APPLICATION OF THE FOUR-FACTOR MODEL INTO MEASURING THE RETURN RATE OF STOCKS LISTED IN HOSE

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Vietnam's stock market is step by step perfected. Any investment in this market always bears certain risks. Yet, to measure and forecast the return rate of stocks and risks is not easy at all. Nowadays, many people have been employing quantitative paradigms to evaluate factors affecting stock returns and risks in investment. This paper is to investigate the application of the four-factor model into predicting the return rate of listed securities.

Keywords: four-factor model, stocks listed in HOSE, return rate, capitalization

1. Theoretical fundamentals

At present, to predict and measure returns on stocks is based on some tools, such as CAPM (Capital Asset Pricing Model), and APT (Arbitrage Pricing Theory), etc. Each tool also contains its pros and cons. CAPM, for example, is often employed due to its simplicity and several of other advantages; yet, it is undertaken on the basis of fictional hypotheses that are hardly attainable in the real life, such as a perfect capital market, no tax, etc. For this reason, some empirical researches have overcome disadvantages of CAPM to develop a new paradigm, such as the three-factor paradigm introduced by Fama and French in 1993. On the ground of CAPM, their model helps to explain factors affecting the return on stock and risks in investment. The first factor is the market risk premium which is measured via the difference between the average return on market ($\overline{r_M}$) and the risk-free return ($\overline{r_{RF}}$). To establish the second factor, they classifies listed stocks into two groups according to their size, viz. small-cap stocks and big-cap stocks, and then calculated the return on these portfolios to produce the return rate of a third portfolio namely SMB, which stands for small market capitalization minus big. This portfolio is to measure fluctuations in the return on stocks affected by the size. To establish the third factor, they classifies stocks into two groups according to their book-to-market ratio, i.e. stocks with high book-to-market ratio and stocks with low book-to-market ratio; and then they measures the return rate of stocks with high book-to-market ratio over low ones to produce the third portfolio _ HML, which stands for (high minus low). This third factor is to measure the latent risk of stocks with low book-to-market ratio. In 1997, Carhart, on the basis of the difference in the return rate between stocks with high return and those with low return, added the fourth factor to the model of Fama and French, namely UMD (Upward forecast minus downward forecast). This factor is to measure the latent risk in stock price appreciation.

The four-factor model may be written as follows:

$$(\overline{r_i} - \overline{r_{RF}}) = \alpha_i + \beta_i(\overline{r_M} - \overline{r_{RF}}) + s_i(\overline{r_{SMB}}) + h_i(\overline{r_{HML}}) + m_i(\overline{r_{UMD}}) + e_i \quad (1.1)$$

Where:

$\overline{r_i}$: past return rate of the stock i

$\overline{r_M}$: past return rate of the entire stock market

$\overline{r_{RF}}$: risk-free returns

$\overline{r_{SMB}}$: past return rate of the portfolio SMB

$\overline{r_{HML}}$: past return rate of the portfolio HML

$\overline{r_{UMD}}$: past return rate of the portfolio UMD

α_i: Ordinate origin of the stock i

β_i, s_i, h_i, m_i : the regression coefficient of the

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stock

e_i : random error

2. Application of the four-factor model into measuring the return rate of stocks listed in HOSE

In order to insure the quantity of observed samples, the author just opts for stocks listed since 2002. The time is considered as per the period of month. The numerical data of listed stocks are chosen within the period of 90 months (from September 2002 through February 2010), and there are 90 observed samples in total. The author employs ten types of stock that satisfy mentioned conditions. Based on the stock closing price, the return rate of the market (r_M) and the return rate of the stock i can be calculated as follows:

$$R_{Mt} = \frac{P_t - P_{t-1}}{P_{t-1}}$$

There are a lot of factors, both quantitative and qualitative, impinging on the return rate and risks of stocks, such as governmental policies, local and global economic situation, and etc. In predictive paradigms, it is often assumed that such these factors are reflected via the market price.

Based on the level of market capitalization, the author classifies ten types of stock into two groups, i.e.:

- Stocks with high level of market capitalization: including REE, SAM, GMD, BBC, and BT6.

- Stocks with low level of market capitalization: including AGF, GIL, TS4, HAP, and TMS.

Table 1: The level of market capitalization

Stock codes	Number of outstanding stocks	Price (onFeb.26, 2010)	Market capitalization (at the end of Feb.2010)
REE	80,792,462	44,800	3,619,502,297,600
GMD	47,447,505	75,000	3,558,562,875,000
SAM	63,749,216	28,400	1,810,477,734,400
BT6	10,997,850	58,000	637,875,300,000
BBC	15,420,782	31,500	485,754,633,000
AGF	12,859,288	34,600	444,931,364,800
GIL	10,089,818	34,000	343,053,812,000
TS4	8,469,828	36,300	307,454,756,400
HAP	14,624,002	18,200	266,156,836,400
TMS	6,348,000	32,000	203,136,000,000

Source: www.hsx.com and author's calculations

By calculating the mean value of big-cap stocks and small-cap stocks for the return rate of SMB, we have results as shown in Table 2.

In order to work out the return rate of HML, the author calculates the book-to-market ratio of stocks as from January 2004 to February 2010, and then their mean value. The results are set forth in the table below.

Table 3: The average book-to-market ratio of stocks

Stock codes	Book-to-market ratio
TS4	0,49
BBC	0,41
HAP	0,35
GIL	0,32
AGF	0,28
REE	0,26
SAM	0,25
TMS	0,23
BT6	0,23
GMD	0,16

Source: www.sbsc.com.vn and publicized financial statements

Accordingly, stocks with high book-to-market ratio include TS4, BBC, HAP, GIL, and AGF; and stocks with low book-to-market ratio are REE, SAM, TMS, BT6, and GMD. Then, the author measures the return rate of the high over the low to produce the portfolio HML as set forth in the Table 4.

For the monthly return rate of market, it is based on the closing price of the VN-index within the period from September 2002 to February 2010. Then, the calculation of the difference between the market return and the risk-free return (r_m-r_{rf}) will be based on the yearly interest rate of the government bonds (Table 5).

For the fourth factor (UMD), the author calculates the average return rate of stocks and then divides them into two groups, namely:

- Stocks with high return rate including REE, GMD, BBC, BT6, and TS4

- Stocks with low return rate including SAM, AGF, GIL, TMS, and HAP (Table 6).

The author continues calculating the average return rate of each group to generate the average return rate of UMD (Table 7).

a. The regression results

Table 2: The return rate of SMB (as percent per month)

Date	$\overline{r_{SMB}}$	Date	$\overline{r_{SMB}}$	Date	$\overline{r_{SMB}}$	Date	$\overline{r_{SMB}}$
Sep-02	-3.94	Aug-04	2.77	Jul-06	-2.39	Jun-08	-10.85
Oct-02	-2.15	Sep-04	0.91	Aug-06	1.88	Jul-08	0.83
Nov-02	2.91	Oct-04	-0.01	Sep-06	-4.14	Aug-08	24.46
Dec-02	1.67	Nov-04	-2.59	Oct-06	0.68	Sep-08	-2.78
Jan-03	3.62	Dec-04	7.48	Nov-06	14.25	Oct-08	-2.52
Feb-03	-0.72	Jan-05	-1.48	Dec-06	14.71	Nov-08	-6.04
Mar-03	-7.23	Feb-05	0.44	Jan-07	5.73	Dec-08	11.47
Apr-03	2.32	Mar-05	-0.47	Feb-07	-6.86	Jan-09	2.88
May-03	-3.17	Apr-05	1.08	Mar-07	-1.87	Feb-09	-6.93
Jun-03	0.98	May-05	1.44	Apr-07	4.31	Mar-09	20.97
Jul-03	-0.37	Jun-05	2.73	May-07	-22.41	Apr-09	-4.21
Aug-03	4.63	Jul-05	1.73	Jun-07	-1.44	May-09	-3.46
Sep-03	-0.90	Aug-05	3.69	Jul-07	14.49	Jun-09	-1.30
Oct-03	-0.12	Sep-05	7.52	Aug-07	6.91	Jul-09	9.01
Nov-03	7.48	Oct-05	-3.89	Sep-07	3.54	Aug-09	-7.69
Dec-03	4.48	Nov-05	4.01	Oct-07	-6.76	Sep-09	0.95
Jan-04	9.65	Dec-05	-4.61	Nov-07	-1.02	Oct-09	-11.04
Feb-04	14.30	Jan-06	0.52	Dec-07	-2.77	Nov-09	2.15
Mar-04	11.76	Feb-06	5.63	Jan-08	5.18	Dec-09	-0.07
Apr-04	-6.64	Mar-06	5.55	Feb-08	-6.56	Jan-10	2.23
May-04	-6.12	Apr-06	4.09	Mar-08	8.24	Feb-10	-0.30
Jun-04	6.26	May-06	0.17	Apr-08	-10.86		
Jul-04	0.94	Jun-06	7.24	May-08	-1.76		

Source: www.sbsc.com.vn and author's calculations

The regression results as per the four-factor model for ten types of stocks with 90 months of observation have pointed out that the β, the company size (SMB), the book-to-market ratio (HML) and UMD are all casting impacts on the stock return with the statistical significance at 10% (the reliability coefficient of .90). Testing results show that the variables employed in the equation (1.1), with Sig = 0.00, are able to explain the return rate of stocks. The variance inflation factor smaller than 10 (VIF<10) proves that the model does not commit the multi-collinearity. Let us consider the Table 8 for the regression result of HAP.

Similarly, we have the regression results of ten types of stocks as shown in Table 9.

b. Estimating the return rate of stock as per the four-factor model

On the ground of the regression results, it is possible to calculate the monthly average return rates of market (1.6%), of SMB (1.25%), of HML (-0.54%), and of UMD (1.5%); and in combination with the interest rate of the government bonds promulgated in the early 2010 (11.2% per annum, equivalent to 0.933% per month), we can estimate the return rate of stocks as follows (Table 10).

The results show that stocks with high return rate, although affected by other factors, still belong to the group of those with the highest returns. Almost big-cap stocks, such as blue chips, bring in the high return. By contrast, small-cap stocks usually generate the low return. However, for the HML, the differentiation is not clear-cut in

Table 4: The return rate of HML (as percent per month)

Date	$\overline{r_{HML}}$	Date	$\overline{r_{HML}}$	Date	$\overline{r_{HML}}$	Date	$\overline{r_{HML}}$
Sep-02	1.47	Aug-04	-3.90	Jul-06	-3.09	Jun-08	9.56
Oct-02	1.40	Sep-04	-0.08	Aug-06	1.30	Jul-08	-22.35
Nov-02	-3.12	Oct-04	1.51	Sep-06	-1.26	Aug-08	-9.33
Dec-02	-1.57	Nov-04	4.41	Oct-06	-3.72	Sep-08	5.29
Jan-03	-3.02	Dec-04	-8.66	Nov-06	-18.98	Oct-08	-8.64
Feb-03	-0.75	Jan-05	2.22	Dec-06	-6.94	Nov-08	5.22
Mar-03	9.17	Feb-05	-1.62	Jan-07	0.33	Dec-08	-13.76
Apr-03	-8.60	Mar-05	-2.29	Feb-07	6.94	Jan-09	-3.80
May-03	-1.10	Apr-05	-1.71	Mar-07	8.54	Feb-09	5.41
Jun-03	-2.36	May-05	-2.55	Apr-07	-9.11	Mar-09	-3.04
Jul-03	-5.13	Jun-05	0.25	May-07	25.20	Apr-09	9.93
Aug-03	-0.63	Jul-05	-0.84	Jun-07	2.85	May-09	27.24
Sep-03	-4.32	Aug-05	-2.47	Jul-07	-3.50	Jun-09	1.14
Oct-03	-1.98	Sep-05	-0.80	Aug-07	2.28	Jul-09	-5.97
Nov-03	-2.54	Oct-05	0.31	Sep-07	2.28	Aug-09	17.26
Dec-03	0.83	Nov-05	-5.87	Oct-07	9.24	Sep-09	-5.01
Jan-04	0.74	Dec-05	4.34	Nov-07	0.95	Oct-09	-3.43
Feb-04	-7.79	Jan-06	0.28	Dec-07	-4.33	Nov-09	4.75
Mar-04	-18.28	Feb-06	-5.91	Jan-08	-12.06	Dec-09	-2.56
Apr-04	3.09	Mar-06	4.80	Feb-08	11.62	Jan-10	-3.77
May-04	-1.59	Apr-06	9.26	Mar-08	-5.27	Feb-10	6.35
Jun-04	9.09	May-06	-0.68	Apr-08	-8.57		
Jul-04	0.67	Jun-06	-5.59	May-08	-1.98		

Source: www.sbsc.com.vn and author's calculations

that stocks with low book-to-market ratio can produce the high return and so can the low ones. REE is an example. Despite its low book-to-market value, it is predicted to produce the highest return. This is to say, investors can ignore the book-to-market ratio and pay all attention to the remainder.

3. Conclusions

Via testing results in subpart 2.b, it seems that big-cap stocks will bring in the high return. This is to say, investors in the stock market should attend to big-cap stocks with a view to gaining the highest profit.

The testing results of SMB and HML in this study are kind of different from the empirical results of Fama and French in 1993. In their study, they figure out that the annual return rates of SMB and HML are 3.2% and 4.8% respectively [R(SMN) = 3.2% p.a.; R(HML) = 4.8% p.a.]. That is, the return rate of small-cap stocks must be higher than that of big-cap stocks due to the fact that the risk borne by a small-cap company is higher than that by a big-cap company. Accordingly, small-cap companies must generate a higher return rate for the sake of investors (high growth, high ROE, high dividend, etc.) so as to make up for their small market capitalization and attract investments from the stock market. The return rate of HML, which is equal to 4.8%, proves that the return rate of stocks with high book-to-market

Table 5: The difference between the market return and the risk-free return $\overline{r_M} - \overline{r_F}$ (as percent per month)

Date	$\overline{r_M} - \overline{r_{RF}}$	Date	$\overline{r_M} - \overline{r_{RF}}$	Date	$\overline{r_M} - \overline{r_{RF}}$	Date	$\overline{r_M} - \overline{r_{RF}}$
Sep-02	-5.44	Aug-04	-2.60	Jul-06	-17.40	Jun-08	-2.80
Oct-02	-3.51	Sep-04	0.15	Aug-06	20.65	Jul-08	9.48
Nov-02	-0.29	Oct-04	-0.57	Sep-06	5.06	Aug-08	19.87
Dec-02	1.68	Nov-04	-1.76	Oct-06	-4.45	Sep-08	-15.99
Jan-03	-6.59	Dec-04	2.53	Nov-06	20.75	Oct-08	-24.34
Feb-03	-5.09	Jan-05	-2.27	Dec-06	18.42	Nov-08	-10.43
Mar-03	-12.24	Feb-05	0.53	Jan-07	39.91	Dec-08	-0.42
Apr-03	8.81	Mar-05	3.91	Feb-07	6.41	Jan-09	-4.15
May-03	-0.78	Apr-05	-0.34	Mar-07	-5.40	Feb-09	-18.32
Jun-03	-0.18	May-05	-0.54	Apr-07	-13.10	Mar-09	12.40
Jul-03	-4.71	Jun-05	0.22	May-07	14.94	Apr-09	10.17
Aug-03	-2.08	Jul-05	-1.02	Jun-07	-5.56	May-09	21.35
Sep-03	-2.54	Aug-05	3.05	Jul-07	-9.34	Jun-09	4.21
Oct-03	-2.72	Sep-05	12.86	Aug-07	-2.27	Jul-09	7.63
Nov-03	20.11	Oct-05	6.86	Sep-07	11.92	Aug-09	15.93
Dec-03	0.68	Nov-05	-0.36	Oct-07	-2.45	Sep-09	5.14
Jan-04	26.12	Dec-05	-2.10	Nov-07	-10.29	Oct-09	2.26
Feb-04	25.23	Jan-06	1.64	Dec-07	-6.84	Nov-09	-11.17
Mar-04	1.63	Feb-06	24.09	Jan-08	-2.51	Dec-09	-4.83
Apr-04	-6.04	Mar-06	24.63	Feb-08	-28.69	Jan-10	-7.71
May-04	-5.70	Apr-06	13.12	Mar-08	-19.35	Feb-10	1.11
Jun-04	-1.49	May-06	-12.63	Apr-08	-1.23		
Jul-04	-4.65	Jun-06	-4.33	May-08	-21.27		

Source: www.sbsc.com.vn and author's calculations

Table 6: The average return rates

Stock codes	Average return rates
REE	30.91
GMD	27.69
BBC	27.23
BT6	24.88
TS4	24.46
SAM	16.94
AGF	8.92
GIL	8.78
TMS	5.96
HAP	4.53

Source: www.sbsc.com.vn and author's calculations

ratio is higher than that of low ones because of the fact that the higher the book-to-market ratio, the lower the level of risk. However, the empirical tests for some of stocks listed in HOSE produce contrary results. With R(HML)<0, it raises some problems as follows:

Is it true that big-cap companies perform more effectively than small-cap ones, and thereby generating higher ROE? Or, investors have ignored risk factors when investing in small-cap companies, yet required a high ROE, haven't they?

Investors seem to ignore risk factors when investing in stocks with low book-to-market ratio. It may be proven that several of stocks with low book-to-market ratio can produce a high return

Table 7: The return rate of UMD (as percent per month)

Date	$\overline{r_{UMD}}$	Date	$\overline{r_{UMD}}$	Date	$\overline{r_{UMD}}$	Date	$\overline{r_{UMD}}$
Sep-02	-2.60	Aug-04	1.72	Jul-06	-7.61	Jun-08	-11.52
Oct-02	-2.07	Sep-04	0.05	Aug-06	6.35	Jul-08	5.55
Nov-02	1.08	Oct-04	2.10	Sep-06	-2.42	Aug-08	16.70
Dec-02	2.52	Nov-04	-2.37	Oct-06	-2.87	Sep-08	12.42
Jan-03	2.89	Dec-04	8.15	Nov-06	-9.54	Oct-08	-7.65
Feb-03	0.68	Jan-05	-0.21	Dec-06	10.90	Nov-08	-3.85
Mar-03	4.17	Feb-05	0.95	Jan-07	-8.46	Dec-08	16.27
Apr-03	-2.35	Mar-05	2.93	Feb-07	5.36	Jan-09	-1.42
May-03	-2.91	Apr-05	-0.46	Mar-07	3.04	Feb-09	-7.82
Jun-03	0.85	May-05	-0.58	Apr-07	5.01	Mar-09	19.56
Jul-03	-0.47	Jun-05	1.88	May-07	-12.37	Apr-09	13.96
Aug-03	4.45	Jul-05	1.41	Jun-07	3.87	May-09	5.22
Sep-03	-1.73	Aug-05	1.64	Jul-07	8.10	Jun-09	-1.29
Oct-03	-0.47	Sep-05	5.27	Aug-07	1.61	Jul-09	5.07
Nov-03	6.47	Oct-05	-6.49	Sep-07	14.17	Aug-09	2.46
Dec-03	3.87	Nov-05	3.13	Oct-07	-5.95	Sep-09	9.86
Jan-04	6.01	Dec-05	3.58	Nov-07	0.55	Oct-09	-4.46
Feb-04	0.47	Jan-06	2.99	Dec-07	-4.92	Nov-09	0.97
Mar-04	1.77	Feb-06	-7.85	Jan-08	-7.79	Dec-09	0.42
Apr-04	-3.26	Mar-06	3.65	Feb-08	11.63	Jan-10	-3.65
May-04	-6.83	Apr-06	20.85	Mar-08	12.97	Feb-10	2.34
Jun-04	6.28	May-06	-8.37	Apr-08	-14.21		
Jul-04	0.30	Jun-06	5.86	May-08	-0.48		

Source: www.sbsc.com.vn and author's calculations

Table 8: The regression result of HAP

	Regression coefficients		t	Sig.	Progressive statistics	
	β	Standard error			Tolerance	Coefficient VIF
Constants	-0.317	1.170	-0.271	0.787		
$\overline{r_M} - \overline{r_{RF}}$	1.143	0.107	10.645	0.000	0.797	1.255
$\overline{r_{SMB}}$	0.521	0.284	1.833	0.070	0.335	2.985
$\overline{r_{HML}}$	1.184	0.209	5.670	0.000	0.512	1.955
$\overline{r_{UMD}}$	-0.695	0.220	-3.159	0.002	0.576	1.736

a Dependent variable: $\overline{r_{HAP}} - \overline{r_{RF}}$

Nguồn: Tính toán của tác giả, kết quả xử lý bằng SPSS 11.5

rate.

The research results once again remind a basic investing foundation, that is, high risk high return. Yet in fact, many of investments are mainly affected by sentimental factors or herd behaviors. Stocks with small cap and high book-to-market ratio generate the lower return in comparison with those with big cap and low book-to-market ratio. Accordingly, managers of small-cap companies can face more difficulties in attracting investments than big-cap ones; and thus, it is a must for them to work out a more effective business strategy with a view to enhancing the growth rate and the return rate.

Besides, government policies (e.g. policies on

Table 9: The regression results of ten types of stocks as per the four-factor model

Stock codes	α_i	β_i	S_i	H_i	M_i	R^2	Sig
AGF	-0.14	0.86	0.23	0.54	-0.38	0.68	0.0000
BBC	-0.38	0.84	1.23	1.33	0.26	0.83	0.0000
BT6	-0.40	0.69	-0.37	-0.58	0.88	0.49	0.0000
GIL	-0.23	1.08	-0.43	0.36	0.02	0.72	0.0000
GMD	-0.19	1.08	0.26	0.03	0.34	0.78	0.0000
HAP	-0.31	1.14	0.52	1.18	-0.69	0.71	0.0000
REE	-0.09	1.31	0.43	0.14	0.21	0.81	0.0000
SAM	-0.53	1.15	1.08	0.17	-0.70	0.77	0.0000
TMS	-0.39	0.84	-1.27	-1.17	0.26	0.65	0.0000
TS4	-0.53	1.15	-1.42	0.17	1.80	0.77	0.0000

Source: Authors' calculations

interest rate, credit, etc.), and economic and political stability also have impacts on the stock return. The financial crisis and economic regression in 2008 is a typical example. Thus, it is also necessary to attend to macroeconomic factors when forecasting the economic health.

In this study, the author just employs a small number of samples, thus the accuracy and reliability of research results may be limited. If all listed stocks are taken into account, the results will definitely more reliable.

Finally, forecast model is based on the condition that investors must hold stocks within a specific period of time instead of surfing waves of investment. It is also the target of the capital market in general and the stock market in particular■

Table 10: The estimates of stock returns as per the four-factor model

Stock codes	$\overline{r_{RF}}$	α_i	$(\overline{r_M}-\overline{r_{RF}})\beta_i$	$\overline{r_{SMB}}S_i$	$\overline{r_{HML}}H_i$	$\overline{r_{UMD}}M_i$	Monthly return rates (%)	Annual return rates (%)	Size	B/M	Return rates
REE	0.93	-0.09	0.87	0.54	-0.08	0.32	2.49	29.88	H	L	H
BBC	0.93	-0.38	0.56	1.54	-0.72	0.39	2.32	27.87	H	H	H
GMD	0.93	-0.19	0.72	0.33	-0.02	0.51	2.28	27.38	H	L	H
BT6	0.93	-0.40	0.46	-0.46	0.31	1.32	2.16	25.96	H	L	H
TS4	0.93	-0.53	0.77	-1.78	-0.09	2.70	2.01	24.07	L	H	H
SAM	0.93	-0.53	0.77	1.35	-0.09	-1.05	1.38	16.57	H	L	L
AGF	0.93	-0.14	0.57	0.29	-0.29	-0.57	0.79	9.52	L	H	L
TMS	0.93	-0.39	0.56	-1.59	0.63	0.39	0.54	6.45	L	L	L
HAP	0.93	-0.31	0.76	0.65	-0.64	-1.04	0.36	4.33	L	H	L
GIL	0.93	-0.23	0.31	-0.54	-0.19	0.03	0.31	3.73	L	H	L

Source: Authors' calculations

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