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Factors in the Returns on Stock: Inspiration from Fama and French Asset Pricing Model

Yuanzhen JIANG

Abstract

Under the inspiration of Fama and French asset pricing model, this paper mainly studies the relationship between the month return of A shares and the factors that may have an effect on the stocks' month return. It also compares the differences in the reaction of all shares and GEM board shares to these factors. It is important to highlight that these factors include the market, firm size, earnings and book-to-market information. The data used in this project comes from the quarterly data of China stock market from March of 2000 to December of 2011 and was used in panel model regressions. The regression time period of A shares is from March of 2000 to December of 2011, and the regression time period of GEM board shares is from December of 2009 to December of 2011 as a consequence that China's GEM board was officially established in October 30th of 2009. This document will show several linear models to explain the correlation between stock return (A shares and GEM board shares) and the factors (market factor, firm size factor, earning factor and book-to-market factor). Based on the result of the empirical study, we found that relative small book-to-market ratio may have positive effect on the stock returns of A shares and GEM board shares. Also that for the GEM board shares, relative smaller size and relative higher earnings are good for the price to rise. And that for A shares, size factor and earning factor have little influence on the stock return. Finally the GEM board shares are more sensitive to market factor than A shares.

Keywords: A shares, GEM board shares, Fama and French Asset Pricing Model

1. Introduction

1.1 Brief Introduction

Once you are in the stock market and you are in the position of a stock investors, one of the most important concerns will be related to the factors that will directly influence the stock's expected return. This paper mainly studies the relationship between the month return of A shares and the factors that may have an effect on the stocks' month return, also comparing the differences in the reaction of all shares and GEM board shares to these factors. It's important to highlight that these factors include the market, firm size, earnings and book-to-market information.

The information that was used in this process comes from the quarterly data of China stock market from March of 2000 to December of 2011 which was used in a panel model to run the regression. The regression time period of A shares is from March of 2000 to December of 2011, and the regression time period of GEM board shares is from December of 2009 to December of 2011 as China's GEM board was officially established in October 30th of 2009

For both models in this paper a fixed effect model according to Hausman test results was used.

1.2 Brief Literature Review

Fama and French (1992) improved the asset pricing model by using cross-section method. In its process they used US stock market data to study the factors that may influence individual stock return. As shown in the Cross-Section of Expected Stock Returns¹ the results showed that the book-to-market equity and size have a strong role in explaining the cross-section of average returns on stocks, particularly in multiple test model.

Type	Variable Name	Variable Sign	Descriptions
The dependent variable	Monthly Share return	STKR	Monthly return of all shares, including A shares and GEM board shares, considering the cash dividend and reinvestment
	Monthly GEM Board Share return	GSTKR	Monthly return of GEM Board Shares, considering the cash dividend and reinvestment
The control variable	Monthly market return	MARKET	Monthly return of total market, including A Share market and GEM board market, considering the cash dividend and reinvestment, using market-value-weighted method

¹ Fama, E. F., & French, K. R. (1992). The cross section of expected stock returns. *The Journal of Finance*, 47(2), 427-465.

The independent variable	Relative firm size	ASIZE	Specific firm's asset relative to industry average asset ratio, calculated by Asset of the firm divided by the arithmetic average value of total asset of firms in the same industry
	Relative earnings per share	EPSIZE	Specific firm's EPS relative to industry average EPS ratio, calculated by EPS of the firm divided by the arithmetic average value of total EPS of firms in the same industry
	Lag of relative earnings per share	L.EPSIZE	First order lag of relative earnings per share
	Relative book-to-market ratio	BMIZE	Specific firm's book-to-market ratio relative to industry average book-to-market ratio, calculated by book-to-market ratio of the firm minus the arithmetic average value of total book-to-market ratio of firms in the same industry

Table 1: The definition and description of variables

2. Model

2.1 Model Description and Constructing

The model used in this paper is the fixed effect model after the consideration of Hausman test result. Hausman test result showed that the p-value is 0; which means that we can reject null hypothesis that difference in coefficients between fixed effect model and in random effect model is not systematic.

The first order lag of relative earnings per share is added by observing the difference between regression result of pooled model without lagged term and regression result of pooled model with lagged term. Also the time lines of residuals in these two regressions show some clues.

	(1) stkr	(2) stkr	(3)crse stkr	(4)crse stkr
market	1.040*** (140.47)	1.028*** (191.23)	1.040*** (6.93)	1.028*** (6.88)
asize	0.00152*** (6.78)	0.00149*** (9.21)	0.00152*** (3.20)	0.00149*** (3.17)
epsizer	0.0000516 (1.53)	0.0000458* (1.89)	0.0000516 (1.37)	0.0000458 (1.26)
bmizer	-0.0663*** (-19.81)	-0.0643*** (-25.96)	-0.0663*** (-5.93)	-0.0643*** (-5.59)
L.epsizer		0.0000486**		0.0000486**

		(2.00)		(2.07)
_cons	-0.00759*** (-11.32)	-0.00933*** (-18.67)	-0.00759 (-1.01)	-0.00933 (-1.17)
N	61553	56187	61553	56187

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Pooled model regression result and cluster-robust standard errors for All share

The R-squared of regression without lag term is 0.2466, and R-squared of regression with lag term is 0.3988, which indicates that the second model explains dependent variable better than the first one. And by adding lag term, the significance level of coefficient in earnings factor improved.

(1) All share model

$$STKR_{it} = \beta_{1i} + \beta_2 MARKET_t + \beta_3 ASIZE_{it} + \beta_4 EPSIZE_{it} + \beta_5 L.EPSIZE_{it} + \beta_6 BMIZE_{it}$$

a. Variable explanation:

STKR_{it}: The monthly return of firm i at the time t, sample data including A shares and GEM board shares from 2000 March to 2011 December, but unbalanced.

MARKET_t: The monthly return of total market at the time t.

ASIZE_{it}: The quarterly reported asset of firm i compared with the average value of the quarterly reported asset of the industry which firm i belongs to at time t. If this variable is larger than 1, we consider firm i as a relative big company. And vice versa.

EPSIZE_{it}: The quarterly reported earnings per share of firm i compared with the average value of the quarterly reported earnings per share of the industry which firm i belongs to at time t. If this variable is larger than 1, we consider firm i as a relative profitable company. And vice versa.

L.EPSIZE_{it}: The quarterly reported earnings per share of firm i compared with the average value of the quarterly reported earnings per share of the industry which firm i belongs to at time t-1.

BMIZE_{it}: The quarterly reported book-to-market ratio of firm i minus the average value of the quarterly reported book-to-market ratio of the industry which firm i belongs to at time t. If this variable is smaller than 0, we consider firm i is becoming better at capital financing. And vice versa. Because the book-to-market ratio will get smaller when firms finance more capital and when firms' share prices increase.

b. Coefficient explanation:

β_{1i} : constant term in regression, different according to different firms by fixed effect model.

(2)GEM board share model

$$GSTKR_{it} = \beta_{1i} + \beta_2 MARKET_t + \beta_3 ASIZE_{it} + \beta_4 EPSIZE_{it} + \beta_5 L.EPSIZE_{it} + \beta_6 BMIZE_{it}$$

a. Variable explanation:

GSTKR_{it}: The monthly return of firm *i* at the time *t*, sample data including GEM board shares from 2009 December to 2011 December.

The other variables are the same than in the first model, the only difference between them is the time period.

2.2 Selection Reasons

Based on the findings of Fama and French, two easily measured variables, size and book-to-market equity, combined with market factor, can explain some anomalies in the stock return.² Therefore, it is important to use the industry average of these factors as a benchmark, to see if the relative size and relative book-to-market equity have relationship with stock return.

According to Efficient Market Hypothesis, the Fundamental Analysis method is useful in the weak-form of efficient market. Earnings per share would be a factor that stockholders and investors will look at when they are using fundamental analysis. So the investors' behavior in financial market may be influenced by this factor, which lead to the price movement in the stocks. For example, if a firm's earnings per share is higher than the industry average level, the investors may think the potential of profiting and earning capital gains of investing in this firm is higher than other firms whose earnings per share is lower than industry average level.

2.3 Expected Coefficient

Below is the expectation of coefficient in both models without special note.

(1) Coefficient of MARKET

a. For All share model: Positive, close to 1

According to CAPM, this coefficient should measure the sensitivity of stock return to the systematic risk in market. Since the data base is all shares in the market, the sensitivity to systematic risk should be equal to the market sensitivity which is 1.

b. For GEM board share model: Positive, larger than 1.

The GEM board share is a smaller data base. It is possible the coefficient deviate from 1. And price volatility of GEM board stocks in China may be higher compared with the total market. So it's reasonable to assume that the sensitivity to systematic risk is larger than 1.

(2) Coefficient of ASIZE: Positive

When this variable is larger than 1, the individual firm is a relative big company from the asset's aspect. The investors may have more trust on these firms and will think that these

² Fama, E. F., & French, K. R. (1992). The cross section of expected stock returns. *The Journal of Finance*, 47(2), 427-465.

firms are reliable, or that the potential profitability of these firms is larger, which may lead to investing behavior and stock buying behavior.

(3) Coefficient of EPSIZE: Positive

When this variable is larger than 1, the individual firm is a relative profitable company because their earnings to stockholders are higher than the industry average level. The investors may think that the management in these companies is better or the profitability is better, which is a positive sign for the stock market.

(4) Coefficient of L.EPSIZE: Positive

The information revealed by new quarterly financial statement may take time to be reflected in stock market. The investors also need time to digest new public information and make a fundamental analysis.

(5) Coefficient of BMIZE: Negative

When this variable is smaller than 0, the individual firm may become better at capital financing and capital budgeting. Because the book-to-market ratio will get smaller when firms finance more capital and when firms' share prices increase. For those the investors believe in the trend of the stock price, reason why they might follow the trend and invest in it.

2.4 Assumptions

(1) The market is weak-form efficient or inefficient. The public information takes time to be totally reflected in price movement.

(2) Investors need time and other cost to digest and analyze the market and stocks, and to make investment decisions.

(3) Not all investors are rational. Some investors may follow the trend, or some investors will speculate on stocks due to gambling psychology. Also some investors may need more time to decide to sell a stock than buying one due to lost-aversion psychology.

2.5 Potential Problems in the Model

(1) Models don't include macro economy factor

Because the variables that can be used as proxy for macro economy factor are risk free rate like Treasury bond rate, or inflation rate like consumer price index. And these rates are sticky from time period, also less reliable due to statistical errors or benchmark bias. This potential problem may lead to omission of explanatory variables.

(2) Models don't consider endogeneity among independent variables

It is hard to process Hausman test for endogeneity in panel data. This problem may lead to incorrect coefficients or incorrect standard errors for variables.

3. Data

3.1 Data source

The data used in this paper is mainly from the CSMAR database. The original data source used in the regression includes Shareholder profitability table, Balance sheet, Individual stocks monthly return table, Comprehensive market monthly return table, and Industry category table. Except for the Industry category table which is from SW Securities, the other data is from the CSMAR database. Some listed companies that lack of data in important variables are dropped.

Because the dependent variable is the monthly growth rate of stock prices, and the independent variables are mostly quarterly reported except for market return. To solve the time period mismatch problem was necessary to use the last month data of stock return and market return of each quarter. This makes time range of dependent variable are March, June, September and December from 2000 to 2011.

CSMAR database is a database built by GTA Company in accordance with international standards (CRSP and COMPUSTAT). It specializes in precise type of database development for China's financial and economic fields, covering financial (stocks, bonds, funds, futures, warrants, etc.), the economy (macro economy areas, regions, industries, etc.). And SW Securities is one of the famous security companies in China. The data source of this paper is generally reliable.

3.2 Potential Problems

(1) Unbalanced problem

In the first model, the GEM board shares only have the time period from 2009 to 2011. But A shares have data from 2000 to 2011. This unbalanced panel data may lead to some errors in regression result.

4. Reporting Result

4.1 All Share Model

	(1) (1)re stkr	(2)fe stkr
market	1.028*** (191.23)	1.027*** (189.59)
asize	0.00149*** (9.21)	0.000888* (1.70)
epsize	0.0000458* (1.89)	0.0000289 (1.18)
L.epsize	0.0000486** (2.00)	0.0000304 (1.23)

bmize	-0.0643*** (-25.96)	-0.107*** (-29.63)
_cons	-0.00933*** (-18.67)	-0.00875*** (-12.37)
<i>N</i>	56187	56187

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Fixed effect and random effect regression result for All share

To test the fixed effect and random effect of this regression, it was necessary to use the Hausman test and Breusch-Pagan test. The result in Hausman test significantly shows that there is a fixed effect in this model. But the result in Breusch-Pagan test shows that p-value equal to 0.1731. We can't reject the null hypothesis that there is no random effect at the significance level of 20%.

By comparing the regression results in Table 3, we found that the relationship between the earnings per share factor and the stock return is positive but not significant in the fixed model. And the relationship is significant in the random effect. It might indicate that EPS factor is a firm specific factor that contributes to stock return.

The result shows that coefficients are consistent with the expected coefficients.

	(1)fe stkr	(2)fe stkr	(3)fe stkr	(4)fe stkr	(5)fe stkr
market	1.027*** (189.59)	1.038*** (138.91)	1.038*** (138.91)	1.038*** (138.90)	1.044*** (140.87)
asize	0.000888* (1.70)	0.000931 (1.33)	0.000930 (1.32)		
epsized	0.0000289 (1.18)	0.0000287 (0.84)			
L.epsized	0.0000304 (1.23)				
bmize	-0.107*** (-29.63)	-0.112*** (-23.22)	-0.112*** (-23.22)	-0.111*** (-23.26)	
_cons	-0.00875*** (-12.37)	-0.00698*** (-7.40)	-0.00695*** (-7.37)	-0.00602*** (-9.52)	-0.00497*** (-7.98)
<i>N</i>	56187	61553	61553	61553	63784

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Fixed effect regression result for all share

From Table 4, it shows statistical significant evidence that stock return is negative related to the book-to-market ratio. Earning factor and size factor are not important to stock return in most cases.

4. 2 GEM Board Share Model

One of the results is that the lag term in GEM board share model doesn't explain dependent variable well because the R-square is near to 0.30 regardless adding the lag term or not. Also the size factor lost its significance to explain the stock return in GEM board.

By comparing Table 5 with Table 2, GEM board share is more sensitive to market because the coefficient of market factor in GEM board share model is larger than it in all share model. But it is still close to 1.

	(1) gstr	(2) gstr	(3)crse gstr	(4)crse gstr
market	1.269*** (24.10)	1.176*** (20.51)	1.269*** (5.50)	1.176*** (5.90)
asize	0.00783 (0.62)	0.00487 (0.35)	0.00783 (0.34)	0.00487 (0.22)
epsize	0.00318* (1.82)	0.0113*** (3.35)	0.00318 (0.99)	0.0113** (3.02)
bmize	-0.0809*** (-4.11)	-0.0691*** (-3.28)	-0.0809** (-2.44)	-0.0691 (-1.81)
L.epsize		-0.00290 (-1.42)		-0.00290 (-1.00)
_cons	-0.0278*** (-5.64)	-0.0344*** (-5.80)	-0.0278 (-1.51)	-0.0344** (-2.39)
N	1356	1080	1356	1080

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Pooled model regression result and cluster-robust standard errors for GEM share

The Hausman test result in GEM board share model can reject null hypothesis. So it was necessary to use fixed effect model to do the regression.

The interesting thing lies on the size factor that shows no significant effect on GEM board share return in pooled model. But statistic evidence in Table 6 shows that, for GEM board shares in China, stock return is negative related to asset factor at significant level. This is not consistent with expectation. But it can make sense that GEM board shares firms are usually start-up firms with small asset size. And the smaller the size of the firm means the younger the firm, also that these firms usually have more space to increase their value, which may be an attractive factor to investors.

The result also shows that GEM board shares return is positive to the earning factor. But the lag term of it has few effect on the return.

	(1)fe gstr	(2)fe gstr	(3)fe gstr
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market	1.168 ^{***} (17.05)	1.261 ^{***} (20.38)	1.267 ^{***} (20.43)
asize	-0.419 ^{***} (-2.97)	-0.185 (-1.59)	-0.218 [*] (-1.88)
epsize	0.0250 ^{***} (4.72)	0.00599 ^{***} (2.79)	
L.epsize	-0.00132 (-0.60)		
bmize	-0.224 ^{***} (-4.84)	-0.243 ^{***} (-5.95)	-0.238 ^{***} (-5.80)
_cons	0.0611 (1.65)	0.0278 (0.93)	0.0447 (1.52)
<i>N</i>	1080	1356	1356

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Fixed effect regression result for GEM board share

4.3 General Findings

Through the regression results above, relative small book-to-market ratio may have positive effect on stock returns of A shares and GEM board shares. For GEM board shares, relative smaller size and relative higher earnings are good for the price to rise. For A shares, size factor and earning factor have little influence on the stock return. GEM board shares are more sensitive to market factor than A shares.

5. Summary and Future Improvement

Although the above testing and regression results show significant relationship between some variables to stock return, this model also has many loopholes so it cannot be concluded that stock returns have certain relationship with the independent variables mentioned in this paper.

Firstly, there is sample bias in this paper because some listed companies that lack of data in important variables are dropped and the panel data is not balanced; the time period for GEM board share model is relatively short; and the data sample is limited to China stock market. Secondly, the degree of dependent variable that can be explained by independent variables is relatively small because R-square is smaller than 0.5. A more comprehensive model can be modified by adding macro economy factors, regional factors, business cycle factors or event factors. Last but not the least, this paper's assumptions are weak-form efficient market or inefficient market. But from the result of regression, the public information does not show delayed effect on stock prices. Generally speaking, there is still a lot of work to do to improve this model.

Reference

- Fama, E. F., & French, K. R. (1992). The cross section of expected stock returns. *The Journal of Finance*, 47(2), 427-465.