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Comparison Study on Asset Pricing Model in Chinese Stock Market: CAPM and Fama-French Model

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Harry Markowitz (1959) develops a mean-variance model for efficient portfolio management. Based on this model, Sharpe (1964), Lintner (1965) and Black (1972) build the CAPM. Merton (1973) then generalizes the CAPM and proposes the ICAPM. Afterwards, Fama and French (1996) take the idea of Ross's (1976) arbitrage pricing theory and construct a three-factor model. The Fama-French three-factor model explains covariation in average returns around the capital market in the world. However, empirical findings are not in favour of the use of the CAPM that may arise from the features of Chinese capital market which are state-owned system and non-capitalization. The purpose of this research is to explore the explanatory power of asset pricing models in regards to investor behaviour in Chinese stock market. The findings of this study are that the Fama-French three-factor model better explains time-series variation in stock returns than the CAPM. Size effect exists in Shanghai and China (Shanghai and Shenzhen) stock market. However, value effect is found only in Shanghai stock market. Empirical results also show that, in Shanghai stock market, firms with low E/P ratios tend to have higher returns and firms with higher E/P ratios tend to have lower returns. Robustness tests show that the Fama-French three-factor model is better than CAPM to explain stock return variation in Chinese stock market.

JEL Codes: G11, G12, B41, C12, C32

Key words: CAPM, Fama-French model, Shanghai stock market, China stock market, Average return

1. Introduction

As widely known, asset pricing is one of the most important topics in finance field. Markowitz (1959) establishes a mean-variance model and proposes that rational and risk-averse investors should choose "mean-variance-efficient" portfolios. Sharpe (1964) and Lintner (1965) build a capital asset pricing model (CAPM) based on this model. They add two assumptions to their model: complete agreement and unlimited borrowing and lending at a risk-free rate which include the meaning of complete capital market. Black (1972) develops his own version of the CAPM (called *'Black CAPM'*). He replaces the assumption, allowing unlimited borrowing and lending at a

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risk-free rate, with allowing unlimited short sales of risky assets to make model more efficient and more actually used in the modern developed capital market. These CAPMs (Sharpe, 1964, Lintner, 1965 and Black, 1972) use beta, forms of measurement that measure the expected return of the market and the expected return of a theoretical risk-free asset to present the asset's sensitivity to a non-diversifiable risk.

In the meantime, the CAPM tests are based on three implications. First, expected returns on securities are a linear function of their market betas. Market betas suffice to explain expected returns. Second, the beta premiums are positive to present the reaction or sensitivity of individual firm values to the market return changes. Third, in the Sharpe-Lintner model, the expected returns of securities, uncorrelated with the returns of the market, are equal to a risk-free interest rate. The Black model only requires that the expected returns on securities unrelated to the market must be less than a risk-free interest rate. This is the primary difference between the Sharpe-Lintner model and Black model.

The early tests focus on predictions of the Sharpe-Lintner model and cross-sectional regression is commonly used to analyze and derive results. However, there are two problems with these tests. The first problem is an inaccurate estimate of betas for individual securities which induce some other alternative methods to get betas such as industry beta. The second problem is that the regression residuals are positively correlated (Fama and French, 2004). To improve the accuracy of estimating betas, Blume (1970) and Black, Jensen and Scholes (1972) use portfolios rather than individual securities. The Fama-MacBeth regression is used to correct correlational residue. Jensen (1968) first implements time series regressions to test the Sharpe-Lintner model. He suggests the intercept term (Jensen’s alpha) should be zero if the average premium on securities is completely explained by its expected CAPM risk premium (its beta multiplied by the expected premium on market).

Early cross-sectional tests show that there is a positive relationship between beta and stock returns and time series tests confirm these findings (Black, Jensen and Scholes 1972; Friend and Blume, 1970; Stambaugh, 1982). These early tests also reject the Sharpe-Lintner version of the CAPM.

However, empirical findings in the late 1970s show that average returns are unrelated to the market beta. These findings also do not favor the Black version of the CAPM (Fama and French, 2004). Thereafter, more ratios are added to catch the variation in average returns missed by the beta. These ratios include size, the ratio of earnings to price of a common stock (hereafter referred to as *‘E/P’*), the ratio of the book value of a common stock (BE) to its market value (ME; hereafter referred to as *‘BE/ME’*) and leverage. Basu (1977) finds that E/P ratios explain the average returns missed by betas. Banz (1981) and Reinganum (1981) find that size is a risk factor that helps betas to predicts average returns and the role of size is confirmed by Blume and Stambaugh (1983). Bhandari (1988) also reports that leverage ratios are associated with average returns. Leverage ratios and size enhance the explanatory power of market betas. Chan, Hamao and Lakonishok (1991) find that the BE/ME ratio is a distress factor and that there is a strong relation between the BE/ME ratio and average returns in Japanese stock market. Capaul, Rowley and Sharpe (1993) confirm the explanatory power of the BE/ME ratio to variation in returns in four European stock markets and in Japanese stock market.

In this regard, Fama and French (1992) identify the roles of the beta, E/P, BE/ME, size and leverage ratios. They find when they control size, there is no relation between the beta and returns. The size and BE/ME ratio absorb the roles of the leverage ratio and E/P in average stock returns. Fama and French (1993, 1996) use a time-series regression approach to test the role of size and BE/ME ratio and come to the same conclusion. The size and BE/ME ratio explain the covariation in returns. Furthermore, Fama and French (1996) propose that size and the BE/ME ratio are related to the profitability.

Firms with high BE/ME ratio tend to be persistently distressed and have weak profitability. Small stocks tend to be less profitable than big stocks. Barber and Lyon (1997) include financial firms in their sample to test the robustness of the Fama-French three-factor model. They suggest that the size and BE/ME ratio explain the covariation in average returns, including in financial firms. The study of Fama and French (1998) shows that the international version of the Fama-French three-factor model is better than the international version of the CAPM.

Nevertheless, behavioral researchers such as Lakonishok, Shleifer, and Vishny (1994), Haugen (1995) and MacKinlay (1995) argue that return premiums are not driven by common risk factors. They suggest that relative distress premiums are too large to be explained by rational pricing, that they are similar to arbitrage opportunities. They also argue that periods of poor return on distressed stocks are not typically periods of low GNP growth or overall market returns. Additionally, they argue that diversified portfolios of high and low book-to-market firms have similar return variances. Danel and Titman (1997) also propose that premiums between high and low BE/ME stocks are firms' characteristics rather than abnormal return driven by risk.

Although there are some arguments surrounding the Fama-French three-factor model (1996)**.** Fama-French three-factor model is widely used in empirical research as an asset pricing model. For instance, with sample firms in Europe, Malin and Veeraraghavan (2004) show that size and BE/ME are important factors to take into consideration when explaining the price risk of France, Germany and UK stock markets. Moerman (2005) also demonstrates the applicability of the three-factor model in the Eurozone. A study conducted by Nartea, Gan and Wu (2008) indicates that the Fama-French three-factor model is more robust than the CAPM in the Hong Kong stock market.

There are also some empirical studies regarding the Fama-French three-factor model and Chinese stock market. A cross-sectional regression is used in most of these studies. A study by Drew, Naughton and Veeraraghavan (2003) shows that the size and BE/ME ratio explain the price risk that is not captured by the beta. A size effect, but no value effect, exists in Shanghai stock market over the period of years from 1993 to 2000. Their study reveals that small firms tend to generate higher returns than big firms and growth firms tend to generate higher returns than value firms. These results are not in accordance with what are found by Fama and French (1996). Wang and Xu (2004) examine the stock return patterns in both Shanghai and Shenzhen stock markets over the period of 1996 to 2002. Their findings confirm the role of size, but do not show that the BE/ME ratio has any returns explanatory power. Wong, Tan and Liu (2006) also demonstrate the role of size in Shanghai stock market, but their study shows that the explanatory power of BE/ME ratio is weak. Wang and Iorio (2007) and Chen, Kan and Anderson (2007) use different approaches to examine the role of size and the BE/ME ratio in Chinese stock market and find that the size and BE/ME ratio explain the stock returns from 1994 to 2002. These results are in agreement with Fama and French (2006).

However, empirical findings are not in favour of the use of the CAPM that may arise from the features of Chinese capital market which represents state-owned system and non-capitalization. In this regard, Chinese market can make suitable materials to support asset pricing models and other empirical study (Baek and Liu, 2008). Existing studies did not discuss price efficiency by applying two models to two exchanges. Therefore, this study analyses the suitability of the model in two exchanges under this background. The purpose of this paper is to explore the applicability of asset pricing models in Chinese stock market. In order to achieve the goal of this paper, the CAPM and Fama-French three-factor model are separately used to price the rate of returns on stocks in Shanghai stock market and China stock market (China stock market is also called as 'Shenzhen stock market'). Furthermore, robustness is tested to adaptive capacity of the Fama-French three-factor model. Finally, we test whether or not the size and BE/ME ratio are related to profitability.

The main findings of this study are that the Fama-French three-factor model better explains time-series variation in stock returns than the CAPM, based on different sample data. Size effect exists in Shanghai and China (Shanghai and Shenzhen) stock market. However, value effect is found only in Shanghai stock market. The results also show that, in Shanghai stock market, firms with low E/P ratios tend to have higher returns and firms with higher E/P ratios tend to have lower returns. Robustness tests show that the Fama-French three-factor model is robust.

The remainder of the paper is structured as follows. Section 2 focuses on model introduction. Section 3 describes the data. Section 4 presents empirical results of this study. Section 5 summarizes the paper and includes research implication and suggestion for further research.

2. Methodology

2.1 Capital Asset Pricing Model (CAPM)

The CAPM is developed by Jack Treynor (1962), William F. Sharpe (1964), John Lintner (1965), and Jan Mossin (1966) independently. The equation for the CAPM is as follows:

$$\mathrm{E}(r_i) = r_f + \beta_i (E(r_m) - r_f) \qquad \text{equation (1)}$$

Where: $\mathrm{E}(r_i)$ is the expected return on the capital asset

r_f is the risk-free rate of interest

β_i is the sensitivity of the expected excess asset returns to the expected excess market returns

$E(r_m)$ is the expected return of the market

The CAPM describes the linear relation between the beta and expected rate of return. The beta reflects asset-specific sensitivity to non-diversifiable systematic risk. In other words, the beta is a factor which rewards the systematic exposure taken by an investor.

2.2. Intertemporal Capital Asset Pricing Model (ICAPM)

The Intertemporal Capital Asset Pricing Model (ICAPM) is constructed by Robert Merton (1973). He uses a maximization method to get this model. The main difference between the ICAPM and the classic CAPM is the state variables. State variables are used to reflect the fact that investors hedge against shortfalls in consumption or against changes in the future investment opportunity set.

$$E(r_i) = r_f + \frac{COV(r_i, r_m)}{\sigma_M^2}\left[E(r_m) - r_f\right] + \frac{COV(r_o, r_i)}{\sigma_o^2}\left[E(r_o) - r_f\right]$$

$$E(r_i) = r_f + \beta_{im}\left[E(r_m) - r_f\right] + \sum_{s=1}^{S}\beta_{is}\left[E(r_s) - r_f\right] \qquad \text{equation (2)}$$

Where: COV means covariance

r_f is the risk free rate of return

β_{im} is the sensitivity of a portfolio to its market portfolio

$E(r_i)$ is the asset's expected rate of return

β_{is} is the sensitivity of a portfolio to additional state variables

$E(r_m)$ is the expected return of a market portfolio

$E(r_s)$ is the expected return of a state variable

$E(r_o)$ is the rate of return on a portfolio that hedges against the changes in the opportunity set

2.3. Fama-French three-factor model

Fama and French (1993) set three portfolios to capture risk: MKT (return on market portfolio minus risk-free rate), SMB (return on portfolio of small stock minus return on portfolio of big stock) and HML (return on portfolio of high book-to-market ratio stock minus return on portfolio of low book-to-market ratio stock).

$$E(r_i) - r_f = \beta_{im}\left[E(r_m) - r_{ft}\right] + \beta_{is}E(SMB) + \beta_{ih}E(HML) \qquad \text{equation (3)}$$

Where: SMB is the returns on portfolios of small stocks minus returns on portfolios of big stocks.

HML is the returns on portfolios of high book-to-market ratio stocks minus returns on portfolios of low book-to-market ratio stocks.

SMB and HML mimic risk factors in returns.

MKT is the returns on market portfolios minus risk-free rates,

$E(r_i)$ is the portfolio's expected rate of return.

r_f is the risk-free return rate.

$E(r_m)$ is the expected return of the stock market.

β_{im}, β_{is} and β_{ih} are the sensitivity of the portfolio to the market portfolio, SMB, and HML, respectively.

If the Fama-French three factor model has higher explanatory power, the market beta cannot account for changes in expected excess return in the stock market. Instead, factors such as 1) size of the firm 2) book to market ratio 3) market factor may be useful in explaining the change in the return of the Chinese stock market. In other words, small and medium-sized value stocks with low price-book value ratios have an advantage in raising their excess return in the Chinese stock market.

3. Data Description

Stock prices for empirical analysis are collected from the Guangfa Securities Company and these data cover the years from 2006 to 2010. Income statements and balance sheets are collected from Shenzhen Securities Information Co. Ltd. Interest rates are collected from the Bank of China. Sample firms of this study exclude financial firms and ST (Special Treatment) firms. The Special Treatment (ST) system was implemented in Chinese stock market on April 22th, 1998. This is a system in which special treatment is given to listed firms that are in abnormal financial situations. Once a firm is labelled as a ST firm, its daily price fluctuation range will be restricted within ±5%. In order to avoid survivor bias, we excluded ST firms from our sample firms.

To implement empirical tests, we use the following method. First, we use monthly returns of stocks as cumulative returns. Risk-free rate (r_f) is a one-month interest rate converted from a three-month interest rate. BE is the book value of stockholders' equity plus balance sheet deferred taxes. ME is calculated by multiplying a stock's price at the end of December by shares outstanding. Firm size is the logarithm of firm size in May of year *t*. The BE/ME ratio is calculated by BE divided by ME. E/P is calculated by earnings divided by a stock's price at the end of December of a given year.

The explanatory variables, $r_{M,}$ SMB and HML are calculated by the following approaches. First, stocks are split into two groups based on the size of firms. Then stocks are independently divided into three BE/ME ratio groups based on breakpoints. The three breakpoints are defined as the bottom 30 percent, the middle 40 percent, and the top 30 percent of the BE/ME ratio values, respectively. When the BE/ME ratio groups are formed, the negative BE firms are excluded. Intersections of the two size groups and the three BE/ME ratio portfolios were used to form six size-BE/ME portfolios (S/L, S/M, S/H, B/L, B/M, B/H; S=small size, B=large size, L, M, H=low, medium, small BE/ME). Market return is the value-weighted return on all sample stocks including the negative BE stocks. SMB is the difference of between returns on small stock portfolios and the returns on big stock portfolios. HML is the difference between returns on high book-to-market ratio stock portfolios and returns on low book-to-market ratio stock portfolios.

Our data period covers the years from 2006-2010, including the global financial crisis period. Table 1 presents the means of excess returns on 25 portfolios. The 25 portfolios in panel A and panel B are constructed on the basis of firms individually listed in Shanghai stock market and China stock market. The average of the means of excess returns on the 25 portfolios represented in panel A and in panel B is are

0.32 percent and 0.37 percent. The average of the means of excess returns on the 25 portfolios in Shanghai stock market is 0.05 percent lower than average of means of excess returns on the 25 portfolios in China stock market (panel B). The average of standard deviations of all of the excess returns on the 25 portfolios in panel A is 5.58 while the average of standard deviations of all of the excess returns on the 25 portfolios in panel B is 5.53. The average of standard deviations of all of the excess returns on the 25 portfolios in panel A is slightly higher than that in panel B. The means of excess returns on the 25 portfolios in panel A indicate that small firms tend to generate higher average returns than big firms and high BE/ME ratio firms tend to have higher returns than low BE/ME ratio firms in Shanghai stock market. The means of excess returns on the 25 portfolios in panel B show a consistent trend with those in panel A, however, high BE/ME ratio stocks in China stock market do not tend to generate higher returns than low BE/ME ratio stocks. These results are partially consistent with Fama and French (1993, 1996).

Table 1: Excess Returns by BE/ME Ratio

This table presents the monthly excess returns, based on BE/ME ratios, of 25 portfolios from 2006 to 2011, constructed on the basis of firms listed in Shanghai *stock market* and *China stock market*.

Panel A. Shanghai stock market

	Book-to-Market value of Equity (BE/ME) Quintiles									
	Low	2	3	4	High	Low	2	3	4	High
	Mean					Standard Deviation				
Size Small	0.75	0.82	0. 92	0.89	0.98	5.92	5.44	5.81	5.77	5.71
2	0.42	0.54	0.49	0.52	0.68	5.76	5.60	5.37	5.62	5.80
3 4	0.06	0.17	0.28	0.35	0.44	5.19	5.23	5.36	6.05	5.59
Big	0.02	-0.01	0.06	0.26	0.14	5.21	5.39	5.69	5.56	5.95
	-0.29	-0.02	-0.02	0.01	0.16	5.38	5.38	5.51	5.40	5.79

Panel B. China stock market

	Book-to-Market value of Equity (BE/ME) Quintiles									
	Low	2	3	4	High	Low	2	3	4	High
Size	Mean					Standard Deviation				
Small	0. 79	0. 91	0. 86	0. 98	0. 93	5.76	5.32	5.78	5.79	5.76
2	0. 42	0. 59	0. 43	0. 48	0. 61	5.72	5.85	5.47	5.54	5.89
3	0. 28	0. 32	0. 36	0. 33	0. 22	5.70	4.79	5.38	5.75	5.73
4	-0. 02	0. 13	0. 07	0. 31	0. 14	5.09	5.31	5.49	5.34	5.66
Big	-0. 20	-0. 05	0. 05	0. 10	0. 12	5.26	5.37	5.70	5.15	5.70

Source: Stock prices are collected from the Guangfa Security Company
Interest rates are collected from the Bank of China
Annual statements are collected from Shenzhen Securities Information Co., Ltd.

Table 2 presents the means of excess returns on five portfolios constructed on the basis of E/P ratios. Table 3 shows that firms with higher E/P ratios reveal lower excess returns and excess returns on five portfolios decline with the decrease of E/P ratios. This result is in accordance with the findings of Fama and French (1996).

Table 2: Excess Returns in Shanghai Stock Market by E/P Ratio

This table presents the monthly excess returns, based on E/P ratios, of five portfolios from 2006 to 2011, constructed on the basis of firms listed in Shanghai *stock market*.

Earnings to Price of Common Stock (E/P) Quintiles									
Low	2	3	4	High	Low	2	3	4	High
Mean					Standard Deviations				
0.81	0.69	0.53	0.49	0.47	5.93	5.69	5.33	5.15	5.62

Source: Stock prices are collected from the Guangfa Security Company
Interest rates are collected from the Bank of China
Annual statements are collected from Shenzhen Securities Information Co., Ltd.

In Table 3, panel A presents the summary statistics on average sizes, BE/ME ratios, and E/P ratios of firms listed in Shanghai stock market and panel B presents the ratios of firms listed in China stock market. The trends of average sizes and BE/ME ratios in both Shanghai and China stock markets are almost same. The average size tends to increase from 2006 to 2007 and decrease in 2009 and the standard deviation of average sizes varies little from one year to the next. The average of the BE/ME ratios varies from one year to the next. From 2006 to 2008, the average of the BE/ME ratios decreases, but this ratio rebound in 2009 and declines again in 2010. The standard deviations of average BE/ME vary more than the standard deviations of average size. The trend of the average of E/P ratios is similar to that of the BE/ME ratios.

Table 3: Summary Statistics for Size and BE/ME Ratios

Panel A: Shanghai stock market

	Size		(billion Yuan)	
	Mean	Standard Deviation	Maximum	Minimum
2006.12	9.20	0.44	11.72	8.26
2007.12	9.69	0.43	11.99	8.84
2008.12	9.69	0.48	12.04	8.79
2009.12	9.62	0.44	11.93	8.83
2010.12	9.78	0.42	11.94	8.95
	Book-to-Market value of Equity (BE/ME)			
	Mean	Standard Deviation	Maximum	Minimum
2006.12	0.67	0.29	1.76	0.01
2007.12	0.48	0.25	1.46	0.00
2008.12	0.21	0.11	0.73	0.01
2009.12	0.55	0.27	1.92	0.04
2010.12	0.27	0.13	0.89	0.03
	E/P			
	Mean	Standard Deviation	Maximum	Minimum
2006.12	0.04	0.03	0.23	0.00
2007.12	0.04	0.03	0.24	0.00
2008.12	0.02	0.01	0.11	0.00
2009.12	0.04	0.03	0.20	0.00
2010.12	0.02	0.02	0.36	0.00

Panel B: China stock Market

	Size		(billion Yuan)	
	Mean	Standard Deviation	Maximum	Minimum
2006.12	9.16	0.43	11.72	8.21
2007.12	9.67	0.42	11.99	8.79
2008.12	9.67	0.47	12.04	8.78
2009.12	9.58	0.44	11.93	8.70
2010.12	9.74	0.41	11.94	8.94
	Book-to-Market value of Equity (BE/ME)			
	Mean	Standard Deviation	Maximum	Minimum
2006.12	0.66	0.31	2.28	0.01
2007.12	0.47	0.25	1.67	0.00
2008.12	0.20	0.11	0.73	0.02
2009.12	0.54	0.27	1.92	0.02
2010.12	0.25	0.13	0.89	0.00

Source: Annual statements are collected from Shenzhen Securities Information Co., Ltd.

4. Empirical Result

Fama-French (1996) shows that except for the continuation of short-term returns documented by Jegadeesh and Titman (1993), Fama-French three-factors model is a good description of returns on portfolios sorted on size and BE/ME. Fama-French three-factors model explains patterns in returns when portfolios are set on E/P,cash flow/price and sales and other patterns such as size effect (Lakonishik, Shleifer and Vishny, 1994). This model also explains the reversal of long-term returns. Chan and Chen (1991) and Fama and French (1994, 1995) think the BE/ME ratio is related to relative distress. Their findings are in agreement with ICAPM and APT and take irrational pricing and data problems into consideration. Chinese stock market has some unique characteristics, which listed firms basically do not pay dividend, 2/3 shares of major listed firms are nontradable, share prices of listed firms tend to be the same trend, mergers and acquisitions are irrelevant to the behaviour of listed firms. We examine whether Fama-French three-factor model capture the covariation of share prices in Chinese stock market, just as it does in American stock market.

Table 4 shows the CAPM test results. Panel A in table 4 presents test results of firms listed in Shanghai stock market. The results show that 12 percent of intercepts are not close to zero at a significance level of 5 percent and 24 percent of intercepts are not close to zero at significance level of 10 percent. These results indicate that the CAPM risk premiums do not completely explain excess returns on portfolios. The average of the adjusted R^2 is 0.88. Panel B in table 4 presents the test results of firms listed in China stock market. Panel B also shows that 20 percent of intercepts are not close to zero at a significance level of 5 percent and 40 percent of intercepts are not close to zero at a significance level of 10 percent. These results indicate that premiums on more portfolios cannot be explained by the CAPM risk premiums. The average of the adjusted R^2 is 0.89. Either 0.88 or 0.89 is not high average of the adjusted R^2. These number of intercepts or the adjusted R^2 indicate that the CAPM does not describe the pattern of the stock returns in Chinese stock market well. As discussed in the introduction, unlike previous researches, this study examines which could be more useful by applying two asset pricing models into two Chinese stock markets. The next section presents how much Fama-French three-factor model describes the return on the two stock markets. If the Fama-French three-factor model shows higher explanatory power, the Chinese market provides the basis for demonstrating that the size of the firm, the ratio of the book to the market price, and the market factors are more useful than the market risk-based CAPM. And we find evidence in the empirical analysis.

Table 4: CAPM Test Result

This table presents the CAPM test results of 25 portfolios, from 2006 to 2011, constructed on the basis of firms listed in Shanghai *stock market and China stock market*.

Panel A. Shanghai stock market

$$E(R_i) - R_f = \alpha + \beta\left[E(R_m) - R_f\right] + \varepsilon$$

	Book-to-Market value of Equity (BE/ME) Quintiles									
	Low	2	3	4	High	Low	2	3	4	High
Size			α					P-value		
Small	0.03	0.05	0.04	0.05	0.04	0.34	0.06*	0.22	0.04**	0.09*
2	0.02	0.01	0.01	0.01	-0.00	0.37	0.71	0.79	0.79	0.88
3	-0.03	-0.02	-0.01	-0.01	-0.03	0.24	0.44	0.71	0.81	0.19
4	-0.04	-0.05	-0.04	-0.02	-0.04	0.13	0.03**	0.08	0.26	0.14
Big	-0.07	-0.04	-0.05	-0.03	-0.04	0.02**	0.15	0.08*	0.26	0.15
			β					P-value		
Small	0.99	0.92	0.97	0.98	0.97	0.00***	0.00***	0.00***	0.00***	0.00***
2	0.99	0.96	0.89	0.97	0.98	0.00***	0.00***	0.00***	0.00***	0.00***
3	0.85	0.91	0.92	1.05	0.97	0.00***	0.00***	0.00***	0.00***	0.00***
4	0.88	0.93	0.98	0.98	1.02	0.00***	0.00***	0.00***	0.00***	0.00***
Big	0.88	0.89	0.93	0.92	0.96	0.00***	0.00***	0.00***	0.00***	0.00***
			Adjusted R^2					$s(\varepsilon)$: standard error		
Small	0.85	0.87	0.85	0.89	0.89	0.03	0.02	0.02	0.02	0.02
2	0.91	0.91	0.85	0.92	0.87	0.02	0.02	0.03	0.02	0.03
3	0.82	0.92	0.91	0.92	0.91	0.03	0.01	0.02	0.02	0.02
4	0.86	0.92	0.91	0.94	0.91	0.02	0.02	0.02	0.01	0.02
Big	0.81	0.84	0.87	0.89	0.84	0.03	0.03	0.02	0.02	0.03

Panel B. China stock market

$$E(R_i) - R_f = \alpha + \beta\left[E(R_m) - R_f\right] + \varepsilon$$

	Book-to-Market value of Equity (BE/ME) Quintiles									
	Low	2	3	4	High	Low	2	3	4	High
Size			α					P-value		
Small	0.03	0.05	0.04	0.05	0.04	0.29	0.05**	0.18	0.06*	0.08*
2	-0.01	0.01	-0.00	-0.00	0.01	0.81	0.73	0.87	0.87	0.69
3	-0.02	0.00	0.01	-0.02	-0.03	0.34	0.93	0.57	0.39	0.23
4	-0.05	-0.03	-0.04	-0.02	-0.04	0.04**	0.08*	0.03**	0.27	0.06*
Big	-0.06	-0.05	-0.04	-0.04	-0.04	0.03**	0.04**	0.07*	0.10	0.23
			β					P-value		
Small	0.96	0.90	0.96	0.98	0.98	0.00***	0.00***	0.00***	0.00***	0.00***
2	0.95	0.99	0.92	0.92	0.99	0.00***	0.00***	0.00***	0.00***	0.00***
3	0.97	0.89	0.92	0.99	0.97	0.00***	0.00***	0.00***	0.00***	0.00***
4	0.86	0.91	0.94	0.93	0.97	0.00***	0.00***	0.00***	0.00***	0.00***
Big	0.86	0.90	0.96	0.87	0.94	0.00***	0.00***	0.00***	0.00***	0.00***
			Adjusted R^2					$s(\varepsilon)$: standard error		
Small	0.86	0.89	0.87	0.89	0.90	0.03	0.02	0.03	0.02	0.02
2	0.87	0.91	0.88	0.88	0.90	0.03	0.02	0.02	0.02	0.02
3	0.91	0.86	0.92	0.93	0.90	0.02	0.081	0.01	0.01	0.02
4	0.89	0.93	0.93	0.95	0.93	0.02	0.01	0.01	0.01	0.02
Big	0.83	0.87	0.89	0.90	0.86	0.03	0.02	0.02	0.02	0.03

Source: Stock prices are collected from the Guangfa Security Company
Interest rates are collected from the Bank of China
Annual statements are collected from Shenzhen Securities Information Co., Ltd.

*, **, *** indicate that the factors are significant at the 10%, 5% and 1% levels, respectively

Table 5 presents the test results of the Fama-French three-factor model. Similar to above, panel A in table 5 presents test results of firms listed in Shanghai stock market. The results show that 12 percent of the intercepts are not close to zero at a 5 percent significance level. The average adjusted R^2 is 0.92. The higher average values of the adjusted R^2 and lower amount of intercepts that are significantly different from zero indicate that explanatory power of the Fama-French three-factor model is better than the CAPM. Panel B in table 5 presents test results of firms listed in China stock market. The results show that all intercepts are close to zero. The average of adjusted R^2 is 0.92. These results also indicate that the Fama-French three-factor model is better than the CAPM. The SMB and HML are used to reflect investor's hedge behavior. Table 5 also shows that loadings of firms with the lowest size (called "small firm" in table 5) on the SMB are positive and loadings of size firms with the biggest size (called "big firm" in table 5) on the SMB are negative. Positive loadings indicate that small firms tend to generate higher average returns. Negative loadings indicate big firms tend to have lower average returns. Firms with a low HML have negative loadings indicate that the firms tend to generate lower average returns. Stocks with a high HML have positive loadings. These positive loadings sensitivity indicate that stocks with high HML firms tend to have higher average returns. These findings are consistent with Fama and French (1996), Wang and Iorio (2007) and Chen, Kan and Anderson (2007).

In table 5, panel A shows that the loadings of small firms are positive and the loadings of big firms are negative. These results are in line with the results in Table 4. Panel B in table 5 also presents that the loadings of low HMLs are negative; however, loadings of high HMLs are not significantly different from zero. This indicates that firms with a high HML do not tend to generate higher returns. This also means that there is no value effect in China (Shenzhen) stock market over the test period and value effect is found only in Shanghai stock market.

Table 5: Three-factor Model Regression Results

This table presents the three-factor model regression results of 25 portfolios, from 2006 to 2011, constructed on the basis of firms listed in Shanghai *stock market and China stock market*. SMB stands for returns on portfolios of small stocks minus returns on portfolios of big stocks and HML stands for returns on portfolios of high book-to-market ratio stocks minus returns on portfolios of low book-to-market ratio stocks.

Panel A. Shanghai stock market

$$R_i - R_f = \alpha_i + \beta_i (R_M - R_f) + s_i SMB + h_i HML + \varepsilon_i$$

	Book-to-Market value of Equity (BE/ME)									
	Low	2	3	4	High	Low	2	3	4	High
Size			α					P-value		
Small	-0.03	-0.00	-0.02	0.00	-0.01	0.15	0.97	0.34	0.85	0.78
2	-0.01	-0.02	-0.04	-0.03	-0.04	0.69	0.34	0.14	0.11	0.09*
3	-0.03	-0.03	-0.02	-0.02	-0.02	0.19	0.20	0.47	0.39	0.32
4	-0.04	-0.04	-0.02	-0.03	-0.03	0.09*	0.13	0.31	0.13	0.15
Big	-0.04	-0.01	-0.01	0.00	-0.00	0.09*	0.61	0.76	0.48	0.91
			β					P-value		
Small	0.98	0.90	0.93	0.95	0.94	0.00***	0.00***	0.00***	0.00***	0.00***
2	1.00	0.97	0.88	0.96	0.92	0.00***	0.00***	0.00***	0.00***	0.00***
3	0.90	0.92	0.93	1.04	0.93	0.00***	0.00***	0.00***	0.00***	0.00***
4	0.91	0.97	0.99	0.96	0.98	0.00***	0.00***	0.00***	0.00***	0.00***
Big	0.96	0.92	0.95	0.91	0.91	0.00***	0.00***	0.00***	0.00***	0.00***
			SMB					P-value		
Small	1.12	0.90	1.05	0.87	0.88	0.00***	0.00***	0.00***	0.00***	0.00***
2	0.55	0.51	0.81	0.65	0.85	0.00***	0.00***	0.00***	0.00***	0.00***
3	0.27	0.20	0.16	0.27	0.32	0.12	0.12	0.28	0.08*	0.02**
4	0.05	-0.00	-0.29	0.15	0.06	0.74	0.98	0.06*	0.23	0.66
Big	-0.60	-0.47	-0.71	-0.76	-0.79	0.00***	0.01**	0.00***	0.00***	0.00***
			HML					P-value		
Small	-0.42	-0.25	0.04	0.10	0.30	0.01***	0.08*	0.82	0.44	0.04**
2	-0.40	-0.30	-0.08	0.00	0.44	0.00***	0.04**	0.64	0.99	0.00***
3	-0.86	-0.27	-0.23	0. 04	0.33	0.00***	0.06*	0.15	0.80	0.03**
4	-0.64	-0.56	-0.05	0.16	0.72	0.00***	0.00***	0.75	0.22	0.00***
Big	-0.94	-0.25	0.11	0.58	1.09	0.00***	0.19	0.49	0.00***	0.00***
			Adjusted R^2					$s(\varepsilon)$: standard error		
Small	0.93	0.93	0.93	0.94	0.94	0.02	0.01	0.02	0.01	0.01
2	0.93	0.93	0.89	0.95	0.94	0.01	0.02	0.02	0.01	0.01
3	0.87	0.93	0.91	0.92	0.93	0.02	0.01	0.02	0.02	0.02
4	0.89	0.93	0.91	0.94	0.94	0.02	0.01	0.02	0.01	0.02
Big	0.92	0.87	0.91	0.94	0.92	0.02	0.02	0.02	0.01	0.02

Source: Stock prices were collected from the Guangfa Security Company
Interest rates were collected from Bank of China
Annual statements were collected from Shenzhen Securities Information Co., Ltd

*, **, *** indicate that the factors are significant at the 10%, 5% and 1% levels, respectively

Panel B. China stock market

$$R_i - R_f = \alpha_i + \beta_i(R_M - R_f) + s_i SMB + h_i HML + \varepsilon_i$$

	Book-to-Market value of Equity (BE/ME)									
	Low	2	3	4	High	Low	2	3	4	High
Size			α					P-value		
Small	-0.01	0.01	-0.01	0.01	0.01	0.55	0.66	0.62	0.55	0.65
2	-0.02	-0.01	-0.03	-0.02	-0.03	0.54	0.81	0.19	0.19	0.27
3	-0.01	-0.01	-0.01	-0.02	-0.39	0.58	0.79	0.67	0.37	0.12
4	-0.02	-0.01	-0.02	-0.00	-0.03	0.40	0.65	0.23	0.85	0.16
Big	0.00	0.01	0.01	0.01	0.07	0.94	0.62	0.54	0.57	0.79
			β					P-value		
Small	0.86	0.85	0.88	0.91	0.91	0.00***	0.00***	0.00***	0.00***	0.00***
2	0.93	0.97	0.87	0.87	0.94	0.00***	0.00***	0.00***	0.00***	0.00***
3	0.97	0.89	0.91	0.98	0.94	0.00***	0.00***	0.00***	0.00***	0.00***
4	0.88	0.94	0.96	0.94	0.98	0.00***	0.00***	0.00***	0.00***	0.00***
Big	0.87	0.91	0.90	0.90	0.93	0.00***	0.00***	0.00***	0.00***	0.00***
			SMB					P-value		
Small	0.82	0.66	0.88	0.63	0.60	0.00***	0.00***	0.00***	0.00***	0.00***
2	0.21	0.26	0.52	0.52	0.63	0.29	0.13	0.00***	0.00***	0.00***
3	-0.13	0.36	-0.02	0.05	0.22	0.42	0.31	0.87	0.74	0.19
4	-0.48	-0.44	-0.31	-0.24	-0.13	0.00***	0.00***	0.02**	0.03**	0.37
Big	-1.16	-1.03	-0.98	-0.78	-0.74	0.00***	0.00***	0.00***	0.00***	0.00***
			HML					P-value		
Small	-0.16	-0.076	-0.01	-0.09	-0.04	0.00***	0.14	0.89	0.11	0.51
2	-0.11	-0.04	-0.05	-0.07	-0.08	0.05**	0.49	0.30	0.24	0.14
3	-0.11	-0.16	-0.05	-0.02	-0.07	0.04**	0.20	0.29	0.64	0.22
4	-0.11	-0.02	-0.05	-0.04	-0.04	0.01***	0.62	0.22	0.27	0.45
Big	-0.15	-0.05	-0.06	-0.03	-0.01	0.00***	0.28	0.17	0.39	0.82
			Adjusted R^2					$s(\varepsilon)$: standard error		
Small	0.91	0.92	0.92	0.92	0.93	0.02**	0.02	0.02	0.02	0.02
2	0.87	0.91	0.90	0.90	0.93	0.02**	0.02	0.02	0.02	0.02
3	0.91	0.88	0.92	0.93	0.91	0.02**	0.02	0.02	0.02	0.02
4	0.91	0.94	0.94	0.96	0.93	0.02**	0.01	0.01	0.01	0.02
Big	0.92	0.95	0.95	0.95	0.92	0.01**	0.01	0.01	0.01	0.02

Source: Stock prices are collected from the Guangfa Security Company
Interest rates are collected from the Bank of China.
Annual statements are collected from Shenzhen Securities Information Co., Ltd.

*, **, *** indicate that the factors are significant at the 10%, 5% and 1% levels, respectively

The global financial crisis first occurred in the Unites States in 2008, and then spread to other countries which brought structural changes in the financial market. As well known, the global crisis resulted in the threat of the total collapse of large financial institutions, the bailout of banks by national governments, and downturns in stock markets around the world including China and Asian market. In order to find the impact of this crisis on Chinese stock market, a dummy variable for financial crisis is added into the Fama-French three-factor model.

Table 6 (panel A) presents the results. This table presents additional three-factor model regression results of 25 portfolios, constructed on the basis of listed firms in China and Shanghai stock market. The sensitivities of MKT, SMB and HML are not shown in Table 6 because they are similar to those in Table 5. Table 6 shows that all of the sensitivities of the dummy variables are not significantly different from zero. The result indicates that dummy variables do not affect the explanatory power of the Fama-French three-factor model. Fama and French (1996) proposes that size and BE/ME ratios are related to profitability. E/P is one of the important profitability ratios.

Panel B in Table 6 shows that the MKT and SMB explain the covariation in returns in Shanghai stock market. However, the HML has no explanation power on the excess returns of the five portfolios. The loadings of the low E/P ratios are not all positive. Positive loadings indicate that stocks with low E/P ratios tend to generate higher returns while negative loadings indicate that stocks with high E/P ratios tend to generate lower returns. In this regard, these results in Shanghai stock market are not consistent with Fama and French (1996) explanation.

Table 6: Additional Three-factor Model Regression Results

This table presents additional three-factor model regression results of 25 portfolios, from 2006 to 2011, constructed on the basis of listed firms in *China and Shanghai stock market*. SMB stands for returns on portfolios of small stocks minus returns on portfolios of big stocks and HML stands for returns on portfolios of high book-to-market ratio stocks minus returns on portfolios of low book-to-market ratio stocks.

Panel A. Chinese stock market including financial crisis dummy

$$R_i - R_f = \alpha_i + \beta_i (R_M - R_f) + s_i SMB + h_i HML + Dummy + \varepsilon_i$$

	Book-to-Market Equity value of (BE/ME)									
Size	Low	2	3	4	High	Low	2	3	4	High
			α					P-value		
Small	-0.01	0.01	-0.01	-0.02	0.02	0.73	0.76	0.71	0.56	0.55
2	-0.06	-0.06	-0.08	-0.05	-0.05	0.25	0.17	0.06	0.13	0.19
3	-0.05	0.02	-0.03	-0.07	-0.08	0.27	0.80	0.35	0.06*	0.05**
4	-0.07	-0.03	-0.05	-0.03	-0.04	0.04**	0.33	0.08	0.25	0.31
Big	-0.03	-0.02	-0.02	0.03	0.06	0.40	0.60	0.60	0.26	0.20
			Dummy					P-value		
Small	-0.00	-0.00	0.00	0.01	-0.00	0.37	0.97	0.93	0.22	0.68
2	0.01	0.01	0.01	0.00	0.00	0.33	0.12	0.17	0.33	0.41
3	0.01	-0.01	0.00	0.01	0.01	0.31	0.59	0.40	0.09*	0.22
4	0.01	0.00	0.01	0.00	0.00	0.05**	0.38	0.19	0.19	0.84
Big	0.01	0.001	0.001	-0.001	-0.01	0.26	0.27	0.29	0.33	0.15
			Adjusted R^2					$s(\varepsilon)$: standard error		
Small	0.91	0.93	0.92	0.92	0.92	0.02	0.02	0.02	0.02	0.02
2	0.87	0.91	0.90	0.94	0.93	0.02	0.02	0.02	0.01	0.02
3	0.91	0.88	0.92	0.93	0.91	0.02	0.03	0.02	0.02	0.02
4	0.91	0.94	0.94	0.96	0.93	0.02	0.01	0.01	0.01	0.02
Big	0.92	0.95	0.95	0.95	0.90	0.01	0.01	0.01	0.01	0.02

Panel B. Shanghai Stock Market by E/P

	Earnings to Price of Common Stock (E/P) Quintiles				
E/P	Low	2	3	4	High
α	0.00 (0.00***)	0.00 (0.00***)	0.00 (0.00***)	0.00 (0.00***)	0.00 (0.00***)
β	1.03 (0.00***)	0.99 (0.00***)	0.96 (0.00***)	0.93 (0.00***)	1.02 (0.00***)
SMB	0.37 (0.00***)	0.18 (0.00***)	-0.17 (0.00***)	-0.34 (0.00***)	-0.60 (0.00***)
HML	0.01 (0.66)	0.00 (0.91)	0.00 (0.82)	0.01 (0.49)	0.01 (0.84)
Adjusted R^2	0.99	0.99	0.99	0.99	0.98
$s(\varepsilon)$	0.01	0.01	0.01	0.01	0.01

Source: Stock prices are collected from the Guangfa Security Company
Interest rates are collected from the Bank of China
Annual statements are collected from Shenzhen Securities Information Co., Ltd

Numbers in ( ) represent p-values and *, **, *** indicate that the factors that are significant at the 10%, 5% and 1% levels, respectively

5. Summary and Conclusions

The aim of this empirical research is to explore which asset pricing model can catch the variation in returns on stocks in Chinese stock market. The CAPM and the Fama-French three-factor model are used to analyse their fit with the data. Empirical test results show that the beta does not suffice to explain patterns of returns of stocks in Shanghai or China stock market. The main finding of the study is that the Fama-French three-factor model better explains time-series variation in stock returns than the CAPM. Three explanatory variables, MKT, SMB and HML, capture the covariation among the averages of returns of stocks in the two stock markets. The MKT and SMB have stronger explanatory powers than the HML. These results present empirical implication that the Fama-French three-factor model could be more useful than a risk-based model as a pricing index in the Chinese market.

Our results also indicate that investors, in general, who hold small size or high BE/ME ratio stocks tend to obtain higher returns. Investors in Shanghai stock market who hold large size or low BE/ME ratio stocks tend to have lower returns. However, investors who invest in value stock tend to have higher returns in Shanghai stock market while growth firms tend to generate higher returns than value firms in China market. The coefficients of the financial crisis dummy variables indicate that the 2008 global crisis does not weaken the explanatory power of the three factors. This provides further evidence that the Fama-French model is better than CAPM to explain stock return variation in Chinese market. Fama and French (1996) also proposed that firms with higher BE/ME ratios tend to have weaker profitability and that small stocks tend to be less profitable than stocks with large equity value. But the additional results of this study are not consistent with these proposals. Further extended research with more details of Chinese firms needs to be implemented on this inconsistency.

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