ISSN : 0974 - 7435 Volume 10 Issue 12

2014

BioTechnology

An Indian Journal

FULL PAPER

BTAIJ, 10(12), 2014 [6158-6165]

The empirical research of application of CAPM in China market

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ABSTRACT

Since the birth of CAPM, it has undergone many scholars empirical research and tests. The main purpose of the paper is to conduct a study of CAPM in China's Stock markets. The data for this study are Stocks data and combined data of Shanghai Stock Exchange. Empirical analysis of these data has been carried out by way of t-statistics and joint test to verify whether CAPM model would be true of China's stock market. And the conclusion was reached that CAPM model is essential in China's stock market. Thus, CAPM model can be used to promote the development of China's stock market. And this model can be applied in empirical analysis and theoretical study on the market.

KEYWORDS

Capital asset pricing model; Listed company; T-statistic Test; Joint detection; China's stock market.

INTRODUCTION

In finance, the capital asset pricing model is the price decision theory about financial assets including shares, bond, futures and option. American economists Markowitz first created the modern portfolio theory and put forward the method of diversification when he researched the relationship between risk and required rate of return. Sharpe, on the basis of portfolio theory, assumed that all investors used the utility function with average yields and risk as the independent variable to make decision. When analyzing the relationship between system risks and benefits, he put forward Capital Asset Pricing Model, namely CAPM. The CAPM is a model for pricing an individual security or portfolio. For individual securities, we make use of the security market line (SML) and its relation to expected return and systematic risk (beta) to show how the market must price individual securities in relation to their security risk class. The SML enables us to calculate the reward-to-risk ratio for any security in relation to that of the overall market.

The Particular Form of CAPM

Under the described previously assumed, the concrete form of Sharpe - Linter model:

$$E(R_i) = R_f + \beta_{im}[E(R_m) - R_f] \quad \textbf{(1)}$$

R_f represents risk-free rate, R_m represents the rate of return of market portfolio, $E(R_i)$ represents the required rate of return of investment portfolio. β_{im} represents certain one securities which is relative to the risk measures of market portfolio, forms of expression:

$$\beta_{im} = \frac{Cov(R_i, R_m)}{Var(R_m)} \quad \textbf{(2)}$$

The following instructions of β: (1) Since the risk-free asset with an effective combination of covariance must be zero, then β value of any risk-free asset must also be zero. While any β value of zero excess return of assets must also be zero. (2) If the covariance of certain a security risk is equal to the effective combination of variances, the value of β is 1, then the expected return of the asset must be equal to the market rate of return on the effective combination of expectations that such risk assets can be an effective combination of average rate of return.(3) The value of β is high, the expected rate of return on the investment securities acquired higher; the value of β is low, the lower the expected rate of return of investment in the securities acquired. In fact, the return of investor is proportional to the risks to investors, that there is no free lunch.

Requirements of the standard form of the CAPM request that there must be risk-free securities(R_f) in the market. What will happen then, if there is no R_f in the market. Black (1972) calculated the general form of the CAPM in the condition of risk-free asset, called the zero-β capital asset pricing model. In this model, the expected excess stock returns any asset i through its β coefficient can be expressed as market portfolio returns and linear function of zero β market portfolio on the market portfolio, as follow:

$$E(R_i) = R_{om} + \beta_{im}[E(R_m) - R_{om}] \quad \textbf{(3)}$$

And R_{om} is market portfolio of zero β portfolio returns, This combination is usually defined as the minimum variance portfolio which is among all of the combination of the market portfolio.

The Meaning of CAPM Model

CAPM is the first equilibrium model on the capital asset pricing. CAPM also can do the quantitative inspection. The primary significance of the model is to establish the relationship between risk and return of capital, clearly indicating the expected return of securities is the sum of risk-free rate of return and risk compensation, which reveals the internal structure of securities compensation.

Another important significance of CAPM is that it divided risks into unsystematic risk and systemic risk. Unsystematic risk is the risk that belongs to some particular companies or specific industry; it can be dispersive through asset diversification. Systemic risk refers to the inherent risk factors that affect the whole market. It intrinsic exists in the stock market and this risk cannot be eliminated through diversification. The function of CAPM is to use the assets portfolio to eliminate unsystematic risk; the systematic risk is the only one remains. β coefficient has been introduced in the model to characterize the systemic risk.

In reality, many studies questioned the validity of the CAPM, but it is still widely used in the investment community. Although the change of individual stocks is difficult to be predicted through β, but investors still believe that equity portfolio with bigger β value has bigger volatility than the market price, regardless of market prices rise or fall; while equity portfolio with smaller β value has smaller volatility than the market price. This point is very important for investors. When the market prices declines, they can invest in a low β value stocks. And when the market rises, they can share a β value of the investment is bigger than 1.

CAPM is not a perfect model, but it is correctly analysis of the problem. It provides a model can measure the size of the risk, to help investors determine whether the excess return obtained matches the risk among.

DATA COLLECTION AND COLLATION

The CAPM empirical tests we did are based on Chinese market. Due to the development of China's stock market is late, starting from December 1990 until today, is less than two decades. In order to have sufficient data to ensure the accuracy of the CAPM test results and fit the need for contrast, when we choose the stocks data, the main criteria is sufficiently long trading hours. The following briefly describes the process of data collection and collation.

Data collection

The stock date we collected is mainly form GTA database Shanghai stock market, meets the Capital Asset Pricing Model portfolio described; In addition, many domestic CAPM theory on empirical research papers are based on Shanghai stock market as the research object, the paper also selects the Shanghai stock market in securities; Furthermore, GTA database (CSMAR) has processed and computed commonly used date. Specifically:

(1) Stocks Data: We packed from the GTA database downloaded Shanghai Stock Exchange traded A shares all relevant information, the time span from January 1991 to December 2012, which mainly use information items include:

Stock Code. Related securities in the Shanghai Stock Exchange code, for example 600651 are the famous "old stereotype" Feale Audio-Visual securities code.

Trading Month. Noticing different months, short pauses caused by Share reform and general meeting, stocks fluctuate a great deal of time, or even some months stop plate no deal. Since we use monthly yield to test the CAPM, so as long as there are the trading hours of the month, when calculating the monthly GTA yields can use the relative prices of last trading day of that month. For the month had no transactions, of course that month yield is zero, then the next month, the yield is calculated based on the previous trading month. (In fact, at the time of testing, we gave up those months have trading stocks.)

Considering monthly cash dividends reinvested stock return. This is the GTA has been calculated of information item, specific calculation formula is as follows:

$$r_{n,t} = \frac{P_{n,t}}{P_{n,t-1}} - 1 \quad \textbf{(3)}$$

In this calculation formula, is the stock n in month t in last trading day's closing price of "comparable" considered cash dividends, and comparable price is GTA database provided exclusively for use in the calculation of stock returns, and it is different from the market price, is equal to the price of the complex after the exercise. Therefore, the yield data can be used directly.

(2) The Market Yields: The market portfolio we are using is not SSE. Considering already has a lot of indices achieved tests used the card, here we use the weighted average market capitalization of all the Shanghai A-share gains as a representative market rate of return. The formula is:

$$R_{M,t} = \frac{\sum_n w_{n,t} r_{n,t}}{\sum_n w_{n,t}} \quad \textbf{(4)}$$

In this calculation formula, $w_{n,t}$ is proportional to the total market capitalization of the stock market capitalization. We believe that this portfolio may represent market yields. The yield data is also provided directly by the GTA database.

(3) The Risk-Free Rate: We use the People's Bank of China announced the one-year deposit interest rate risk-free rate over the same period as the representative of the data from the People's Bank of China website.

Data processing

Data sorting process is the process of obtaining test data from the raw data collected. Our data processing work has mainly in two steps:

(1)Select Stocks for Inspection. As introduced before, the standard we have chosen is in a given data range, there are more than 200 transactions month all stocks, in fact, only 9 stocks meet the requirements, the basic information is as follows:

TABLE 1 : CAPM test stocks with basic information

code	name	listing date	Total equity	Circulate capital	Name of industry
600601	Fangzheng technology	1990/12/19	1726486674	1726486674	IT industry
600602	SVA electron	1990/12/19	1172943082	1172943082	manufacture
600603	ST	1992/01/13	194641920	194641920	Real estate
600606	Jinfeng Investment	1992/03/27	390227810	257690925	Real estate
600651	Feile Audio-Visual	1990/12/19	559897963	559897963	Comprehensive
600652	Aishi stock	1990/12/19	506365967	506365967	Comprehensive
600653	Shenhua holdings	1990/12/19	1455316931	1455316931	Comprehensive
600654	Feile holdings	1990/12/19	755043154	755043154	IT industry
600656	ST	1990/12/19	190343678	106659258	manufacture

(2)After the selection of individual stocks, then we select the month for inspection. Taking into account prior to 1994, China's stock market is also very irregular, often with a large proportion of stocks allotment and dividends, resulting in the month yield is very unusual, as a result, we actually only use transaction data after 1995; From the beginning of 2007, after another because of the ownership structure reform of listed companies and other suspended over a month's time. At least one stock for the whole month of May to stop the disc, we used to give up the monthly data processing method because

CAPM test does not depend on the continuity of time, so we think this will not affect the nature of the results; In addition, finishing GTA database data obtained from the stock, I found that the selected nine stocks Jinfeng Investment (600606) and ST Xingye (600603) in the presence of missing data in some months between 2010 to 2012. Therefore, I removed the data from 2010 to 2012, the data selected time range from January 1995 to December 2009.

Finally, the data we are using for test, including the nine stocks mentioned above in January 1995 to December 2009 (except May 2007 to June 2008) monthly yield data, and we can get the monthly market return data and risk-free return data.

THE EMPIRICAL ANALYSIS

T-statistic test

In this action, stocks and different combinations of data were tested by t-statistics to verify CAPM.

(1) Stocks. The following attach detailed calculation results and see appendix regression straight line diagram.

TABLE 2 : T-statistics test of stocks

Stock Code		Estimate	Std. Error	t value	Pr (>|t|)	R Square
600601	intercept term	0.015071	0.009771	1.542	0.125	0.4969
	slope	1.29293	0.101586	12.727	<2e-16 ***	
600602	intercept term	0.009654	0.010044	0.961	0.338	0.418
	slope	1.134905	0.104423	10.868	<2e-16 ***	
600603	intercept term	-0.0007258	0.0084726	-0.086	0.932	0.5076
	slope	1.1453895	0.088088	13.003	<2e-16 ***	
600606	intercept term	0.009219	0.010411	0.885	0.377	0.3551
	slope	1.028718	0.108246	9.504	<2e-16 ***	
600651	intercept term	0.02063	0.01077	1.915	0.0572.	0.435
	slope	1.25862	0.112	11.238	<2e-16 ***	
600652	intercept term	0.00813	0.009057	0.898	0.371	0.4577
	slope	1.107819	0.094167	11.764	<2e-16 ***	
600653	intercept term	0.01084	0.008295	1.307	0.193	0.5448
	slope	1.208232	0.086241	14.01	<2e-16 ***	
600654	intercept term	0.012607	0.007231	1.744	0.0831.	0.651
	slope	1.314825	0.075176	17.49	<2e-16 ***	
600656	intercept term	0.0001684	0.009984	0.017	0.987	0.3386
	slope	0.9511932	0.1038022	9.164	<2e-16 ***	

Signif. codes: 0 '*' 0.001 '**' 0.01 '*'**

From the results it is easy to draw a conclusion, in a given data and the data range:1, The regression results clearly reject no linear relationship between excess returns of stocks on the Shanghai Composite Index and the excess rate of return assumption;2, for the selected stocks, we can't refuse CAPM was established.

Based on the above results, the results of our data using the stocks CAPM tests, the data used in the basic display that we can't refuse the establishment of the Chinese market CAPM assumptions.

(2) Board. We selected stock involves four segments: IT Industry, manufacturing, real estate industry, Miscellaneous. We are testing these four sectors described above (which we construct a portfolio of a few stocks in the sector to represent the data plate: the portfolio of any two stocks is equal to the ratio of the weight percentage of the value of their stocks have been in circulation).

TABLE 3 : T-statistics test of board

Board		Estimate	Std. Error	t value	Pr (>|t|)	R Square
IT Industry	intercept term	0.014321	0.007737	1.851	0.066.	0.6141
	slope	1.299592	0.080442	16.156	<2e-16 ***	
Manufacturing	intercept term	0.00494	0.007403	0.667	0.506	0.545
	slope	1.078922	0.076973	14.017	<2e-16 ***	
Real estate industry	intercept term	0.01247	0.006868	1.816	0.0712.	0.6324
	slope	1.199255	0.071403	16.796	<2e-16 ***	
Miscellaneous	intercept term	0.008863	0.009339	0.949	0.344	0.4477
	slope	1.119592	0.097097	11.531	<2e-16 ***	

Signif. codes: 0 '*' 0.001 '**' 0.01 '*'**

From the regression results found: 1, The regression results clearly reject no linear relationship between excess returns of stocks on the Shanghai Composite Index and the excess rate of return assumption; 2, data of the selected board for us, we can't refuse CAPM; 3, information technology and the integrated regression fitting is better and compared to other two board, these board does not support that the assumption of CAPM was founded.

Based on the above results, the results we use the data board CAPM tests are similar to those of stocks, which can not reject the hypothesis established CAPM.

(3) Asset portfolio. In this action, we use all nine stocks with different weights constructed three kinds of asset portfolio. Three combinations are as follows:

a. Equally weighted portfolio: considering the weight of the portfolio of 9 kinds of shares (hereinafter referred to as the asset portfolio 1)

b. Float portfolio: The proportion of nine kinds of stocks have been in circulation for the stock market portfolio weights constructed (hereinafter referred to as the asset portfolio 2)

c. Markowitz optimal portfolio: We calculate the average yield of 9 stock, earnings volatility (variance), and the Correlation coefficient Matrix, and then according to the Markowitz portfolio theory to calculate the global optimal portfolio (hereinafter referred to as the asset portfolio. 3).

The above portfolio are CAPM test respectively, The following attach detailed calculation results and see appendix regression straight line diagram.

TABLE 4 : T-statistics test of asset portfolio

Asset portfolio		Estimate	Std. Error	t value	Pr (>|t|)	R Square
Asset portfolio 1	intercept term	0.00951	0.004958	1.918	0.0568.	0.7555
	slope	1.160292	0.05155	22.508	<2e-16 ***	
Asset portfolio 2	intercept term	0.011961	0.005577	2.145	0.0334 *	0.7274
	slope	1.213007	0.057982	20.92	<2e-16 ***	
Asset portfolio 3	intercept term	0.00025	0.060432	2.516	0.0532	0.6623
	slope	1.09529	0.005203	19.81	<2e-16 ***	

Signif. codes: 0 '*' 0.001 '**' 0.01 '*'**

We use these three portfolios of excess returns and the Shanghai composite index of excess returns for regression to test the CAPM. The conclusion is as follows:

1. The regression results clearly reject no linear relationship between the three asset portfolio and the Shanghai index excess return.

2. For the portfolio we have constructed, we can't refuse that CAPM model was established;

3. The R^2 above three portfolios of stocks was significantly higher than the front board data R^2.

Joint test

We observation period (January 1995-December 2008) were divided into different time periods, with each piece of data to conduct joint tests of the CAPM respectively and compare the results. Specifically, the entire data is divided into three segments interval, two segments interval and the whole data, statistics structure J_0, J_1, J_2 to be tested to be tested. Concrete results in the following table.

TABLE 5 : Joint test of observation period

statistics	J_0 (p-value)	J_1 (p-value)	J_2 (p-value)
1/95-3/99	2.570(0.979)	0.223(0.988)	2.507(0.981)
4/99-5/03	9.582 (0.385)	0.856 (0.571)	8.781(0.458)
6/03-12/09	4.993 (0.835)	0.448(0.900)	4.768(0.854)
1/95-5/01	7.293(0.607)	0.705(0.702)	6.968(0.644)
6/01-12/09	3.943 (0.915)	0.381(0.940)	3.845(0.921)
1/95-12/09	3.663 (0.932)	0.381(0.943)	3.620 (0.935)

No matter which the test results of the inspection statistics, we can get similar results as follows:1, the test results of the three data range can't refuse that CAPM was established and we can't reject from the global data either;2, in April 1999 to range segment in May 2003, compared with other time periods, the evidence established CAPM model seems more badly.

CONCLUSION

According to the result of the inspection, the combination of individual stocks or joint inspection seems that we can't refuse CAPM established in the Chinese market.

But considering the data we used, it is not appropriate to conclude that the CAPM model found in the Chinese market because small number of individual stocks and the overall amount of data that did not last long. Meanwhile, considering the establishment of the CAPM assumptions, whether rational or efficient market hypothesis, there is no convincing evidence in the Chinese stock market which is "policy-driven" in the initial development of the market. Then we can't get the conclusion that CAPM found in the Chinese market by statistical results.

ACKNOWLEDGEMENTS

The helpful comments of the editor and two anonymous referees are gratefully acknowledged. The work has been supported by the SARFT project (GDT1239) Internet TV Trends and Regulatory Issues, the Beijing Youth Excellence Project (YETP0633) New Media Content Supply Chain and Trading Platform in Multi-leading and Multi-followers Market, and Cultivation Fund (3132014XNG1458) of Communication University of China. Moreover, this work has been performed in the project "A Study on Interconnection Charges during China's Integration of Telecommunications, Broadcasting and Internet Networks" supported by National Natural Science Fund (71203202).

REFERENCES

[1] E.Fama, James D.Macbeth; Risk, return and equilibrium: empirical tests. Journal of Political Economy, **81**, 607-636 **(1973)**.

[2] J.B.DeLong, A.Shleifer, L.Summers, R.J.Waldman; Positive Feed-back Investment Strategies and Destabilizing Rational Speculation. Journal of Finance, **(1990)**.

[3] Qingshun Meng; Asset Pricing Models and their Tests on China's Stock Market. Jilin University, **4**, **(2005)**.

[4] Luo Li; The Empirical Research of Application of CAPM and Extensions of CAPM in China's Security Market. East China Jiaotong University, **5**, **(2008)**.

[5] Campbell, Y.John, John H.Cochrane; By Force of Habit: A Consumption-based Explanation of Aggregate Stock Market Behavior. Journal of Political Economy, **107(2)**, 205-251 **(1999)**.

[6] W.Hu, A.N.Kercheval; Portfolio optimization for student t and skewed t returns. Quantitative Finance, **10(1)**, 91-105 **(2010)**.

[7] J.Bartholdy, P.Peare; The Relative Efficiency of Beta Estimates, Social Science Research Network, New York, http://www.hedgefund-index.com/sp_bartholdy1-5.asp, **(2011)**.

[8] D.Bradfield; Investment basics on estimating the beta coefficient. Investment Analysts Journal, **57**, 47-53 **(2003)**.

[9] Li Xingwei, Wang Jian; Based CAPM GEM IPO capital cost Empirical research, **10**, **(2012)**.

[10] J.Y.Campbell, W.L.Andrew, A.Craig MacKinlay; The Econometrics of Financial Markets, Princeton University Press, New Jersey, **(1997)**.