An Empirical Study on the Relationship between Real Estate Investment and National Economic Growth in China - based on Granger Causality Test and Error Correction Model

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Abstract—In recent years, there has been a close link between real estate investment and the national economy in China. This article selects the time series data of China's real estate development investment and national economic growth from 2000 to 2019, carries out price deflations to eliminate the inflation factor, and transforms the data into logarithms to eliminate heteroskedasticity, followed by the analysis using econometric theories such as co-integration theory, Granger causality test, and error correction model. The results show that: there is a long-term equilibrium relationship between the amount of real estate development investment and national economic growth in China; in the short term, the increase in real estate investment in China is the cause of national economic growth, while in the long term this relationship is not obvious; and the long-term elasticity of real estate investment to national economic growth is greater than the short-term elasticity.

Keywords-real estate; economic growth; cointegration test; error correction model

1 INTRODUCTION

In recent years, real estate investment, as an important part of fixed asset investment, has played an important role in the process of driving economic growth. The influence of real estate investment on China's national economy is not only reflected in its promotion of the economy as fixed asset investment itself, but also in the process of its investment, which will drive the development of real estate-related industries.

The current views held by domestic scholars on the relationship between real estate investment and national economic growth in China are broadly divided into two categories: a part of scholars believe that the development of the real estate industry will drive the development of the national economy. Xu Xianchun et al. (2015) argued that a reasonable and stable growth of

the real estate economy would contribute greatly to the growth of China's national economy [1]; Chen Lei and Cao Ze (2017) analyzed the relationship between the amount of real estate development investment and GDP based on the years 2000-2015 and 1995-2016, respectively, and found that there was a long-term stable equilibrium relationship between the two [2] [3]. Jing Gang and Wang Liguo (2019) found that real estate investment drives economic growth to a certain extent by analyzing panel data of 31 provinces across the country from 2000-2016, but the impact effect varies in different provinces [4]. Some other scholars believe that unreasonable real estate investment will inhibit the growth of the national economy to a certain extent. Chao Liu et al. (2018) found that excessive real estate investment has a certain hindering effect on economic growth [5]. Wang Yehui (2019) found through empirical analysis that there is an optimal investment ratio for real estate investment in China, and that excessive real estate investment growth will promote GDP growth in the short term, but inhibit economic growth in the long term [6]. Zhang Yishan and Chen Jian (2021) argue that real estate investment has a slight inhibitory effect on economic growth during the high economic development stage[7].

In this paper, data from 2000 to 2019 were selected for statistical analysis, and unit root test, cointegration test, Granger causality test, and error correction model were used to empirically analyze the relationship between China's real estate development investment and China's gross national product and to explore the relationship between them in the long and short term.

2 THE QUANTITATIVE ANALYSIS OF REAL ESTATE INVESTMENT AND NATIONAL ECONOMIC GROWTH

As a non-negligible part of China's national economy, the development and stability of real estate directly affect the stable growth of the national economy. According to the relevant statistics from 2000 to 2019, from the number of relevant enterprises, the number of real estate development enterprises increased to 99,544 in 2019, which is nearly four times that in 2000. Also, the area of houses built by real estate enterprises has grown significantly, with the construction area of houses growing 13 times as much as in 2000 and the completed area growing nearly four times as much as in 2000 in 20 years.

In addition, the scale of real estate investment in China has climbed year by year, with the investment in real estate development in 2019 growing approximately 26.5 times as much as in 2000, and the country's fixed-asset investment and GDP have also increased year by year, which is consistent with the basic situation of achieving economic growth in China. During this process, the ratio of real estate investment to fixed investment has fluctuated but has remained in a relatively stable range. The ratio of real estate investment to GDP maintained a trend of increasing year by year until 2014, and although it has fallen in recent years, it has remained at more than 13%.

In order to observe more intuitively the relationship between real estate investment and GDP in China, the following trend and correlation charts of the two variables are used to illustrate the relationship between real estate investment and national economic growth in China. Using X variable to denote the amount of real estate development investment and Y variable to denote GDP, the trend and correlation graphs between the amount of real estate development investment and GDP are plotted using EViews as follows.
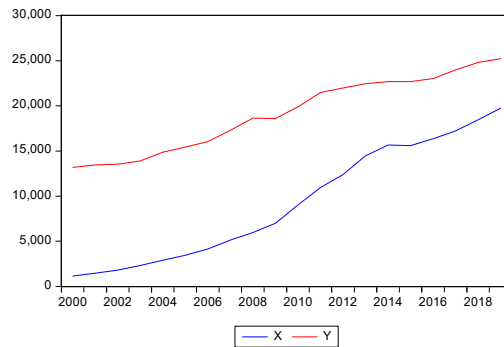
Figure 1. The trend of real estate development investment volume and GDP, 2000-2019
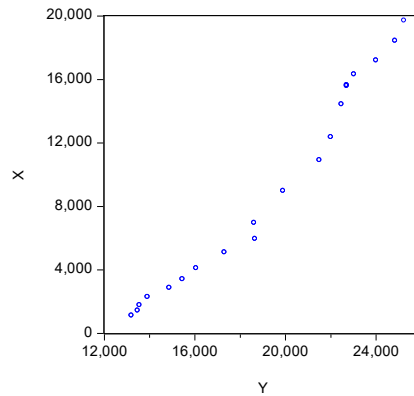

Figure 2. Correlation chart between the amount of real estate development investment and GDP

The above figure indicates that the two economic variables, real estate development investment, and GDP, have the same trend between them and they are positively correlated. As can be seen from Figure 1, the increase in real estate investment is greater than the increase in GDP, and real estate investment grew faster before 2014 and slowed down after 2014, but still maintained an upward trend overall. The reason may be that the accelerated urban process in China after the reform and opening-up has brought opportunities for the development of real estate in China as well, and the development of the real estate industry has attracted the inflow of capital, which has played a role in the growth of the national economy. In addition, real estate investment, as an important part of social fixed investment, has also indirectly driven the growth of China's economy in the process of real estate industry development. Figure 2 shows that the amount of real estate development investment in China is positively correlated with GDP, which conjectures that probably the real estate investment in China has a positive contribution to the growth of the national economy. The relationship between the two variables will be further discussed in the following section using the model.

3 AN EMPIRICAL ANALYSIS OF REAL ESTATE INVESTMENT AND NATIONAL ECONOMIC GROWTH

3.1 Data sources and processing

The annual data from 2000-2019 are selected as the research sample, and the amount of China's real estate development investment (REI) and gross domestic product (GDP) for the required years are compiled from the China Statistical Yearbook as the indicators of China's real estate investment and national economic growth, respectively. In order to reduce the impact caused by price changes, the data used in this paper and the year 1978 as the base period are processed using the GDP deflator to obtain the real GDP of China between 2000 and 2019. the amount of real estate development investment is processed using the CPI data with 1978 as the base period, and the inflation factor is excluded to turn the data into real values. To reduce the heteroskedasticity and to make the data more smooth and stable, the data were transformed into logarithmic form as LNREI and LNGDP. the data analysis tool used was EViews10.

3.2 Unit root test

Traditional econometric models are built based on the smoothness of the data, and if the variables used in the model are non-smooth, we directly use these variables for analysis, and pseudo- or spurious regressions will occur. Therefore, in this paper, before using the original time series data to build the model, the ADF test was selected to test the smoothness of the data on the gross domestic product (LNGDP) and real estate development investment (LNREI). The results of the unit root test are shown in Table 1.

TABLE 1 UNIT ROOT TEST RESULTS

	ADF value	threshold (1%)	Threshold (5%)	Threshold (10%)	result
$LNGDP$	-2.335443	-3.857386	-3.040391	-2.660551	unstable
$\Delta LNGDP$	-1.398409	-3.857386	-3.052169	-2.666593	unstable
$\Delta^2 LNGDP$	-4.642951	-3.886751	-3.052169	-2.666593	stable
$LNREI$	-0.955217	-3.831511	-3.029970	-2.655194	unstable
$\Delta LNREI$	-3.257731	-3.857386	-3.040391	-2.660551	unstable
$\Delta^2 LNREI$	-6.141369	-3.920350	-3.065585	-2.673459	stable

The test results in Table 1 above show that LNGDP and LNREI show a smooth, second-order single integer series after second-order difference, and there may be a cointegration relationship between the two variables.

3.3 Co-integration test

In this paper, we use the EG two-step test to examine the time series data. The linear equations are first constructed using two variables, LNGDP and LNREI, with LNGDP as the explanatory variable and LNREI as the explanatory variable, and the least-squares method is applied to

estimate the parameters for both variables. Regression equations were constructed for LNGDP and LNREI as follows.

$$\ln GDP = \alpha_0 + \alpha_1 \ln REI + e_t \tag{1}$$

The regression results of the equation are:

$$\ln GDP = 7.7122 + 0.6415 \ln REI \tag{2}$$

$$(113.9367) \quad (31.55425)$$

$$R^2 = 0.982243 \quad \overline{R}^2 = 0.981256$$

$$F = 995.6706 \quad DW = 0.632341$$

The regression results above show that the statistical values of both the constant term and the explanatory variables are greater than the critical values, indicating that the t-test is significant and the goodness of fit of is R^2 as high as 0.98, indicating a good fit of the two variables. If we want to prove that LNGDP and LNREI are cointegrated, then we also need to test whether the residuals are smooth. The following are the test results of the unit root test on the residual term e_t.

TABLE 2. Unit root test for the residual term e_t

	T-statistic	P-value
ADF test	-2.951607	
1%	-2.692358	**0.0054**
5%	-1.960171	
10%	-1.607051	

From the test results in Table 2, it can be seen that the residual series of both variables show smoothness at 1%, 5%, and 10% significance levels, respectively, so there is a cointegration relationship between the two variables LNREI and LNGDP used in this paper, i.e., there is a long-run equilibrium relationship between the amount of real estate development investment in China and the gross national product of China. And from the above equation, we can get that the long-run elasticity between the two is 0.6415, that is, in the long run, for every unit increase in the amount of our real estate development investment, our gross national product increases by 0.6415 units.

3.4 Granger causality test

Through the cointegration test, we can determine that there is a cointegration relationship between LNGDP and LNREI, but the causal relationship between them is uncertain, so we will establish a simple test model for the Granger causality test for the causal relationship between the two variables, and the lag order of this paper is chosen to be 1-4 periods. The test results are shown in Table 3.

TABLE 3. RESULTS OF GRANGER CAUSALITY TEST

Original hypothesis	Lag time	Observed value	F-statistic	P-value	Concluded
LNREI is not the Granger reason for LNGDP	1	19	7.79571	0.0131	decline
LNGDP is not the Granger reason for LNREI	1	19	0.58762	0.4545	accept
LNREI is not the Granger reason for LNGDP	2	18	5.80553	0.0158	decline
LNGDP is not the Granger reason for LNREI	2	18	0.52761	0.6021	accept
LNREI is not the Granger reason for LNGDP	3	17	8.03336	0.0051	decline
LNGDP is not the Granger reason for LNREI	3	17	3.92869	0.0433	decline
LNREI is not the Granger reason for LNGDP	4	16	2.82677	0.1093	accept
LNGDP is not the Granger reason for LNREI	4	16	1.87957	0.2189	accept

The results from Table 3 show that at the 5% significance level: at the lag of 1, LNREI is the Granger cause of LNGDP and LNGDP is not the Granger cause of LNREI. At the lag of 2, the results are the same as above. At the lag of 3, LNGDP and LNREI are causal to each other. At the lag of 4, there is no causal relationship between LNGDP and LNREI.

3.5 Error correction model (ECM)

The error correction model is used to respond to the corrected cointegration relationship between two variables in the long and short term. In this paper, the model is developed according to the basic form of the error correction model as follows.

$$\Delta \ln GDP = 0.0153 + 0.2007 \Delta \ln REI - 0.4705 ecm_{t-1} \qquad (3)$$

$$(1.1461) \quad (2.9951) \quad (-1.7339)$$

$$R^2 = 0.5732 \quad \overline{R^2} = 0.5234$$

$$F = 9.7126 \quad DW = 1.9934$$

From the above regression results, it can be seen that the overall regression effect of the model is good, and each variable is found to be significant by the t-value test, and the residual series of the model is shown to be a smooth series by the test. From equation (2) above, it can be found that the long-term elasticity of real estate investment for China's national economic growth is

relatively high, that is, in the long run, for every 1% increase in investment in the real estate sector, the national economy will grow by 0.6415%. In equation (3) of the error correction model, it can be found that the short-term elasticity of real estate investment to national economic growth is relatively small, that is, in the short term, for every 1% increase in investment in the real estate sector, the national economy will only increase by 0.2007%. That is, the long-term elasticity of real estate investment to national economic growth is greater than the short-term elasticity. In addition, the coefficient of the error correction term ecm_{t-1} in the model is -0.4705. Since the coefficient of the correction term in this paper is negative, it indicates that when the changes in the national economy deviate from the equilibrium, the error correction term will reverse the variables, and the adjustment strength is 0.4705 at each stage to gradually adjust it to the equilibrium level of the system.

4 CONCLUSIONS AND POLICY RECOMMENDATIONS

4.1 Conclusion

From the analysis results of this paper, the following conclusions can be obtained.

First, there is a cointegration relationship between the amount of investment in real estate development and the two variables of the national economy, indicating that there is a long-term stable equilibrium relationship between China's real estate investment and GDP. That is, with the development of China's real estate market, the inflow of funds into the real estate industry will also increase, which in turn will play a role in promoting the economic development of China. Second, in the short term, the increase in the amount of real estate investment in China is the reason for the growth of the national economy, however, in the long term, this causal relationship is not obvious. Third, the long-term elasticity of China's real estate development investment amount for China's national economic growth is greater than the short-term elasticity, that is, the growth of real estate development investment amount, in the long run, has a greater impact on the national economy than it does in the short run.

4.2 Policy recommendations

From the above empirical results, it can be seen that there is a long-term stable equilibrium relationship between real estate investment and the growth of China's national economy. Therefore, promoting the coordination between the real estate industry and the development of the national economy is of great significance to the development of China's macroeconomy. To this end, this paper consists of the following recommendations.

First, to strengthen the country's macro-control based on the regulatory role of the market mechanism to establish a harmonious and stable real estate market environment. Given that the resource allocation mechanism of China's market has not yet been developed, the government should establish a sound real estate early warning system promptly on time to collect, organize, analyze and forecast the market information of China's real estate, to provide theoretical guidance for the government's decision making, give some stimulation when the real estate market is weak, and give the necessary restraint and restraint when the market is overheated.

Second, upgrade the financial structure and improve the financial policy. For a long time, the financing channels of China's real estate industry have been relatively single. According to statistics, 60% of the current real estate investment still comes from banks, and the real estate industry, as a capital-intensive industry, will provide a more solid guarantee for its long-term development by solving the capital problem. Real estate enterprises can shift their financing channels from just relying on free funds and bank loans to absorbing funds from the private sector, increasing the issuance of bonds, private placements, trusts, and listings, etc. Real estate enterprises are encouraged to actively establish cooperation with credit companies, investment banks, and real estate management companies to make the financial structure and financial policies more suitable for the development of the real estate industry and to improve the financing ability and development management projects of real estate enterprises.

Thirdly, it should be placed in the macro environment to explore and plan the real estate industry in the long term. Real estate in China's national economy can not be ignored, even in the short term will deviate from the stable equilibrium state, from long-term considerations, the real estate industry will certainly maintain a relatively stable market size and consumption conditions, and the national economy is the same direction of development. As the long-term elasticity of real estate investment to national economic growth is greater than the short-term elasticity, so the government needs to take into account the policy lag and regional differences in the formulation of relevant regulatory policies, combined with the macroeconomic environment of the country to develop a scientific long-term regulatory policy. At this stage, China's housing prices are significantly higher than the per capita disposable income of residents, if the government's regulation is too broad, it is easy to fail to achieve the expected policy effect, if the regulation is too strong, it is easy to affect the various industries related to real estate, which has a certain impact on the development of the national economy. This puts forward high requirements for China's macro-control, to explore ideas based on the market mechanism, placed in the macro context of economic development.

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