Chapter 4

Empirical results

4.1 Data

China's stock market separated into 3 parts: Shenzhen stock market (Shenzhen Index), Shanghai stock market (Shanghai Index) and Hong Kong stock market (Hengsheng Index). The real estate sector stock is one of the important parts of Shenzhen Index. Therefore this study uses Shenzhen Index and real estate sector stock as the mirror of China's economy and real estate respectively. This study is mainly based on Real Estate Sector Stock data and Shenzhen Index data of People's Republic of China. It covered 6 years' daily data, from August, 30th, 2006 to June, 13th, 2012**,** and the total numbers of data are 1,404 as our study sample. The data are secondary data, which are derived from the official website, namely Real Estate Sector Stock (RESS) and Shenzhen Index (SZI). August, 30th, 2006 to June, 13th, 2012

The data have been collected from People's Republic of China Statistics Bureau website.

All of the following results (tables and figures) are calculated by software R, S-PLUS and Excel.

4.2 Data processing

The statistic of LnRESS and LnSZI from 2006 to 2012 showed as below. In table 4.1, this study can be seen that, there are 1,404 observations of People's

Republic of China's Real Estate Sector Stock return in percentage and Shenzhen Index return in percentage respectively. The mean value of LnRESS is 0.000757. The median value of LnRESS is 0.001901. The maximum value and minimum value are 0.093974 and -0.096031 respectively. The standard deviation is 0.02599. From Skewness value and Kurtosis value this study get that the normal distribution is not suit for LnRESS, it shows the heavy-tailed characteristic.

On the other hand, the mean value of LnSZI is 0.000619. The median value of LnSZI is 0.001295. The maximum value and minimum value of LnSZI are 0.091615 and -0.097501 respectively. The standard deviation is 0.021727. This study also get that the characteristic of LnSZI shows the heavy-tailed distribution. The heavy-tailed distribution means our study for data tail characteristic significantly.

Table 4.1: The descriptive statistics of People's Republic of China's Real Estate Sector Stock and Shenzhen Index return in percentage from the period of 2006 to 2012.

	People's Republic of China's Real Estate Sector Stock return in percentage (RESS)	People's Republic of China's Shenzhen Index return in percentage (SZI)
Mean	0.000757	0.000619
Median	0.001901	0.001295
Maximum	0.093974	0.091615
Minimum	-0.096031	-0.097501
Std.Dev	0.02599	0.021727
Skewness	-0.360211	-0.383502
Kurtosis	4.317917	4.814752
Jarque-Bera Statistic	131.9709	227.3983
Number of obs.	1404	

Source: From computed

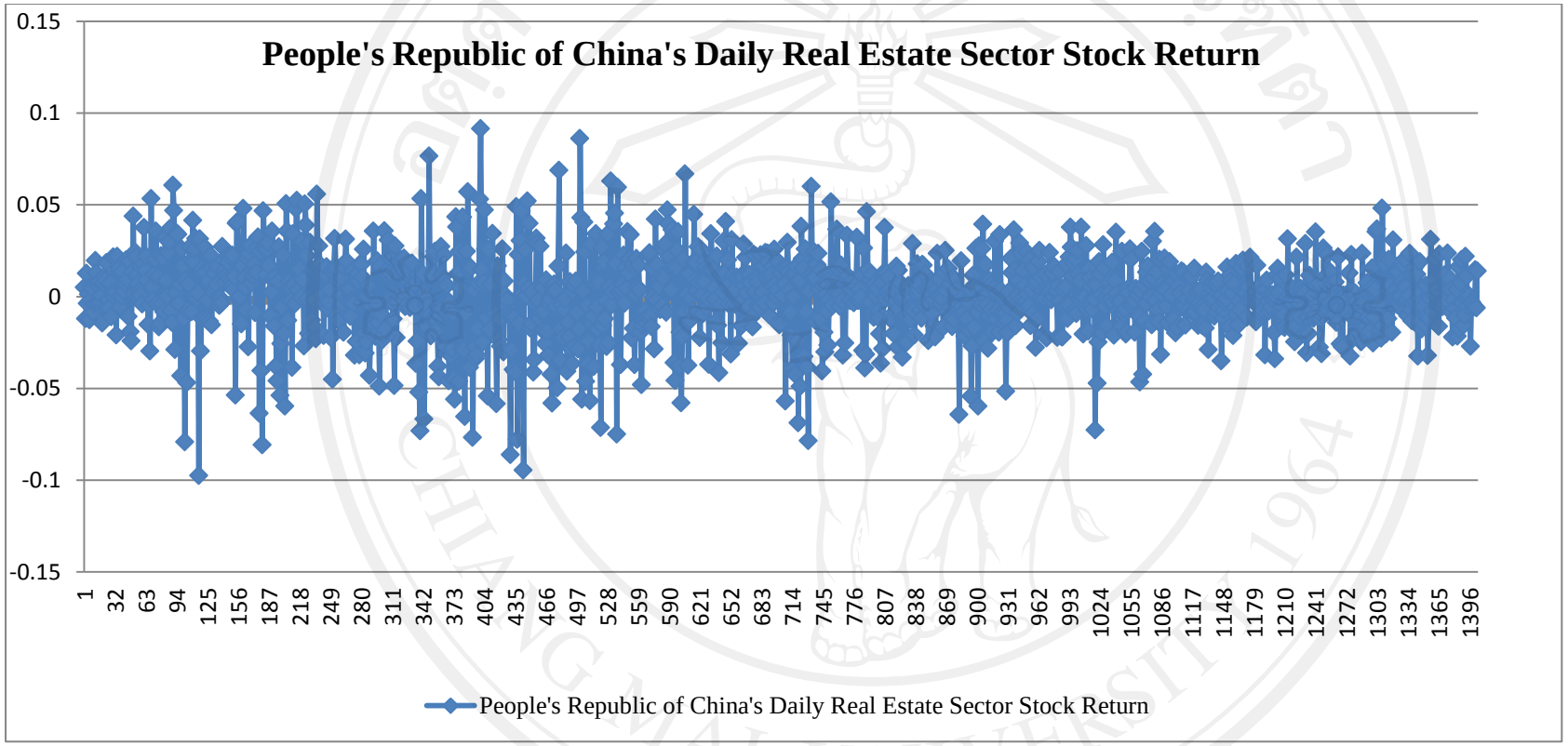

Figure 4.1 The historical daily data of People's Republic of China's Real Estate Sector Stock return in percentage from 2006 to 2012

Source: People's Republic of China Statistics Bureau

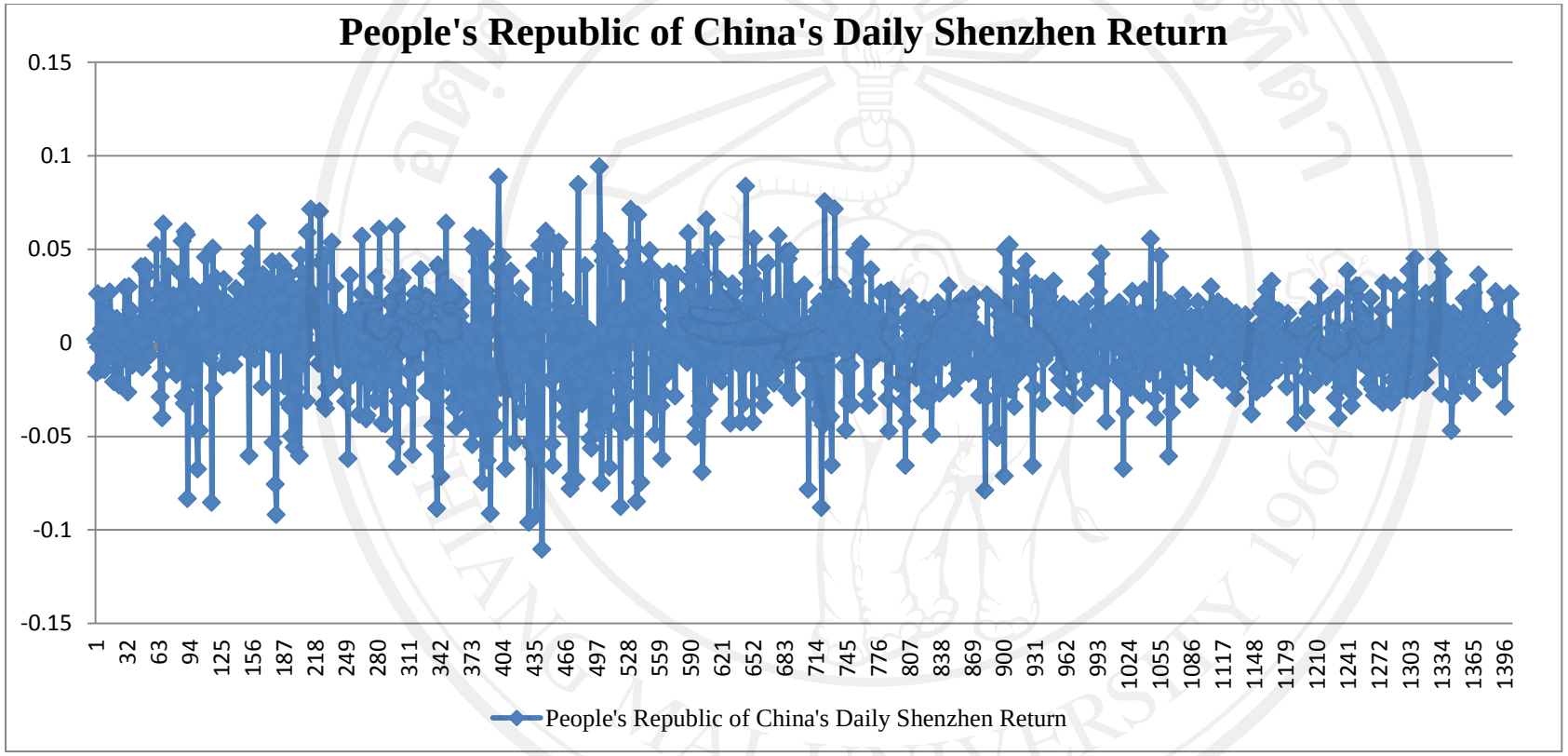

Figure 4.2 The historical daily data of People's Republic of China's Shenzhen Index return in percentage from 2006 to 2012

Source: People's Republic of China Statistics Bureau

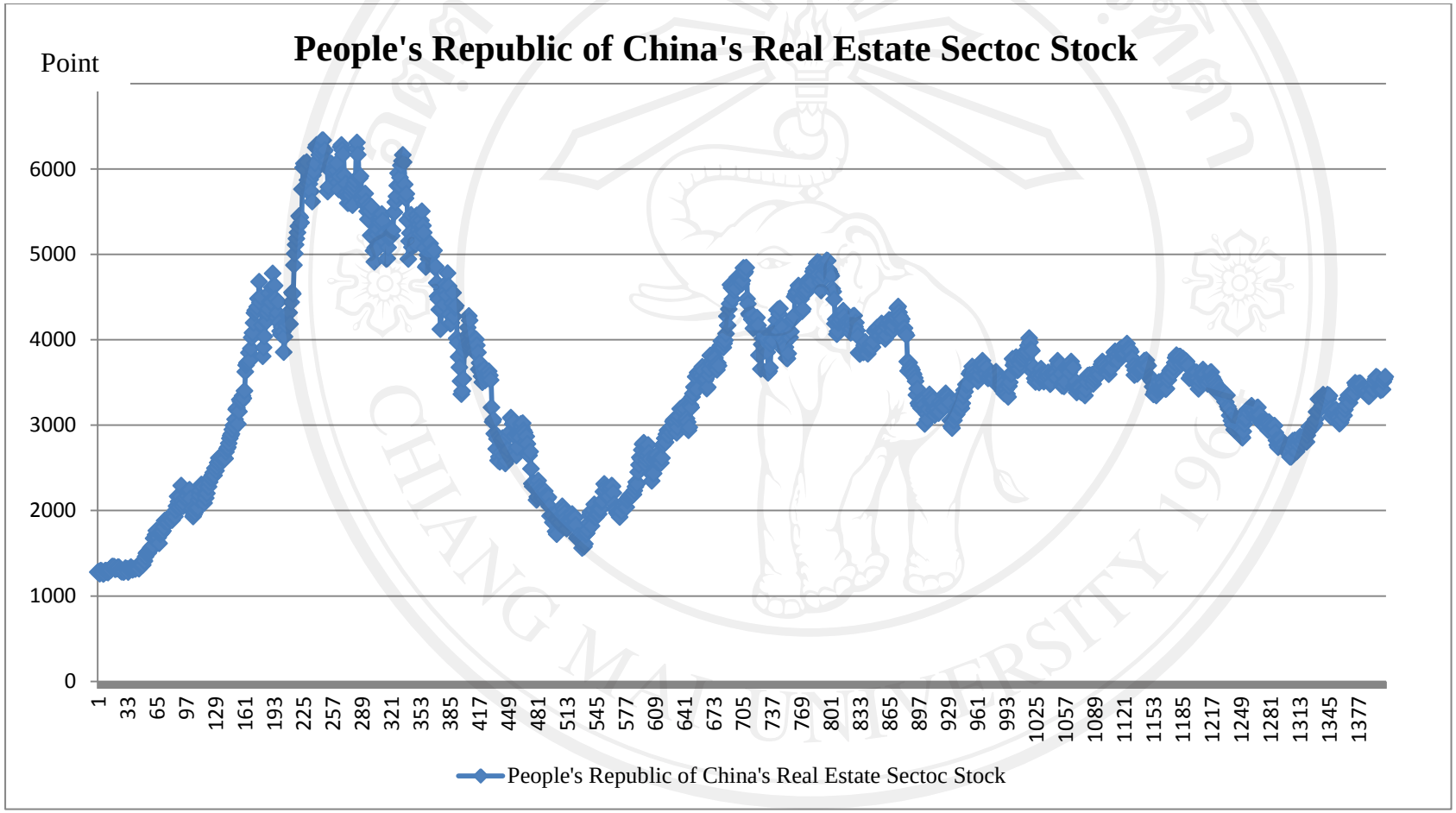

Figure 4.3 The People's Republic of China's Real Estate Sector Stock from 2006 to 2012

Source: People's Republic of China Statistics Bureau

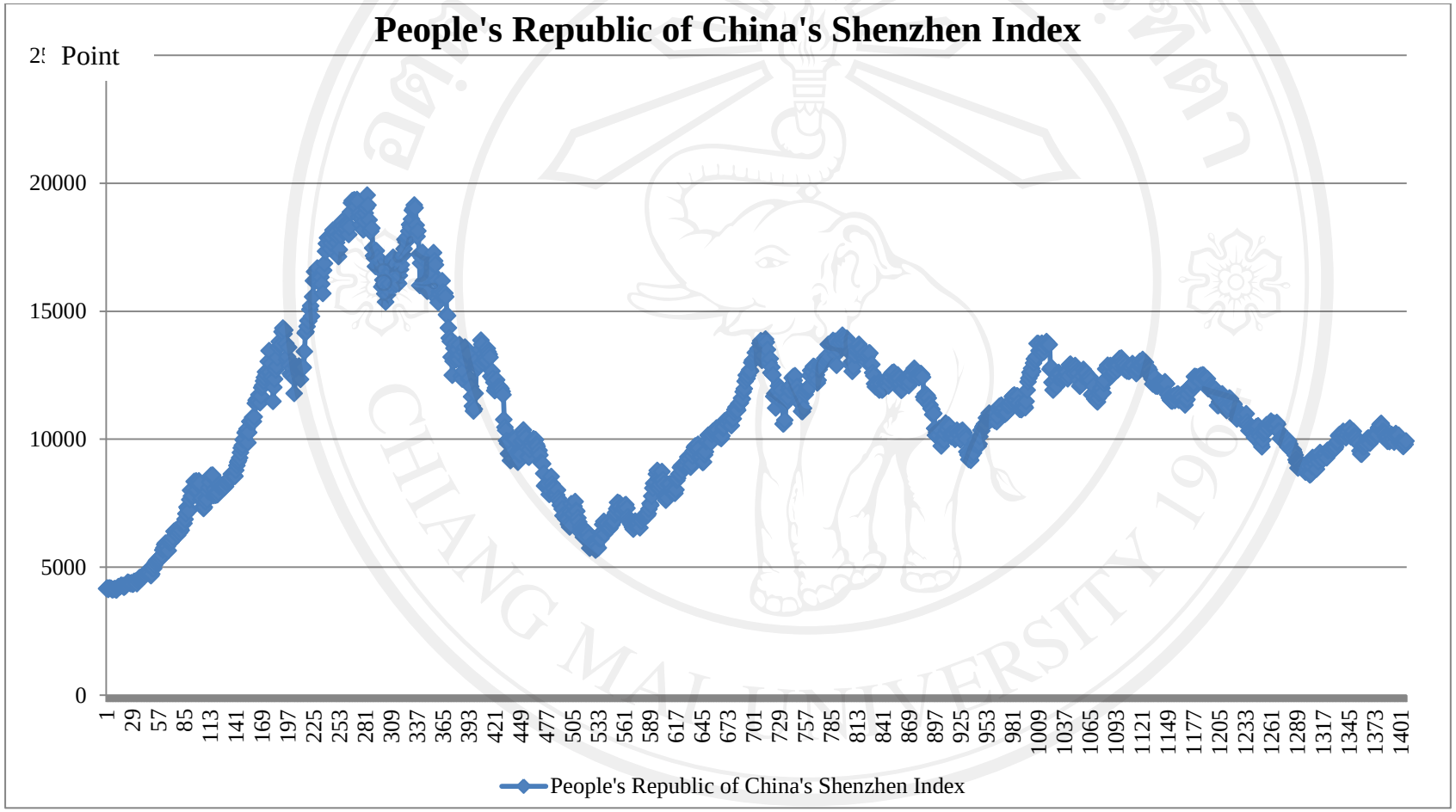

Figure 4.4 The People's Republic of China's Shenzhen Index from 2006 to 2012.

Source: People's Republic of China Statistics Bureau

Figure 4.3 and Figure 4.4 shows the People's Republic of China's nominal Real Estate Sector Stock and Shenzhen Index. This study can find that the trend of each index is similar.

4.3 Unit root test results

The econometric statistical software R is used to conduct a unit root test of both observations. Table 4.2 and Table 4.3 summarize People's Republic of China's Real Estate Sector Stock observation and Shenzhen Index observation results respectively. These two stock indexes P-value at 1% significant level. The results show that the data are stationary and no unit root.

Table 4.2: Results of People's Republic of China's Real Estate Sector Stock return in percentage Unit Root test

Name of Observation: RESS Null Hypothesis: RESS has a unit root		
Augmented Dickey-Fuller test statistic		
Intercept	Trend and Intercept	None
-36.01065***	-36.11011***	-35.99578***
(0.0000)	(0.0000)	(0.0000)
Phillips-Perron test statistic		
Intercept	Trend and Intercept	None
-36.01065***	-36.11011***	-35.99578***
(0.0000)	(0.0000)	(0.0000)

Note: *** means rejection of null hypothesis of non-stationary at 1% significant level.

Source: From computed

Table 4.3: Results of People's Republic of China's Shenzhen Index return in percentage Unit Root test

Name of Observation: SZI Null Hypothesis: SZI has a unit root		
Augmented Dickey-Fuller test statistic		
Intercept	Trend and Intercept	None
-36.53292***	-36.58266***	-36.51803***
(0.0000)	(0.0000)	(0.0000)
Phillips-Perron test statistic		
Intercept	Trend and Intercept	None
-36.52706***	-36.58266***	-35.51803***
(0.0000)	(0.0000)	(0.0000)

Note: *** means rejection of null hypothesis of non-stationary at 1% significant level.

Source: From computed

4.4 The appropriate forecasting models selection of People's Republic of China's Real Estate Sector Stock and Shenzhen Index return in percentage

4.4.1 The appropriate model of People's Republic of China's Real Estate Sector Stock return in percentage

This study use AIC, BIC and MAPE (Mean Absolute Percent Error) help us to select the appropriate model for People's Republic of China's Real Estate Sector Stock return in percentage estimated by linear and nonlinear approaches.

Table 4.4: The model selection of People's Republic of China's Real Estate Sector Stock return in percentage based on AIC, BIC and MAPE (%)

	AIC	BIC	MAPE (%)
Autoregressive Linear Model	-10246.84	-10231.10	1.129636
Self-Exciting Threshold Autoregressive Model	-10243.83	-10207.10	1.207508
Logistic Smooth Transition Autoregressive Model	-10240.68	-10198.71	1.241155
Neural Network Model	-10226.86	-10158.64	1.131131
Additive Autoregressive Model	-10214.84	-10115.15	1.129636

Source: From computed

From Table 4.4, the forecasting evaluation statistics indicated that selected Autoregressive Linear Model (AR Model) is the best model to forecast the People's Republic of China's Real Estate Sector Stock return in percentage of exploration period, which minimizes AIC and MAPE (%) among all candidate models.

For People's Republic of China's Real Estate Sector Stock return in percentage the appropriate model's function this study get shows below:

$$Y_{rt+1} = 0.00071 + 0.02516Y_{rt} - 0.02335Y_{rt-1} + \varepsilon_{rt+1} \quad (4.1)$$

const	phi.1	phi.2
0.000710045*	0.025159629*	-0.023348044*
(0.03085)	(0.03463)	(0.03820)

Where '*' indicate significant at level 0.01

This study will put the appropriate forecasting model's function into generated map:

$$\hat{Y}_{rt+1} = \hat{f}(Y_{rt}, Y_{rt-1}) \tag{4.2}$$

Where $\hat{f} = f(\cdot, \hat{\theta})$, f is generic function. (more detail this study mentioned in Chapter 2)

4.4.2 The appropriate model of People's Republic of China's Shenzhen Index return in percentage

The function AIC, BIC and MAPE (%) can be used to compare all models fitted to the same data. Therefore AIC, BIC and MAPE (%) will help us find the appropriate model for People's Republic of China's Shenzhen Index return in percentage by linear and nonlinear approaches.

Table 4.5: The model selection of People's Republic of China's Shenzhen Index return in percentage based on AIC, BIC and MAPE (%)

	AIC	BIC	MAPE (%)
Autoregressive Linear Model	-10767.01	-10751.26	1.440390
Self-Exciting Threshold Autoregressive Model	-10769.91	-10733.18	1.856281
Logistic Smooth Transition Autoregressive Model	-10765.05	-10723.06	1.734101
Neural Network Model	-10747.69	-10679.46	1.465916
Additive Autoregressive Model	-10762.36	-10662.64	1.743608

Source: From computed

From Table 4.5, the forecast evaluation statistics found that selected Autoregressive Linear Model (AR model) is the best model to forecast the People's Republic of China's Shenzhen Index return in percentage of exploration period because this model has minimize value of BIC and MAPE (%).

For People's Republic of China's Shenzhen Index return in percentage the appropriate model's function this study gets shows below:

$$Y_{st+1} = 0.00061 + 0.03981Y_{st} - 0.04097Y_{st-1} + \varepsilon_{st+1} \quad (4.2)$$

const	phi.1	phi.2
0.000613701*	0.039812964*	-0.040968187*
(0.02917)	(0.01358)	(0.01248)

Where '*' indicate significant at level 0.01

This study will put the appropriate forecasting model's function into generated map:

$$\hat{Y}_{st+1} = \hat{f}(Y_{st}, Y_{st-1}) \tag{4.3}$$

Where $\hat{f} = f(\cdot, \hat{\theta})$, f is generic function. (more detail this study mentioned in Chapter 2)

These appropriate forecasting models' function will fit the sample this study selected in the special period from 2006 to 2012. These results indicate that the linear models are the optimal forecasting models of the real estate sector stock and Shenzhen Index. It shows that the trend of each index is similar, and linear model can capture the characteristics of these stock indexes. The main reason is that the real estate sector stock is one of the important components of Shenzhen index. In my research period 2006 to 2012，the Chinese stock market faced depression in 2007, and financial crisis broken up in 2008. Therefore the linear approach should be used when one country's economy affected by global financial crisis.

From the micro perspective, this study select appropriate model to study of interaction mechanism between them can help investors to understand how the stock indexes run in stock market and forecast the stock indexes in the future. From the macro perspective, it will help Chinese government to put forward effective policy

suggestion in capital market. If the real estate sector stock rise or fall rapidly，the Chinese government should use an appropriate economic leverage to promote a sustainable and stable development of the real estate market and stock market.

4.5 Dependence Coefficients

In order to capture the overall dependence measures between returns in percentage of real estate sector stock and Shenzhen Index, this paper uses a non-linear correlation method, namely, including Kendall's tall and Spearman's rho. Meanwhile, in order to compare with the nonlinear correlation the Pearson's linear correlation will compute.

4.5.1 The dependence measures based on Empirical copulas approach

Table 4.6: The dependence measure of People's Republic of China's real estate sector stock and Shenzhen Index based on Empirical Copula, 2006-2012

Correlation items based on Empirical Copula	People's Republic of China's real estate sector stock and Shenzhen Index Dependence Coefficients
Kendall's tau statistics	0.6962
Spearman's rho statistics	0.8703

Source: From computed

From Table 4.6 this study will get that based on Empirical Copula the Kendall's tau statistics of dependence measure between People's Republic of China's real estate sector stock and Shenzhen Index is 0.6962. In addition, the Spearman's rho statistics of dependence measure between People's Republic of China's real estate sector stock and Shenzhen Index is 0.8703.（see more detail in appendix）

4.5.2 The dependence measures based on Pearson's correlation coefficient

Table 4.7: The dependence measure of People's Republic of China's real estate sector stock and Shenzhen Index based on Pearson's correlation coefficient, 2006-2012

Correlation items based on Empirical Copula	People's Republic of China's real estate sector stock and Shenzhen Index Dependence Coefficients
Pearson's corr. statistics	0.8961

Source: From computed

From Table 4.7 this study will get that based on Pearson's correlation coefficient statistics of dependence measure between People's Republic of China's real estate sector stock and Shenzhen Index is 0.8961.

For classical linear correlation, it will capture the characteristic of normal distribution. Compare with nonlinear correlation such as Kendall's tau and Spearman's rho, Pearson's linear correlation cannot capture heavy-tailed

characteristic. From the basic statistic summary of our data, the Kurtosis and Skewness indicate that our data will obey the heavy- tailed distribution. Therefore, this study will use Kendall's tau and Spearman's rho to measure the dependence structure between RESS and SZI. The Pearson linear correlation should be used when one country's economy affected by global financial crisis or economic crisis. This study calculates the Pearson linear correlation in this paper, because this study will provide a comparison result with the nonlinear correlation.

According to empirical copula approach and Pearson's linear correlation coefficient，the results indicate that the dependence measure between these two stock indexes return in percentage are very strong. These results show that the interactions between these two stock indexes are very strong. If real estate sector stock increase，Shenzhen index also will rise, due to real estate price reactions also lag behind the stock index, thus real estate sector stock as the variable will be react the real estate market prosperity accurately. Real estate market is one of the pillar industries of Chinese economy，it playing as a key driving force for economic development. China's stock market as the role react economic operation. Therefore Chinese government in order to drive GDP sustainable and stable growth，it should restrict the excessive depreciation of real estate price to prevent the real estate market recession.