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Empirical Study on China's Stock Market Anomaly: Examining the Related Data of Aggregate Market

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Abstract: In this study, we study on the anomaly in China's stock market. There are many phenomena that cannot use the existing asset pricing model and the classical theories of capital market to explain in the stock market, especially the emerging markets. It has become a hot research issues to explore and provide a satisfactory explanation of these anomalies. Calculates the China's stock market rate of return, risk-free interest rate and rate of consumables growth based on the accumulation of market data, to find the actual change in relationship among these data. These prove that there are some phenomenon of higher equity premium and stock prices excess volatility in the China's stock market which validate existing puzzles of the equity premium and the excess volatility and the great long-term market volatility further verify that the Chinese stock market is inefficient market.

Key words: Market anomaly, aggregate market, empirical study

INTRODUCTION

Financial asset pricing model as well as market price formation mechanism has always been the study core in the capital market. However, because of the harsh assumption conditions in mathematical models, abstract mathematical models from complex financial markets could hardly portray the dynamic process of the market as a whole, particularly when there are large numbers of complex interaction among individuals and the environment in the market) Weil, 1989; Fishburn, 1996). While trying simulating real financial markets through experimental method provides new ideas and methods for financial theory. But since there are large numbers of individuals and complex relationships among individuals within stock markets, especially that it is difficult to portray decision-making process of individual investment, the establishment of scale experiments become a dilemma.

All the markets which are made up by the portfolioes can consider that they are composed by two dimensions, one is Time dimension, the other is Spatial dimension. No matter what the phenomena are, only if it is descriped by price and yield. They can all put into the plane constituted by the two dimensions to observe (Lux and Marches, 1999; Oh *et al*., 2008; Glaser and Weber, 2009). Time dimension can describe the portfolioes' changes in different periods and to describe different securities' diversifications in the same period, we can use Spatial dimension. According to the standard financial theory, the price of securities should reflect all the informations on the relavent securities' price (Stanley *et al*., 1999; Levy *et al*., 1994; Christie and Huang, 1995). Investors can't use the information and analysis of long-term sustainable patterns in the stock market to access excess profits.However, plenty of studies and observations resulting in the capital market show that there really exist many benefit exception phenomena (Avery and Zemsky, 1998; Wermers, 1999; Doyle and Chen, 2009; Yoon and Kang, 2009; Acker and Duck, 2008). These phenomena can't explain the existing assets of the pricing models and the conventional financial theory. So, this is called 'heteromorphism'. Yet, Barberis and Thaler (2003) divide the stock market of vision into two categories (Barberis and Thaler, 2003): One is the heteromorphism in Aggregate market, another heteromorphism exsist in Market section.The so-called heteromorphism in the cumulative market means not consider space dimension.That is not considering the differences between the securities and thinking only in a time dimension of phenomenon, Including the share price of the overflow (Mehra and Prescott, 1985), mystery of excess volatility (Shiller, 1981; Campbell and Cochrane, 1999). However, the vision section of the market means a phenomenon inconsistent to finance described in the traditional showed in different securities or investment portfolio. Mainly for short-

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term phenomenon (Jegadeesh and Titman, 1993) and long-term reverse phenomenon (De Bondt and Thaler, 1985; Daniel *et al*., 1998).

Different testaments hold different results to the inspections on wether there exist some heteromorphism in China stock markets, some results even diametrically opposite. For example, studing on inertia in China stock markets and reverse effects (Shen and Chen, 2009) and studying on equity premium puzzle (Xiao and Wang, 2004; Chu, 2010); Some foreign countries have been found in the market vision but China lacks the corresponding empirical test. This article refer from foreign scholars this method on the aspect to test cumulative market heteromorphism by China's capital market time dimension of data.

DATA SET AND METHOD

Data set: In order to verify the existence of Chinese stock market equity premium and excess volatility phenomenon, the essay used the stock market stock index yield replace the stock market return rate, because the change of stock index is the embodiment of the change of stock price in stock market, represented the change of overall market trends highly and the essay also chose one -year savings deposit rate to represent risk-free rate of interest. If the interest will change in a year it will be got weighted on time.The paper used the actual growth rate of the total volume of retail sales of Chinese society these years to represent actual consumption growth. The data above are from wind database and China Statistical Yearbook including all of daily trading data of the listing stocks in Shanghai stock exchange and Shenzhen stock exchange which are from January 1997 to 2009 December, time span over 10 years.

The Shanghai composite index samples are including 3645 day data and Shenzhen composition index samples are including 3627 day data.

Empirical research methods: Rate of return of stock price index r_t is that:

$$r_t = \log(P_t) - \log(P_{t-1}) \tag{1}$$

In the Eq. 1, rt-N (μ, σ^2):

$$\hat{\mu} \equiv \frac{1}{T}\sum_{t=1}^{T}\varepsilon_t \tag{2}$$

$$\hat{\sigma}^2 \equiv \frac{1}{T}\sum(\varepsilon, \hat{\mu})^2 \tag{3}$$

$$\hat{S} \equiv \frac{1}{T\hat{\sigma}^3}\sum_{t=1}^{T}(\varepsilon_t - \hat{\mu})^3 \tag{4}$$

$$\hat{K} \equiv \frac{1}{T\hat{\sigma}^4}\sum_{t=1}^{T}(\varepsilon_t - \hat{\mu})^4 \tag{5}$$

Under large sample data of normal distribution, estimators of kurtosis $\hat{K}$ and skewness $\hat{S}$ is normal distribution, means of them should be 0 and 3 and variances should be 6/T and 24/T, respectively.

Mehra and Prescott defined the coefficient of relative risk aversion, in the form of:

$$u(C_t) = \frac{C_t^{1-\gamma}}{1-\gamma},\ 0 < \gamma < \infty \tag{6}$$

$$C_t(r) = \lim_{N\to\infty}\frac{1}{N}\sum_{i,j=1,i\neq j}^{N}\theta(r - |Y(t_i) - Y(t_j)|) \tag{7}$$

$$\begin{aligned} Y(t_i) = [&x(t_i), x(t_i+\tau), x(t_i+2\tau), \cdots, \\ &x(t_i+(m-1)\tau)],\ i = 1, 2, \cdots \end{aligned} \tag{8}$$

Among them, γ is investors' coefficient of risk aversion, the higher γ is, the greater degree of investors' risk aversion represented. When $\gamma = 1$, the utility function is defined as logarithmic form. Through the derivation the of expected utility function for the two kind of asset (stock and bonds) come to the risk premium of the stock is:

$$\text{InE}(R) - \text{In}R_f = \gamma\sigma_x \tag{9}$$

Among them, R is the yield of the stock of assets, R_f is the yield of the risk-free market. X represents the consumption increase rate.

According to the Eq. 9 we can draw that the risk premium of stock comes mainly from the investors' coefficient of risk aversion and the volatility of consumption growth. When the volatility of consumption growth is not high, the risk premium of stock comes mainly from the high investors' coefficient of risk aversion. According to it, Mehra and Prescott calculated for the American stock market and drew that the investors' coefficient of risk aversion is nearly between 30 to 40 but the reasonable coefficient of risk aversion should be between 0 to 10, so Mehra and Prescott judged that American stock market has the " equity premium" phenomenon.

The article borrowed ideas from part of Mehra and Prescott (1985) and Shiller (1981). research approach. By calculating the authors describe the changing relation between Chinese stock market return rate, risk-free interest rate and actual consumption growth rate and verify the existence of Chinese stock market equity premium and excess volatility phenomenon. Figure 1, 2 and 3 and Table 1 indicate that China' s stock market has the characteristics of Peak and thick tail.

Table 1: Distribution of Price index of Shanghai stock and Shenzhen stock

	Observations	Mean	Maximum	Minimum	Std.Dev	Skewness	Kurtosi	Jarque-Bera	Probability
Shanghai composite index	3645	4.0395e-004	0.2886	-0.1791	0.0217	1.4644	27.2025	9.0130e+004	0
Shenzhen component index	3627	5.3074e-004	0.2327	-0.1841	0.0216	0.4710	14.3298	1.9501e+004	0

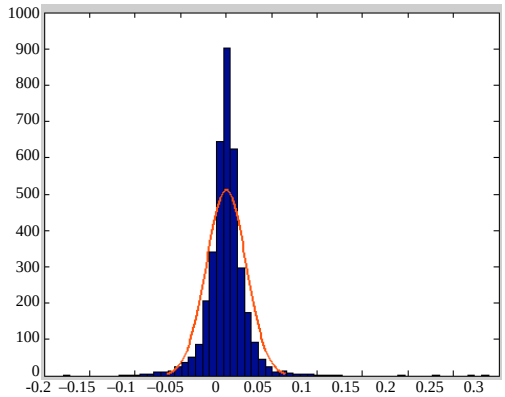

Fig. 1: Distribution of the day earning rate of Shanghai composite index (1997.1-2010.12)

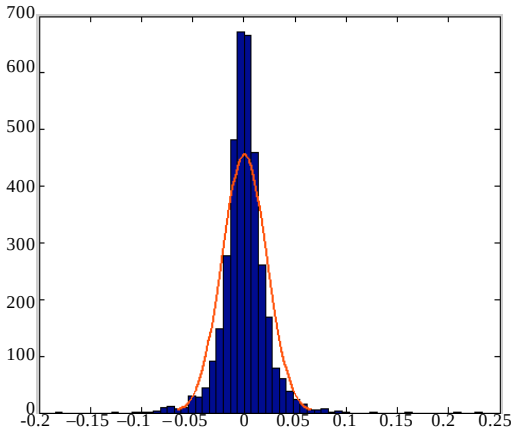

Fig. 2: Distribution of the day earning rate of Shenzhen component index (1997.1-2010.12)

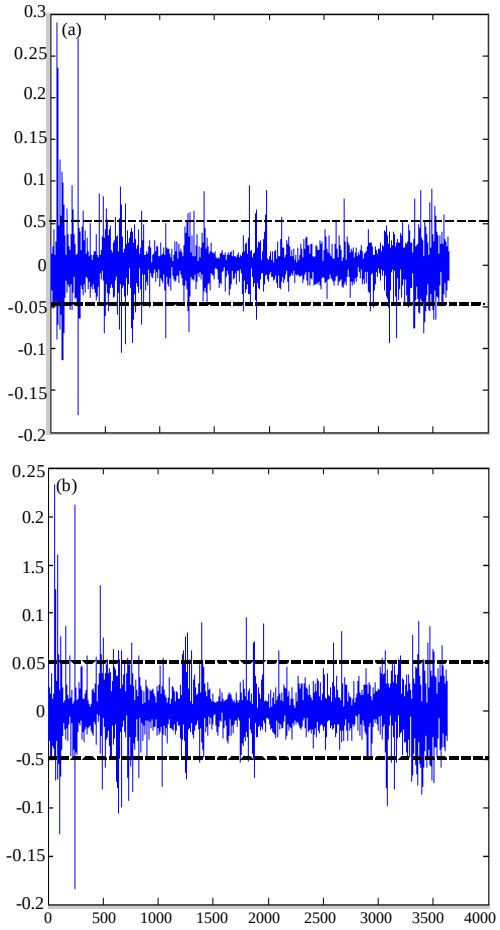

Fig. 3(a-b): Distribution of the day earning rate of Shanghai composite index

Experimental results: China's stock market returns, interest rates and consumption of the general characteristics are as follows, Fig. 4-6 and Table 2:

- The rate of return of China's stock market is high. on an annual basism, between 1997-2010 Shanghai Stock Composite Index was 17.75% average yield, Shenzhen Stock Component Index was 25.26% average yield (Table 3). The Index Return in 2006 and 2007 is the highest
- The average risk-free interest rate is lower. Chinese the average annual real return on savings deposits was 2.98% from 1997-2010
- The growth in real consumption is relatively smooth, China's total retail sales of social consumer goods was 12.40% in real growth rate and the standard deviation is 7.66%
- China stock index returns the standard deviation is very high, Shenzhen Stock Exchange Component Index returns the standard deviation is 75.71% while the Shanghai stock market is 50.79%. The standard deviation of the effective interest rate is very low, One-year savings deposits, the annual standard deviation of the actual return is 3.64%. It shows that the overall level of risk that China stock market is high. The investors bearing the high rate of return is

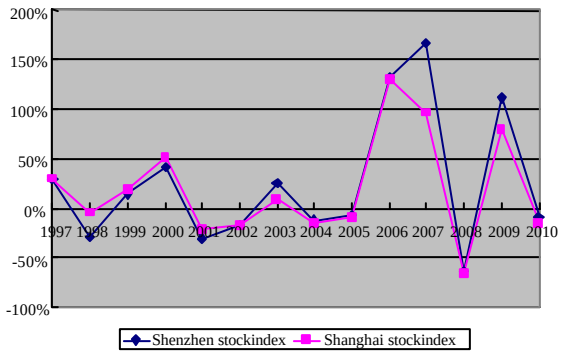

Fig. 4: 1997-2010 China's stock index between the real rate of return

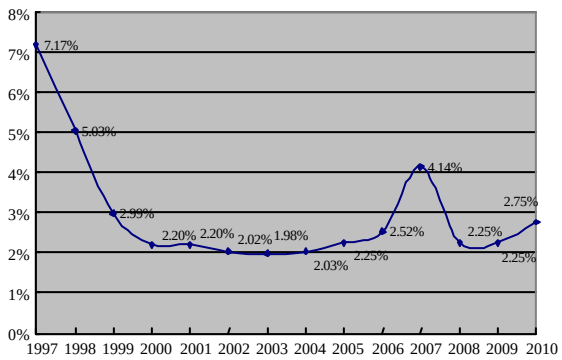

Fig.5: Actual annual savings rate of return in China from 1997 to 2010

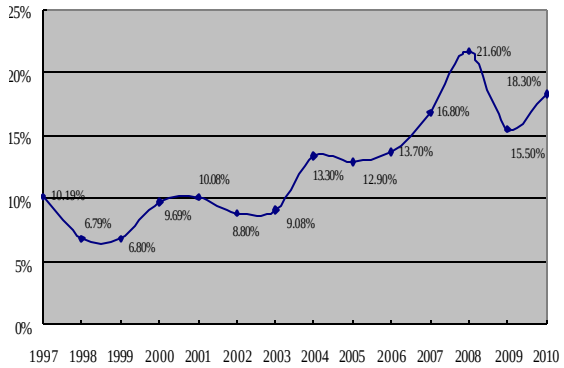

Fig. 6: Actual growth rate of retail sales of consumer goods in China from 1997to 2010

based on the premise of high-risk. What's more it is higher in Shenzhen stock market than that in Shanghai

- When the degree of freedom is df = 14-2 = 12, 5 and 1% significance level critical value of correlation

Table 2: Index Return, the interest rate and consumption growth-related statistics (1997-2010)

$\bar{R}_1$	$\sigma(R_1)$	$\bar{R}$	σ	$\bar{R}$	σ	$\bar{R}$	σ
25.26%	75.71%	1	5	2	3	1	7

$\bar{R}_1$ and $\bar{R}_2$ representing the average rate of return for Shenzhen and Shanghai Component Index, respectively representing the average consumption growth

Table 3: Index Return, the interest rate and consumption growth rate correlation (1997-2010)

$\rho(R_1,R_2)$	$\rho(R_1,R)$	$\rho(R_2,R)$	$\rho(R_1,C)$	$\rho(R_2,C)$	$\rho(R, C)$
0.795**	(0.001)	0.225	(0.438)	0.180	(0.537)*
0.094	(0.750)	0.026	(0.931)	0.573*	(0.032)

coefficient were 0.532 and 0.661, significance level $t_{0.05/2}$ = 2.179, $t_{0.01/2}$ = 3.055. According to Fig. 6, only if the Shenzhen Component Index and the Shanghai Stock returns the level at 0.01 significant positive is correlated. It was not significant for the relationship between Shanghai and Shenzhen stock index returns. However, the rates of the interests and consumption growth are relative, when at 5% level

- China's stock market risk-free rate is of return of 3-4 times of the yield securities and as shown in Fig. 5, the risk premium in Shanghai and Shenzhen, respectively, up to 12.31 and 17.15%. Such a high excess rate of return can not be explained by the stock market risk, so you can determine the equity risk premium phenomenon exist in China (Table 4)

The corresponding volatility is large and the standard deviation reached 34.29%, far more than the mature Western stock markets (the United States 15.27% France 23.18%, UK 21.2%). It indicates higher levels of overall risk of China's stock market and investors commitment to achieve high yields are high risk as a precondition.

- China's Shanghai and Shenzhen stock index fluctuated and changes in real interest rates and consumption growth rate is very smooth. From Fig. 7 it can also be seen that the fluctuation index of performance of listed companies with significant positive relationship was not, Sometimes the contrary, negative relationship, such as the 1997-2006 stock rose a lot and the rate of return on net assets per share results fell a lot (Table 5). From this, the Chinese stock market volatility can not be with the dividend volatility, the volatility of risk-free real interest rate is consistent. Price change is difficult to be explained by fundamental changes in growth, indicating that

Table 4: China's stock market risk premium situation.

Category index	year	Average market index	Average risk-free securities	Risk premium
Shenzhen component index	1997-2010	25.26%	2.98%	22.28%

Table 5: Chinese listed companies annual key financial indicators

Project	1997	1998	1999	2000	2001	2002	2003
Number of listed companies	52	183	291	323 530	745	851	
Average earnings per share (yuan)	0.23	0.35	0.35	0.34 0.33	0.30	0.24	
Return on net assets (%)	11.74	13.04	15.91	16.70	15.29	12.77	11.06
Stock index							
The Shanghai composite index	1194	1146	1366	2073	1645	1357	1497
The Shenzhen component index	4184	2949	3369	4752	3325	2759	3479
Project	2004	2005	2006	2007	2008	2009	2010
Number of listed companies	949	1088	1154	1223	1285	1373	1377
Average earnings per share (yuan)	0.26	0.22	0.17	0.14 0.16	0.10	0.06	
Return on net assets (%)	10.35	8.76	7.34	6.46 6.17	5.98	4.86	
Stock index							
The Shanghai composite index	1266	1161	2675	5261	1820	3277	2808
The Shenzhen component index	3067	2863	6647	17700	6485	13699	12458

Data sources: wind database and National Bureau of Statistics (http://www.stats.gov.cn)

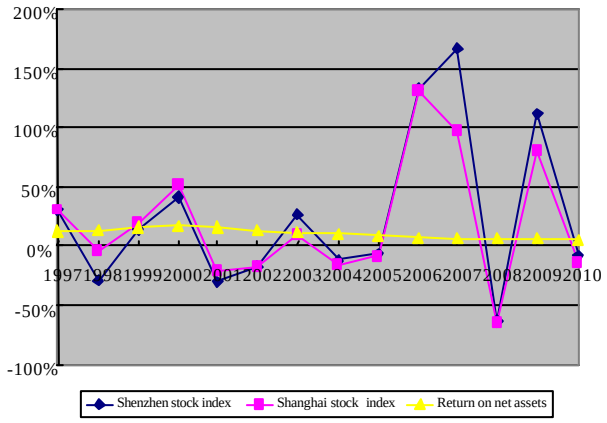

Fig.7: China's stock index return on assets compared with the real rate of return form 1997 to 2010

China's securities market is difficult to use a standard asset pricing model to explain, so there are volatility puzzle of China's stock market

CONCLUSION

In this study, an improved artificial bee colony algorithm is developed for global optimization problems with opposition-based initialization method and new search mechanism. The experimental results tested on 10 benchmark functions show that IABC algorithms is competitive with ABC algorithm. The improvement can mainly be attributed to the following reasons. First, the new search mechanism can balance the exploration and exploitation abilities very well which can both maintain the diversity and improve the convergent speed. Secondly, the initialization methods can affect the quality of the solutions and the convergence speed. Therefore, the IABC algorithms are accuracy and effective for global optimization problems.

It is desirable to further apply IABC algorithms to solving those more complex real-world optimization problems and it will be our further work.

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