815	−0.4310	−0.0943	0.3458	0.4271	−5.2040	−3.3040	−0.7184	2.4251	4.0238
Big	−0.8174	−0.2688	0.0777	0.5026	0.7204	−8.6354	−2.4651	0.6617	3.7862	6.5424
			R^2					s(e)		
Small	0.9089	0.9192	0.9262	0.9312	0.9103	0.0370	0.0371	0.0337	0.0328	0.0382
2	0.8620	0.8784	0.8603	0.8733	0.9009	0.0441	0.0411	0.0467	0.0461	0.0406
3	0.8347	0.8647	0.8669	0.8430	0.8869	0.0463	0.0424	0.0427	0.0481	0.0417
4	0.8255	0.8228	0.8442	0.8481	0.8982	0.0461	0.0459	0.0462	0.0502	0.0374
Big	0.8745	0.8754	0.8718	0.8354	0.8772	0.0333	0.0384	0.0414	0.0468	0.0388

The regression intercept of the three-factor model can also reflect its explanatory power. Theoretically, if Equation (1) can satisfactorily explain changes in expected returns, then the intercepts produced by the time series regression will tend toward zero. It can be seen from Table 6 that the intercepts of the twenty-five size-BE/ME portfolios, ranging from −0.0011 to 0.0054, are extremely close to zero. At the same time, the majority of the t-statistics are insignificant, with only two exceptions: portfolio $size(5)\_BE/ME(1)$ and $size(1)\_BE/ME(4)$. Therefore, the three-factor model can indeed reflect and explain most of the variations in portfolio returns.

In the CAPM, excess returns on market portfolios are the only factor that can account for excess returns on stock portfolios. Nevertheless, after introducing the size factor and value factor as additional explanatory variables, the excess return on market portfolios (the market factor) still has explanatory power. In the three-factor model, the coefficient on market factor b is equivalent to β in the CAPM. Table 6 shows that in the coefficient b matrix, all the coefficients on the market factor are significant at the 1 percent level and thus reflect a positive sensitivity to market risk.

As for the size factor, SMB, the test results in Table 6 show that, except for the portfolio $size(5)\_BE/ME(5)$, all the other twenty-four size-BE/ME portfolios show a positive sensitivity to the size factor, though to varying degrees. Specifically, in the coefficient *s* matrix, holding the BE/ME ratio constant, the portfolio returns decrease with the increase of stock size. For example, in the $BE/ME(1)$ portfolio (the first column of matrix *s*), as the size gradually increases, the coefficient *s* decreases from 1.1998 to 0.1819. This indicates that for larger stocks, the marginal returns to decreasing size are smaller. Fama and French (1996) show that small portfolios have both a large and positive sensitivity to SMB, whereas big portfolios have a small and negative sensitivity to SMB. Though different from their observations, the positive coefficients on the SMB factor and the decreasing trend of *s* with increasing size in our article also provide adequate evidence to support the existence of a size premium.

Finally, with regard to the value premium, Table 6 shows that the twenty-five size-BE/ME portfolios exhibit varying degrees of sensitivity to the value factor, HML. However, the general trend is that the higher the BE/ME ratio, the higher the return. Specifically, in the coefficient *h* matrix, when holding size constant, the portfolio return increases significantly with the increase of the BE/ME ratio. For example, in the $size(5)$ portfolio (the fifth row of matrix *s*), as the BE/ME ratio gradually increases, the coefficient *h* increases from −0.8174 to 0.7204. This shows that for stocks with higher values, the marginal returns to increasing the BE/ME ratio tend to be larger. Fama and French (1996) show that portfolios with high BE/ME ratios have both a large and positive sensitivity to HML, while portfolios with low BE/ME ratios have a low and negative sensitivity to HML. In this article, the positive average value of HML and the increasing trend of *h* with increasing BE/ME support the existence of a value premium.

Empirical Results for the Four Sector Portfolios

In this section, we aim to employ the three-factor model to analyze the monthly returns on the four sector portfolios in the SSE A-Share market from January 2005 to December 2012. The four sectors include industrial sector, commercial sector, real estate sector, and utility sector. As in the previous section, we first present the regression results for the four sector portfolios using the conventional CAPM and then present the results of the three-factor model, in order to provide a brief comparison of the two models.

Table 7 presents the regression results of the conventional CAPM. Evidently, with higher R^2 values, the CAPM has a better explanatory power over the stock sector portfolios than the size-BE/ ME portfolios. In addition, the insignificant intercept terms suggest that no abnormal returns exist when the CAPM is fitted to the four sector indices. Therefore, the results here seem to justify the validity of the CAPM.

Table 8 presents the regression results of the three-factor model. Among the different sectors, the industrial index has the best goodness of fit at 92.68 percent on average, the utility index comes next with a goodness of fit of 87.40 percent, the commercial index ranks third with 78.84 percent, and the real estate index reveals the lowest goodness of fit with only 60.39 percent. The increase in explanatory power for the four sector indexes is generally smaller than that of the twenty-five size-BE/ME portfolios. As for the robustness of the results, the different choices of threshold when constructing the HML factor cause no obvious discrepancy in the regression results.

In addition, it can also be seen that the intercepts for all the four sector portfolios are rather insignificant. The average of the absolute value for the sixteen intercepts is only 0.0073. By constructing HML with a ratio of 20 percent, the regression on the real estate sector obtains the largest positive intercept, namely 0.0073; by constructing HML with a ratio of 50 percent, the regression on the utility sector obtains the smallest negative intercept, namely −0.0040. These show that the three-factor model has a strong explanatory power over stock portfolio returns and can reflect a large proportion of the risks relating to average portfolio returns.

Table 7. CAPM time series regressions on monthly excess returns of four sector indexes (2005–12, ninety-six months)

Sector	Regression Equation: $R_i - R_f = \alpha_i + \beta_i(R_M - R_f) + \varepsilon_i$	
	α	t(α)
Industrial	0.0010	0.3313
Commercial	0.0056	0.8950
Real Estate	0.0117	1.3550
Utility	−0.0011	−0.2978
	β	t(β)
Industrial	1.0125	32.3893
Commercial	0.8845	13.0537
Real Estate	1.0326	11.0819
Utility	0.9304	22.6587
	R^2	s(e)
Industrial	0.9178	0.0283
Commercial	0.6445	0.0613
Real Estate	0.5664	0.0843
Utility	0.8452	0.0372

Table 8. Three-factor time series regressions on monthly excess returns of four sector indexes (2005–12, ninety-six months)

Sector	Book-to-Market Equity (BE/ME) Division Methods							
	B/M10	**B/M20**	**B/M30**	**B/M50**	**B/M10**	**B/M20**	**B/M30**	**B/M50**
Regression Equation: $R_i - R_f = a_i + b_i(R_M - R_f) + s_iSMB + h_iHML + \varepsilon_i$								
	α				t(α)			
Industrial	−0.0007	−0.0008	−0.0007	−0.0008	−0.2606	−0.2756	−0.2662	−0.2668
Commercial	−0.0009	−0.0007	−0.0009	−0.0010	−0.1882	−0.1454	−0.1787	−0.1912
Real Estate	0.0073	0.0069	0.0070	0.0070	0.8502	0.8109	0.8259	0.8246
Utility	−0.0039	−0.0040	−0.0039	−0.0039	−1.0977	−1.1295	−1.1072	−1.1056
	b				t(b)			
Industrial	1.0230	1.0212	1.0227	1.0225	33.1783	32.8255	32.8727	33.2441
Commercial	0.9398	0.9527	0.9518	0.9441	17.0658	17.3706	17.3292	17.3117
Real Estate	1.0380	1.0176	1.0131	1.0177	11.0607	10.8372	10.8192	11.0151
Utility	0.9164	0.9094	0.9068	0.9124	23.3887	23.2328	23.3579	23.8049
	s				t(s)			
Industrial	0.1421	0.1407	0.1426	0.1425	3.3544	3.2643	3.2742	3.2761
Commercial	0.5863	0.6081	0.6139	0.6089	7.7476	8.0031	7.9828	7.8940
Real Estate	0.3167	0.2874	0.2731	0.2707	2.4560	2.2095	2.0833	2.0713
Utility	0.1583	0.1402	0.1294	0.1298	2.9398	2.5856	2.3798	2.3953
	h				t(h)			
Industrial	−0.0106	0.0036	−0.0113	−0.0147	−0.1856	0.0469	−0.1307	−0.1226
Commercial	−0.1398	−0.2816	−0.3077	−0.3825	−1.3768	−2.0847	−2.0207	−1.8013
Real Estate	0.1229	0.3296	0.4165	0.6171	0.7100	1.4251	1.6040	1.7153
Utility	0.1969	0.2955	0.3586	0.5032	2.7255	3.0649	3.3310	3.3718
	R^2				s(e)			
Industrial	0.9268	0.9267	0.9268	0.9268	0.0270	0.0270	0.0270	0.0270
Commercial	0.7851	0.7905	0.7900	0.7881	0.0482	0.0476	0.0476	0.0479
Real Estate	0.5975	0.6040	0.6063	0.6078	0.0821	0.0815	0.0812	0.0811
Utility	0.8710	0.8735	0.8756	0.8759	0.0343	0.0340	0.0337	0.0336

The regression results also show that the coefficients on the market factor in the SSE A-Share market do vary with the sectors. The *b* coefficients on the industrial and real estate stock portfolios are relatively higher than those of the commercial and utility portfolios. In total, the *b* coefficients range from 0.9068 to 1.0380 with an average of 0.9756 and are significant at the 1 percent level. This means that when excess returns on market portfolios increase by 1 percent, the returns on the four sector portfolios will increase about 0.98 percent on average. However, as *b* is close to one, it means that the market factor cannot fully explain fluctuations in portfolio returns.

As for the test results of coefficient *s* on the size factor, SMB, the stock sector portfolios show significant variations in their sensitivity to size, with the commercial stocks being most sensitive to SMB and the industrial and utility stocks being relatively insensitive to SMB. In the commercial stock sector, the four size factor *s* coefficients, produced by different HML regressions, are all positive (0.6043 on average) and are significant at the 1 percent level. In the real estate sector, the four size factor *s* coefficients are also positive (0.2870 on average) and are significant at the 5 percent level. In the industrial and utility sectors, although the coefficients from applying different HML ratios are still significant at the 1 percent level, the average values of the four coefficients are only 0.1429 and 0.1394, respectively, indicating less sensitivity to SMB.

These test results suggest that, since the average for the SMB factor itself is positive (see Table 2), a negative relationship between size and average stock returns clearly exists. In other words, small stocks tend to have higher returns than big stocks. During the sample period, the average monthly return on the small stocks group is 1.17 percent higher than that of the big stocks group (see Table 2), which is generally what we would expect to see in a size premium. This indicates that size premiums generally exist in China's stock market. However, the size premium does not have the same significant level in all sectors: the size premium in the commercial sector is the most obvious, followed by the real estate sector, while the size premium in the industrial sector is not so noticeable, and the utility sector exhibits the weakest size premium.

The test results for coefficient *h* on the value factor, HML, suggest that there are significant variations in the sensitivity of different sector portfolios to the BE/ME ratio. It seems that only the utility stocks exhibit positive sensitivity to HML and the *h* coefficients for the other sectors are insignificant. Specifically, it is only in the utility sector that the four value factor *h* coefficients are all positive (0.3386 on average) and significant at the 1 percent level when using different HML ratios. In the industrial and real estate sectors, the size factor coefficients under different HML ratios exhibit different signs, and the four *h* coefficients for the commercial sector are all negative. Moreover, in these three sectors none of the *h* coefficients are significant at the 1 percent level.

The test results also suggest that since the average of the HML factor is positive (see Table 1), this confirms the positive relationship between the BE/ME ratio and average stock returns, i.e., high BE/ME stocks tend to have higher returns compared to low BE/ME stocks. Moreover, the average monthly returns on the high BE/ME portfolio, H, is 0.40 percent higher than that of the low BE/ME portfolio, L (see Table 3), which is consistent with a value premium, indicating that value premiums generally exists in China's stock market. Nonetheless, the level of the premium is not the same across all the sectors. Specifically, there is evidence of a positive value premium on utility sector stocks, but the other sectors do not show any significant value premium.

Conclusion

Using monthly data from China's Shanghai Stock Exchange A-share market between 2005 and 2012, this article conducts an empirical investigation of the applicability of the Fama-French three-factor model to China's stock market. Specifically, this article tests for the existence and significance of size and value premiums. Our four main findings are as follows.

First, the Fama-French three-factor model is applicable to the SSE A-share market, as the model can satisfactorily explain the cross-sectional variations in stock returns. When different variable sorting and construction methods are used, the goodness of fit remains high and none of the intercepts are significant. In the test of the twenty-five size-BE/ME portfolios, we find that the average value for R^2 is 87.36 percent and the average absolute value of the intercept α is 0.0029. In the test of the four stock sector portfolios, we find that the average value for R^2 is 79.83 percent, with the industrial sector having the highest R^2 value of 92.68 percent, and the average absolute value of the intercepts is 0.0032. In addition, compared to the regression results of the CAPM, the regression results from the three-factor model for the twenty-five size-BE/ME portfolios show a large increase in the R^2 values, which implies that the three-factor model can explain cross-sectional variations in stock returns better.

Second, during the sample period, we find that a size premium does exist in the SSE A-share market, i.e., small stocks have higher returns than big stocks. The size factor, SMB, has a monthly average of 1.17 percent, which is consistent with a size premium. Moreover, the coefficients on this factor are all positive in all regressions. For the twenty-five size-BE/ME portfolios, the portfolio returns show a positive level of sensitivity to SMB, and when holding BE/ME constant, the coefficient *s* gradually decreases as the portfolio size increases. This means that for stocks with a larger size, the marginal returns to decreasing size are smaller. However, the size premium varies across different sectors, with the commercial sector being the most sensitive to the SMB factor, while the industrial and utility sectors are relatively less sensitive.

Third, during the sample period, we find that a value premium also exists in the SSE A-share market, i.e., high BE/ME stocks have higher returns than low BE/ME stocks. The value factor, HML, has a monthly average of 0.47 percent and most of the corresponding coefficients on this factor are significant, providing evidence for the existence of a value premium. For the twenty-five size-BE/ME portfolios, if we hold size constant, the coefficient *h* gradually increases with an increase in BE/ME ratio, which means that for stocks with higher BE/ME ratios, the marginal returns to increasing the BE/ME ratio tend to be larger. However, there are obvious differences in the value premium between the four sectors, with the utility sector being the most sensitive to the HML factor, while the other three sectors are relatively insensitive.

Finally, the regression coefficients on the three-factor model are fairly robust to different sorting and construction methods of the variables. The only exception is commercial stocks, where the coefficient *h* is insignificant only when the 10 percent HML ratio is used, while when the 20 percent, 30 percent and 50 percent HML ratios are employed, the *h* coefficients are significantly positive. This is possibly due to the fact that the division rate of 10 percent is too “extreme” for the proportion of individual stock samples in portfolios H and L to be representative of a diversified portfolio, thus the fluctuation pattern of portfolio returns becomes more similar to that of an individual stock. Nevertheless, we can conclude that under different variable sorting and construction methods, the regression results of the three-factor model are generally the same, and the factor coefficients are highly robust.

References

Banz, R. W. 1981. The relationship between return and market value of common stocks. *Journal of Financial Economics* 9:3–18. doi:10.1016/0304-405X(81)90018-0.

Basu, S. 1983. The relationship between earnings yield, market value, and return for NYSE common stocks: Further evidence. *Journal of Financial Economics* 12:129–56. doi:10.1016/0304-405X(83)90031-4.

Chui, A. C. W., and K. C. J. Wei. 1998. Book-to-market, firm size and the turn-of-the-year effect: Evidence from Pacific Basin emerging markets. *Pacific Basin Finance Journal* 6:275–93. doi:10.1016/S0927-538X(98)00013-4.

Daniel, K., and S. Titman. 1997. Evidence on the characteristics of cross sectional variation in stock returns. *Journal of Finance* 52:1–33. doi:10.1111/j.1540-6261.1997.tb03806.x.

Davis, J. L., E. F. Fama, and K. R. French. 2000. Characteristics, covariances, and average returns: 1929–1997. *Journal of Finance* 55:389–406. doi:10.1111/jofi.2000.55.issue-1.

DeBondt, W. F. M., and R. H. Thaler. 1985. Does the stock market overreact? *Journal of Finance* 40:793–805. doi:10.1111/j.1540-6261.1985.tb05004.x.

Drew, M. E., and M. Veeraraghavan. 2001. Explaining the cross-section of stock returns in the Asian region. *International Quarterly Journal of Finance* 1:205–21.

Fama, E. F., and K. R. French. 1992. The cross-section of expected stock returns. *Journal of Finance* 47:427–65. doi:10.1111/j.1540-6261.1992.tb04398.x.

Fama, E. F., and K. R. French. 1993. Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics* 33:3–56. doi:10.1016/0304-405X(93)90023-5.

Fama, E. F., and K. R. French. 1995. Size and book-to-market factors in earnings and returns. *Journal of Finance* 50:131–55. doi:10.1111/j.1540-6261.1995.tb05169.x.

Fama, E. F., and K. R. French. 1996. Multifactor explanations of asset pricing anomalies. *Journal of Finance* 51:55–84. doi:10.1111/j.1540-6261.1996.tb05202.x.

Fama, E. F., and K. R. French. 2015. A five-factor asset pricing model. *Journal of Financial Economics* 116:1–22. doi:10.1016/j.jfineco.2014.10.010.

Gan, C., H. Baiding, Y. Liu, and L. Zhaohua. 2013. An empirical cross-section analysis of stock return on the Chinese a-share stock market. *Investment Management and Financial Innovations, Issue* 1:127–36.

Gaunt, C. 2004. Size and book to market effects and the Fama French three factor asset pricing model: Evidence from the Australian stockmarket. *Accounting & Finance* 44:27–44. doi:10.1111/acfi.2004.44.issue-1.

Jegadeesh, N., and S. Titman. 1993. Returns to buying winners and selling losers: Implications for stock market efficiency. *Journal of Finance* 48:65–91. doi:10.1111/j.1540-6261.1993.tb04702.x.

Lakonishok, J., A. Shleifer, and R. W. Vishny. 1994. Contrarian investment, extrapolation, and risk. *Journal of Finance* 49:1541–78. doi:10.1111/j.1540-6261.1994.tb04772.x.

Lintner, J. 1965. The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. *Review of Economics and Statistics* 47:13–37. doi:10.2307/1924119.

Mossin, J. 1966. Equilibrium in a capital asset market. *Econometrica* 34 (4):768–83. doi:10.2307/1910098.

Sharpe, W. F. 1964. Capital asset prices: A theory of market equilibrium under conditions of risk. *Journal of Finance* 19:425–42.

Xu, J., and S. Zhang. 2014. The Fama-French three factors in the Chinese stock market. *China Accounting and Finance Review* 16:210–27.