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Abstract

When we consider stock markets, it is important to identify theoretical models that fit actual stock market behavior. It is known that the stock price can be approximated by a lognormal distribution. The academic field, however, consider it the first order approximation and many alternative processes, such as Levy process, are proposed to better model the fat tail behavior. In this study, we use the Kolmogorov-Smirnov test and the chi-square test to check the fitness of the Chinese stock market, a market that has particular characteristics as compared to mature Western markets, with lognormal distribution. Based on the data of fifteen most representative stocks in Chinese market, we find that almost of the stock prices do not have the lognormal process. But the implementation of the split share structure reform program provide evidence to make the process of the stock price tend to have the lognormal process, gradually.

Key Words and Phrases: Kolmogorov-Smirnov test, chi-square test, fat tail, lognormal process, split share structure reform, reducing state holdings policy, state owned enterprise

1. Introduction

1.1. The established theory

In financial area, numbers of famous theories are established based on one hypothesis, the random walk hypothesis. It is claimed that the behavior of the stock price can be expressed as a geometric Brownian motion. It can be written explicitly as follows,

$$\frac{dS_t}{S_t} = \mu dt + \sigma dz_t \tag{1}$$

where, S_t denotes to the stock price at time t, z_t is the standard Brownian motion, and the parameter μ and σ are the expected rate of return and the volatility of the stock price, respectively. In order to converting to the expression of stock price S_t, by using the Ito's Lemma and let the function $G(x) = \ln(x)$, the equation (1) can be expressed as follows,

$$dG(S_t) = d\ln(S_t) = \left(\mu - \frac{\sigma^2}{2}\right)dt + \sigma dz_t \tag{2}$$

As a result, the logarithm of the stock price is subject to normal distribution, in other words, the stock price is subject to lognormal distribution.

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If we take logarithm value of the rate of return of the stock price, $\ln(S_{k+1}) - \ln(S_k)$, for many values of time k and make the histogram, the graphic should fit the normal distribution well. However, although the difference is trivial by general criterion, there exists fat tails, specified in Investment Science.David (1997) Therefore some alternatives that overlay the continuous geometric Brownian motion with some discretion jumps or directly replace the continuous geometric Brownian motion all by discretion jumps, appeared. Those alternatives are called Levy process in general.Hull (2005)

In this study, what we do is based on the random walk hypothesis.

1.2. Characteristics of Chinese stock market

Chinese stock market institution was established in 1990. Compared with the mature western stock markets, the nearly twenty-year history is no more than trivial. But following along with the development of Chinese economy, the Chinese enterprises are growing swiftly and attracting much more foreign capitals. In such background, Chinese stock market has also experienced considerable growth ever since. The number of companies listed, increased from a dozen in 1991 to more than 1000 in 2008. At the same time, the market total capitalization increased from less than 10 billion to more than 32 trillion on RMB. By the end of 2007, the total capitalization of Chinese stock market (including Hong Kong) has exceeded Tokyo Stock Exchanges and becomes the second largest stock market in the world. However, it is undeniable that there exist a number of unique characteristics in Chinese stock market, some of which are regarded as the impediment to the development of the market.

The daily fluctuation restriction and the way of dividend payment are two of the special characteristics in Chinese stock market. In order to keeping the stabilization of the stock market, in current status of Chinese stock market, the daily maximum fluctuation range is 20%, 10% for increasing and 10% for decreasing, while in developed stock markets such restriction does not exist. Such restriction is consistently applicable to every trading day except the ex-right (dividend) day. So far almost of the Chinese listed companies are using the way of stock dividends annually. That is because Chinese stock market is in a position of high speed development, therefore enlarging the equity of the company is seen as the first order strategy, meanwhile the shareholders of the companies are bullish on the long-term investment. Therefore the way of stock dividends rather than cash dividends is the better choice for both the owner and shareholders of the listed companies. Consequently, comparing with the limited equity of listed companies, the proportion of stock dividends is quite big, even to the level of giving 10 shares for every 10 shares shareholders owned, which means on the ex-right day the stock price turns to half of it as the day before. Comparatively, in developed stock markets, cash dividend formation is preferred by shareholders and the proportion is generally lower than 5%.

The most distinguish characteristic of Chinese stock market is the split share structure, which a minority of shares are tradable while majority of shares are excluded from the market. Since the creation of the stock market, in order to characterizing the market socialism rather than privatization, although there exist privately-controlled listed companies, for majority of companies, the control rights should not be transferred to non-state investors. Therefore, more than 60% of all shares are controlled by the state and legal person and can not be freely traded in the market, only less than 30% shares are bought and sold by individuals. As a result, there is no distinct relationship be-

tween the performance of companies, and the stock price fluctuation, which leads to the distorting stock prices and the market is blamed to be no-value to invest. In order to resolving such problem to attract much more investment continuously, the China Securities Regulatory Commission (CSRC) promulgated the policy that the listed state owned enterprises (SOE) should reduce a certain rate of the state holdings and the funds raised should be spent on building China's social security system in late 1999, which is called "reducing state holdings policy". The pilot program included two SOEs immediately after the policy is announced, and the second phase related to all of the SOEs in the early 2001. The purpose of the policy is to reduce the state holdings from two-thirds to fifty-one percent of the total, and allow diverse shareholders to supervise the listed company management. However, since allowing state shares on the market would lower the price of existing tradable shares, it becomes very unfair to the shareholders of tradable shares. After a sharp drop in stock prices, the policy is forced to suspended in the late 2001, and finally abandoned in June 2002, but the negative influence to the whole market persisted until early 2005. Although the reducing state holdings policy is discarded, the discussion of resolving the non-tradable shares has not disappeared. After learning the lesson of regardless on the behalf of the shareholders of tradable shares which eventually destroyed the confidence of the investors, the CSRC announced a new policy called "the split share structure reform" on April 29, 2005. In the contents of the reform, each listed company should first draw up a compensation proposal which pay from the owners of non-tradable shares to the owners of tradable shares according to the share structure situation of company respectively. After studying the details of the proposal, all the shareholders vote on the proposal to determine whether it is accepted or rejected. If rejected, the company should make amendment until the proposal is passed by majority of the shareholders. Even the proposal is implemented, which means all of the shares can be nominal traded freely in the market, the owners of non-tradable shares will have to wait at least one year before they can sell their shares in the stock market. Also anyone owning at leat 5% of a company's non-tradable shares is not permitted to sell more than 5% of the shares for another 12 months after the one-year restricted period. The features of the reform can be accurate described by Inoue, "(1) it attempts to be flexible rather than impose a one-size-fit-all solution; (2) it leaves the final decision to shareholders (especially the owners of tradable shares); and (3) it tries to deal with short-term market volatility."Inoue (2005) By the reform, the listed companies are seperated by three phases. The first phase involved four companies (Hebei Jinniu Energy Resources, Sany Heavy Industries, Shanghai Zi Jiang, and Tsinghua Tongfang) from May 9, 2005, the second phase involved 42 companies from June 17, 2005, and the rest of the listed companies are the third phase from September 12, 2005.

In this study we will use the statistical methods to engage in the practical performance of the split share structure reform by fifteen sample listed companies, meanwhile the performance of the reducing state holdings policy is used as a contrast as well.

2. Experiment

2.1. Statistical test

Two statistical tests are selected to testify the null hypothesis that the rate of return of stock price in Chinese stock market is subject to normal distribution, i.e. the stock price in Chinese stock market is subject to lognormal distribution. However, the stock

return should be independent with each other according to the random walk hypothesis, therefore the serial correlation test is selected to testify the prerequisite.

Serial correlation test If there are n observations X_1,...X_n, the serial correlation coefficient can be computed by the statistic defined as follows

$$C = \frac{n(X_1X_i + X_2X_{i+1} + ... + X_{n-i+1}X_n + ... + X_nX_{i-1}) - (X_1 + ... + X_n)^2}{n(X_1^2 + ... + X_n^2) - (X_1 + ... + X_n)^2}$$

where the range of i is from 1 to n. The serial correlation coefficient defined above is a measure of the amount X_j depends on X_{j+i}. Under the null hypothesis the observations are the stock returns. A "good " value of C, which means that the observations can be considered as independent with each other, will be between $\mu_n - 2\sigma_n$ and $\mu_n + 2\sigma_n$ Knuth (1998), where

$$\mu_n = \frac{-1}{n-1}, \qquad \sigma_n = \frac{1}{n-1}\sqrt{\frac{n(n-3)}{n+1}}, \quad n > 2$$

C is expected to be between the limits about 95 percent of the time.

Chi square test The chi-square test was introduced by Karl Pearson in 1900, which is regarded as one of the foundations of modern statistics. The method can be summarized as follows. A fairly large number, n, of independent observations are made. The number of observations falling into each of k categories is counted as Y_k, the summation of the discrepancy between the observation numbers and the expectation np_s from each category is the main component of statistic V which is computed as

$$V = \sum_{s=1}^{k} \frac{(Y_s - np_s)^2}{np_s}$$

Corresponding to the null hypothesis situation, category k represents the kth interval of rate of return of stock price which is identically divided by probability, meanwhile observation and Y_k denotes to the rate of return of stock price and the counting number which real rate of return of stock price falls into,respectively. Then statistic V is compared with the entries in the table of selected percentage points of the chi-square distribution with $\nu = k-1$. If V is less than the 1% entry or greater than the 99% entry, the test object is rejected otherwise accepted. Each entry in the table is computed by the equation $\nu + \sqrt{2\nu}x_p + \frac{2}{3}x_p^2 - \frac{2}{3} + O(1/\sqrt{\nu})$, where x_p for $p = 1\%$, 5%, 25%, 50%, 75%, 95%, and 99%, respectively, are -2.33, -1.64, $-.674$, 0.00, 0.674, 1.64, 2.33. Generally, n should be large enough to make np_s larger than five.Knuth (1998) In this paper, we determine to make np_s round fifteen, by considering the number of daily stock returns n is around 450, therefore we make k equal to thirty.

Kolmogorov-Smirnov test The Kolmogorov-Smirnov test base on the conclusion that the empirical distribution function $F_n(x)$ converges to the cumulative distribution function $F(x)$ almost surely. The method can be summarized as follows. n independent observations X_1,...X_n taken from some distribution specified by a continuous function

$F(x)$ are given. The statistics are computed as follows

$$K_n^+ = \sqrt{n} \max_{1 \le j \le n} (\frac{j}{n} - F(X_j))$$

$$K_n^- = \sqrt{n} \max_{1 \le j \le n} (F(X_j) - \frac{j-1}{n})$$

The purpose of the equations is to compute the discrepancy between the probability of observations and the corresponding empirical distribution function. Under the null hypothesis situation, $F(x)$ represents the cumulative normal distribution, and the definition of observation is the same with that in Chi square test. These statistics K_n^+ and K_n^- are compared with the entries in the table of selected percentage points of the distributions. The equation $y_p - \frac{1}{6}n^{-1/2} + O(1/n)$ is the way to acquire each entry in the table, where y_p for $p = 1\%$, 5%, 25%, 50%, 75%, 95%, and 99%, respectively, are 0.07089, 0.1601, 0.3793, 0.5887, 0.8326, 1.2239, 1.5174.

2.2. Control experiment by original data

There are fifteen listed companies chosen from Chinese stock market as the sample of the statistical tests. Since the implementation order of the split shares structure reform is separated by three phases, first four stocks, then forty-two stocks and others in the end, we choose the fifteen listed companies by the criterion that all four listed companies from the first phase, six out of forty-two from the second phase and five from the third phase. The six stocks from the second phase and the five stocks from the third phase are components of the Shanghai Stock Exchanges (SSE) 50 index which is composed by fifty largest stocks of good liquidity and representativeness from Shanghai stock market and is also called the Shanghai Stock Exchanges's Blue Chip Index. The ten listed companies chosen from NYSE consist of a large range of American industries, including energy sources, motor factory, manufacturing, insurance company, commercial and investment banks. Since the sub-prime loan crisis triggered the global economy recession from 2007, in order to staying out of the external influence we choose a relative stable period from 2005 to 2006 as the test interval.

As examples, the daily stock return of the Tsinghua Tongfang stock, one of the fifteen listed companies from Chinese stock market and the Goldman Sachs stock, one of the ten listed companies from NYSE are selected to make the serial correlation test. The results are shown in Table 1 and Table 2. As a result, almost of the serial correlation coefficient of the two stocks fell into the "good" limits except one from Tsinghua Tongfang stock, which the successful probability is 95 percent. Therefore we conclude the daily stock returns from both of the two stock markets can be considered as independent with each other to do the two statistical tests.

The statistical test result and corresponding p-value of original data is shown by Table 3 and Table 4. If we designate the significance level to be 1%, it is easy to find out eight of ten listed companies from NYSE are accepted by both of the statistical tests, one of ten are accepted by either of the two statistical test and only one is rejected by both of them. Accordingly, fourteen of fifteen listed companies from Chinese stock market are rejected and only one of them are accepted by both of the statistical test. Based on such facts, we find out that the stock price of Chinese stock market is not subject to lognormal distribution.

Table 1: the seiral correlation test of Goldman Sachs stock

"good" limits	[-0.091, 0.087]									
i range	1	2	3	4	5	6	7	8	9	10
serial correlation coefficient	0.018	-0.025	-0.046	-0.013	0.002	-0.011	0.019	0.013	0.023	-0.057

Table 2: the serial correlation test of Tsinghua Tongfang

"good" limits	[-0.097, 0.093]									
i range	1	2	3	4	5	6	7	8	9	10
serial correlation coefficient	0.019	-0.120	0.071	0.004	0.032	-0.052	-0.071	0.002	-0.092	-0.013

Table 3: test result from 2005.1.1 to 2006.12.31

Chinese stock market					
company name (code)	chi-square test (k = 30)		KS test		
	statistic (V)	p value	statistic (kn^+)	statistic (kn^-)	p value
Tsinghua Tongfang (600100)	71.51	3E-5	1.74	1.65	2E-3
Jinniu Energy Resources (000937)	225.3	<1E-6	3.00	3.54	<1E-6
Zi Jiang Enterprise (600210)	209.7	<1E-6	1.48	1.86	9E-4
Sany Heavy Industry (600031)	172.6	<1E-6	2.48	3.13	<1E-6
Shenergy (600642)	138.2	<1E-6	1.94	2.22	5E-5
Shanghai Oriental Pearl (600832)	219.5	<1E-6	3.23	3.13	<1E-6
Shanghai Port Container (600018)	930.3	<1E-6	5.16	6.24	<1E-6
Baoshan Iron Steel (600019)	134.8	<1E-6	2.31	2.00	2E-5
China Yangtze Power (600900)	69.27	6E-5	1.96	1.71	5E-4
Citic Securities (600030)	89.93	<1E-6	1.87	1.55	9E-4
Huaneng Power International (600011)	47.33	0.02	0.93	1.42	0.02
China Minsheng Bank (600016)	177.5	<1E-6	2.60	3.25	<1E-6
GD Power Development (600795)	78.60	3E-6	1.39	1.67	3E-3
China United Telecommunications (600050)	361.5	<1E-6	2.22	1.64	5E-5
Guizhou Maotai Wine (600519)	426.2	<1E-6	3.96	4.65	<1E-6

Table 4: test result from 2005.1.1 to 2006.12.31

New York Stock Exchanges					
company name (code)	chi-square test (k = 30)		KS test		
	statistic (V)	p value	statistic (kn^+)	statistic (kn^-)	p value
Walmart	32.8	0.29	1.11	0.63	0.09
Exxon mobil	16.88	0.96	0.53	0.69	0.39
General Electronics	52.02	0.005	0.97	0.67	0.15
citigroup	48.07	0.014	1.29	1.17	0.04
Procter and Gamble	42.90	0.04	1.20	1.08	0.06
Bank of America	39.47	0.09	0.90	0.55	0.20
Johnson and Johnson	47.09	0.02	1.32	1.06	0.03
JP morgan	30.23	0.40	0.98	0.76	0.15
AIG	63	3E-4	1.49	1.85	1E-3
Goldman Sachs	29.91	0.42	0.76	0.56	0.31

2.3. Adjustment of original data

As mentioned above, almost Chinese listed companies prefer high proportion stock dividend rather than cash dividend which is generally used in developed stock market like NYSE. High proportion stock dividend leads to the multiple enlargement of the equity, as the capitalization is constant, enlargement of the equity leads to the huge fluctuation of the stock price. That will confuse our judgment by purely observe the original variation of the stock price. However such confusion will not happen on the occasion of cash dividend. So in order to eliminating the situation of huge fluctuation of stock price, we convert the original stock price of each Chinese listed company to the same equity level. Generally, the ex-dividend stock price is computed as follows in Chinese stock market

$$exdividend\ stock\ price = \frac{the\ closing\ price\ of\ the\ date\ of\ record - cash\ dividend}{1 + proportion\ of\ stock\ dividend}$$

$$+\frac{stock\ dividend \times ratio\ of\ stock\ dividend}{1 + proportion\ of\ stock\ dividend}$$

Stock Exchange (2009) Based on the equation of ex-dividend stock price defined above, we confirm every date of stock dividend payment and compute the ex-dividend stock price in accordance with the time sequence. In the following part of the paper, the sampling data of stock returns are all computed by the adjusted daily stock price.

2.4. Result about the split shares structure reform and analysis

We divide the test period of the split shares structure reform into two parts, the transition part and the real-beginning part. The transition part of each stock is counted from the starting day of the phase which the stock belongs to until a certain year after the permission date of the company's proposal announcement. Although the split share structure reform for each listed company starts from the permission announcement of

the compensation proposal theoretically, the actual starting point for each company is far more earlier than that even can be retrospected to the announcement of the phase the stock involved. In addition, as the shareholders of non-tradable shares are not allowed to sell any of the shares they owned in the fixed year determined by each company, generally is one year, so such fixed year of the reform can be also seen as the transition period. The date after the transition part till the end of 2008 can be seen as the real-beginning part. Meanwhile as mentioned above the reducing state holdings policy period from 2001 to 2003 is used as a contrast. Since the test period of sample listed companies are different with each other, the tests are proceeded separately in the following part.

Test result of first phase The first phase of the split shares structure reform is regulated by CSRC from May 9, 2005, including Hebei Jinniu Energy Resources, Sany Heavy Industries, Shanghai Zi Jiang, and Tsinghua Tongfang four companies.

(1) Tsinghua Tongfang with 52.48% non-tradable shares promises that tradable shareholders will receive 10 new shares, 3.56 of which are in fact, compensation, for every 10 shares they hold, and the non-tradable shareholders are not allowed to sell any of their holdings in the first year, 5% in the second year and 10% in the third year. The permission announcement is on Feb 10th, 2006. The histogram of the Period III is shown by Figure 1 and Figure 2 represents the histogram of the identical stock from January 1st, 2005 to December 31th, 2006, which is called Period I shown in section 2.2. Compare the two histogram graphics, the performance of Period III with non-distinctive fat-tail phenomenon is better than that of Period I.

(2) Hebei Jinniu Energy Resources with 72.11% non-tradable shares promise that every 10 shares owned by tradable shares can receive 2.5 shares as the compensation from the non-tradable shareholders. The major shareholders are not allowed to sell any possession shares in the first 2 years. The permission announcement is June 28th, 2005.

(3) Shanghai Zi Jiang with 58.47% non-tradable shares promise that every 10 shares owned by tradable shares can receive 3 shares as the compensation from the non-tradable shareholders. The major shareholders are not allowed to sell any of their shares in the first 1 year. And the permission announcement is July 29th, 2005.

(4) Sany Heavy Industries with 75% non-tradable shares make the promise that the owners of non-tradable shareholders will give tradable shareholders 3.5 shares and 8 RMB for every 10 shares. Following the general rule that the non-tradable shares should not be sold in the first year. Permission announcement is June 17, 2005. Since Sany Heavy Industries missed the prosecution of the reducing state holdings policy, only two test period are considered.

the statistical result of phase I is shown by Table 5.

The statistical test results can be summarized briefly as follow. If we keep the 1% significance level up, the stock price variation of all the three listed companies experienced the reducing state holdings policy are rejected by both chi square and KS test. Correspondingly, two listed companies passed both of the two statistical test, and the left two passed one of them. Finally, almost of the four listed companies are rejected by statistical tests in transition part.

Test result of second phase On June 17th, 2005, another forty-two listed companies are selected to start the split shares structure reformed by CSRC. The scale of the selected companies has great extension compared with the first phase. The list includes

Table 5: Statistical test of phase I

			Period I	Period II	Period III
Tsinghua Tongfang			01.6 ∼ 03.6	05.4.29 ∼ 07.2.12	07.2.13 ∼ 08.12.31
1)	observation numbers		475	397	462
2)	chi-square test(k=30)	statistic (V)	70.43	67.44	38.33
		p-value	3E-5	7E-5	0.12
3)	KS test	statistic (kn^+)	1.62	1.77	0.52
		statistic (kn^-)	1.68	1.04	0.97
		p-value	4E-3	2E-3	0.15
Jinniu Energy Resources			01.6 ∼ 03.6	05.4.29 ∼ 07.7.06	07.7.07 ∼ 08.12.31
1)	observation numbers		473	506	342
2)	chi-square test(k=30)	statistic (V)	88	85.74	44.50
		p-value	<1E-6	<1E-6	0.03
3)	KS test	statistic (kn^+)	1.80	1.61	0.77
		statistic (kn^-)	1.78	1.72	0.74
		p-value	2E-3	3E-3	0.31
Shanghai Zi Jiang			01.6 ∼ 03.6	05.4.29 ∼ 06.8.01	06.8.02 ∼ 08.12.31
1)	observation numbers		470	259	584
2)	chi-square test(k=30)	statistic (V)	99.38	116.7	85.74
		p-value	<1E-6	<1E-6	<1E-6
3)	KS test	statistic (kn^+)	1.96	1.38	1.14
		statistic (kn^-)	1.77	0.89	1.48
		p-value	5E-4	0.02	0.013
Sany Heavy Industries			01.6 ∼ 03.6	05.4.29 ∼ 06.6.19	06.8.02 ∼ 08.12.31
1)	observation numbers		-	258	605
2)	chi-square test(k=30)	statistic (V)	-	49.54	61.28
		p-value	-	0.01	4E-4
3)	KS test	statistic (kn^+)	-	1.55	1.04
		statistic (kn^-)	-	0.71	1.01
		p-value	-	8E-3	0.11

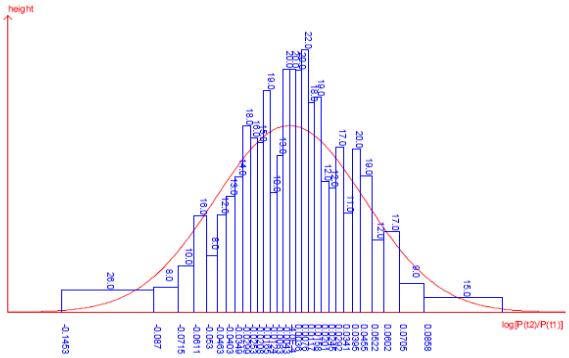

Figure 1: histogram of Tsinghua Tongfang in Period III

seven companies from the SSE 50 index which six of them are chosen as the sample of our test, and the market capitalization of the forty-two companies equals to 10% of the total temporal market value. The compensation proposal and statistical test result can be seen from the Table 6 and Table 7.

By keeping the 1% significance level up, the statistical results of second phase can be summarized as three points. First of all, similar to the first phase, all the stocks paticipated the reducing state holdings policy are rejected by both of the statistical tests; secondly, three of six chosen stocks are accepted by both of the statistical tests in the real-beginning period with one accepted by either of them and two rejected; thirdly, almost of the stocks are rejected by the statistical tests in the transition period.

Test result of third phase On September 12th, 2005 the CSRC announced that the split shares structure reform extended to a comprehensive reform which all other listed companies were designated to participate. Like the second phase, all the five sample listed companies are the components of SSE 50 index, and the statistical test results are shown from Table 8.

With the 1% significance level unchanged, the statistical test told us that all the three of four listed companies which experienced the reducing state holdings policy are rejected by the statistical tests while stocks of real-beginning period are all accepted by the statistical tests. The rejection and acceptation of the transition period is half and

Table 6: Statistical test of phase II

			Period I	Period II	Period III
Shenergy			01.6 ∼ 03.6	05.6.17 ∼ 06.8.17	06.8.18 ∼ 08.12.31
1)	observation numbers		470	252	575
2)	chi-square test(k=30)	statistic (V)	82.4	51.31	55.35
		p-value	1E-6	6E-3	2E-3
3)	KS test	statistic (kn^+)	2.15	1.08	1.27
		statistic (kn^-)	1.67	1.14	1.63
		p-value	1E-6	0.07	5E-3
compensation proposal: 1) 10 for 3.2 (shares); 2) 1 year sell restriction of non-tradable shares; 3) 05.8.17 permission announcement					
Shanghai Oriental Pearl			01.6 ∼ 03.6	05.6.17 ∼ 06.8.7	06.8.8 ∼ 08.12.31
1)	observation numbers		472	253	579
2)	chi-square test(k=30)	statistic (V)	74.89	57.84	56.31
		p-value	6E-6	1E-3	0.002
3)	KS test	statistic (kn^+)	1.99	1.72	0.96
		statistic (kn^-)	1.83	1.27	1.33
		p-value	4E-4	3E-3	0.03
compensation proposal: 1) 10 for 4 (shares); 2) 1 year sell restriction of non-tradable sharesshares; 3) 05.8.7 permission announcement					
Shanghai Port Container			01.6 ∼ 03.6	05.6.17 ∼ 06.8.22	06.8.23 ∼ 08.12.31
1)	observation numbers		471	253	545
2)	chi-square test(k=30)	statistic (V)	106.9	53.66	83.31
		p-value	<1E-6	0.004	<1E-6
3)	KS test	statistic (kn^+)	2.59	1.80	1.42
		statistic (kn^-)	1.71	1.17	1.57
		p-value	2E-6	0.002	0.007
compensation proposal: 1) 10 for 2.2 (shares) 10 RMB; 2) 1 year sell restriction of non-tradable shares; 3) 05.8.22 permission announcement					
Baoshan Iron & Steel			01.6 ∼ 03.6	05.6.17 ∼ 07.8.20	06.8.21 ∼ 08.12.31
1)	observation numbers		467	502	329
2)	chi-square test(k=30)	statistic (V)	249.6	137.6	34.18
		p-value	<1E-6	<1E-6	0.23
3)	KS test	statistic (kn^+)	2.31	2.67	0.69
		statistic (kn^-)	2.02	2.16	0.57
		p-value	2E-5	<1E-6	0.39
compensation proposal: 1) 10 for 2.2 (shares) call option; 2) 2 year non-tradable shares sell restriction; 3) 05.8.18 permission announcement					
China Yangtze Power			01.6 ∼ 03.6	05.6.17 ∼ 06.8.15	06.8.16 ∼ 08.12.31
1)	observation numbers		-	254	410
2)	chi-square test(k=30)	statistic (V)	-	80.24	46.47
		p-value	-	1E-6	0.02
3)	KS test	statistic (kn^+)	-	1.96	1.00
		statistic (kn^-)	-	1.62	1.16
		p-value	-	5E-4	0.07
compensation proposal: 1) 10 for 1.42 (shares) 4.14 RMB; 2) 1 year non-tradable shares sell restriction; 3) 05.8.15 permission announcement					

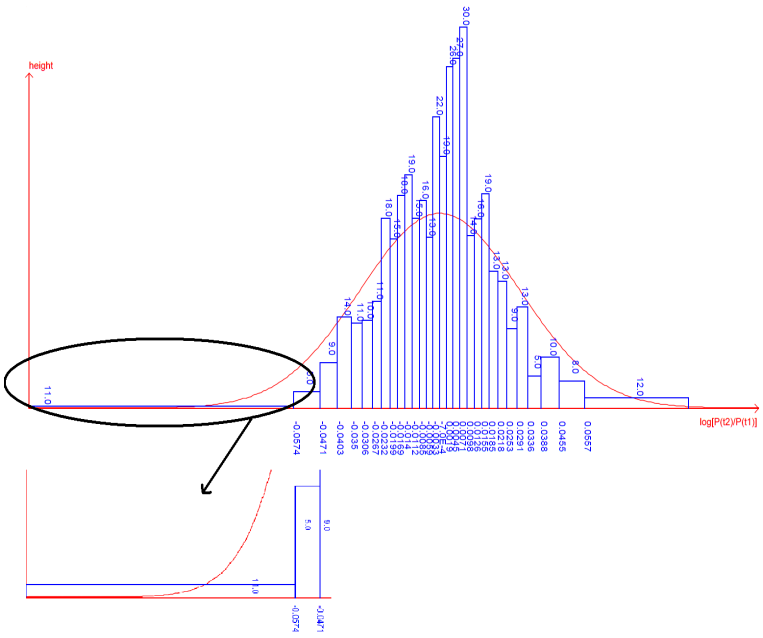

Figure 2: histogram of Tsinghua Tongfang from the period 2005.1.1-2006.12.31

half.

3. Conclusion

Stock exchanges is a virtual economy, which is believed to indicate an embrace of the market and a retreat from state coordination of the economy. Therefore, the operation of the stock market should be regulated by the market itself and is considered as a free process. However, the current Chinese stock market depends too much on the political factors. From the statistical test result above by comparing with the developed stock market, like NYSE, we find out Chinese stock market is still far from the real free market.

Recently, it has claimed two competing assessment of China's political economy. One claims that China is pursuing a gradual strategy, and can be regulated by the role of market eventually. The opposite one states that China will be trapped into the current political-centralized dilemma.Mary (2008) In Mary Comerford Cooper's paper, she pointed out that although Chinese stock market continues to exhibit shortcomings, the reform of the split shares structure which improve the liquidity of the stock market effectively supports the first statement of the debate through regression analysis of the split shares structure reform. Meanwhile based on her findings, she took an optimistic view of the development of the Chinese financial market.

After summarizing the statistical results from the three periods, we find out that

Table 7: Statistical test of phase II

			Period I	Period II	Period III
Citic Securities			01.6 ∼ 03.6	05.6.17 ∼ 06.8.15	06.8.16 ∼ 08.12.31
1)	observation numbers		-	252	560
2)	chi-square test(k=30)	statistic (V)	-	92.20	47.24
		p-value	-	<1E-6	0.02
3)	KS test	statistic (kn^+)	-	1.73	0.58
		statistic (kn^-)	-	1.46	0.80
		p-value	-	3E-3	0.28
compensation proposal: 1) 10 for 3.5 (shares); 2) 1 year non-tradable shares sell restriction; 3) 05.8.15 permission announcement					

fourteen of fifteen stocks are rejected by the tests which corresponds to the failure finale of the reducing state holdings policy; nine are rejected, three are accepted by both tests and three are accepted by either of the two in the transition period; ten are accepted, two are rejected by both tests and three are accepted by either of the two in the real-beginning period. Based on the test results, we demonstrate that the implementation of the split shares structure reform provides evidence to make the process of the stock price tends to have the lognormal process. Although we can not justice whether the split shares structure reform draws Chinese stock market to freedom or not, it surely pushes the behavior of the Chinese stock market forward.

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Table 8: Statistical test of phase III

			Period I	Period II	Period III
Huaneng Power International			01.6 ∼ 03.6	05.9.12 ∼ 07.4.19	07.4.20 ∼ 08.12.31
1)	observation numbers		341	353	409
2)	chi-square test(k=30)	statistic (V)	73.28	33.31	37.29
		p-value	1E-5	0.27	0.14
3)	KS test	statistic (kn^+)	1.93	1.04	0.76
		statistic (kn^-)	1.38	0.96	0.79
		p-value	6E-4	0.11	0.28
compensation proposal: 1) 10 for 3 (shares); 2) 1 year sell restriction of non-tradable shares; 3) 06.4.19 permission announcement					
China Minsheng Bank			01.6 ∼ 03.6	05.9.12 ∼ 06.10.26	06.10.27 ∼ 08.12.31
1)	observation numbers		466	242	526
2)	chi-square test(k=30)	statistic (V)	60.06	36.89	32.27
		p-value	6E-4	0.15	0.31
3)	KS test	statistic (kn^+)	1.86	0.99	0.97
		statistic (kn^-)	1.35	0.72	0.81
		p-value	1E-3	0.14	0.15
compensation proposal:1) 10 for 5.02 (shares); 2) 1 year sell restriction of non-tradable shares; 3) 05.10.26 permission announcement					
GD Power Development			01.6 ∼ 03.6	05.9.12 ∼ 07.8.31	07.9.01 ∼ 08.12.31
1)	observation numbers		466	425	328
2)	chi-square test(k=30)	statistic (V)	150.4	38.04	28.70
		p-value	<1E-6	0.12	0.48
3)	KS test	statistic (kn^+)	2.34	0.87	0.55
		statistic (kn^-)	2.19	0.99	0.88
		p-value	2E-5	0.14	0.21
compensation proposal:1) 10 for 2.5 (shares) call option; 2) 1 year sell restriction of non-tradable shares; 3) 06.8.31 permission announcement					
China United Telecommunications			01.6 ∼ 03.6	05.9.12 ∼ 07.5.21	07.5.22 ∼ 08.12.31
1)	observation numbers		-	378	391
2)	chi-square test(k=30)	statistic (V)	-	274.7	36.05
		p-value	-	<1E-6	0.17
3)	KS test	statistic (kn^+)	-	2.30	0.94
		statistic (kn^-)	-	1.67	0.87
		p-value	-	3E-5	0.17
compensation proposal:1) 10 for 2.8 (shares); 2) 1 year non-tradable shares sell restriction; 3) 06.5.19 permission announcement					
Guizhou Maotai Wine			01.6 ∼ 03.6	05.9.12 ∼ 07.5.25	07.5.26 ∼ 08.12.31
1)	observation numbers		412	350	392
2)	chi-square test(k=30)	statistic (V)	48.53	64.71	39.67
		p-value	0.012	2E-4	0.09
3)	KS test	statistic (kn^+)	1.51	1.87	1.35
		statistic (kn^-)	1.15	1.24	0.67
		p-value	0.01	9E-4	0.03
compensation proposal:1) 10 for 10 (shares) 20.6 RMB; 2) 1 year sell restriction of non-tradable shares; 3) 06.5.25 permission announcement					