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# Research on Management Policy and National Real Estate Climate Index in China

***Abstract.*** *Using ARIMA time series analysis method, this paper predicts NRECI from May to December 2011. Then detailed analysis is made of the NRECI trend and the major management policies introduced in corresponding periods. The results show that NRECI is closely related with management policy of real estate industry in China. The development trend of the NRECI from May to December 2011 indicates that the authorities should take moderate management measures to keep the stable trend sustained.*

***Streszczenie.*** *W artykule przedstawiono metodę obliczania iprzewidywnia współczynnika NRECI (National Real Estate Climate Index). Do tego celu wykorzystano metodę analizy szeregu ARIMA. (**Badania nad polityką zarządzania wykorzystującą indeks NRECI – National Real Estate Climate Index**)*

**Keywords:** China real estate industry, seasonal ARIMA model, management policy, national real estate climate index
**Słowa kluczowe:** real estate – pośrednictwo nieruchomości, **model ARIMA**

## 1. Introduction

National real estate climate index (NRECI) is a comprehensive quantized index to reflect development trends and changes of China real estate industry. The estimation of NRECI is significant to the sound development of the real estate industry in China, as it functions as the basis on which the authorities can develop management policies to regulate the development of real estate industry.

Estimating index was conducted by a few scholars in different areas in the latest 20 years. Taylor and Bowen (1987)[1] examined a number of forecasting techniques and assessed their suitability via the vehicle of the Bureau for Economic Research (BER) building cost index. Their result showed ARMA model had the best accuracy. Francis and Glenn (1991)[2] studied the ability of the composite index of leading economic indicators to predict future movements in aggregate economic activity, and they found a substantial deterioration of forecasting performance in the real-time framework which uses the provisional and partially revised data for the leading index that were actually available historically, along with recursive out-of-sample forecasts. Williams (1994)[3] presented a neural network model to predict short-term change of the construction cost index with two additional economic variables such as the prime rate and new housing starts. N. Kulendran and S. F. Witt (2003)[4] developed leading indicator transfer function (TF) models to generate forecasts of international tourism demand from the UK to six major destinations. The inclusion of a causal input within an ARIMA time series framework (TF model) does not result in an improvement in forecasting performance. The time series models outperform the ECM for short-term forecasting. Baabak and Jian (2010)[5] summarized and compared the applicability and predictability of various univariate time series approach for forecasting of CCI. It was shown that the seasonal autoregressive integrated moving-average model is the most-accurate time series approach for in-sample forecasting of CCI. Despite various methods presented to date, the potential of forecasting NRECI, especially along with research on the relationship between management policy and NRECI in China, has not been explored fully.

This paper predicts NRECI from May 2011 to December 2011 by using seasonal ARIMA model and then analyzes management policies and NRECI from January 1991 to December 2011, aiming to give useful lessons for China management policy of real estate industry.

## 2. Seasonal ARIMA Model

An autoregressive integrated moving average (ARIMA) model is a generalization of an autoregressive moving average (ARMA) model (Brockwell and Davis, 2002)[6]. ARIMA is recommended to model time series data displaying nonstationary behaviors (Box and Jenkins 1970)[7]. These models are fitted to time series data either to better understand the data or to predict future points in the series. An ARIMA model is determined by three parameters: p, q, and d. Parameters p and q are integers describing the orders of AR and MA parts of the model, respectively, and parameter d is an integer representing the difference order required to transform the original data set to stationary time series data. The seasonal ARIMA approach is an extended ARIMA technique that is developed to handle seasonality in time series data. In addition to parameters p, q, and d required to define a regular ARIMA model, parameters P, Q and D are used to describe the seasonal ARIMA model. Parameters P and Q are integers describing the orders of AR and MA seasonal parts of the ARIMA model, respectively, and parameter D is an integer representing the difference order required to remove the seasonality of the transformed stationary dataset. A seasonal ARIMA model of ARIMA(p,d,q)(P,D,Q) is described by the following equation (Baabak and Jian, 2010)[5]:

$$(1-B)^d(1-B^S)^D Y(t) = \mu + \frac{\theta(B)\Theta(B^S)}{\phi(B)\Phi(B^S)} Z(t) \quad (1)$$

where B =backshift operator, d =differencing order, D=seasonal differencing operator, S=period of seasonality, μ=constant mean of time series $(1-B)^d(1-B^S)^D Y(t)$, Φ(B)=AR operator for the seasonal part of the ARIMA model, Θ(B)=MA operator for the seasonal ARIMA model, and Z(t)=white noise time series sampled from a random variable with mean 0 and finite variance $\sigma^2 < \infty$.

## 3. Forecasting Model of NRECI

NRECI reflects trends and changes in the real estate industry with the percentage system. Specifically, the NRECI value of 100 is the boom line. A value above 100 indicates that the real estate industry is in a situation of prosperity, whereas a value below 100 means the industry is in a situation of recession. The NRECI data is updated monthly by statistical agencies of real estate industry in the National Bureau of Statistics.

The data used in this paper consist of 216 data points corresponding to the values of NRECI in every month from

January 1991 to December 2008. This time series data set is denoted by {Y(t):t=1,2,…,216}, where Y(1)=NRECI in January 1991, Y(2)=NRECI in February 1991,…, Y(216)=NRECI in December 2008. The source of this time series data is the website of National Bureau of Statistics.

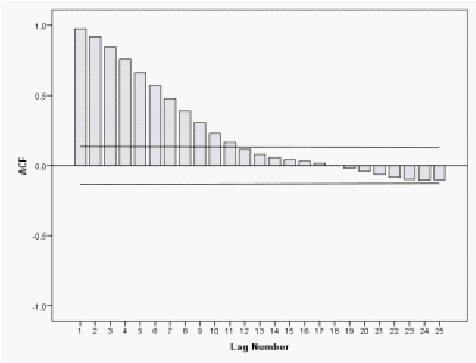


Fig.1. ACF plots of {Y(t):t=1,2,…,216}

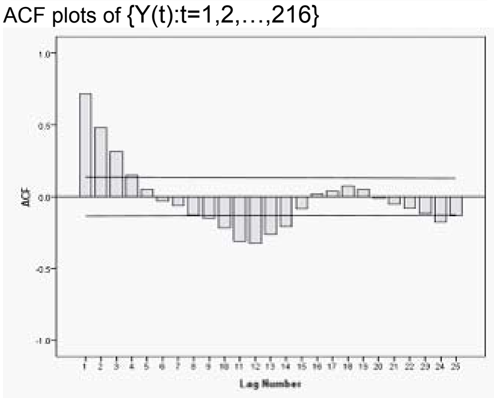


Fig.2. ACF plots of {C(t):t=1,2,…,216}

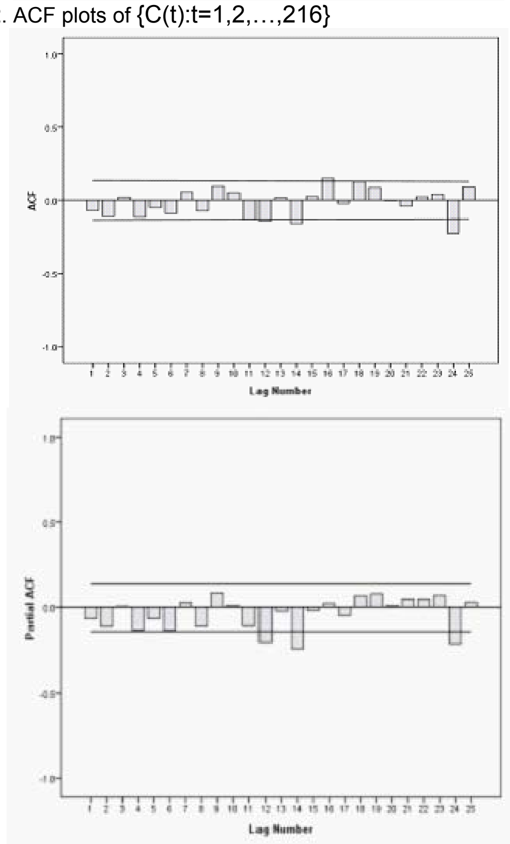


Fig.3. ACF (top) and PACF (bottom) plots of {D(t):t=1,2,…,216}

### 3.1. Transformation of NRECI Data Set

ARIMA model requires the time series used for building the model to be stationary. Or if the requirement in not met with the original data set, a sequential differencing operation should be applied to create a stationary time series data set. We uses ACF graph as a visual tool to study whether NRECI is stationary. The formulation for calculating the ACF of a time series at various lag levels is reviewed in Brockwell and Davis (2002)[6]. Time series data set is stationary if all ACF values would be inside the two black straight lines that identify the stationary thresholds with a 95% significant level. Fig. 1 shows the ACF values of NRECI at various lag levels with discrete bars. Since the ACF bars in Fig. 1 are located outside the significant level before lags 13, it can be said that this time series data set is nonstationary. The first difference is applied to NRECI. The new time series dataset is denoted by {C(t):t=1,2,…,216}.

Fig.2 shows the ACF bars of {C(t):t=1,2,…,216} are still located outside the significant level with volatility, which means this time series data set remains nonstationary. Therefore, the second difference is applied to NRECI. This transformed data set is denoted by {D(t):t=1,2,…,216}. Fig.3 (top) shows almost every ACF value of {D(t):t=1,2,…,216} is inside the two black straight lines that identify the stationary thresholds with a 95% significant level, which can be visual evidence about the stationary property of the transformed time series data .

### 3.2. Determination of Parameters

Since twice differences and zero seasonal difference is applied to{Y(t):t=1,2,…,216}, so differencing order d=2 and seasonal differencing operator D=0.

A series of rules is recommended by Watson and Teelucksingh (2002) to select an appropriate time series model by observing the behaviors of the ACF and PACF graphs of a specific time series data set. If ACF and PACF values of a time series are equal to zero at all lag levels the time series is a white noise. If the PACF graph of a time series cuts off after lag p and its ACF graph dies down the time series is AR (p). If the ACF graph of a time series cuts off after lag q and its PACF graph dies down the time series is MA (q). If both ACF and PACF graphs of a time series die down the time series is ARIMA. As is shown in Fig. 3, both ACF (top) and PACF (bottom) of the transformed data set{D(t):t=1,2,…,216} graph die down to zero; therefore, ARIMA is an appropriate model for this data set, and initially p=0 or p=1,q=0 or q =1. Parameters P and Q of the seasonal ARIMA model are identified by observing the behaviors of ACF and PACF plots of the transformed data set {D(t):t=1,2,…,216}at multiples of lag 12, which is the seasonality period of the monthly incremental changes in NRECI time series data. The sample ACF and PACF plots are respectively shown in the top and bottom of Fig. 3. It can be seen that both the value at lag 12 of ACF graph and PACF graph are significantly not zero, therefore, P=1 and Q =1. Then four initial ARIMA model to forecast NRECI time series data are developed, which are ARIMA(0,2,0)(1,0,1), ARIMA(0,2,1)(1,0,1), ARIMA(1,2,0)(1,0,1) and ARIMA(1,2,1)(1,0,1).

### 3.3. Estimation of Coefficients

AR and MA coefficients in Eq. (1) are determined based on the maximum likelihood estimation (MLE) approach. The coefficient of the initial ARIMA(0,2,0)(1,0,1) model is $\phi(1)=0.728338$ and $\theta(1) = -0.987198$ with the p value of <0.0001 and <0.0001. The coefficients of the initial ARIMA(0,2,1)(1,0,1) are $\phi(1)=0.094535$, $\theta(1) = -0.987233$ and $\Phi(1)=0.684198$ with the p value of 0.3905, <0.0001 and <0.0001. The coefficients of the initial ARIMA(1,2,0)(1,0,1) are ϕ(1)=0.68462, θ(1) = -0.988225 and Θ(1)=0.09928, and with the p value of <0.0001, <0.0001 and 0.2889. The coefficients of the initial ARIMA(1,2,1)(1,0,1) are ϕ(1)=-0.854727, θ(1) = -0.989732 and Φ(1)=0.712567 and Θ(1)=0.98399, and with the p value of <0.0001, <0.0001 , <0.0001 and <0.0001. Since ϕ(1) of ARIMA(0,2,1)(1,0,1) with the p value of 0.3905 and Θ(1) of ARIMA(1,2,0)(1,0,1) with the p value of 0.2889 shows that these two coefficients does not contribute much in building an forecasting model respectively. Therefore, ARIMA(0,2,0)(1,0,1) and ARIMA(1,2,1)(1,0,1) are selected to be more accurate seasonal ARIMA models.

### 3.4. Selection of Models

According to Eq. (1), the residuals of the seasonal ARIMA model must also be a white noise time series data set that is sampled from a random variable with mean 0 and finite variance $\sigma^2 < \infty$. Therefore, the Ljung-Box Q test is used to test whether residual time series data follow a white noise random process. Fig. 4 shows the p values of this test for various lag levels on residual data sets of ARIMA(0,2,0)(1,0,1) and ARIMA(1,2,1)(1,0,1) models. Fig. 4 (bottom) shows that the p values for most lag levels are all above the threshold line of the 5% significance level for ARIMA(1,2,1)(1,0,1). This observation rejects the hypothesis that the residual time series data for this model follow white noise distribution. However, Fig. 4 (top) shows that p values after lag 13 are all below the threshold line of the 5% significance level for ARIMA(0,2,0)(1,0,1). Therefore, the hypothesis that the residual time series data for this seasonal ARIMA model follow white noise distribution cannot be rejected. Consequently, ARIMA(0,2,0)(1,0,1) is the seasonal ARIMA model that is applicable to our NRECI data set based on the results of the diagnostic checking test of the residuals. Eq. (2) describes the formulation of the seasonal ARIMA(0,2,0)(1,0,1) model

$$(1-B)Y(t) = \frac{(1+0.987198B)}{(1-0.728338B)}Z(t) \qquad (2)$$

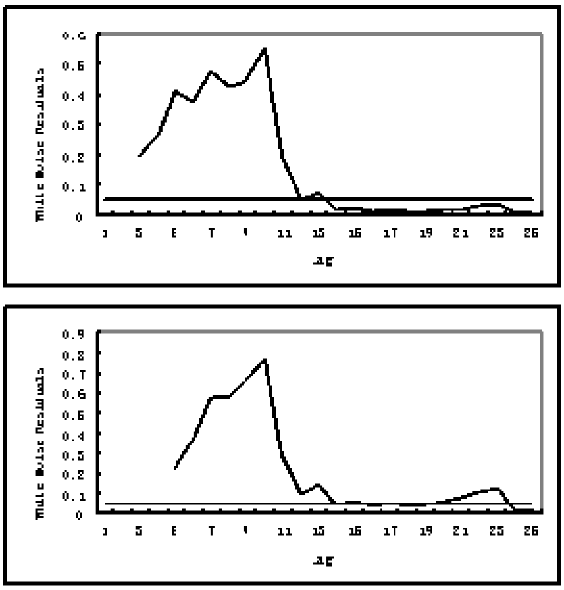

Fig.4. p-values plots of residuals of the ARIMA(0,2,0)(1,0,1) (top) and ARIMA(1,2,1)(1,0,1) (bottom) models for conducting the Ljung-Box Qtest

### 4. Forecast and Discussion

To predict the NRECI for the period from May to December 2011, we extended the sample size to include 244 points, covering data from January 1991 to April 2011. Then data fitting was made with the new RECI entrants from January 2009 to April 2011, based on ARIMA (0,2,0) (1, 0,1) Model. The result shows MAE is 0.470694, MAPE is 0.453886, indicating the ARIMA (0,2,0) (1,0,1 ) Model is valid for the prediction.

We then made the prediction and obtained the RECI for the period from May to December 2011. With these data we were able to draw the NRECI chart from January 1991 to December 2011 (as in Fig. 5). One point to note, as the data from China's National Bureau of Statistics are missing those of the three Januaries from 2009 through to 2011, the corresponding month in the figure are three breakpoints. Further analysis of Fig. 5 shows:

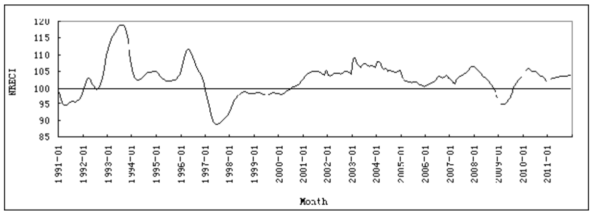


Fig. 5. NRECI chart from January 1991 to December 2011

(1) From early 1991 to mid-1993, NRECI went all the way up, rising from a low point of 94.46 to a very high point of 118.99, showing a sharp warming trend of the real estate industry. That could mainly be attributed to the impact of Deng Xiaoping' Talk in South China in February 1992.

(2) In 1992 to 1993, financial institutions invested heavily in real estate, resulting in overheated real estate development during this period. In response, in June 1993 the Chinese government proposed 16 management measures to rectify the financial order and to strengthen macro-management over the economy. In November of the same year the Government began the reorganization and rectification of the real estate industry in China, making the industry resume a sharp downturn. Correspondingly, NRECI went down from a high point of 118.99 in July 1993 all the way to a very low point of 88.79 in June 1997.

(3) July 1998, saw the Chinese real estate industry recover quickly, with NRECI rising nearly to reach the boom line of 100. It kept rising and reached a high point of 109.14 in February 2003. The main influence of management policy on Chinese real estate industry during this period was that it was clearly stated in July 1998 that the authorities wanted to make the housing industry into a new economic growth point. This ended the former welfare housing program and opened a new era of housing reform in China. Accordingly, the real estate financial and credit policy made corresponding adjustments, with the core aim to stimulate domestic housing consumption. Thus the real estate market began to walk out of years of recession.

(4) With the real estate market heating up again in China after 1998, China's commercial housing vacancy kept growing and the vacancy rate in some cities even went above the international warning line. To deal with this problem, China's central bank took measures to tighten the real estate credit business management in June 2003. This was seen as an indicator that the Chinese government started to take management measures to regulate the overheated real estate industry. Meanwhile, the Chinese government required that those real estate development companies and real estate projects meeting certain requirements should continue to get greater credit support. With these two management policies in effect together from February 2003 to November 2007, the NRECI was mainly stable above the boom line of 100, with the rate of change no more than 8%.

(5) From November 2007, the NRECI began a rapid decline, dropping from 106.59 to 94.74 in March 2009, decline rate reaching 11.12%. This was mainly because the Government put forward a real estate management policy package after the beginning of 2007, aiming to stabilize real estate prices and to cool the real estate market. The package policies covered a wide range from land, credit to taxation. For example, the central bank increased Interest rates in March 2007. In addition, the international financial crisis which began in September 2008 further accelerated the downward trend in China's real estate industry, making the NRECI once again fall into recession interval.

(6) In order to mitigate the impact of financial crisis on the real estate industry, the Chinese government repeatedly cut interest rates after September 2008. As a follow-up measure, it introduced preferential policies for Second-hand housing sales tax exemptions and concessions in November 2008. With these incentives, the Chinese real estate industry entered into a recovery stage, and the NRECI increased from 94.74 in March 2009 to 105.06 in June 2010, coming back into the boom interval.

(7) From April 2010, the Chinese government has introduced a number of regulations in order to effectively curb speculative investment and to ensure smooth and healthy development of the real estate market. In this phase, the NRECI again declined, from 105.89 in March 2010 to 101.79 in December 2010, hovering near the boom line.

Through analysis of the data from January 1991 to April 2011, we can see the NRECI trend is closely related with the real estate management policy. When the real estate industry is overheated, the industry management policy will be tightened, and the NRECI will generally decline. In contrast, when the real estate industry enters a downturn stage, the Chinese government will introduce active management policy, and the NRECI will bounce up.

The prediction curve shows that in the period from May 2011 to December 2011 the NRECI is always above the boom line, rising from 103.3478 to 104.2141 with a steady upward trend. This indicates that the development of China's real estate industry in the remaining months of 2011 will be smooth and stable, which, to some extent, is in line with the Chinese government's management objectives of ensuring healthy and stable development of the real estate industry. Nonetheless, the Chinese government should pay close attention to the development of the situation to ensure that this growth trend will not evolve into another round of excessive overheated growth. Therefore, for the Chinese government, the future management of the real estate industry must balance the two aspects between keeping the industry from overheating and ensuring a healthy, balanced and sustainable growth. To achieve that objective, it is necessary to continue to introduce stringent measures to resolve real estate bubbles and guide the industry back into normal orbit but these management measures must be strict but appropriately so that the real estate industry will not be affected too much.

## 5. Conclusions

This paper establishes an ARIMA (0,2,0) (1,0,1) as the NRECI Prediction model through methods of smooth time series processing, parameter estimation and model comparison, using the NRECI from 1991 to 2008 as the sample data. Based on this ARIMA (0,2,0) (1,0,1) model, the NRECI from May to December 2011 are predicted and the NRECI chart from January 1991 to December 2011 is obtained. Then the relationship between policy and NRECI is analyzed. The results show that the NRECI trend is closely related with the real estate management policy. When the real estate industry overheats, the management policy will be tightened, and the NRECI will generally decline; when the real estate industry downturns, the Government will introduce stimulating management policy, and the NRECI will bounce up. Among those policies already implemented, several played a key positive role in promoting the development of the real estate industry and lifting it out of the downturn valley. These include active measures respectively taken in February 1992, July 1998 and November 2008 all. While a few other management policies respectively issued in June 1993, March 2007 and April 2010 were of great importance in stabilizing the industry, keeping it from overheating. The development trend of the NRECI from May to December 2011indicates that China's real estate industry will remain stable in development, which is in line with the management objectives of the Government. The implication is the authorities should continue present management policies or take moderate measures to keep this stable trend sustained. Radical measures are not needed and therefore should be avoided.

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