A TEST OF RELATION BETWEEN RETURN AND RISK OF STOCKS LISTED ON THE HCMC STOCK EXCHANGE

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The study aims at examining the relation between return and risk of shares listed on the HCMC Stock Exchange (HOSE). Data for the study include series of VN-Index and stock prices of 80 shares listed on the HOSE gathered on a weekly basis from Jan. 2, 2007 to Dec. 31, 2009. The results based on the regression method show that the riskier the portfolio, the higher the return ; and a non-linear relation between return and risk of these shares does exist.

Keywords: return, risk, CAPM, stock price, portfolio, beta

1. Introduction

Finance market is an indispensable part of the financial system of a country and plays an important role in economic development. In a finance market, ways of determining prices of shares is a matter of great concern for researchers. Relation between return and risk is considered as the principal basis for pricing a stock.

One of important achievements of modern financial theories is the CAP Model developed by Sharpe (1964), Lintner (1965) and Mossin (1966). CAPM affirms that a high expected return is associated with a high degree of risk. In other words, CAPM maintains that the expected return of an asset must be higher than risk-free rate of return and have a linear relation with market risk (measured by coefficient beta). Although CAPM has been tested in many empirical researches in the past decades and become a basis for the modern portfolio theory, doubts about its explanatory power in practice tended to increase.

This study aims at testing the hypothesis about whether the CAPM is correct for the case of Vietnamese stock market in general and HOSE in particular. It will provide more empirical evidence of rationality of CAPM in the case of emerging economies and help investors to made more reasonable decisions. This is an important factor that can help the Vietnamese stock market gain a more stable and sustainable development. Remaining parts of the paper are

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as follows: Part 2 provides a literature review; Part 3 describes data and methodology used for the study; Part 4 summarizes results of the study; and Part 5 concludes.

2. Literature review

There have been many CAPM-testing researches so far and they produced contradictory results. Some authors support CAPM after finding empirical evidence of a linear relation between return and risk of a share while others express doubt about rationality of CAPM based on their empirical researches. In this section we can only mention most typical researches from a long list of relevant works that guide our study.

One of the first empirical researches supporting the CAPM is by Black, Jensen and Scholes (1972). Employing monthly return data of portfolios, they find a linear relation between return and coefficient beta of the portfolios and conclude that the risk is directly proportional to return from the portfolios.

Andor et al. (1999) test the CAPM in the Hungarian stock market. They use time-series data with a month frequency from 17 companies listed on the Budapest Stock Exchange and such indexes as BUX-Index of the Budapest SE, NYSE and MSCI world index (market portfolio) in the period from July 31, 1991 to June 1, 1999. Employing the regression analysis, the authors show that the rate of return of a share is directly proportional to the coefficient beta. In other words, the CAPM suits perfectly stocks listed on the Budapest SE.

Michailidis et al. (2006) test the relation between return and risk of stocks on the Greek stock market. They use data on weekly prices of 100 stocks listed on the Athens Stock Exchange from January 1998 to December 2002. Their regression results show that high degrees of risk of stocks are not associated with high rates of return. However, they also find that no non-linear relation exists between return and risk of stocks.

In their recent research, Choudhary and Choudhary (2010) examined the CAPM in the Indian stock market through monthly return produced by 278 stocks listed on the Bombay Stock Exchange from January 1996 to December 2009. Results of their research showed that stocks with high degrees of risk do not ensure high rates of return. They also proved that a linear relation existed between return and risk of stocks.

3. Data and methodology

a. Data: Data used in this study include weekly time series of VN-Index and prices of stocks listed on the HOSE collected in the period from Jan. 2, 2007 to Dec. 31, 2009 (152 observations). There were 136 stocks listed on the HOSE on Jan. 2, 2007. To ensure continuation of data employed, we select only 80 stocks for the study.

VN-Index and stock price employed in the study are closing index and price on Wednesdays. If no trading session is held on a Wednesday, the index and closing price on Thursday (or Tuesday if no session takes place on Thursday) is used as a replacement. If no session is held on both Tuesday and Thursday, data are considered as unavailable. Closing price on Wednesday is selected for the study to avoid effects of transactions during weekend (Huber, 1997).

Risk-free interest rate employed in the study is that of 2-year government bonds, comprising bonds issued by the State Treasury and by Bank for Development of Vietnam.

b. Methodology: To identify the relation between return and risk of HOSE stocks, we employ the method used by Michailidis et al. (2006). Specifically, the method comprises the following steps:

- Step 1: Estimating beta for each stock according to the formula:

$$R_{it} - R_{ft} = \alpha_i + \beta_i(R_{mt} - R_{ft}) + e_{it} \qquad (1)$$

where R_{ft} is rate of return on a risk-free asset and R_{it} is rate of return on stock i at week t.

For observations where no stock options are issued, and no dividend or bonus paid, rate of return of each stock is computed according to the following formula:

$$R_{it} = \frac{P_{it} - P_{it-1}}{P_{it-1}} \qquad (2)$$

For observations where more options are issued and dividends or bonuses are paid (in cash or stocks), the rate of return is determined by:

$$R_{it} = \frac{P_{it} - P_{it-1} + DIV_{it} + I_{1it} \times P_{it} + I_{2it} \times (P_{it} - P_{rit})}{P_{it-1}} \qquad (3)$$

where

P_{it}: Price of stock i at week t

P_{it-1}: Price of stock i at week t-1

DIV_{it}: Value of bonus/dividend in cash at week t

I_{1it}: Percentage of capital increased by payment in stocks for bonuses or dividends

I_{2it}: Percentage of capital increased by issue of more stock options

P_{rit}: Preferential price of stock offered to holders of stock options

+ R_{mt}: Market rate of return is determined by:

$$R_{mt} = \frac{P_{mt} - P_{m,t-1}}{P_{m,t-1}} \qquad (4)$$

where:

P_{mt}: VN-Index at week t

$P_{m,t-1}$: VN-Index at week t-1

Model (1) is estimated with OLS method. After checking residual (e_{it}) from estimation with this method, we find that heteroskedasticity exists in many surveyed stocks and decide to use GARCH(1.1) model instead of OLS to estimate beta coefficients of these stocks.

- **Step 2:** Establishing the portfolio and determining its beta coefficient:

+ Establishing the portfolio: to eliminate stock-specific effects, thereby enhancing the precision of the beta estimates, we use the beta of the portfolio instead of those of individual stocks. The beta coefficient gained in the Step 1 allows establishment of the portfolio by arranging beta coefficients according to their absolute values (from low to high). With 80 selected stocks, we divide them into 10 portfolios comprised of eight stocks each. The average return of each portfolio at week t (r_{pt}) is determined by:

$$r_{pt} = \frac{\sum_{i=1}^{8} r_{it}}{8} \qquad (5)$$

+ Determining portfolio beta coefficient: Beta coefficient of each portfolio is calculated by the linear regression model with the following equation:

$$r_{pt} = a_p + \beta_p.r_{mt} + e_{pt} \qquad (6)$$

- **Step 3:** Determining relation between return and market risk of portfolios:

+ The average return of the portfolio (r_p): After calculating the average return of each portfolio at week t (r_{pt}) in Step 2, the average return of each portfolio during the whole surveyed period (from Jan. 2, 2007 to Dec. 31, 2009) can be worked out using the following formula:

$$r_p = \frac{\sum_{t=1}^{n} r_{pt}}{n} \qquad (7)$$

with n as observations for each portfolio (152).

+ Relation between return and market risk of portfolios: Based on the CAPM, the capital market line is estimated to identify the relation between return and market risk of portfolios. The capital market line is shaped with the following simple linear regression model:

$$r_p = \gamma_0 + \gamma_1.\beta_p + e_p \qquad (8)$$

where:

r_p: Average return of each portfolio

β_p: Portfolio beta estimated by Equation (6)

e_p: Random error

If the CAPM is correct, γ_1 will be greater than 0 and becomes the premium for market risk of portfolios.

- **Step 4:** Testing the non-linear relation between return and market risk of portfolios (portfolio beta):

The following regression model is used in this study to test the non-linear relation between return and market risk of portfolios:

$$r_p = \gamma_0 + \gamma_1.\beta_p + \gamma_2.\beta^2_p + e_p \qquad (9)$$

If the hypothesis of CAPM is correct, return and risk of portfolio is linearly related and γ_2 will be equal to 0. Contrarily, if γ_2 is different from 0,

a non-linear relation does exist between return and risk of portfolios.

4. Results

a. Beta coefficient of surveyed stocks:

To test the relation between return and risk, beta coefficients of 80 surveyed stocks are obtained in Step 1. With 152 observations, the beta of each stock is estimated using the regression model, OLS and GARCH (1.1), and presented in details in Table 1.

b. Average return and portfolio beta:

The calculated beta coefficients for stocks allow us to divide the stocks into 10 portfolios according to their beta values. To estimate the relation between return and market risk of the portfolio, we calculate beta coefficients and average return of 10 portfolios for the whole surveyed period. Beta coefficients and average return are presented in Table 2.

Table 1: Beta coefficients of surveyed stocks

No	Stock code	Beta
1	ABT	0.799*
2	AGF	0.913*
3	BBC	0.972*
4	BHS	0.804*
5	BMC	1.088*
6	BMP	1.017*
7	BT6	0.537*
8	CII	1.063*
9	CLC	0.578*
10	COM	0.651*
11	CYC	0.879*
12	DCT	0.959*
13	DHA[1]	0.969*
14	DHG	0.723*
15	DIC	0.943*
16	DMC	0.686*
17	DRC	1.140*
18	DTT	0.717*
19	FMC	0.774*
20	FPC	0.683*
21	FPT	1.136*
22	GIL	1.036*
23	GMC	1.010*
24	GMD	1.046*
25	HAP	1.195*

No	Stock code	Beta
26	HAS	0.964*
27	HAX	0.787*
28	HBC	1.078*
29	HMC	1.052*
30	HRC	1.045*
31	HTV	1.178*
32	IFS	0.801*
33	IMP	0.700*
34	ITA	1.007*
35	KDC	1.168*
36	KHA	0.994*
37	KHP	0.992*
38	LAF	1.225*
39	LBM	1.088*
40	LCG	0.820*
41	MCP	0.558*
42	MCV	1.017*
43	MHC	0.923*
44	NAV	0.997*
45	NKD	0.983*
46	NSC	1.028*
47	PAC	0.745*
48	PGC	1.143*
49	PJT	0.943*
50	PNC	0.812*
51	PVD	1.016*
52	RAL1	0.874*
53	REE	1.250*
54	SAM	1.222*
55	SAV1	0.842*
56	SCD	0.887*
57	SFC	0.835*
58	SFI	1.268*
59	SJD	0.832*
60	SJS	1.261*
61	SMC	0.930*
62	SSC1	0.986*
63	STB	1.129*
64	TAC	1.090*
65	TCR1	0.642*
66	TDH	1.046*
67	TMS	0.597*
68	TNA	1.036*
69	TRI	1.068*
70	TS4	1.298*
71	TTP1	0.994*
72	TYA	1.045*
73	VFC	1.000*
74	VID	0.934*
75	VIP1	1.148*
76	VIS1	0.886*

77	VNM[1]	0.893*
78	VPK	0.845*
79	VSH	0.816*
80	VTB	0.742*

*: Statistically significant at 1%

[1]: Beta is estimated with OLS [Beta values of remaining stocks are estimated with GARCH (1.1)]

Table 2: Average return and beta coefficient of 10 portfolios

Portfolio	Portfolio average rate of return	Portfolio beta
1	-0.0001	0.6261*
2	-0.0007	0.7533*
3	0.0012	0.8246*
4	-0.0012	0.9054*
5	-0.0004	0.9140*
6	0.0006	1.0020*
7	0.0009	1.0033*
8	0.0007	1.0945*
9	0.0004	1.1250*
10	0.0035	1.2216*

*: Statistically significant at 1%

Results in Table 2 show that the average rate of return varies from the lowest of -0.0012 to the highest of 0.0035 while beta coefficient varies between 0.63 and 1.22. In CAPM, expected return of a portfolio is high when its beta is high. This relation will be tested in the following part.

c. Relation between portfolio return and risk:

Portfolio return and beta obtained in the previous step allow the use of the simple regression model for determining the linear relation between return and risk of portfolios. Dependent variable in the model is average return of the portfolio while portfolio beta is treated as the independent variable. Table 3 shows results of regression analysis.

Table 3: Relation between portfolio return and risk

Indicator	Estimate	t-stat
γ_0	-0.004	-1.948***
γ_1	0.004	2.247***
R^2		0.387
F-value		5.049*

***: Statistically significant at 10%

Results of regression analysis show that market risk of portfolio (measured by the beta) is directly proportional to the portfolio return. Specifically, 1% of market risk is rewarded with 0.004% of return. Statistically, the relation is significant at 10%. This result is consistent with predictions of the CAPM, i.e. the higher risk is closely associated with a higher level of expected return as a risk premium.

In this regression model, moreover, value of R^2 is 0.387. This means that changes in the beta coefficient explain 38.7% of changes in portfolio return. This result is theoretically consistent because the portfolio risk must be offset by a corresponding return while only market risk is included in the model. Thus, remaining changes in return (61.3%) that have not been measured in the model may come from other factors such as firm size, market value vs. book value of the firm and other macroeconomic factors.

d. Testing the non-linear relation between portfolio return and risk:

The above results of regression analysis show that there exists a linear relation between return and risk of surveyed stocks listed on the HOSE. Previous researches, however, suggest that a non-linear relation between return and risk may exist. To test this relation in the regression equation, the beta squared (β^2) is introduced as an independent variable. Testing results are shown in Table 4.

Table 4: Results of test of non-linear relation between return and risk

Indicator	Estimate	t-stat
γ_0	0.011	1.482
γ_1	-0.029	-1.740
γ_2	0.018	2.016[***]
R^2		0.612
F-value		5.524[**]

[**], [***]: Statistically significant at 5% and 10% respectively

Table 4 shows that coefficient γ_2 is equal to 0.018 and statistically significant at 10%. This result implies that a non-linear relation exists between return and risk of stocks listed on the HOSE. This is contrary to a basic argument proposed by the CAPM, i.e., return and risk is linearly related.

5. Conclusion

The paper presents a test of relation between return and risk of stocks listed on the HOSE. Data used for the study comprise VN-index series and prices of 80 stocks listed on the HOSE in the period from Jan. 2, 2007 to Dec. 31, 2009. To enhance precision of beta estimates when testing the relation, surveyed stocks are divided into 10 portfolios comprised of eight stocks each according to their beta values (from low to high). Results obtained from the regression analysis model show that CAPM is consistent with HOSE stocks. Specifically, the higher risk degree produces higher rates of return. However, empirical evidence from this study implies that the relation between return and risk of HOSE stock is non-linear instead of a linear one as predicted by CAPM■

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