RISK MEASUREMENT OF STOCKS IN CHINA'S STOCK MARKET: A TIME VARYING CAPM APPROACH

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Abstract - This paper empirically measures the performance of twenty individual stocks listed on SSE A share. These stocks are selected from ten stock sectors (finance, real estate, construction, black metal, catering, beverage, information, communication equipment, transportation equipment and logistic sectors). We apply closing price of each stock, Shanghai Composite Index and China's T bills from 2013 to 2017 by using a time varying CAPM approach to create the CAPM beta which shows the risk level of each stock. Via the empirical analysis, we are able to capture the performance of each stock and the result of CAPM betas provides a lot of information on stock investment. It has a great reference value for the stock investors.

Keywords - Capital Asset Pricing Model; Time Varying Beta; Risk Measurement; Shanghai Stock Exchange; A Share.

I. INTRODUCTION

1.1 Background

Nowadays, the world stock market continues to expand. And it's well recognized that the stock market plays an important role in the development of economy because it accelerates capital flows and mobilizes the idle saving, transferring them into productive capital. In terms of China's stock market, which is considered as one of the emerging markets all around the world attracts a number of investors to invest on the stocks. Compared with the stock markets of other countries, Chinese stock market is experiencing a fast capital flows which leads to the fluctuation of the stock price, and it will also have a huge impact on the market return (Chen Kao Lyuu, & Wong, 2006). As known by people, the stock market is constantly changing with lots of uncertainties and risks. Financial market in china started relatively later than other countries. What's more, the methods used to measure the financial risk are fell behind other countries, which is mostly for so the risk in financial market increased (Xinjie Ma & Yongsheng Yang, 2012). Based on this situation, the study of risk measurement seems to be important to the stock system in China. Through the application of a copula-time varying CAPM model to conduct empirical analysis, the study can estimate the risk of a specific stock and offer suggestions for investment. It will be useful for investors to do risk measurement before investing the capital.

1.2 Research purpose

The purpose of this paper is to measure the risk of twenty individual stocks of SSE A share and analyze the result to provide some reference information for the investors. By using time varying CAPM method, we can compare the CAPM beta of each stock and come up with empirical strategies of investment. The result can help the investors to reduce the risk of losses during the investment.

1.3 Structure of paper

Chapter one introduces the background, research objective and the structure of this paper.
Chapter two briefly summarizes the relevant literature. The literature relevant to China's stock market, time varying CAPM are considered in this chapter.
Chapter three is to explain the theoretical model of time varying CAPM approach including the data collection and model specification.
Chapter four shows the empirical result of this research. We apply the data in R software, Excel to get the result including CAPM beta of twenty individual stocks.
Chapter five is the conclusion and suggestion offered based on the empirical result.

II. LITERATURE REVIEW

2.1 Literature review of worldwide research

Capital Asset Pricing model has attracted a lot of attention from researchers all over the world when it came out. Many researchers start the empirical test of its feasibility in the real world especially in the stock market. In the early days, there are a lot of literature support CAPM method, especially the literature of 70s. Sharpe and Cooper (1972) collected the yearly return data of New York Stock Exchange from 1954 to 1963, calculating the standard deviation of annual average rate of return and rate of return. By using the Least squares regression to prove the linear relation between them. The main objective of their research is to verify whether high risk is accompanied by high return during a long-time span. Black Jensen and Scholes (1972) applied the monthly data of all the listed stocks of New York Stock Exchange from 1931 to 1965 to test the feasibility of CAPM method. The result shows it works in analyzing the risk of stocks. In order to avoid select error, they estimated the beta value by time series data, and ranked the stocks from top to bottom according to their value of beta. They

also divided the stocks into ten groups as portfolio. Their research proved that there is a significant positive linear relationship between the value of beta and the return. The ordinary least squares (OLS) assumes that the CAPM beta is constant beta risk (Fama and MacBeth, 1973). Klemkosky and Martin (1975) and Bollerslev et al. (1988) support that the expectation of economic agents for future return are conditional. Therefore, the variable shall be random rather than constant. This implies that the beta of a risky asset should be time-varying. Bos and Newbold (1984), Collins et al. (1987), Brooks et al. (1992), and Choudhry (2002, 2004) have suggested that a constant-beta CAPM is unable to explain the cross-section of average returns on equities and the market to capture dynamics in volatility.

2.2 Literature review of research in China

Fangni Xiang (2001) selected the stock data of SSE from 1997 to 1999. Her empirical test shows the acceptability of CAPM in Shanghai stock market. Jianfeng Li (2002) collected the sample data of 100 stocks in Shanghai stock market to draw the Security Market Line (SML). Result shows the correlation between system risk coefficient beta and the rate of return. Their researches both explained the feasibility of using CAPM method to measure the performance of Shanghai stock market. Xuebo Wei and Haiyan Xie (2009) conducted an empirical study of least square method on 31 sorts of stocks by using time series regression. This research proved that the empirical result from CAPM has reference value during the investment. It can help investors to choose a portfolio.

III. METHODOLOGY

3.1 Data collection and processing

The dataset of this study consists of the closing price of twenty individual stocks selected from A-shares of Shanghai Stock Exchange. The data are collected from NetEast website. The range of time period covers from 3rd Jan, 2012 to 3rd Jan, 2018. It's widely acknowledged that the dataset used for estimating risk and forecasting shall be more than 5 years of observation period. Hence, this study covers 6 years data to be analyzed. Moreover, the study also collects 6 years closing price of China's T bills and Shanghai Stock Exchange Composite Index. As the model used in the study is time varying CAPM model, the China's T bills will be used as risk-free rate and the SSE Composite Index will be use as the return of market. Table 1 shows the information of sectors and stocks selected in this paper.

Table 1 Sectors and Stocks Information

No.	Sector name	Stock code
1	Finance	601288
		601398
2	Real estate	600048
		600340
3	Construction	601668
		600170
4	Black metal	601003
		600019
5	Catering& Restaurant	601007
		600258
6	Food& Beverage	600809
		600519
7	Information technology	600050
		002230
8	Communication equipment	000725
		600839
9	Transportation equipment	601989
		601766
10	Logistic	600028
		600115

According to the data showed on the NetEast finance, there are total 46 stock industries in the A share market. And in this paper, we view each industry as a sector. Among these 46 sectors, the communication equipment industry, information technology industry and financial industry rank top 3 according to their turnover, followed by the real estate industry and black metal industry. In addition, in terms of the trading volume, turnover and the performance in the field, we select these 20 individual stocks to do the risk measurement since they may have relatively huge effects on the future trend of the sector.

3.2 Model Specification

In order to measure the risk of each individual stock, a time varying CAPM model will be used.

In CAPM framework, R_f represents risk-free rate. $R_{it} = (r_{1,t}, \dots, r_{n,t})'$ is the vector of return with $r_{i,t} = S_{i,t}/S_{i,t-1}$ where $S_t = (S_{1,t}, \dots, S_{n,t})'$ is the price vector. The formula of CAPM model can be written as Eq.(1):

$$E_{t-1}[R_{it} - R_f] = \lambda \sum_t \omega_{t-1}. \quad (1)$$

where $\sum_t$ is the covariance matrix of the risky assets at time t conditional on the information set available at time $t-1$. ω_t is the weight vector of the assets at time t. The expected utility $E[U(R_{mt})]$ can be expressed by $\upsilon(\mu_t, \sigma_{mt}^2)$. Considering the assumption of CAPM that the individual expected utilities are functions only of the mean and variance of the returns, so we have this formula:

$$\lambda = -2\frac{\partial \upsilon / \partial \sigma_{mt}^2}{\partial \upsilon / \partial \mu_t}. \quad (2)$$

where $\mu_t = E_{t-1}[R_{it}'\omega_{t-1}]$ is the conditional mean and $\sigma_{mt}^2 = \omega_{t-1}' \sum_t \omega_{t-1}$ is the conditional variance of the market portfolio. Then we have the formula for the market portfolio as:

$$E_{t-1}[R_{it} - R_f] = \lambda | \sigma_{mt}^2, \quad (3)$$

If we plug λ in Eq. (3), we get

$$E_{t-1}[R_{it} - R_f] = \beta_t E_{t-1}[R_{mt} - R_f], \quad (4)$$

Hence we can get the CAPM beta where

$\beta_t = \sum_t \omega_{t-1} / \sigma^2_{mt}$. (5)

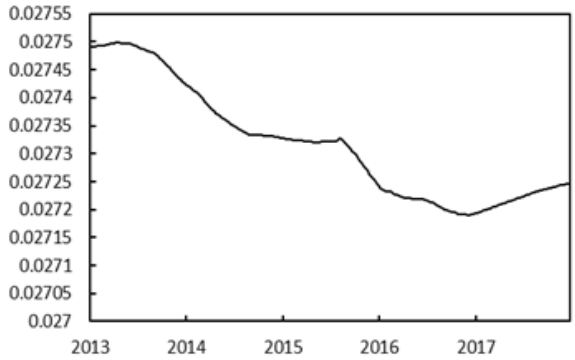
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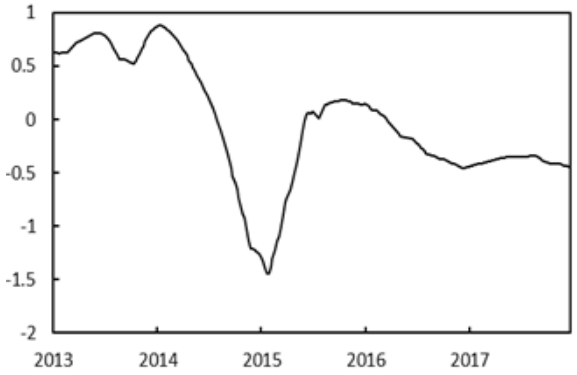
IV. Empirical Result

For data estimation, we apply the weekly closing price of each individual stock, SSE Index, and T bills in to the formula CAPM and calculating by R software. The twenty figures below show the time varying CAPM beta performance of each stock.

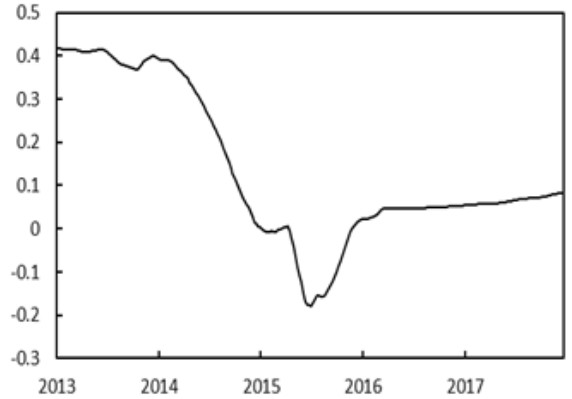
China Zhonggong



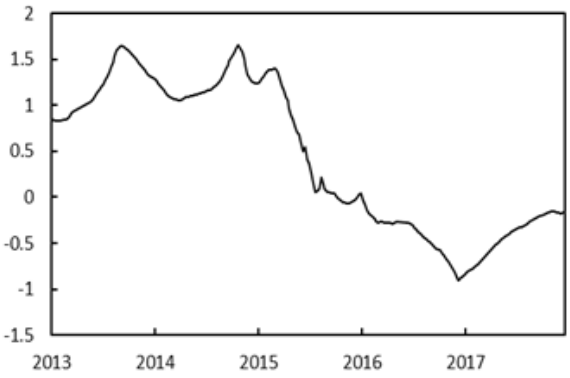
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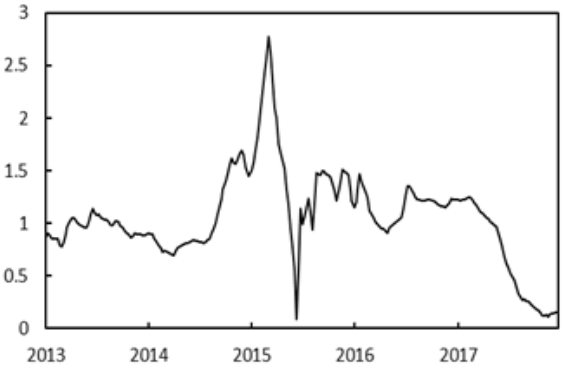
Changhong



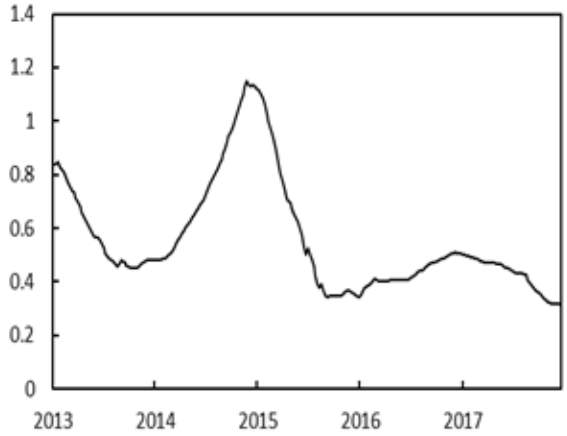
Eastern Airlines



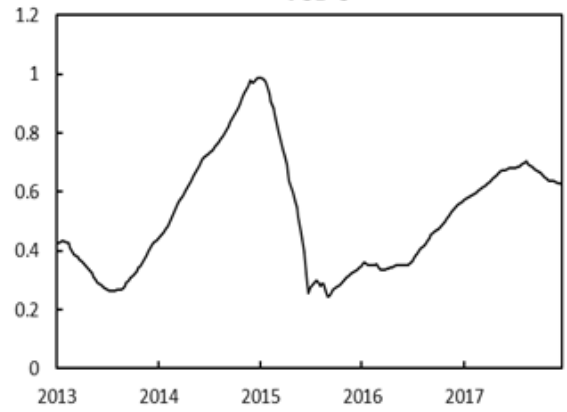
Southern Airlines

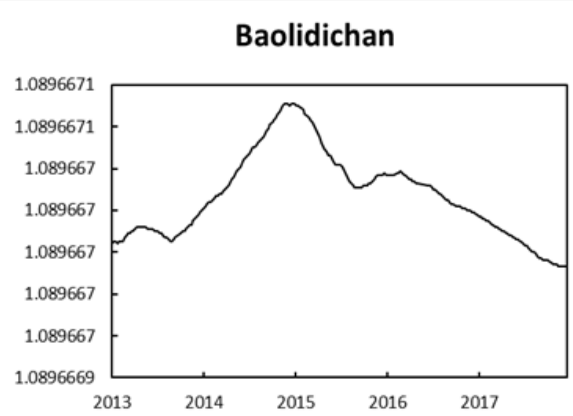


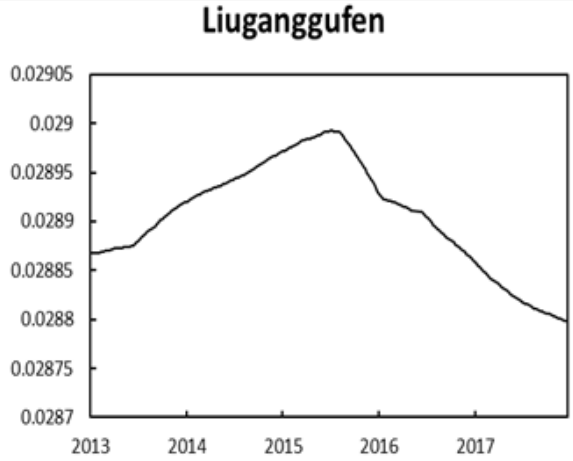
The Agricultural Bank of China

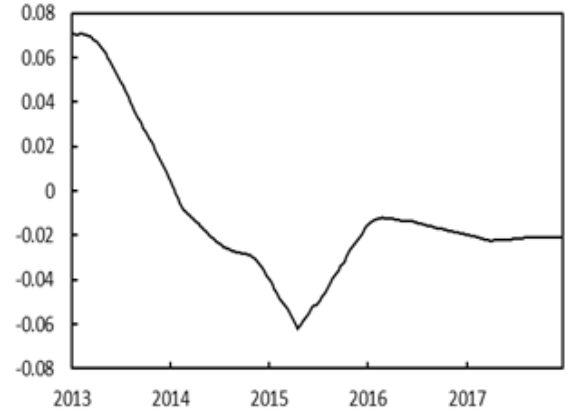


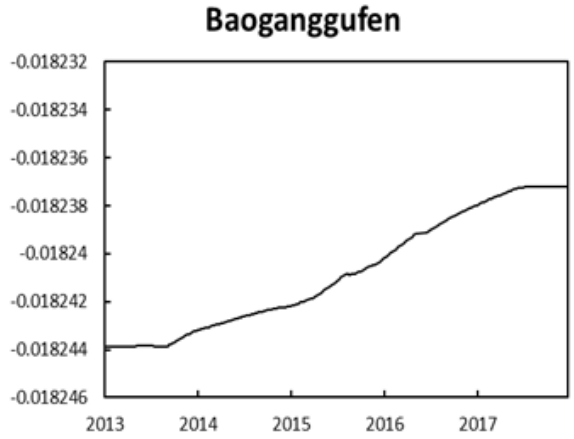
ICBC

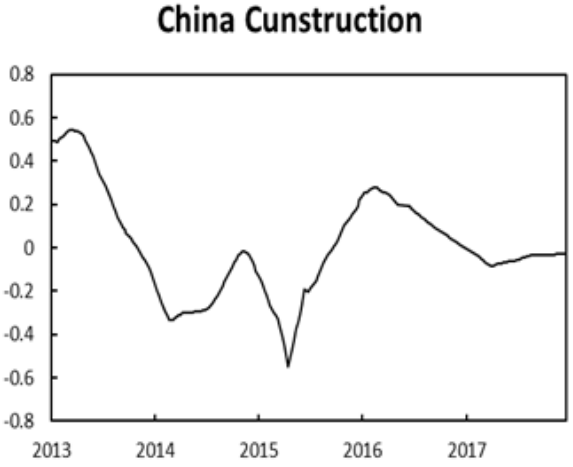


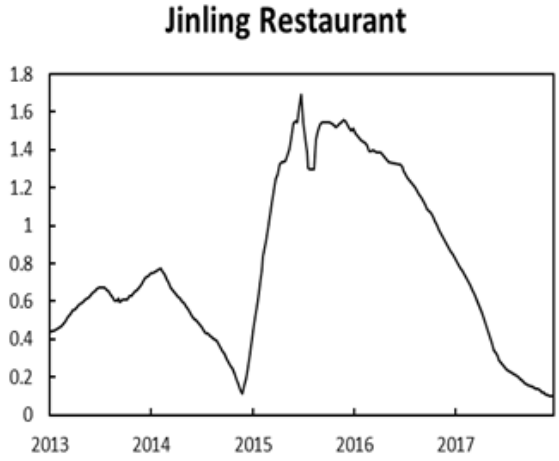

Baolidichan
1.0896671
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2013
2014
2015
2016
2017


Liuganggufen
0.02905
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0.02875
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2013
2014
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2016
2017

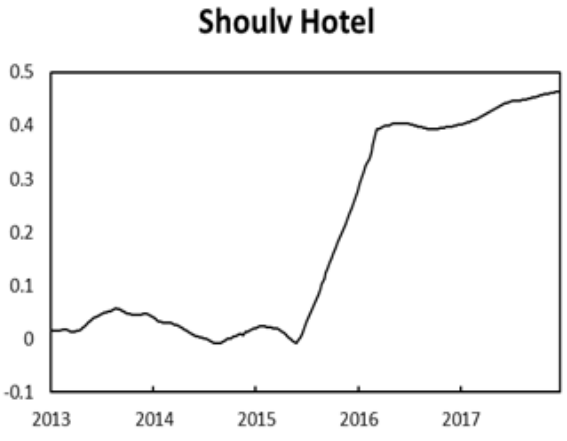

Huaxiaxinfu
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
2013
2014
2015
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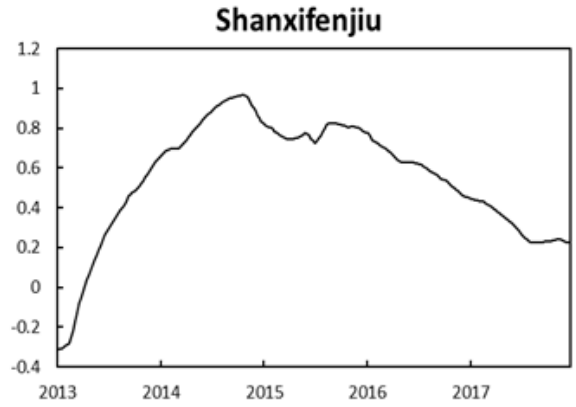

Baoganggufen
-0.018232
-0.018234
-0.018236
-0.018238
-0.01824
-0.018242
-0.018244
-0.018246
2013
2014
2015
2016
2017

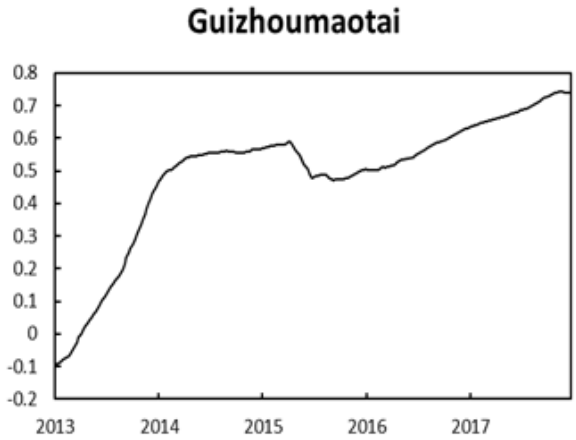

China Cunstruction
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
2013
2014
2015
2016
2017


Jinling Restaurant
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
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0
2013
2014
2015
2016
2017

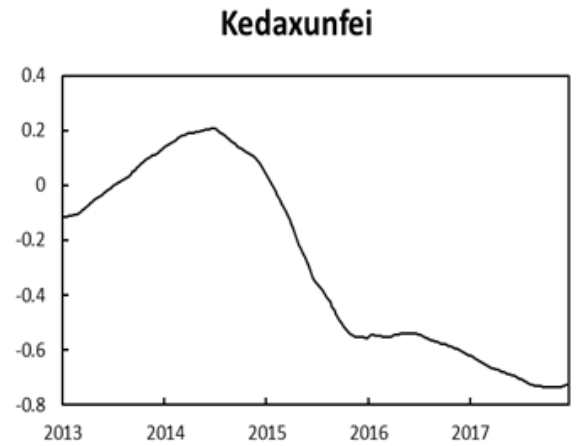

Shanghai Construction
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2013
2014
2015
2016
2017


Shoulv Hotel
0.5
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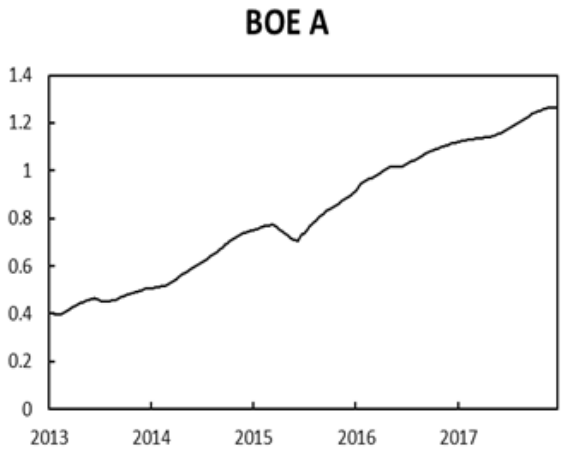


Figure 1. Time varying CAPM beta of selected stocks (continued)

Figure 1 contains twenty pictures which present the time varying beta of twenty individual stocks selected as the research objective respectively. These pictures clearly show the performance of stocks from 2013 to 2017. We notice that there are ten stocks (Huaxiaxinfu, China construction, Baoganggufen, Shoulv Hotel, Shanxifenjiu, Guizhoumaotai, Kedaxunfei, Changhong, China Zhonggong, Eastern Airlines) different from others because the beta value turns out to be negative during a certain period of time. The question is: can the CAPM beta be negative and what does it mean when it is less than zero? Generally, high beta means high correlation, but it's not necessarily the case if the company stock is substantially more volatile than the market. In that case, it is conceivable that the part of volatility that is not explained by market moves might have an upwards or nonlinear drift that is sufficient to overcome the effects of a long-term rising market plus a negative beta. Negative beta only means that statistically direction of the return on overall market and on the given stock are opposite, doesn't necessarily mean the sign of total return should be opposite versus stock market. So, having a negative beta doesn't necessarily mean that these ten companies would have to go bankrupt in the long run. If we divide these stocks into four groups according to their beta level, just like Fama and MacBeth (1973) did, the group can be like: Baoli, Shanghai Construction, Southern Airlines, Jinling Restaurant and the Agricultural Bank of China are in the first group with average beta value 1.32. Second group includes Shanxifenjiu, ICBC, Guizhoumaotai, Easthern Airlines and Shoulv Hotel with average beta value 0.44. Third group consists of BOE A, Sichuanchanghong, China Unicom, Liuganggufen and China Zhonggong with the mean beta 0.09. China Construction, Huaxiaxinfu, Baogang, Zhongche, and Kedaxunfei make up the last group with 0.015 average beta value. It is acknowledged by people that if the coefficient beta of an asset or portfolio is greater than 1 ($\beta > 1$), which means the volatility of

assets' price will be higher than the market price. For example, when the bull market is coming, the investors can choose the asset which coefficient beta is relatively high since it can bring greater benefits. Conversely, if it is bear market, investors are suggested to invest those assets or portfolio with lower risk in order to reduce the possibility of losses.

CONCLUSION

The main purpose of this paper is to measure the risk of these twenty stocks and give some suggestion on investment. We apply weekly data ranging from 2013 to 2017, and creating time-varying beta by CAPM method. The empirical result presented above has reference value for investors. As we know, in the micro economy, there are three types behaviors of risk preference. The first type of people is risk lover. When the market is in a good situation, the first group may be the best choice for this type of people to invest money since high risk means high profits at the same time. Another type of people refers to the risk averter. With the same expected return, they would like to choose those assets or portfolio with lower risk. Therefore, the time varying CAPM beta can be the standard to evaluate an asset or a portfolio. Also, more further researches can be conducted by using data from other countries like United State, Korea, Japan, etc. This paper aims at helping investors to cut losses in China's stock market.

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