Data Analysis of Shenzhen and Shanghai Land Indices

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Abstract: - In this paper, the data of Shenzhen and Shanghai land indices is analyzed, and the statistical properties of Shenzhen and Shanghai land indices are studied. We select the data for Shenzhen and Shanghai land indices during the year 2001-2006, and investigate the statistical properties, fat tails phenomena and the power-law distributions of returns for these two land indices. Further, we analyze the fluctuation of the relative land prices, and discuss the corresponding probability distributions of the relative land prices.

Key-Words: - land index; returns; power law distribution; relative price

1 Introduction

In this paper, we analyze quotes data from Shenzhen Stock Exchange and Shanghai Stock Exchange during the year 2001-2006, especially we analyze the data of the land indices for these two Chinese stock markets. It is known that the real estate markets play a key role in economy of a country, it is one of the most important assets in capitalism. Shenzhen and Shanghai land indices are two synthetical indices which consist of land stocks of Shenzhen Stock Exchange and Shanghai Stock Exchange respectively. They can reflect the activity and the trend of Chinese land markets in large degrees, so this will be helpful for us to understand the status of Chinese macroeconomic. With the reformation and development of Chinese economic system, the Chinese real estate and the Chinese real estate markets develop rapidly, now the movement of land prices has a strong influence on the economic behavior of individuals and firms, as a result, it affects the economic development of China directly. In the present paper, our studies focus on the scaling behavior in land market, we analyze the statistical properties of Shenzhen and Shanghai land indices, we discuss the power law distributions of returns for the land indices, and study the probability distribution of relative price, and then we try to explain the trend and fluctuations of Chinese land markets.

The database which used in the present paper is from the websets of Shenzhen Stock Exchange and Shanghai Stock Exchanges (www.sse.org.cn, www.sse.com.cn). Considering the history of financial situation of Chinese stock markets, the daily price limit (now 10%), the trading rules of the two stock markets, and the financial policy of Chinese government, we select the data of the daily closing price (for each trading day) for each land index covering the recent 6-year period during the year 2001-2006, the total number of observed data for one land index is about 1400.

2 The Statistical Properties of Land Index

In recent years, the probability distribution in financial market fluctuations has been studied, the empirical research has shown the power-law tails in price fluctuations. More specifically, some research results show that the distribution of large returns follow a power law distribution with exponent 3, that is $P(r_t > x) \sim x^{-\xi_r}$, where r_t is the returns of the stock prices in a given time interval Δt, $\xi_r \approx 3$, for example see [1][6-7][9]. In this section, according to the statistical method and data analyzing method (see [2-3][5-7][9-10]), we will study the probability distributions of daily returns and the power-law character of daily returns for Shenzhen and Shanghai land markets. Since the distribution of returns is also characterized by skewness and kurtosis, here we also study the skewness and kurtosis of returns for Shenzhen and Shanghai land indices.

2.1 The Probability Distributions of Returns

Let $S(t)$ denote the price process at time t $(t = 0, 1, 2, \cdots)$, and let $r(t)$ be the return of the price which defined by (see [4][8][11])

$$r(t) = \left(S(t+1) - S(t)\right)/S(t) = \Delta S(t)/S(t)$$

where $\Delta S(t) = S(t+1) - S(t)$. For a stock price $S(t)$, since the daily change of the price $\Delta S(t)$ is relative small with respect to the price $S(t)$, so we have that the logarithm of return

$$R(t) = \ln(S(t+1)/S(t)) \approx r(t).$$

In this paper, for $t = 1, 2, \cdots$, let $r(t)$ be the daily return process of t-th trading day. According to the data observed from the two land indices, we plot the daily returns figures as follows:

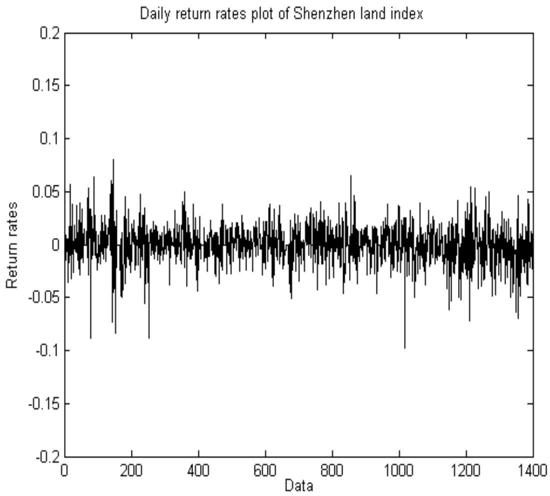

Figure1 (a)

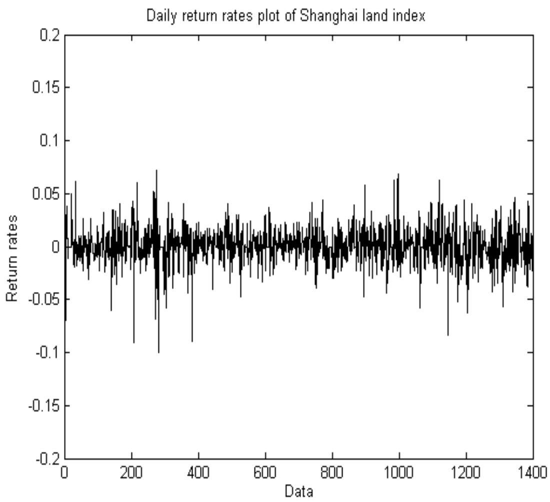

Figure1 (b)

Fig.1. Daily returns plots of land indices for Shenzhen (a) and Shanghai (b) during the year 2001-2006.

Recently, a lot of research work has been done to study the fluctuations of returns for stock prices, see [1-3][5-7][9]. The fluctuations of returns are believed to follow a Gaussian distribution for long time intervals but to deviate from it for short time steps, especially the deviation appears at the tail part of the distribution, usually called the fat-tails phenomena. In the present paper, we try to study the probability distribution of returns for Shenzhen and Shanghai land indices during the year 2001-2006, and the data comes from Shenzhen Stock Exchange and Shanghai Stock Exchange. Comparing the daily returns of Shenzhen and Shanghai land indices with the corresponding normal distributions, we have the following Figure 2.

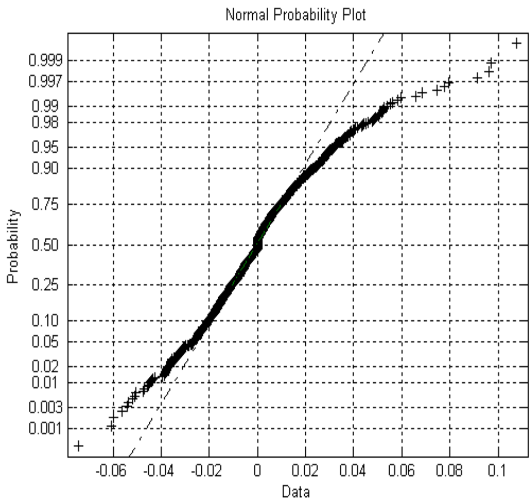

Figure2 (a)

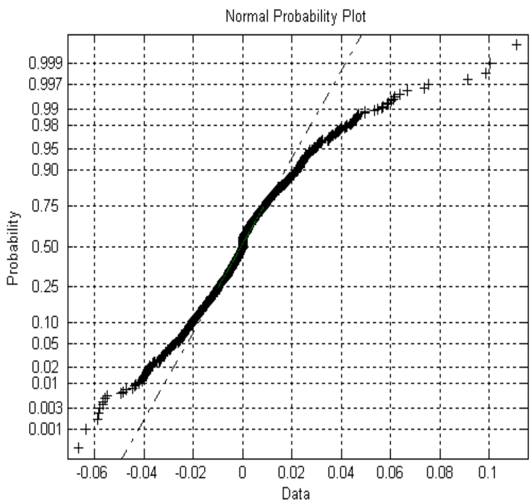

Figure2 (b)

Fig.2. (a) The comparison of Shenzhen land index's daily returns (6-year period) with the corresponding normal distribution. (b) The comparison of Shanghai land index's daily returns (6-year period) with the corresponding normal distribution.

The above plots are the normal probability plots, which is a useful graph for assessing whether data comes from a normal distribution. From Fig.2, we can see that the returns processes of two Chinese land indices are normal distributions in the middle part of Fig.2, since the `+' line (the observed data) coincides with the dash line (the corresponding normal distribution) in the part where the probability is below the 75th and above 25th percentiles of the samples. But the part (where the probability is above the 75th or below 25th percentiles of the samples) deviates from the dash line. This implies that the probability distribution of the returns for the two land indices deviates from the corresponding normal distributions at the tail parts. This also tell us that the fat-tail phenomenon of the returns may exist for the two land indices.

2.2 Skewness-Kurtosis Test of Returns

In this section, we study the properties of skewness and kurtosis (see [10]) on the data of returns for Shenzhen and Shanghai land indices. First, we give the definitions of skewness and kurtosis as following:

$$Skewness = \sum_{i=1}^{n} \left(r_i - u_r\right)^3 / \left(n-1\right)\delta^3$$

$$Kurtosis = \sum_{i=1}^{n} \left(r_i - u_r\right)^4 / \left(n-1\right)\delta^4$$

where r_i denotes the return of i-th trading day, u_r is the mean of r, n is the total number of trading dates, and δ is the corresponding standard variance. It is known that the skewness of standard normal distribution is 0, and kurtosis is 3. From the 6-year data of the two land indices, we have the following Table 1.

In Table 1(a)(b), the values of kurtosis of returns for the two land markets are both bigger than 5, and the values of skewness are close to -0.4. This implies that the statistical distribution of the observed data deviates from the Gaussian distribution in some parts (it may include the tail parts), and it also implies that

Table 1(a) The statistical properties of returns

Land Index of Shenzhen Stock Exchange	
skewness	-0.4203
kurtosis	5.5035
mean value	1.4400e-004
variance	3.4463e-004
maximum	0.0804
minimum	-0.0973

Table 1(b) The statistical properties of returns

Land Index of Shanghai Stock Exchange	
skewness	-0.3684
kurtosis	5.9348
mean value	1.5995e-004
variance	3.1918e-004
maximum	0.0715
minimum	-0.0001

the fluctuation of returns for the two land indices is greater than that of the corresponding Gaussian distribution.

2.3 The Power-Law Behavior of Returns

In this section, we study the statistical properties of tail distributions for the two Chinese land indices. Power law scaling is the universal property that characterizes collective phenomena that emerge from complex systems composed of many interacting units. Power law scaling has been observed not only in physical systems, but also in economic and financial systems. In this section, we study the probability distribution of returns for the land indices, and try to show the power law distribution of returns. In recent years, the empirical research has shown the power-law tails in the return fluctuations, that is, $P(r_t > x) \sim x^{-\alpha}$, and some research results show that the distribution of large returns follow a power law distribution with exponent $\alpha = 3$. First we plot the probability distribution of returns in the year 2004 in Figure 3, which is the log-log plot. Then we compare the exponents α from the year 2001 to 2006 in Table 2.

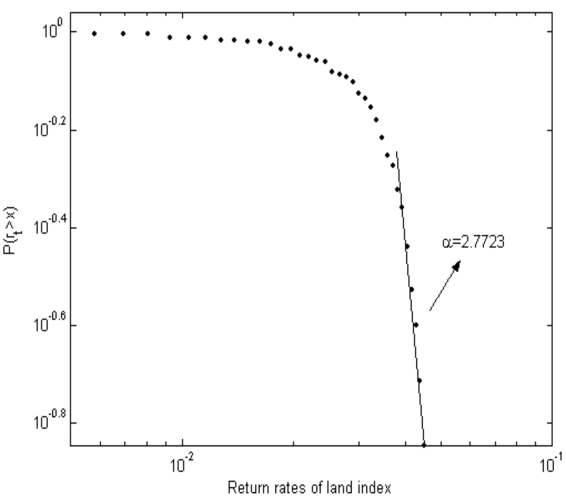

Figure3 (a)

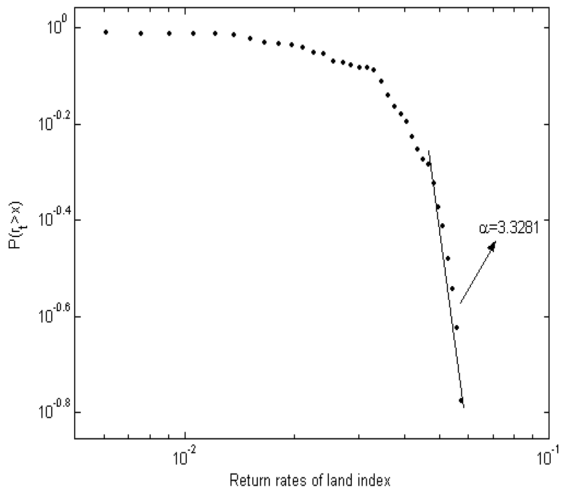

Figure3 (b)

Fig.3. The probability distributions of returns of the land indices for Shenzhen (a) and Shanghai (b) in the year 2004, and $\alpha = 2.7723$ (Shenzhen), $\alpha = 3.3281$ (Shanghai).

Table 2(a). Power law exponents α of the probability distribution for Shenzhen land index

Year	Estimated α	S.E.	R2
2001	2.8069	0.03	0.99
2002	2.8731	0.05	0.99
2003	2.9848	0.02	0.99
2004	2.7723	0.04	0.98
2005	2.8699	0.04	0.98
2006	2.8186	0.07	0.98

Table 2(b). Power law exponents α of the probability distribution for Shanghai land index

Year	Estimated α	S.E.	R2
2001	2.8792	0.02	0.99
2002	2.9660	0.04	0.99
2003	3.3201	0.03	0.99
2004	3.3281	0.06	0.98
2005	2.9683	0.04	0.98
2006	2.9119	0.07	0.98

In Fig.3(a), the probability distribution of returns follows a power-law with exponent $\alpha = 2.7723 \pm 0.04$ $(R^2 = 0.98)$, which is determined by ordinary least-squares regression in log-log coordinates, where R^2 denotes the coefficient of determination. The distribution follows the power law behavior in the large price range, but gradually deviates from the power law as the absolute return becomes small, this shows that the tail distribution of returns for the land index of Shenzhen follows the power-law distribution. Similarly, from Fig.3(b), we can discuss the probability distribution and its tail distribution of returns for the land index of Shanghai in the year 2004. In Table 2, through analyzing the observed data, we show the values of exponents α from the year 2001 to 2006 for the two land markets, Shenzhen (a) and Shanghai (b), where S.E. denotes standard errors and R2 the coefficient of determination, the range of power law exponents is from 2.7723 to 2.9848 in Shenzhen land market, and 2.8792 to 3.3281 in Shanghai land market.

3 The Probability Distribution of Relative Land Price

In this section, we analyze the probability distributions of the relative prices for Shenzhen and Shanghai land indices. Let $t(t = 0,1,2,\cdots)$ denote the t-th trading day, the relative price is defined by

$$P(t) = S(t+1)/S(t)$$

where $S(t)$, $S(t+1)$ are the closing prices of t-th and $(t+1)$-th trading days respectively, i.e., the daily closing prices. From above definition, the relative prices express the values which denote the ratio of $S(t+1)$ to $S(t)$, and we can understand the trend (increasing or decreasing) of land prices from these values. From the data of land indices in Shenzhen and Shanghai stock markets during the year 2001-2006, we have the distributions of the relative prices, and plot the log-log probability density plots in following Figure 4.

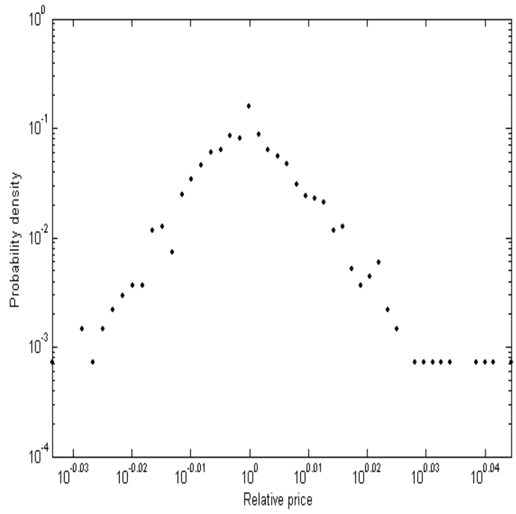

Figure4 (a)

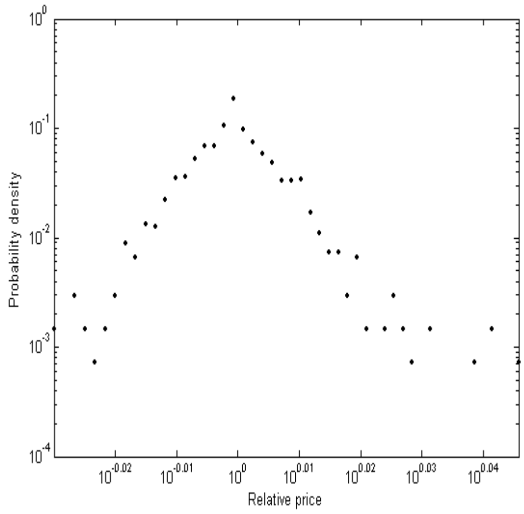

Figure4 (b)

Fig.4. Probability distribution of the relative prices on a log-log scale for land indices of Shenzhen(a) and Shanghai(b) from 2001 to 2006. The horizontal axis denotes the relative prices, defined as the logarithm of the relative price $P(t) = S(t+1)/S(t)$, and the vertical axis denotes probability density.

From Fig.4, the number of dots in the left side of 10^0 (the point of horizontal axis) and the number of dots in the right side of 10^0 implies the fluctuation and trend of Chinese land markets. In Fig.4, there are some dots near $10^{0.04}$, this means that the large jump of land prices occurred in two Chinese land markets.

4 Conclusion

In this paper, we studied the statistical properties of returns and relative prices of land indices for Chinese land markets. The empirical research shows that the distributions of returns have large values of kurtosis and negative values of skewness for the Chinese land indices, we also show that the large returns follow the power law distribution, at last we show the probability density of relative prices. There are two stock exchange markets (Shenzhen and Shanghai) in the mainland of China, and the Chinese stock market is a developing market. Although it has a short history (less than 20 years), the total value of Shenzhen and Shanghai stock markets is more than 50% of GDP for China in January 2007, so we can see that the Chinese stock market plays an important role in the development of Chinese economic. In the present paper, our database is from these markets, so our empirical research is helpful to understand the fluctuations of Chinese land markets.

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