

Cyclical fluctuations of real estate investment across regions in urban China

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Abstract: Taking the concrete conditions of each region into full consideration, the Chinese real estate market is divided into an eastern market, a central market and a western market. For each market, the autoregressive integrated moving average (ARMA) model is established and spectral analysis is carried out to better understand the changes in the real estate markets in each region. The results show the investment levels and several kinds of cycles within each market. The level of real estate investment (LREI) in the eastern region is the highest, and the short cycle of investment is about 4 to 5 years; the LREI in the central region is in the middle, and the short cycle of investment is about 2 to 3 years; the LREI in the western region has been rapidly increasing in recent years, and the short cycle of investment is about 4 to 5 years. Real estate investment in each area has reached a peak and completed a middle-cycle movement after a period of sustained recession and an upsurge process, which has taken about 9 to 10 years.

Key words: real estate investment; ARMA model; spectral analysis; cycle of investment

Real estate has become a fundamental industry and plays a vanguard role in the drive to modernization. It serves as a barometer of economic development, and it is of great significance to the growth of the Chinese economy^[1]. To ensure that the Chinese economy achieves a sustainable, speedy and healthy development, it is necessary to develop the study of cyclical fluctuations of real estate investment across the various regions in urban China. This is all very positive.

Since the implementation of reforms and the opening of doors to the international community in 1978, Chinese real estate has grown from a small industry into a large one in the past twenty years or more, but its growth has had a notable feature: cyclical fluctuations. A research team studying real estate cyclical fluctuations, at the Chinese Academy of Social Sciences, thought that the Chinese real estate industry had experienced four cycles since 1981, and the factors affecting cyclical fluctuations were undergoing broad and profound changes, from a traditional economic structure to a more market-oriented one, and the basic role of the market in allocating resources has become noticeably stronger^[2].

The regional features of Chinese economic development are very outstanding. The eastern coastal areas take the lead in economic development, taking full advantage of their own strengths. But the central and western regions are relatively backward. The above-mentioned features have caused unbalanced real estate development across regions in urban Chi-

na. Chinese real estate investment is centered largely in the eastern region, but in the central and western regions there is relatively little investment. Relative to the central and western regions, the market-oriented reforms of the real estate market in the eastern region started early. Now, the capacity for growth is bigger; the market mechanisms are more advanced, and the competition is on a broader scale, in more spheres and on higher levels. There is a straw in the wind indicating that there are investment overheats in parts of the eastern region. With the implementation of a strategy of large-scale development of the western region and construction of “the new countryside”, the central and western regions’ rapid growth period is coming.

Real estate investors include the state, the collectives and the individuals; the investment targets include the areas of development, operation, management, consumption and services, and the investment in real estate development makes up the greatest part, on which other investment activities are based. To put the investment in real estate development in the right perspective is of overarching importance to a healthy development of the real estate markets. Therefore, the completed investment by enterprises for real estate development is chosen to be the indicator for observation.

Cyclical fluctuations in real estate market research can be traced from the mid-1990s. Zhang et al.^[3-4] analyzed the cyclical fluctuations of the Chinese real estate industry with the use of different kinds of index factors and research methods. They focused on the mutual relations between the Chinese real estate industry cycles and the macro-economic cycles in different cycle phases. Choosing investment and policy factors, they analyzed the reasons for Chinese real estate cycle fluctuations. Tan^[5], on the basis of research on Chinese real estate cycle fluctuations, made use of the diffusion index method to analyze the real estate cycle characteristics of Shenzhen. Tan^[5] looked at the gross, investment, production, trade, financing and price as 6 variables, including 16 indices.

The empirical studies above have made remarkable contributions to the understanding of Chinese real estate theory. However, Hong^[6] pointed out that, no matter in theory or in practice, there are still a lot of insufficiencies in the present research, particularly in Chinese real estate cycle theory. At least, it still needs more extensive study in the following cases: ...China should conduct further research on the regional cyclical fluctuations of the real estate market. The real estate industry has significant geographical features, and there are noticeable differences among different cities. When carrying on research treating Chinese real estate markets as a single entity, the seriousness of some problems may be underestimated^[6]. For this reason, this paper analyzes the track of investment development and changes, as well as the invest-

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ment cycle, from the perspective of the Chinese eastern, central, and western real estate markets. Although the analysis has not reached the “city” level, it has been able to play a useful role in the enterprise’s strategy choices in the real estate market and the government’s macro-control. Also, the methods in this paper should be a very good reference for the “city” level analysis of the real estate market.

Cyclical fluctuations analysis of real estate investment, which mainly studies past year development trends, includes two major parts: the variation trends and the cyclical fluctuations in investment. The former mainly serves in fitting and forecasting in the market, while the latter makes as its main purpose, the analysis of the market’s variation rules on a higher level and makes certain-extent amendments for market forecasts. At present, studies on the combination of these two are not thorough enough. Current studies tend to emphasize one side or the other of the two.

1 Trend Analysis and Fitting of Investment in Real Estate in Each Region

At present, using statistical methods, especially time series analysis to research economic time series and to try to find their variation characteristics is becoming increasingly popular^[7-10]. But there are very few papers researching fluctuations in the real estate cycle using a time series analysis, and there is almost no one specializing in the fluctuations in investment in the real estate market using a time series analysis.

In order to more thoroughly analyze the development track of regional investment in the real estate market, the ARMA model method is used. The data used is real estate investment completed in each region from 1986 to 2004^[11] and it has been collected from the Chinese Statistical Yearbook of 1987–2005. The curves generated by the data are shown in Fig. 1. To facilitate the description, the data (time series) is denoted as X_t . Because the State Housing Index was first released from 1998 by the State Statistical Bureau, we cannot separate the price index from X_t , but it is helpful in forecasting investments, because forecasting itself should take price indices into consideration.

From Fig. 1, we can easily find that the eastern region exponential growth trend is obvious. In order to conveniently deal with the data, a new time series Y_t is formed, $Y_t = \ln(X_t)$ (see Fig. 2).

From Fig. 2, it is not difficult to see that in every region, the value of Y_t grows as time passes, so Y_t is broken into two

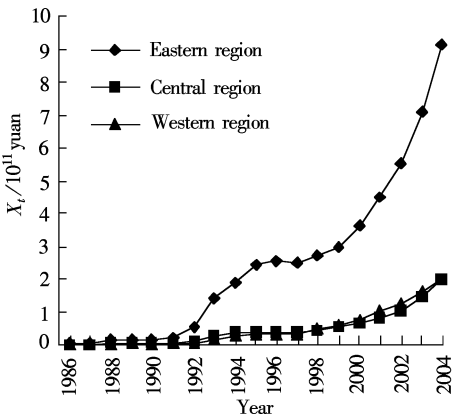


Fig. 1 Variation curve of X_t in different regions

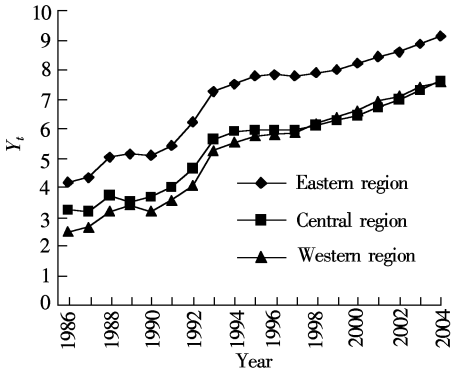


Fig. 2 Variation curve of Y_t in different regions

parts: one is the part of the growth trend, and the other is the random part.

The equation of fitting Y_t in the eastern region:

$y_t = -546.858 + 0.278t \quad t = 1986, 1987, \dots, 2004 \quad (1)$

The equation of fitting Y_t in the central region:

$y_t = -489.948 + 0.248t \quad t = 1986, 1987, \dots, 2004 \quad (2)$

The equation of fitting Y_t in the western region:

$y_t = -584.975 + 0.296t \quad t = 1986, 1987, \dots, 2004 \quad (3)$

The random part is called z_t , $z_t = Y_t - y_t$ (see Tab. 1).

Tab. 1 Value of z_t in each region

Year	Eastern region	Central region	Western region
1986	-0.34	0.09	-0.06
1987	-0.44	-0.25	-0.17
1988	-0.02	0.07	0.06
1989	-0.19	-0.38	-0.03
1990	-0.50	-0.51	-0.54
1991	-0.44	-0.41	-0.44
1992	0.09	-0.02	-0.26
1993	0.80	0.72	0.62
1994	0.83	0.75	0.64
1995	0.81	0.56	0.52
1996	0.57	0.27	0.29
1997	0.27	0.02	0.04
1998	0.09	-0.06	0.06
1999	-0.09	-0.13	-0.01
2000	-0.18	-0.21	-0.06
2001	-0.24	-0.19	-0.05
2002	-0.31	-0.19	-0.17
2003	-0.34	-0.10	-0.17
2004	-0.36	-0.03	-0.27

The first step in forming the ARMA model is to test whether z_t is steady or not; if not, the model cannot be formed directly. The most popular test method is the DF test and the ADF test advanced by Dickey and Fuller^[12]. But these tests are suitable in situations where the samples are very large. The data collected here cannot match such a criterion. If the sample is less than that criterion, the quality standards of the test results should be lowered. After examination, it is found that z_t cannot match the standards corre-

sponding to a 1% confidence level, but can match the standard corresponding to a 5% confidence level (see Tab. 2). Therefore, the time series z_t can be seen as stable, so it can be used to form an ARMA model.

Tab.2 The ADF test result of z_t in each region

Parameter	Eastern region	Central region	Western region
ADF	-2.395291	-2.452873	-2.538063
1% confidence level	-2.708094	-2.708094	-2.708094
5% confidence level	-1.962813	-1.962813	-1.962813
10% confidence level	-1.606129	-1.606129	-1.606129

Regarding autocorrelation and partial correlation coefficients, it is not difficult to see that for each region (see Fig. 3), parameters p and q of the ARMA model are not greater than 2. For security, AR(1)MA(1), AR(1)MA(2), AR(2)MA(1) and AR(2)MA(2) models are tested. Tab. 3 shows the experimental results.

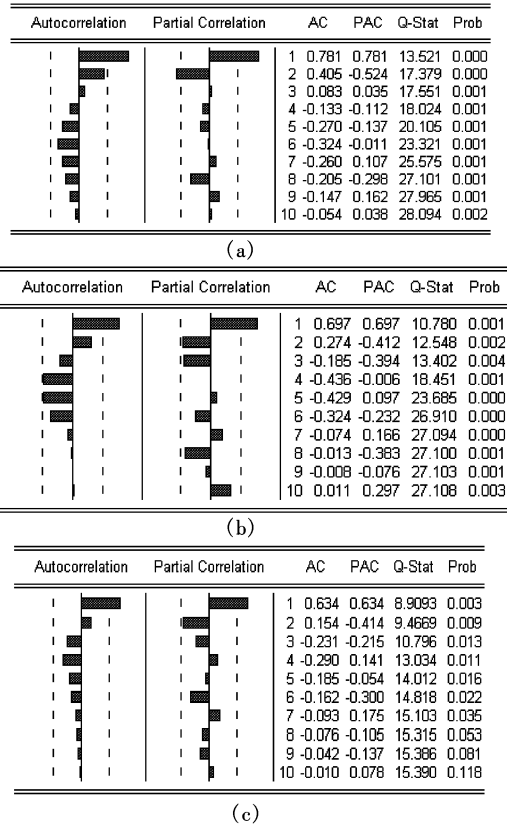


Fig. 3 Correlation test. (a) Eastern region z_t ; (b) Central region z_t ; (c) Western region z_t

Tab.3 Experimental results for each region(Models do not fit for the standard being excluded)

Region	Model	Adjusted R^2	AIC	BC	DW
Eastern region	AR(1)MA(1)	0.774	-0.137	-0.038	1.952
	AR(1)MA(2)	0.776	-0.084	0.064	1.801
	AR(2)MA(1)	0.774	-0.074	0.072	1.929
Central region	AR(1)MA(1)	0.676	-0.203	-0.104	1.935
	AR(2)MA(1)	0.684	-0.142	0.005	1.857
	AR(2)MA(2)	0.693	-0.127	0.069	1.594
Western region	AR(1)MA(1)	0.448	0.135	0.234	1.869
	AR(2)MA(1)	0.425	0.274	0.421	1.236

According to Tab. 3, for each region, AR(1)MA(1) model is the best one. The results of the DW test for residual sequences meet the needs for setting up the ARMA model.

The equation of fitting z_t in the eastern region:

$$z_t = -0.038 + 0.598z_{t-1} + e_t - 0.830e_{t-1}$$

(4)

The equation of fitting z_t in the central region:

$$z_t = 0.016 + 0.52z_{t-1} + e_t - 0.363e_{t-1}$$

(5)

The equation of fitting z_t in the western region:

$$z_t = -0.016 + 0.463z_{t-1} + e_t - 0.355e_{t-1}$$

(6)

where z_t is the random part of each region ($1986 \leq t \leq 2004$) or forecast ($t \geq 2005$) at time t ; e_t is the residual sequencing at time t ($t \geq 2005$; its value is 0). Fig. 4 shows the fitting results for each region. And Tab. 4 shows the fitting model.

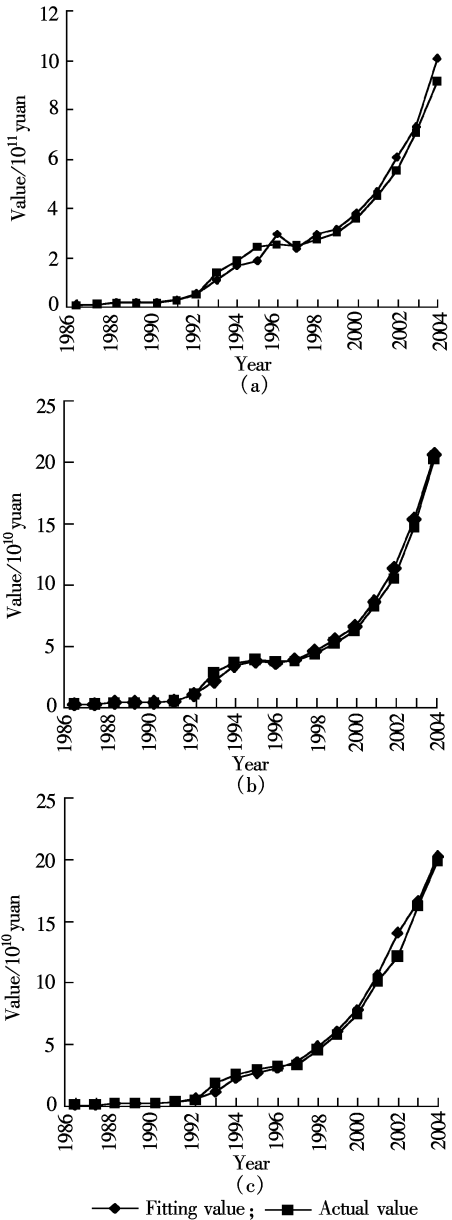


Fig. 4 Fitting results of each region. (a) Eastern region; (b) Central region; (c) Western region

Tab. 4 Fitting model of each region

Region	The fitting model of trend growth	ARMA model
Eastern region	$y_t = -546.858 + 0.278t$	$z_t = -0.038 + 0.598z_{t-1} + e_t - 0.830 e_{t-1}$
Central region	$y_t = -489.948 + 0.248t$	$z_t = 0.016 + 0.52z_{t-1} + e_t - 0.363e_{t-1}$
Western region	$y_t = -584.975 + 0.296t$	$z_t = -0.016 + 0.463z_{t-1} + e_t - 0.355e_{t-1}$

The fitting effects are satisfactory on the whole with the exception of 1992 and 1993. The reason for the poor fitting effects in 1992 and 1993 is that a new economic upsurge started in 1991, and real estate became the new object of investment all over the country, especially in coastland areas.

From 1992 to the first half of 1993, a new wave crest in the real estate cycle formed rapidly. According to the national statistical figures in 1992, total investment in real estate enterprises was 515×10^8 yuan, an increase of 125% compared with the investment in 1991. During this period, foreign capital invested in real estate increased by 238%, and remised land increased by 1000%. Directed against this developing situation, macroscopic readjustments and controls were adopted by the national government from June, 1996. After macroscopic readjustment and control, the real estate market operated rationally and smoothly, and the fitting effects became better. Tab. 5 shows the forecasting results for each region in 2005 by using fitting models of trend growth.

Tab. 5 Forecasting result for each region in 2005

Region	Prediction	Actual	Difference/ %
	value/ 10^8 yuan	value/ 10^8 yuan	
Eastern region	11 613	10 428. 8	11. 36
Central region	2 652	2 682. 2	- 1. 13
Western region	2 869	2 648. 3	8. 33

From Tab. 5, we can see that big differences exist when we forecast the real estate investments in the eastern and western regions, but the central region's fitting effect is satisfactory, which indicates that there are differences among the eastern, central and western regions. Such differences are caused by the forces of macro-economic policies, economic cycles and so on. Because of the specific characteristics of each region, such external factors brought to bear different effects on each region. Compared with the previous years, the biggest change in the Chinese real estate market is that the amount of investment in the eastern region fell very substantially in 2005, but the investment in the central and western regions was relatively steady, and their extents of decline were relatively smaller. Due to their still being in the primary stages of development, the investment growth rates in the central and western regions were greater than the one in the eastern for a period of time, thus high development speed does not mean mock boom. But the investment in the eastern region has maintained its rapid growth for years, and it has been achieved on a broad base, so it becomes the focus of our macro-economic regulation. The significant decline in real estate investment indicates that some progress has been made by the macro-economic regulation. Taking monetary policies as an illustration, in the eastern region, there are va-

rious restrictions on the loans used for real estate investment in terms of scale, but there are fewer restrictions in the central and western regions, and thus the growth in real estate loans are higher there than the ones in the eastern region.

2 Analysis of Regional Real Estate Investment Cycle

Correctly grasping the extent of the real estate investment cycle is an effective approach and a necessary means to analyze the fluctuations in real estate investment and forecast trends in real estate development. Although the general time length of the investment cycle can be preliminarily confirmed by the above model, such a direct judgment method is likely affected by the perturbation of external factors on the real data and by a more complex data series, intuitive judgments should be greatly restricted. Thus it is difficult to confirm a more objective length of a cycle. Therefore, to avoid such intuitive judgments, a quantitative measurement tool based on strict mathematics is urgently needed. Spectral analysis is an advanced and effective measurement method for judging cycles^[13-14].

For a time series of smooth and random processes, $X_t(t = 1, 2, \dots, N)$, spectral density, is usually fitted by a Fourier series:

$$X_t = A_0 + \sum_{m=1}^n \left(\frac{A_m \cos 2\pi mt}{N} + \frac{B_m \sin 2\pi mt}{N} \right) = \varepsilon_t$$
$$m = 1, 2, \dots, n \tag{7}$$

In Eqs. (7) to (10), $t = 1, 2, \dots, N$ is the time index; N is the sample size, $N = 2m$; $m = 1, 2, \dots, n$; $1/N$ refers to frequency, m/N refers to harmonics at frequency m ; ε_t refers to random errors at time t .

The coefficient of the Fourier series fitting function estimated on least squares is

$$A_0 = \sum_{t=1}^N \frac{x_t}{N} \tag{8}$$

$$A_m = \frac{1}{N} \sum_{t=1}^N \frac{X_t \cos 2\pi mt}{N} \quad m = 1, 2, \dots, n \tag{9}$$

$$B_m = \frac{1}{N} \sum_{t=1}^N \frac{X_t \sin 2\pi mt}{N} \quad m = 1, 2, \dots, n \tag{10}$$

Based on data analysis of 18 years(1986—2003), the investment cycle analysis results of each region are shown in Tab. 6.

Tab. 6 Investment cycle of each region

Spectral density	Eastern	Central	Western
The first peak	1. 17	0. 11	0. 32
The first peak corresponding cycle	18	9	18
The second peak	0. 31	0. 09	0. 26
The second peak corresponding cycle	9	18	9
The third peak	0. 06	0. 06	0. 05
The third peak corresponding cycle	4. 5	2. 6	4. 5

Consulting the theories of the economic cycle, according to the length of the investment cycle (i. e. duration of the time span), the real estate investment cycle can be divided into four categories: short-cycle, middle-cycle, long-cycle and combined-cycle^[15].

It is not difficult to find from Tab. 6 that: the real estate investment long-cycles (Kuznets long-cycle) of the three areas are the same, which are about 18 years. The results are quite similar to the conclusions by Wenzlick. Based on the U. S. real estate market transaction volume (or sales), by analyzing the cyclical fluctuations in the United States real estate cycles of about 180 years (1795 to 1973), Wenzlick pointed out that the long-term fluctuations in the United States real estate cycles were about 18 years^[14, 16-17]. The middle-cycle (Zhu Mayoral cycle) of the three areas are basically equal, this conclusion is basically consistent with that of Bo^[14]. Bo believed that there was around a nine-year middle-cycle in the Chinese real estate market. There are disparities among the three areas' short periods (Kitchen cycle): the disparities are small between the eastern and the western short-cycles, about 4.5 years and consistent with the description of the real estate short cycle in the literature, but both of them are quite different with regard to the central region short cycle, which is only 2.6 years and is a new discovery which has not been found in the existing literature. This discovery proves the existence of differences among the three regional real estate investment areas. The fact that the cycle is short in the central region shows why the fitting effect is better than that in the other regions: the cycle is shorter; fluctuations seem more obvious for a short period; but for a longer period, the time series seem to be stable and somewhat regular.

The main reasons resulting in cycle differences are economic development and macro-economic policy. The economy of the eastern region has a good foundation and fast development. This is one of the main reasons why it is always able to maintain the leading level of real estate investment in the whole country. Although the economic development of the western region is slower than that of the eastern, its various investments, including real estate investment, in recent years are growing rapidly and investment levels of its real estate exceed the one in the central region due to the impact of the country's western development policy (see Fig. 2).

3 Characterization of Regional Real Estate Investment

1) LREI in the eastern region is the highest. Its rate of increase is fast when viewing long-term trends, and the short cycle of investment is about 4 to 5 years. Because real estate investment of the eastern region has always been in an upward trend except for some individual years, it is difficult to separate peaks or trough from the present investment series. Therefore, the increase rate is adopted to identify the state of the eastern region at a particular period. It is found that, from the macro-controls from 1996 to 1999, the investment growth rate in the eastern region was lower than 11%, and more than 20% from 2000, and achieved 29.65% in 2004. Taking into account the huge real estate investment base of the eastern region, the speed was amazing. So it can be con-

cluded that the central region is in a state of peaking or nearing the peak.

2) LREI in the central region is in the middle range, but it has been caught up with by the western region in recent years. Its investment growth rate is the slowest among the three districts when viewed from a long-term trend. Its investment short cycle is about 2 to 3 years. From 1995 to 1998, the investment activity laying the doldrums and then entered a rapid growth phase beginning in 1999. Its rate of increase achieved 40.29% in 2003 with a slight decrease to 37.65% in 2004. Due to the fact that the short cycle is shorter, the drop in the increase rate is not obvious, and taking into account that its growth is influenced by external factors the connection is not obvious, so we can conclude that this region is in a natural, relatively stable state of progress; therefore, its gap between prediction value and actual value was the least of all the three regions.

3) LREI in the western region has been rapidly increasing in recent years, and it is greater than that of the central region since 1998. Its growth rate has been the fastest from a long-term perspective; the investment cycle is basically consistent with that of the east. Its rate of increase achieved 33.67% in 2003 and decreased to 22.05% in 2004.

4) Based on the comprehensive analysis of the above, it can be concluded that real estate investments in each area reached a peak and completed a campaign cycle after a period of a sustained recession and an upsurge process which took about 9 to 10 years. The rate of investment both in the central and western regions experienced different degrees of decline in 2004; therefore, it can be inferred that investment growth rates in each region will decline after experiencing a period of adjustment in 2005 and 2006.

5) It can be found that there is a real estate investment gap between the eastern region and the central and western regions, and that the gap still shows a trend of further expansion. In 1986, the gap was small (eastern real estate investment exceeded the total investment in the central and western region by 2.5×10^9 yuan). After that the gap continually widened to over 514×10^9 yuan in 2004. It can be foreseen that the center of real estate investment will be still in the eastern region, which is caused by the differences in economic growth among the regions. The investment climate of the southeast coast is better than that of the other regions, due to such factors as a relatively higher level of economic development, a larger urban population, a more remarkable geographical superiority and so on. So the eastern region has attracted more investment funds. The provinces in the central regions, like Henan, Hubei, and Hunan, with medium levels of economic development, huge population densities, lower per capital disposable income of urban residents, find it difficult to form an upsurge in real estate investment. With the implementation of the western development strategy, the country will invest more and better improve the investment climate more. More real estate investment will be attracted to the western region.

4 Conclusion

By fitting the eastern, central and western regions of the real estate investment trends and analyzing corresponding in-

vestment cycles, the changing trajectory of each regional real estate investment is fully characterized. The ARMA model is applied to fit and predict the level of real estate investments in each region; spectral analysis is used to analyze the fluctuations of real estate investments in each region. The results are basically the same as those in the conclusions of the existing literature. This paper also points out that there is a marked difference in the short period between the central region and the other regions, which is not stated in the existing literature.

However, there are some defects in this paper: First, the applied sample data are fewer and not enough to reflect the development path of Chinese real estate industry; secondly, the analysis on reasons behind the changes in the real estate market is not thorough enough. Despite this, the method and the conclusions introduced in this paper are still helpful to the real estate industry itself and to various organizations in the industry.

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我国房地产区域市场投资轨迹分析

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摘要:根据我国东部、中部和西部房地产市场历年投资数据,分别建立了 ARMA 模型并进行了谱分析,度量各地区的房地产投资发展变化情况,并对各地区的房地产投资作了预测,对各地区的投资周期进行了概要分析. 研究结果表明了各个地区市场的房地产投资水平及其相应的周期情况:东部地区的房地产投资水平最高,投资短周期约 4~5 年,中部地区的房地产投资水平居中,其短周期约 2~3 年,西部地区的房地产投资近年来迅速增长,其短周期约 4~5 年. 各个地区房地产投资在经过了一段时间的持续低迷和一段时间的持续高涨后,都已经达到了波峰,完成了一次中周期运动,这一过程约为 9~10 年.

关键词:房地产投资; ARMA 模型; 谱分析; 投资周期

中图分类号: F293.35