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Do Betas Vary Differently in Different Industries?

The Case of Chinese Stock Market

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ABSTRACT

More than twenty years ago, Sharpe and Cooper did extensive research on the theory of stability of betas. We wonder if we can use their similar methodology to test China's beta stability. In this paper, we will first briefly introduce China's market condition then, we use Sharpe and Cooper's methodology and Analysis of Variance to analyze China's industry betas. We find that the theory of stability of industry betas has its practical meaning in China. Macroeconomic factors greatly affect China's beta trends and microeconomic factor does not always make a company's beta fluctuate significantly. The research on stability of beta in China is far from sufficient and we hope this paper can do basic work for this area.

Keywords*: Industry beta, Beta stability, China's stock market, Systematic risk*

1. INTRODUCTION

In the financial literature there is a paradigm used for studying industry beta. It is said that betas are generally stable for firms remaining in the same industry and only internal and external factors can affect them. We will explain the two factors later in this paper. An extensive study of stability was provided by Sharpe and Cooper. (Reference: W.F. Sharpe and G.M. Cooper, "Risk-Return Classes of New York Stock Exchange Common Stocks, 1931-1967," Financial Analysts Journal, 28: 46-54, 81 (March-April 1972) However, Sharpe and cooper's theory is based on American Stock market crisis in 1970s. Thirty years passed, we wonder whether the theory still apply to nowadays, especially nowadays China, which developed legendary in the previous 20 years.

China accelerated its reform in financial market after it joined WTO in November 2001 and from then on, China's financial market becomes more flexible and wonderful. In 2003, China achieve significant process in national banks and credit union reforms; in 2004,China opened its insurance industry to the world; in the following year, RMB does not peg at US dollar and RMB exchange mechanism becomes more flexible; the year of 2006 is a milestone for China's A share stock market. First of all, 90 percent listed companies have finished Shareholding System Transformation. Secondly, It is a year of IPO and China's A share stock market steps into sustainable development time. As China's stock market has relatively short history, many think it is less efficient compared the markets in the developed countries. It is possible that characteristics and features in Chinese stock market are not the same as the stock market in other matured markets.

The research in stability of China's industry beta is scarce and insufficient. We feel it is necessary to do basic work about this research area. The results from our research show that Sharpe and Cooper's model has practical meanings in China's stock market. Macroeconomic factors influence China's industry betas more greatly than microeconomic factors. This paper chooses the above 2003 to 2007 as our target duration to filter out the big impact of the world's financial crisis. During the pre-crisis period, most of the stock markets in the world experienced blooming lead by the USA market, and factors influencing the risks in different industries are similar and relatively "normal." Hence, it is interesting if betas in different Chinese industries are different.

2. DATA AND METHODOLOGY

The data for this study are taken from the historical transaction in database over the five -year period spanning 2003-2007(from January 2003 to November 2007). The sample consists of more than 360 firms in 15 different industries listed in Shanghai and Shenzhen stock exchange. We choose SHSE-SZSE 300 as our market index and loan interest rate of People's bank of china as our risk free rate. In this paper, we intentionally work on data before the world financial crisis in 2008. Our follow-up paper will focus on the industrial betas with the post-crisis data which will be shown in our next paper.

Table 1: (Data)

		Beta in year				
Industry	**# of stocks**	**2003**	**2004**	**2005**	**2006**	**2007**
Real estate	30	0.78	0.92	0.25	0.01	0.22
Tourism	28	0.72	0.90	0.23	-0.05	0.22
Computer	24	0.94	1.16	0.30	0.06	0.21
Electric power	29	0.70	0.87	0.83	0.35	0.76
Public Service	22	0.88	0.87	0.84	0.38	0.82
Agriculture	30	0.83	0.94	0.91	0.40	0.66
Petrifaction	15	0.75	0.77	0.96	0.29	0.34
Nonferrous metal	29	0.76	0.78	0.88	0.33	0.67
Press	15	0.22	0.15	0.25	0.25	0.25
Foreign trade	17	0.30	0.27	0.47	0.45	0.57
House appliances	25	0.24	0.16	0.27	0.33	0.42
Weaving	47	0.77	0.89	0.93	0.48	0.78
Iron	25	0.81	0.92	0.70	0.47	0.94
Auto mobile	30	0.83	0.92	0.86	0.49	0.77
Telecommunication	26	0.92	1.09	1.11	0.57	0.73

For each stock, the following data has been collected and calculated: daily closing prices, daily return and daily market premium. We calculate our beta by the following steps:

Step 1: collect data of SHSE-SZSE 300; calculate its daily return and market risk premium (see bellow).

Step 2: collect more than 350 companies' daily close price, then, calculate their daily return and firm's risk premium (defined as R_i - R_f) one by one (see bellow).

Step 3:estimate five-year betas of each stock according to CAPM model by calculating (2) for each stock (see bellow).

Step 4: summarize the beta of each industry as the average of betas of each stock in that industry.

2.1 Beta Estimation

CAPM model

Each stock's risk contains two parts: the systematic risk and the unique risk. The systematic risk of a stock is measured in the way of beta, which quantifies the association between the stock's return and the market's return. The relationship between the expected returns on a particular asset *i* and the expected returns of a large and well diversified investment portfolio, called the market portfolio, can be written as the following model:

$$E(R_i) = R_f + \beta_i [E(R_M) - R_f] \quad (1)$$

where $E(R_i)$ = expected return on asset *i*

R_f =risk-free rate of return

β_i =sensitivity of security *i*'s returns to those of the market risk premium,

$[E(R_M) - R_f]$

$E(R_M)$ = expected return on the market portfolio

This is the famous capital asset pricing model or risky capital by firms regulators, and so on.

As it shows above that β_i is the sensitivity of security *i*'s returns to those of the market risk premium, $[E(R_M) - R_f]$, whether it is stable or not is our key topic in our research, no matter it is an individual beta or an industry beta. The basic method of measuring the beta CAPM (Sharpe,1964; Lintner, 1965; Black, 1972) which has been with us for several decades. This model provides us an effective standard for discussing market efficiency, identifying attractive stocks, evaluating performance, estimating opportunity costs of of Company *i* is to estimate:

$$\beta_i = \frac{Cov(R_{it}, R_{Mt})}{Var(R_{Mt})} \qquad (2)$$

using t = 1, 2,……., T observations over time. All the industry betas we calculated are according to this formulation. The following figures show some of the beta estimates.

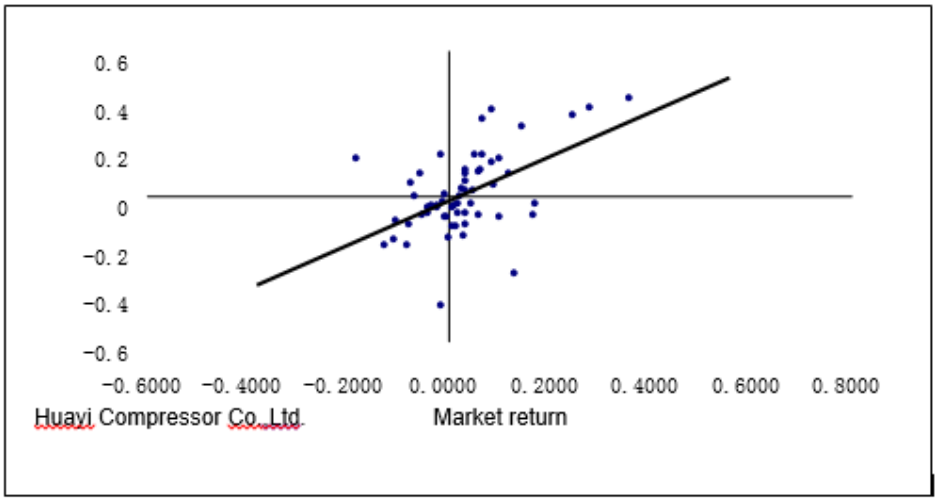

Figure 1: Huayi Compressor Co. Ltd versus SHSE-SZSE 300

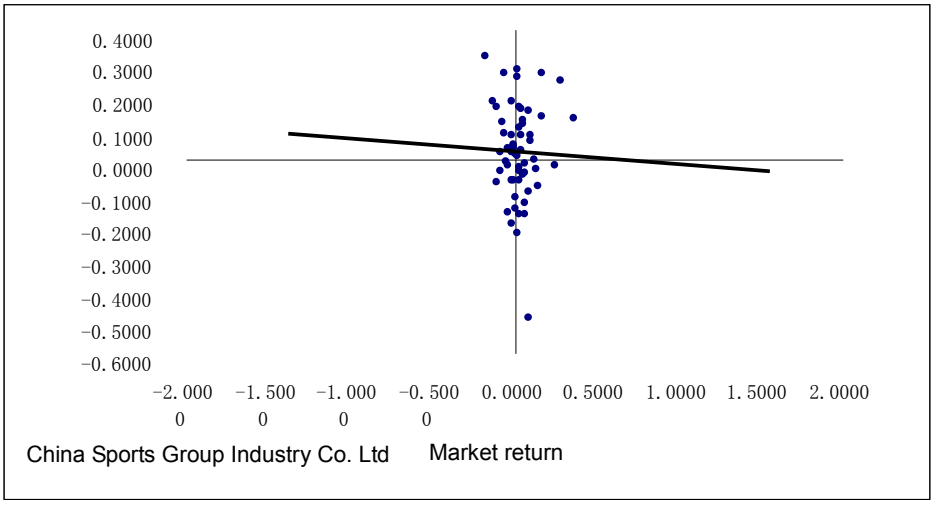

Figure 2. China Sports Group Industry Co. Ltd versus SHSE-SZSE 300

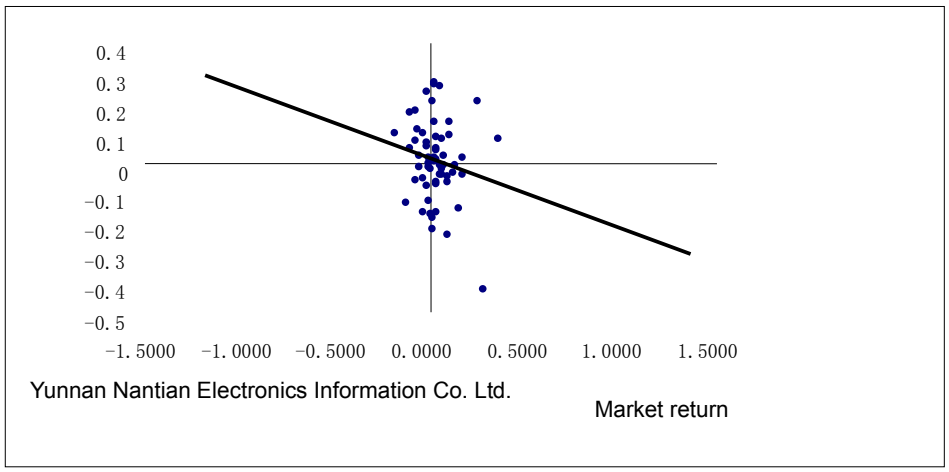

Figure 3: Yunnan Nantian Electronics Information Co. Ltd. versus SHSE-SZSE 300

Figure 1. 2. 3. plot monthly returns for 3 different large firms against monthly returns on the SHSE-SZSE 300**.** We know that each firm has his own characteristic line. The slope of the characteristic line is beta, as estimated using the technique of Table a. b. c. The technique is called *regression* which allows one to estimate the characteristic line of a firm.

This kind of mechanics for calculating betas is quite easy to handle, we estimate industry beta by using available computer program (the regression model in Excel). Generally, a large number of services sell or even give away betas for different firms. However, we cannot find the functional statistics about industry beta in China's stock market.

We assume that the average beta for all stocks in the market is 1. Since beta is a measure of the risk of a single security for someone holding a large and diversified portfolio, a high beta value will be risky while a well-diversified portfolio with low beta value will have relatively little risk.

2.2. Stability of Beta Over Time (Sharpe And Cooper Model)

Table 4 illustrate the conclusion that Sharp and Cooper divided stocks into risk classes according to their betas in 5-year period (class10 contains high betas, class1 contains low betas). They then looked at how many of these stocks were in the same risk class 5 years later.

Table 2

Risk class	Present in same risk class 5 years later	Present within one risk class 5 years later
10	35	69
9	18	54
8	16	45
7	13	41
6	14	39
5	14	42
4	13	40
3	16	45
2	21	61
1	40	62

Whether beta appears to be reasonably stable is our purpose to find out in our research. From the study, Sharpe and Cooper showed that, 40 to 70 percent of the betas were *stable* over the 5 years. What does stable really mean? The question arises whether 40 to 70 percent is perfectly stable? The mechanics of Sharpe and Cooper's model would be discussed the first hand.

In their study, Sharpe and Cooper divided stocks into 10 classes according to the estimated beta in that period. The stocks with the lowest betas go to class 1; Class 2 contains stocks with relatively higher beta and so on. The frequency with which stocks jumped from one class to another are recorded. The more jumps, the less stability. Then, Sharpe and Cooper concluded that, 40 to70 percent of the stocks represented to be stable. The reason why some betas tend to be unstable will be concluded in the following statement:

a. Microeconomic Factors:

These are the factors due to a company changes its product line, changes its technology, or there is a changes in the market, such operational changes in the company or changes in the business environment particular to the company.

b. Macroeconomic Factors:

Macroeconomic factors include the rate of inflation, general business conditions and expectations about relevant future events, among others. These factors may explain some of the fluctuations in betas observed by Sharpe and Cooper. But our question is whether the reason of great fluctuation of betas in China stock market is from above or not. We will demonstrate our question in the next part.

3. CHANGES IN RISK CLASS

3.1. Stability Test

Sharpe and Cooper divided stocks into 10 risk classes due to their betas in one 5-year period. The securities in the top decile (i.e. those with the highest betas) were considered to be risk-return class 10, the securities in the next decile were considered to be in risk-return class 9, etc. Then, they looked at the percentage of stocks which still remain in the same risk class 5 years later. After we calculated betas, we did a

similar job to classify China's stocks according to their betas. There are several variations to Sharpe and Cooper's method. We divide the absolute value of difference between maximum number and minimum number into 10 deciles. The stocks in the top decile have the highest betas and are called class one, the stocks in the second highest decile are called class two, etc. According to this method, we put each beta into appropriate class. The number of stocks in each class is different.

Table 3

Risk Class	Original stock number in each class	Proportion in same risk class 4 years later	Proportion within one risk class 4 years later
10	9	0.0000	0.0000
9	12	0.0000	0.0000
8	52	0.0577	0.3269
7	108	0.3048	0.4095
6	70	0.1714	0.6429
5	23	0.0870	0.4348
4	15	0.1333	0.4667
3	50	0.1600	0.5200
2	26	0.2308	0.3846
1	7	0.7143	0.8571

We can see From Table 3 that there is a tendency for stocks with very low beta to stay that way. If we look at proportion within one risk class 4 years later line, percentage of betas stay in same risk class and betas jumping into adjacent classes are mostly ranges from 40% to 80%. It means at the level of individual securities, betas in China can be considered stable over time. For portfolios, beta would be considerably more stable.

3.2. Analysis Of Variance

3.2.1 Two-Way ANOVA

Table 4

Source of Variation	SS	df	MS	F	P-value	F crit
Row	2.87128379	14	0.205092	5.527914	0.000002	1.872588
Column	1.78924589	4	0.447311	12.05655	0.000000	2.536579
Error	2.07766179	56	0.037101			
Total	6.73819147	74				

Note: Row refers to different industries and Column refers to years. The sample consists of 15 industries' average betas with testing period from Jan.2003 to Dec.2007.

Table 5

Source of Variation	SS	df	MS	F	P-value	F crit
Row	0.092535	2	0.046267	16.55302	0.001435	4.45897
Column	0.088336	4	0.022084	7.900993	0.00698	3.837853
Error	0.022361	8	0.002795			
Total	0.203232	14				

Note: The sample consists of 3 industries' average betas. The three industries are foreign trade, household appliances and press, with testing period from Jan.2003 to Dec.2007.

Table 6

Source of Variation	SS	df	MS	F	P-value	F crit
Row	0.088732	1	0.088732	18.75945	0.012338	7.708647
Column	0.053215	4	0.013304	2.81267	0.170291	6.388233
Error	0.01892	4	0.00473			
Total	0.160867	9				

Note: The sample consists of 2 industries' average betas. The two industries are foreign trade and press, with testing period from Jan.2003 to Dec.2007.

Table 7

Source of Variation	SS	df	MS	F	P-value	F crit
Row	0.040944	1	0.040944	30.1593	0.005357	7.708647
Column	0.09763	4	0.024407	17.9785	0.008037	6.388233
Error	0.00543	4	0.001358			
Total	0.144004	9				

Note: The sample consists of 2 industries' average betas. The two industries are foreign trade and household appliances, with testing period from Jan.2003 to Dec.2007.

2.2 One-Way ANOVA

Table 8

Source of Variation	SS	df	MS	F	P-value	F crit
Between groups	2.871284	14	0.205092	3.182259	0.000899	1.860242
Within groups	3.866908	60	0.064448			
Total	6.738191	74				

Note: The sample consists of 15 industries' average betas with testing period from Jan.2003 to Dec.2007.

Table 4 and Table 8 show that betas from different industries do not differentiate too much from one another. Yearly betas' fluctuations are more significant than that between industries. So betas in China are imperfect guides to the future. There are two reasons, one is because of macroeconomic and microeconomic factors, another is because of limited sample.

We also did the analysis of variance between each two average industry betas and found that betas of foreign trade, household appliances and press are different from the rest of samples, as you can see from Table 5, Table 6 and Table 7. Household appliances and press industry's betas are alike but both different from Foreign trade industry.

4. EMPIRICAL ANALYSIS:

In order to test the effect of microeconomics to a company's beta, we analyse the relationship between each company's internal changes and its betas. The internal changes refer to changes in product line, changes in technology, or changes in the market. We find that, microeconomic factors do affect a company's beta, but do not always affect it. How and to what extent the internal changes can affect a company's beta is still a question for us. There are two examples:

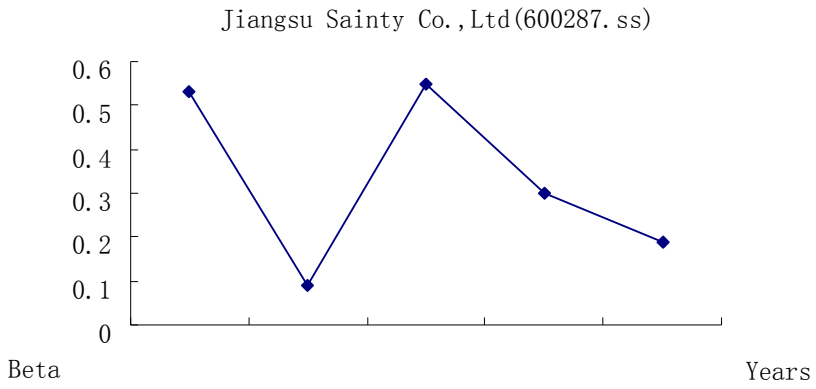

Figure 3

Note: The abscissa scale is from 2003 to 2007

Jiang Su Sainty Co.,Ltd is a foreign trade company. It changes part of its target market and product lines in 2004.We can see from Figure 3 that in year of change, 2004, there is a sharp beta decline.

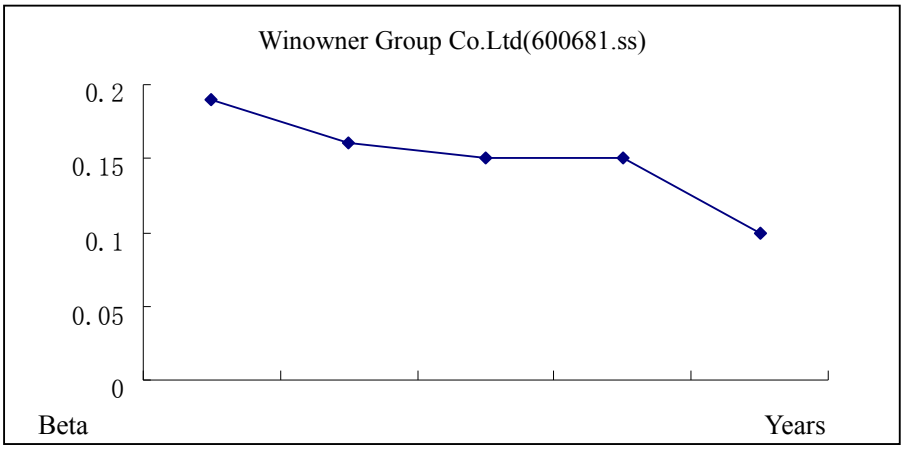

Figure 4

Note: The abscissa scale is from 2003 to 2007, Winowner Group Co.Ltd is a company in Press industry. In the middle of the year 2003 and 2006, it changes its business. We can see from Figure 4 that the betas in 2003 and 2006 remain stable.

5. CONCLUSION

Based on the above discussions, we can draw the following findings, which is before the world's financial crisis in 2008.

First, in China, Annual fluctuations for industry betas are hard to be estimated and the fluctuations do not differentiate from one industry to another. 40% to 80% betas remain in the same or adjacent class indicates that Sharpe and Cooper's theory about beta stability has its practical meaning.

Secondly, in the macroeconomic aspect, general business environment and big world events greatly affect the China's industry betas. As we can see that trend for different industry's betas are almost the same.

Finally, in the microeconomic aspect, we find that Changes in product line, changes in management, mergers and acquisitions do not always greatly affect betas. Many companies rearrange their structure while betas still remain stable.

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