



The five-factor asset pricing model tests for the Chinese stock market



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ABSTRACT

We provide out-of-sample tests of the five-factor model introduced by Fama and French (2015a) for the Chinese stock market. We find strong size, value and profitability patterns in average returns, but weak investment pattern. For portfolios we test, we find that the profitability factor significantly improves the description of average return, however, the investment factor makes marginal contributions. Factor spanning tests prove that the investment factor is redundant during 07/1995–06/2015 and 07/1997–12/2013 for the Chinese stock market. More importantly, the five-factor model passes the GRS tests of Gibbons et al. (1989) for most of portfolios we test.

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1. Introduction

Inspired by the clean surplus relation of Miller and Modigliani (1961) that the total dividend equals total equity earnings minus the change in total book equity, Fama and French (2015a) introduce a five-factor asset pricing model that adds the profitability and investment factors to the three-factor model of Fama and French (1993). The five-factor time-series regression is

$$R_{it} - R_{ft} = a_i + b_i Mkt_t + s_i SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + e_{it}, \quad (1)$$

where $R_{it} - R_{ft}$ is the portfolio i 's return in excess of risk-free rate R_{ft} for month t , Mkt_t is the value-weight (VW) market portfolio return in excess of risk-free rate, SMB_t , HML_t , RMW_t and CMA_t are respectively the size, value, profitability and investment factors. Before the establishment of the five-factor model, there is a large body of literature addressing the profitability and investment patterns in average returns for the U.S. stock market.¹

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¹ See, e.g., Fairfield et al. (2003), Titman et al. (2004), Fama and French (2006, 2008a), Aharoni et al. (2013) and Novy-Marx (2013).

Fama and French (2015b) test the five-factor model for international developed stock markets including North America, Europe, Japan, and Asia Pacific, which is an out-of-sample test of the U.S. results of Fama and French (2015a). They find that the five-factor model significantly improves the performance of description for the anomaly patterns in average returns in global aspect.

However, different regions have different kinds of anomalies, which implies that the importance of a particular factor is diverse for different regions. For example, the value, profitability and investment effects are strong for North America, Europe, and Asia Pacific. But for Japan, there is little relation of average returns with profitability and investment. Fama and French (2012, 2015b) emphasize that the Global version of the factor asset pricing model performs poorly, and the Local version can give a clear explanation of the anomalies.

In this paper, we test the five-factor model of Fama and French (2015a) on the Chinese stock market. Although the Chinese stock market is still a developing market, by the end of July 2015, its capitalization had reached 50 trillion RMB yuan, and its number of listed firms had exceeded 2600, which leads the Chinese stock market to the second largest stock market following NYSE.² The cross-section regressions of Fama and MacBeth (1973) suggest that *Return on Equity* (ROE) is the best selected variable indicating profitability, and the growth rates of *Total Assets* and *Book Equity* (*InvA* and *InvB*) are similar to indicate investment. We find that average returns for the Chinese stock market typically increase with *Book-to-Market* ratio (*B/M*) and ROE, decrease with market cap (*Size*), and have little relation with *InvA* and *InvB*. Consequently, the profitability factor RMW improves the performance of the five-factor model, but the investment factor CMA does not. Factor spanning tests show that the investment factor CMA is redundant in the factor asset pricing model. We evaluate the empirical performance of the five-factor model by 5 factor variables (*Size*, *B/M*, ROE, *InvA* and *InvB*), and use other 9 well-documented anomaly variables to test the robustness of the five-factor model. All variables are tested by Fama (2016), Chen et al. (2015) and Chen et al. (2010). Following Fama and French (1996, 2015a,b), the left-hand-side (LHS) portfolios tested in this paper are 25 (5×5) portfolios double sorted by factor variables and decile portfolios single sorted by anomaly variables. The return spreads of high and low anomaly variable portfolios in the Chinese stock market do not depend on *Size* typically, which is the reason why we use decile portfolios, rather than double sorted portfolios. The high-minus-low decile portfolios single formed by value variables (*Earning-to-Price* ratio (*E/P*) and *Market Leverage* (*A/P*)) and *Research & Development Expenses to Market* (*RD*) are significant, and others are not. Summary statistics prove that high *E/P* and *A/P* portfolios tend to have high *B/M*, and high *RD* portfolios tend to have small market cap. Our results are consistent with Chen et al. (2010), who show that many anomaly variables which are efficient in the U.S. market do not affect the average returns of the Chinese market, except the obvious value effect. More importantly, the four- (excluding CMA) and five-factor models pass the GRS test for most of portfolios we test, but the three-factor model does not. Hence, the profitability factor is critical for the Chinese stock market. Our study can be regarded as out-of-sample tests of Fama and French (2015a,b).

Hou et al. (2015) introduce a *q*-factor model, in which there are four factors without value factor. However, they do not illustrate the reason for dropping the value factor. Similarly, Fama and French (2015a) find that the factor HML is a redundant factor for the U.S. stock market, since it is totally spanned by other four factors. Different from them, we find that, in China, the strong and robust value effect in China can not be explained by profitability and investment factors, and the factor HML is not redundant, which is similar to the Japanese stock market. Our result is consistent with the international tests of Fama and French (2015b), which shows that the value factor HML spanning regressions give the intercepts that are more than 2.3 standard errors from zero, and the result is robust. Thus, the U.S. results are special among the global markets.

On the cross-section of expected returns in the Chinese stock market, Wang and Xu (2004) use a relatively short time sample (07/1996–06/2002) to find the strong size effect and weak value effect. Consequently, they define a new factor, free float, which is the ratio of public company shares to total company shares, to improve the performance of factor model. Hilliard and Zhang (2015) also find little evidence of value effect, because of using smaller number of stocks.³ Chen et al. (2015) argue that the robust value effect in China is due to the extreme values in the early years from 1995 to 1996. However, they do not show the factor spanning tests for factors. Our time-series out-of-sample factor spanning tests omitting the period from 1995 to 1996 show that the value factor HML is still non-redundant, although it tends to be insignificant. Unlike them, Chen et al. (2010) only find the obvious value effect by the data from 07/1995 to 06/2007; Carpenter et al. (2015) and Cakici et al. (2015a) find strong size and value effects both in average returns using their own samples. Cakici et al. (2015b) show that the book-to-market decomposition described in Fama and French (2008b) improves the explanatory power of estimation for the Chinese shares. In addition, there exist some particular factors to the Chinese stock market, such as the price momentum emphasized by Kang et al. (2002) and Naughton et al. (2008), the volume factor considered by Wang and Cheng (2004), and the liquidity factor mentioned by Narayan and Zheng (2010). We find that different studies adopt different time-samples, different stock-samples, and different databases, which makes the results different. Furthermore, the studies mentioned above on the Chinese stock market use the full stock sample breakpoints for anomaly variables. However, Fama and French (1993) use NYSE breakpoints to avoid sorts dominated by tiny but plentiful stocks. Using the full stock sample breakpoints can not distinguish the average returns for portfolios with different level of anomaly variables. Hence, we use the spot China Securities Index 300 (CSI 300) underlying stocks breakpoints for variables, which consists of the biggest and highest liquidity 300 listed firms. As far as we

² Data is from monthly statistical report of China Securities Regulatory Commission.

³ For example, in 2011, the number of listed firms is 1266 in their paper, and 2301 in our studies.

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