DOES THE FACTOR MODEL PERFORM WELL IN EMERGING MARKET? THE EMPIRICAL EVIDENCE OF CHINA STOCK MARKET

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Abstract

The asset pricing models, Fama and French 3 factor (1992, 1993, 1996) and 5 factor (2015) model, in the past few decades are the most widely applied asset pricing model in the rest of world. The U.S. (developed financial markets) country-specific additional 2 factors in the 5-factormodel, RMW and CMA or profitability premium and investment premium, empirically cannot further capture the return variation of classic 3 factors/chrematistics in China (developing financial markets) stock market. Therefore, the classic 3-factor has better performance than the 5-factor model in China. We do not presume that firms in different countries share same features. Following the Liu, Stambaugh and Yuan (2019), we replace the book-to-market ratio to earning-to-price ratio (EP ratio). By using Shanghai and Shenzhen exchange stocks, we find out that the redundancy of HML only exist in the 5-factor model. In the Fama MacBeth regression, the SMB and HML are significant factors in three factor model for explaining the China return variation, surprisingly, the size effect is impressively persistent in both models but the ratio effect has limit explanatory power.

Introduction

At the year end of 2018, China's total equity market capitalization, second biggest equity market, is around $6.09 trillion. U.S. stock market capitalization, the biggest equity market in the world, is around $34 trillion U.S. dollar at the year end of 2018. Figure 1 presents that the uptrend of published firms and total three (Shanghai and Shenzhen A share class and Second-board Market) markets total valuation.

Figure 1

The question is asked by Griffin (2002), according to this paper, the findings support that there are no benefits to extending the Fama and French 3 factor model to global context. Fama and French (2012) analyze application of factor model in North America, Europe, Japan, and Asia Pacific. Expect Japan, they find out the same conclusion as they did before in U.S. Moreover, they find out the return momentum everywhere, expect Japan. In addition, Fama and French (2016), the expected returns in North America, Europe and Asia Pacific positively related to the book to market ratio, B/M ratio, and negative related to investment. However, their conclusion and expectation do not explain the Japan market. Both three and five factor model are the most famous and extensively used asset pricing (investment) model no matter in theoretical or in practical realization. We contribute to the existence literature in several aspects, first, we ask a question about model adoption by using China stock market data, we find out that the three-factor model is more appliable than the five-factor model. Second, the question about model adoption is rarely asked in the existence literature, more specifically, by using China stock market, we investigate

this model adoption issue.

The localized factors or characteristics model should be concerned and developed. Based on U.S. data, Fama and French created common factors to explain expected return anomalies. However, instead of creating another country specific "factors or characteristics zoo", based on framework of FF3/FF5 factors and Liu, Stambaugh and Yuan (2019) ((hereafter, LSY (2019)), we mainly focus on the empirical performance of factor model in the China's expected return. The emerging China stock market is not the case of developed U.S. stock market, the investors are separate and fledgling comparing with the investors in the developed financial market. Many papers found out that the lottery and speculative players in investment behavior. According to LSY(2019) and Lee, Qu and Shen(2017), hereafter LQS (2017), intended IPO firms face extremely long inspectional process and high cost, therefore, these companies brought "nearly bankruptcy or bad performance public firm" – the common part of these firms is small size and low ratio – for completing the indirect Initial Public Offering. We can see the indirect-IPO throughout the past 20 years in China stock market. Until the end of 2013, China Securities Regulatory Commission, (CSRC), implemented IPO Standards in the Audit of Reverse Mergers for regulating and managing requirements of indirect-IPO firms. At September 2019, CSRC revised the previous acts and detailed the processes of the inspection. The typical outperformance of indirect-IPO firms is extremely high return after a successful on board, in addition, this abnormal outperformance attracts entire market eye lights. The anomalies of indirect-IPO should be concerned.

Literature review

The Fama and French three factor model utilize book the market ratio as the way to sort stock portfolios, but in this article, we adopted the reciprocal of price to earnings (EP) ratio in order to replace the book to market (BM) ratio. According to LSY (2019), their findings present the approval of EP ratio because of the outperformance in China equity market. As we know, the size is the market cap, the B is the firm book value, M is the firm's market value, and P is the stock price. SMB is made of firm's market cap (ME or M), HML is made of book to market ratio (B/M). SMB factor is realized as closely related to the "small company effect", and HML factors can be used to represent the return gap between "value stocks" and "growth stocks" (high BE / ME companies correspond to "value stocks" while low BE / ME company corresponds to "growth stock"). Fama and French (1992) issued another paper to elaborate the common risk factors in the returns on stock and bond. Their evidence clearly points out that the three stock-market factors affect the stock average return, such as, overall market factor, firm size factor, and book-to-market-equity factor. The SMB stands for size factor and the HML stands for B/M ratio factor. Fama and French (1996) show that 3 factors model solve the problems that CAMP model cannot solve.

In addition, Griffin (2002), Fama and French (2012), Fama and French (2016), LSY (2019) purpose the model adoptive issues in some countries. Unfortunately, the factor model cannot solve all anomalies across counties. The three factors model provide the outperformance when we fit in the model. The reason of five factor underperformance

could be complex, however, we know that there are some heavy weights on the difference between China and U.S. stock market. For capturing the expected excess return, firms' features that based on U.S. market do not explain the China stocks, we also find out that the size and ratio effect work very well and that the size effect holds the remarkable and persistent explanatory power on left hand side variable, expected excess return. According to LQS (2017), there is a special spot that is extremely difference, the time-killing and complicate IPO processes raise up a question about the indirect-IPO issue. Unlike the US stock market, China's stock market was established 30 years ago, and the market is still on the development mode. Some researchers found the size effect and ratio effect, some did not find out. Stock exchange contains speculation, information disclosure Opaque, information distortion and other emerging market characteristics. The three-factor model is based on the features of developed capital market. China as a new capital market, the adoption of asset pricing model deserves thick spotlight.

Data and Methodology

Regression model:

$$R_{\mathrm{it}} - R_{\mathrm{Ft}} = a_i + b_i(R_{\mathrm{Mt}} - R_{\mathrm{Ft}}) + s_i\mathrm{SMB}_t + h_i\mathrm{HML}_t + e_{\mathrm{it}} \text{----------(1)}$$

$$R_{\mathrm{it}} - R_{\mathrm{Ft}} = a_i + b_i(R_{\mathrm{Mt}} - R_{\mathrm{Ft}}) + s_i\mathrm{SMB}_t + h_i\mathrm{HML}_t + r_i\mathrm{RMW}_t + c_i\mathrm{CMA}_t + e_{\mathrm{it}} \text{--(2)}$$

5 factor construction		
Sort	Breakpoint	Construction
Size and E/P, or Size and OP, or Size and Inv	Size: median E/P: 30th and 70th OP: 30th and 70th Inv: 30th and 70th On percentiles	SMBE/P = (SL+SN+SH)/3 – (BL+BN+BH)/3 SMBop = (SR+SN+SW)/3 – (BR+BN+BW)/3 SMBInv = (SC+SN+SA)/3 – (BC+BN+BA)/3 thus, SMB = (SMBE/P + SMBop + SMBInv)/3 HML=(SH+BH)/2 – (SL+BL)/2 RMW=(SR +BR)/2 – (SW+BW)/2 CMA=(SC+BC)/2 – (SA+BA)/2
3 factor construction		
Sort	Breakpoint	Construction
Size and E/P	Size: median E/P: 30th and 70th	SMB=(SL+SN+SH)/3 – (BL+BN+BH)/2 HML=(SH+BH)/2 – (SL+BL)/2

The empirical results

We sort the stocks into 25 portfolios on size, value and other factors. Low ratios and high ratio represent the incremental level of Earning to Pricing. The small and big size represent the incremental level of firm's market capitalization (total share outstanding times the month end price). We run the time-series regression for estimating the loading of each portfolio, such as, the intercept, α, coefficients of market premium, Coff. RP, size premium, Coff. SMB and value premium, Coff. HML. t(α), t(RP)，

t(SMB) and t(HML) are the corresponding t-statistics. Residuals are the time-series regression of each 25 portfolio. Table 1 shows the coefficients on 25 portfolios of value-weighted stocks. According to Fama and French (1996), the small firms more likely have the higher return than the big size firms and the higher ratio stocks more likely have the higher returns than the low ratio stocks. Our sample provide the same pattern.

Table 1

Fama - French three factor regression - average portfolio excess return												
Size and EP ratio - The performance of Fama and French 3 factor model from 2003 - 2018												
$R_{\mathrm{it}} - R_{\mathrm{Ft}} = a_i + Coff.RP_i(R_{\mathrm{Mt}} - R_{\mathrm{Ft}}) + Coff.SMB_i\mathrm{SMB}_t + Coff.HML_i\mathrm{HML}_t + e_{\mathrm{it}}$												
R square (Time-series regression)							Residual 【stander deviation】					
	Low Ratio	2	3	4	High Ratio			Low Ratio	2	3	4	High Ratio
Small Size	84%	85%	85%	83%	84%		Small Size	4.96%	5.07%	4.98%	5.38%	5.25%
2	85%	86%	87%	86%	90%		2	5.32%	4.97%	4.61%	4.64%	4.05%
3	87%	86%	86%	88%	90%		3	4.79%	4.68%	4.37%	4.05%	3.73%
4	86%	86%	86%	83%	91%		4	5.09%	4.61%	4.62%	4.81%	3.50%
Big Size	80%	88%	88%	91%	92%		Big Size	5.46%	4.00%	3.84%	3.28%	3.24%

Table 1 presents the estimated of three factor time-series regression. Not surprisingly, we find out that almost all of the intercept is insignificant, almost all of t statistics of SMB and HML is significant, thus these two factors provide explanatory power on explaining, the left-hand side, excess return. LSY (2019) propose that the earning to price ratio has better performance to capture the Chinese stock market anomalies, LQS (2017) point out that the indirect-IPO leaves a big noise in the market. Therefore, we follow the methodology of LSY (2019) and eliminate the bottom 30% small market cap firms in order to reduce to the market noise.

Table 2

Fama - French Five factor regression average portfolio excess return												
Size and PE ratio / 2X3model / The performance of Fama and French 5 factor model from 2003 - 2018												
$R_{\mathrm{it}} - R_{\mathrm{Ft}} = a_i + Coff.RP_i(R_{\mathrm{Mt}} - R_{\mathrm{Ft}}) + Coff.SMB_i\mathrm{SMB}_t + Coff.HML_i\mathrm{HML}_t + Coff.RMW_i\mathrm{RMW}_t + Coff.CMA_i\mathrm{CMA}_t + e_{\mathrm{it}}$												
R square (Fama - French regression)							Residual 【stander deviation】					
	Low Ratio	2	3	4	High Ratio			Low Ratio	2	3	4	High Ratio
Small Size	80%	81%	82%	80%	82%		Small Size	5.00%	5.03%	4.88%	5.01%	4.74%
2	81%	80%	84%	84%	87%		2	5.11%	5.35%	4.48%	4.32%	4.05%
3	81%	82%	83%	84%	87%		3	5.12%	4.67%	4.29%	4.10%	3.62%
4	80%	81%	81%	77%	88%		4	5.37%	4.68%	4.57%	4.84%	3.38%
Big Size	72%	82%	84%	87%	89%		Big Size	6.00%	4.16%	3.66%	3.18%	3.09%

Comparation between 3 and 5 factor model is quite interesting, the insignificant intercepts in FF3 (EP ratios instead of BM ratios) obviously dominate the insignificant intercepts in FF5 and the average R square is nearly 87%, moreover, the average standard deviation of residuals is around 4.5%. However, there are 11 significant intercepts in FF5 (EP ratios instead of BM ratios) and the average R square is lower almost 4% than average R square of FF3, the average of residuals is around

4.5%. Therefore, empirically we conjecture that the performance of FF3 is better than the performance of FF5. We propose that the difference between China and U.S. stock markets is different, investment and profitability premium were constructed by the special and common features of public companies, however, these two additional factors can not fit in the emerging Chinese stock market. On another side of coin, the classic Fama and French three factors constructed by the size (market capitalization) and earning to price ratio deserves the trophy of horse racing. In addition, our findings consist with several papers and researchers.

Fama and MacBeth Regression

Referring to Fama and French (1993), in each June, we separate the market cap into 6 equal size section. We apply the individual stock's exposures to the market factor (MRK), size effect (SMB) and ratio effect (HML) for the pre-ranking betas. The pre-ranking betas are estimated on pervious 24 to 36 monthly returns. Because of the high correlation between the size and size-betas, FF (1993) point out the problem of using size and size-betas is obvious. Therefore, to reduce this problem we sub-separate each of the six ranked size section into 6 sections on the basis of pre-ranking CAPM betas. Moreover, we calculate the monthly return on portfolios for the next 15 months starting at July on each year. The post-ranking betas (full sample) are estimated by the calculated-monthly return on 36 portfolios constructed on size and CAPM betas, MRK, SMB and HML on each portfolio. In the second pass of the FM regression, we use post-ranking betas on each factor to estimate the exposures.

Table 3

	1	2	3	4	5
	ALL	SMB+HML	SMB+MRK	HML+MRK	MRK
RP	-0.014		-0.011	-0.001	0.007
	(-0.62)		(-0.47)	(-0.01)	-0.360
SMB	-0.029*	-0.027*	-0.034*		
	(-2.03)	(-2.31)	(-2.33)		
HML	0.044*	0.044*		0.053**	
	2.540	2.520		2.960	
cons	-0.004	-0.005	-0.004	-0.005	-0.005
	(-0.59)	(-0.61)	(-0.59)	(-0.67)	(-0.69)
r2	0.007	0.005	0.006	0.004	0.002
t statistics in	Parentheses				
* p<0.05, ** p<0.01	*** p<0.001				

We compute return in this Fama MacBeth regression. These averages provide test to filter out the which independent variable has non-zero expected premiums. In table 3, we can clearly see all the time series average of the coefficients of month by month cross-sectional regression on size, beta and other factor/characteristics. The size and ratio premium play a very important role to explain the cross-sectional average returns.

The persistent negative (positive) sign and significant level on SMB (HML) on all model, model of 1 – 4, do provide evidences that size effect explains the cross-section of average stock returns.

In table 4, however, in the Fama and French 5 factor model, the uncertain positive significant level on HML supports that the explanatory power of ratio effect is not as dominant as size effect. Actually, Hu et al. (2019) also find out the same results, thus, our empirical evidence support that the size effect contains the biggest explanatory power on the returns. This uncertainty of ratio's explanatory power is the reflection of unique China stock market, and this is the reason why we need to develop the country-specific asset pricing model even though we consider the indirect-IPO.

Table 4

	1	2	3	4	5	6	7
	ALL	S+R+C	H+R+C	R+C	S+H	S	H
RP	0.007	0.004	0.004	0.002	-0.019	-0.024	-0.022
	0.400	0.230	0.230	0.100	(-0.81)	(-1.02)	(-0.96)
SMB	-0.037**	-0.034*			-0.036*	-0.032*	
	(-2.69)	(-2.54)			(-2.51)	(-2.41)	
HML	0.031*		0.024		0.031*		0.024
	2.130		1.730		2.040		1.700
RMW	-0.023	-0.018	-0.027	-0.022			
	(-1.66)	(-1.27)	(-1.88)	(-1.53)			
CMA	-0.033	-0.036	-0.031	-0.034			
	(-1.84)	(-1.95)	(-1.69)	(-1.82)			
cons	-0.003	-0.003	-0.004	-0.004	-0.003	-0.002	-0.004
	(-0.40)	(-0.36)	(-0.52)	(-0.48)	(-0.35)	(-0.31)	(-0.47)
r2	0.015	0.012	0.012	0.010	0.010	0.007	0.007

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

We use the same methodology. In each June, we separate the market cap into 6 equal size section. We apply the individual stock's exposures to the market factor (MRK), size effect (SMB), ratio effect (HML), profitability (RMW) and investment factor (CMA) for the pre-ranking betas. The pre-ranking betas are estimated on pervious 24 to 36 monthly returns. We sub-separate each of the six ranked (small (1) to big (6)) size section into 6 sections on the basis of pre-ranking CAPM betas. Moreover, we calculate the monthly return on portfolios for the next 15 months starting at July on each year. The post-ranking betas (full sample) are estimated by the calculated-monthly return on 36 portfolios formed on size and CAPM betas, MRK, SMB and HML on each portfolio. In the second pass of the FM regression, we use post-ranking betas on each factor to estimate the exposures.

We also find out that the size effect in the empirical results has the strong performance in both factor model. It's surprising low that the difference between R-square of two factor (MRK and SMB) and R-square of three factors (MRK, SMB and HML), more specifically, this difference is around 5%.

In table 4, there is evidence to say the investment and profitability does not make any contribution on explaining the average return, however, the HML, formed by EP ratios, also doesn't provide persistent explanatory power.

Conclusion

Many researches investigate the factors/characteristics model in developed markets, such as G7. However, we found limited researches focusing on emerging market especially on China stock market. By using the earning to price ratio instead of book to market ratio, we found out that the performance of FF3 is empirically better than the performance of FF5 and China-FF3 model do provide explanatory power to the average return in the tradition Fama MacBeth regression. Consistent with Zhao, Yan and Zhang (2016) and Liu, Stambaugh and Yuan (2019), the performance of both the RMW and CMA is neglectable.

As our results showing, the localized multi-factors model is needed to be developed especifically in China stock market. Different stock market has different features and commons, we may not use ruler to measure color difference. Moreover, in 5 factor model, the HML is a redundancy factor/characteristic by using China data. Also, this finding is consistent with other group of Chinese researchers.

The further studies may focus on the common factors of China public companies. We always saw the entirely market turn red (goes up) or green (goes down) in one day or certain period. Thus, this homogenous movement must be investigated in our further research. Because of the supportive policy design, we may also see the abnormal benefits in stock market.

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