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The Systematic Risks for Different Chinese Industries over Time

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Abstract

Beta coefficient is a kind of instrument to evaluate systematic risk. Commonly, we use beta coefficient as a firm-specific risk. There are some researchers ever to do research on US stock market, they find that different industry has different beta, and the betas have time stability. Because the China Stock Market starts a little later, the researches on it is not enough. Whether the beta of public in China has the same rule, this is a very attractive problem to us. In this text, we choose six industries in China and each industry has 10 stocks. We collect a list of returns for the stocks and returns for the index and then calculate the betas of 60 stocks in different industries. After that, we calculate the average betas of each industry and they are used to compare with each industry. Then we can find out whether there are illustrious risk differences among six industries. Finally, according to the 2-Way Anova test, we find out that whether the time factor and industry factor have distinct effects to beta coefficient of public company in China

Keywords: systematic risk; beta; Chinese stock market; industry-variant

I. Introduction

Beta is one of the most important concepts in modern financial theory. It was established together in capital asset pricing model (CAPM) by Sharpe (1970) and Lintner (1972). It is the parameter measuring the systematic risk of the stock or portfolio in terms of the sensitivity of the change of the stock or portfolio' return to the change in the market portfolio's return. In CAPM model, beta is assumed constant over time. That implies the systematic risk of a stock or a portfolio is time invariant. However, from the fundamental viewpoint, a company may change its management strategy, its management judgment on future business may be wrong or right from time to time, they may get into a right or wrong new business or investment, etc. These types of behaviors will have long term effects to the company, therefore change the company's systematic risk, meaning how the company performs in the association with total market performs, while the latter's performance is not affected by individual companies. In addition, companies and industries are competing or complementing each other. As the competition changes, the risk for a company should also change. Therefore, beta may change over time.

Researchers did find that beta is not stable. In US markets, evidence of beta instability includes Fabozzi and Francis (1978), Sunder (1980), Bos and Newbold (1984), Collins, Ledolter and Rayburn (1987), Kim (1993), and Bos and Fetherston (1995). Similar evidence extends to other markets including Korea--Bos and Fetherston (1992); Finland--Bos, Fetherston, Martikainen and Perttunen (1995); Hong Kong--Cheng (1997); Malaysia--Kok (1992, 1994), Brooks and Faff (1997), and Brooks, Faff and Ariff (1997); and Sweden--Wells (1994). Finally, Australian evidence of beta instability may be found in Faff, Lee and Fry (1992), Brooks, Faff and Lee (1992, 1994), and Pope and Warrington (1996). Finally, Australian evidence of beta instability may be found in Faff, Lee and Fry (1992), Brooks, Faff and Lee (1992, 1994), and Pope and Warrington (1996). Most of these evidences suggest that the intertemporal stability of the beta coefficient is

sensitive to the procedure used to select portfolios. In particular, the time-stability of beta is relatively slight and is totally unrelated to the number of securities in the portfolios. Whether the beta is stability or instability, it is dependent on the estimation interval.

For the past decades, there have been increasingly more studies on Chinese financial markets, including Pan (2006 and 2007), Jarret et al (2009) and Pan et al (2012), among many. This paper will study the time-stability of beta across different industries in China, and what other factors affect the beta.

In the US, there is a conclusion that different industries have different betas. Is it same to China? Whether the beta is stability in time, and what factors affect the beta? Let us check out in the project.

II. The Data

There are 13 kinds of industries of public companies in China. There are 13 kinds of industries in China. They are Agriculture, forest, herd, fishery, Excavation industry, Manufacturing industry, Electric power, coal gas and water production and supply industry, Architecture industry, Transportation, warehousing industry, Information technology industry , Wholesale and retail trade industry , Finance, insurance business industry, Real estate industry , Social service industry, Dissemination and media industry. We choose six of them to analyze. They are Banking Business and Insurance, Information Technology, Real Estate industry, Construction Business industry, Carrying trade and Storage industry, Wholesale and retail trade industry. Each industry has 10 stocks, so there are totally 60 stocks. We also collect the indexes that each stock belongs too.

In Banking Business and Insurance, the 10 stocks (with codes) are:

600816	Essence Trust
600109	ChengduConstruction
000562	Hongyuan Securities
601939	CCB
600016	Minsheng Bank
002142	Ningbo Bank
000563	Shaanxi Investments
000001	Shenzhan Development
601318	China Pingan
601628	China Life

Among them, 600816, 600109, 601939, 600016, 601318, 601628 are components of Shanghai Stock Exchange; 000563, 000001, 000562, 002142 are components of Shenzhen Stock Exchange.

In Information Technology industry, the 10 stocks are components of Shenzhen Integrated Index:

000509	China Plastics
000008	Baoan Tech
000021	Changcheng Development
000851	Baohong

002093 Guomai Tech
000602 Jinma Group
000032 Sangda A
000703 Shiji Guanghua
000909 Digital Sources
002095 Net Prosperity

In Real Estate industry, the 10 stocks are:
600159 Dalong Real Estate
000046 Pan-Ocean Construction
002133 Guangyu Group
000006 Shenzhen Promotion
600167 Shenyang New Development
600791 Tianchuang
000002 Vanke
600173 Dragon Real Estate
000511 Fin-base Development
000514 Chongqing Development

Among them, 600159, 600167, 600791, 600173, are from Shanghai Stock Exchange; **000046**, 002133, 000006, 000002, 000511, 000514 are from Shenzhen Stock Exchange

In Construction Business industry, the 10 stocks are:
600068
002081 Golden Mantis
600263 Road-Bridge Construction
600284 Pudong Construction
002163 Sanxin
600170 Shanghai Construction
000090 Shenzhen Tianjian
600039 Sichuan Road Brighe
600512 Tengda Construction
600545 Xinjiang Urban Construction

Among these 10 stocks, 002081, 002163, 000090 are from Shenzhen Stock Exchange; 600068, 600263, 600284, 600170, 600039, 600512, 600545 are from Shanghai Stock Exchange.

In Transportation and Logistics industry, the 10 stocks are:
600004 Baiyun Airport
000996 Jieli
600029 Southern China Airline
000089 Shenzhen Airport
000905 Xiamen Port
000900 Modern Investments

000088	Yantian Port
000429	Guangdong Highway
000099	CITIC Helicopter
600020	Zhongyuan Highway

Among these 10 stocks, 600004, 600029, 600020 are from Shanghai Stock Exchange; 000996, 000089, 000905, 000900, 000088, 000429, 000099 are from Shenzhen Stock Exchange.

In Wholesale and Retail industry, the 10 stocks are:

000572	Golden Disk
000417	Hefei Department Store
000056	Shenzhen International Trading
000010	Shenzhen Huaxin
002024	Suning Appliances
000025	Teli
000759	Wuhan Department Store
000654	Xian Minsheng
000705	Zhejiang Zhenyuan
000715	Zhongxing Commerce

All these 10 are from Shenzhen Stock Exchange**.**

II.2 Methodology

We collect the daily stocks close price and indexes close price from Jan 4, 2000 to Feb 29, 2008, and then calculate their daily returns. We use the formula

$$\beta_a = \frac{\mathrm{Cov}(r_a, r_p)}{\mathrm{Var}(r_p)}$$

to calculate every stock's beta. Where r_a means the daily return of one stock, and r_p means the daily return of an index. We calculate Var(r_p) and Cov (r_a, r_p) with Excel, and then we get every stock's beta, and also we can find the each industry's beta.

After calculating every stock's 8 years beta (from Jan 4, 2000 to Feb 29, 2008), we also calculate each industry's 4-time stages betas. Each time stage is from 2000-2001 end, 2002-2003end, 2004-2005end, and 2006-2007end. These ways help us know beta is stability in time. The following table tells us the truth. The Banking and Insurance industry's 4-time stages data are 1.00, 1.20, 1.23, 1.18, the difference is smaller than 0.23; The Information Technology industry's 4-time betas are 1.03, 1.11, 1.11, 1.02, the difference is smaller than 0.09; The Real Estate industry's 4-time stages data are 1.05, 1.03, 0.97, 0.94, the difference is smaller than 0.11; The difference of Construction Business is smaller than 0.12; The difference of Carrying trade and Storage is smaller than 0.15; And the difference of Wholesale and Retail Trade is smaller than 0.22. In addition, this information tells us that the in different time, the betas of industries are different, and their differences are not very distinct. So we get the conclusion that beta has certain stability in time.

Industry	2000-2001end	2002-2003end	2004-2005end	2006-2007end
Banking and Insurance	1.00	1.20	1.23	1.18
Information Technology	1.03	1.11	1.11	1.02
Real Estate	1.05	1.03	0.97	0.94
Construction Business	1.03	1.15	1.07	1.09
Carrying trade and Storage	0.96	0.96	0.87	1.02
Wholesale and retail trade	1.15	1.29	1.07	0.93

According to the calculation, we also get a conclusion that: different industry has different beta. The following table can prove the conclusion. You can see the beta of Banking Business and Insurance industry is 1.10, and the beta of Information Technology is 1.00, the beta of Real Estate industry is 0.95, the beta of Construction Business industry is 1.01, the beta of Carrying trade and Storage industry is 0.96, the beta of Wholesale and Retail trade industry is 1.04. All the industries have their own betas, and the betas of them are all different. The Banking Business and Insurance industry has the highest beta among 6 industries is 1.10, and the Real Estate industry has the lowest beta among 6 industries is 0.95.

Industrial Betas

Banking Business and Insurance	1.10
Information Technology	1.00
Real Estate	0.95
Construction Business	1.01
Carrying trade and Storage	0.96
Wholesale and retail trade	1.04

A beta for an entire industry would compare how the companies in that industry fare relative to the market. For example, high technology stocks, as a whole, probably have a higher average beta than one. In comparing stocks within an industry, it can be useful to know the industry beta and how a specific company compares to it. For example, from figure 6, we can find that the beta for bank stocks was 1.1 and you found 601939 in that industry with a beta of 0.85, this would tell you that the 601939 is not only less volatile than the market as a whole, but extremely stable compared to its industry -- which could be good or bad depending on whether you are looking for price stability or rapid price growth.

The revenues of some firm are quite cyclical. That is, these firms do well in the expansion phase of the business cycle and do poorly in the contraction phase. From this table, we can see high-tech firms, retailers firms and Banks, Financial Services Insurance fluctuate with the business cycle. Therefore, their industry beta is equal or more than 1. Firms in industries such as railroad, Real Estate Transportation are less dependent upon the cycle. Therefore, their industry beta is less than 1.because beta is the standardized co variability of a stock’s return with the market’s return; it is not surprising that highly cyclical stocks have high betas.

After data collection and calculation, we can get two conclusions: 1. Beta has certain stability in time. 2. Different industry has different beta

III. Analysis and Results

We get the 60 stocks' betas and 6 industries betas, now it is time to find the factors that affect industry beta. We have two methods to help us get the conclusion. The one method is one-way ANOVA and paired samples test by SPSS, the other method is 2-factor classifications by EXCEL. According to the comparison between the results of two methods, we can clearly get our conclusion.

III.1 One-Way ANOVA and Paired Sample Tests

Before the analysis, we think it is necessary to introduce the one way ANOVA and paired samples test to you.

A One-Way Analysis of Variance is a way to test the equality of three or more means at one time by using variances. The program displays the summary statistics of the two samples followed by the mean of the differences between the paired observations, and the standard deviation of these differences, followed by a 95% confidence interval for the mean. Note that the sample size will always be equal (only cases are included with data available for the two variables). Next, the result of the null hypothesis test is displayed. If the calculated P-value is less than 0.05, the conclusion is that the mean difference between the paired observations is statistically significantly different from 0.

How about The Paired Samples T Test: The Paired Samples T Test (sometimes referred to as the correlated-samples t test or matched-samples t test) compares the means of two variables. It computes the difference between the two variables for each case, and tests to see if the average difference is significantly different from zero.

The paired t test provides a hypothesis test of the difference between population means for a pair of random samples whose differences are approximately normally distributed. Please note that a pair of samples, each of which are not from normal a distribution, often yields differences that are normally distributed.

The test statistic is calculated as:

$$t = \frac{\bar{d}}{\sqrt{s^2 / n}},$$

Where d bar is the mean difference, s^2 is the sample variance, n is the sample size and t is a Student t quartile with n-1 degrees of freedom.

Under one-way ANOVA, we use only one factor—industry. In figure 1, var00002 are 6 industries' betas, and var00001 is industry factor, alpha is 0.05. Mean Square=Sum of Squares/df=0.158/5=0.032,
Mean Square=Sum of Squares/df=1.606/54=0.030,
F=MeanSquare/Between Groups=0.032/0.158=1.061.
The Sig. (p value) is 0.392, it is bigger than alpha 0.05, so we get a conclusion that industry factor (not removing time factor) does not affect industry beta.

Under Paired Sample Test, we use only one factor—industry too. Figure 5 is the result of paired samples test, 6 industries have 15 pairs of samples. The 15 pairs are:

Pair 1: Financial vs. IT -
Pair 2: Finacial vs. Real Estate
Pair 3: Financial vs. - Construction
Pair 4: Financial vs. – Transportation and Logistics
Pair 5: Financial vs. Wholesales and Retails
Pair 6: IT vs Real Estate
Pair 7: IT vs. Construction
Pair 8: IT vs. Transportation and Logistics
Pair 9: IT vs. Wholesales & Retails
Pair 10: Real Estate vs. Construction
Pair 11: Real Estate vs. Transportation & Logistics
Pair 12: Real Estate vs. Wholesales & Retails
Pair 13: Construction vs. Transportation & Logistics
Pair 14: Construction vs. Wholesales & Retails
Pair 15: Transportation & Logistics vs. Wholesales & Retails

The p values of the above-paired comparison are is respectively, 0.272, 0.091, 0.311, 0.077, 0.500, 0.619, 0.917, 0.461, 0.374, 0.236, 0.876, 0.299, 0.487, 0.627, and 0.158. They are all greater than level of significance 0.05, so the factor does not affect industry beta.

From the two methods with SPSS, we can get the same conclusion that: when there is an industry factor (not removing the time factor), the industry factor does not affect industry beta.

III.2 Two-Factor ANOVA Test

Here we use the function called Two-Factor ANOVA of Excel. This function can use more than 2 factors, not like the SPSS one way ANOVA or paired sample test, they can only use one factor.

By Two-Factor ANOVA, we have two factors, the time factor and the industry factor. In this method, we need to use the 4-time stages betas of the stocks. Because the most of the Construction Business industry's stocks are in public after 2000, we delete it when we use 2-factor classification (repeated). We choose 6 stocks' betas from each industry randomly in every time period. In figure 7, the longitudinal factor is time, and the transverse factor is industry. We can see the results of figure 7 are, Mean Square (MS), which is Sum of Squares/df :
The MS for time=0.10880397/3=0.036268;
The MS for industry=0.71356888/4=0.178392;
The MS for interaction=0.66465637/12=0.055388;
The MS of between groups=5.87786851/100=0.058779.
The F statistic, which MS/Between Groups SSE, so
The F statistic for time=0.036268/0.058779=0.617;
The F statistic for industry=0.178392/0.058779=3.035;
The F statistic for interaction=0.055388/0.058779=0.942.

The p-value for time is 0.605563734, which is greater than alpha of 0.05, so we reject it, it means the time factor has no effect to industry beta.
The p-value of industry=0.020846717 which is smaller than alpha of 0.05, so we accept, it means the industry factor has effect to industry beta;
The p-value of interaction=0.508656327 which is greater than alpha of 0.05, so we reject it.

From the above materials, we get a conclusion that there is an industry factor (removing time factor), the factor has an effect to industry beta.

IV. Conclusion

From the results of data calculation, one-way ANOVA, paired sample test and Two-factor ANOVA, we get 4 main conclusions. Two conclusions are from data calculation, they are, 1. Betas have certain stability in time. 2. Different industry has different beta. One conclusion is from one-way ANOVA and paired sample test, it is when there is an industry factor (not removing the time factor), the factor does not affect industry beta. In addition, one conclusion is from Two-factor ANOVA, it is when there is an industry factor (removing time factor), and the factor has an effect to industry beta.

Our final conclusions are, 1. Betas have certain stability in time. 2. Different industry has different beta. 3. When there is an industry factor (removing time factor), the industry factor has an effect to industry beta.

Now we have questions, why the conclusion from one-way ANOVA and paired sample test is different from 2-factor ANOVA? Our answer is that it is important to choose right analysis tools. Different analysis tools will show you different results. One-way ANOVA and paired samples test do not remove time analysis, but 2-factor ANOVA removes the time factor. In this case, the conclusions by one-way ANOVA and paired sample test are not right. The conclusion from 2-factor ANOVA is what we need. So do remember, when you need to analyze a case, please choose the right analysis tools.

Beta can be useful in stock research when judging how risky a stock is versus a stable investment with a guaranteed rate of return. It must be noted that the longer period of time the beta is acquired the more accurate that beta will be. In addition, betas are more valuable when used with stocks that have a long record of high volume trading. Smaller stocks that do not trade a lot can fluctuate wildly on a busy day and throw the beta out of whack for the period being measured. It is important for investors to make the distinction between short-term risk--where beta and price volatility are useful--and longer-term, fundamental risk, where big-picture risk factors are more telling. High betas may mean price volatility over the near term, but they do not always rule out long-term opportunities. Therefore, it is up to your manner when you do investments.

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