

Research on the Causal Relationship Between House Prices and Land Prices Based on Matlab

Qian Yu*

School of Mechanics and Civil Engineering, China University of Mining and Technology, Xuzhou, China

*Corresponding author: 1173043896@qq.com

Abstract. House price is related to the national economy and the people's livelihood, and has an important impact on the development of the whole national economy. It is a problem that governments have been concerned about. How to analyze the influencing factors of house price has become the focus of current real estate economic research and concern. Under the above background, based on Matlab platform, this paper studies and analyzes the causal relationship between house price and land price, analyzes its influence relationship by using mathematical model and MATLAB, and finds out how land price factors affect house price.

Keywords: Land Price; House Price; Real Estate; Matlab.

1. Introduction

Land price and housing price are closely related, but whether land price affects high housing price, or high housing price affects high land price, their relationship is mutual influence [1]. Through a series of data analysis, it is shown that the proportion of land price measured by land price and house price is also on the rise [2]. Through the field analysis of urban construction, it is confirmed that the increase of land price will also promote the increase of house price. It will lead to the rise of land prices, so the two influence each other and have an inseparable relationship [3].

In recent years, with the development of the economy, people's living standards have been continuously improved, and the demand for housing is increasing [4]. The phenomenon of the overheating of the real estate economy has an impact on the social economy to a certain extent, and the biggest impact on the real estate economy is the price fluctuation of land resources and the demand for housing purchases [5-6]. Under the influence of high housing prices, central governments at all levels have also issued land policies to regulate the market [7]. Urban land prices and housing prices are the main factors that constitute the real estate price system, and are also of great significance to the government's macro-control and regulation of the real estate market [8]. With the reform of housing system and land system, a series of major changes have taken place in China's land supply system since the 1990s [9]. With a series of reforms in land policy, land prices have continued to rise [10], and land prices and house prices have risen simultaneously in the same period. There are three main aspects, one is that the land price determines the housing price [11]. Second, the main reason for the rise in house prices is that the demand for real estate is too large, and the rise in house prices directly leads to the rise of land prices. Third, the relationship between land prices and house prices is inseparable and affects each other. An important factor for the rise in housing prices, the demand for real estate is very large, and there is a phenomenon in which the supply exceeds the demand [13]. From the data of house prices and land prices, the reform of the land system is the main factor causing the rise of land prices [14]. Although the cost method reflects that land price is one of the main factors that constitute housing prices, it is not the only factor, and other factors also affect the rise of housing prices, so there is no absolute relationship between land prices and housing prices [15]. The demand for housing is the factor that causes high housing prices, and rising housing prices lead to rising land prices. Second, the land price mechanism shows that housing prices are the determinant of the formation of land prices [16]. Therefore, from the perspective of cost method, land prices may affect housing prices [17]. From the perspective of demand, land price is the price caused by demand, and high land price is the result of high housing price rather than the main reason [18]. Find out the key

factors and related policy measures through model empirical analysis, and then analyze and demonstrate them [19].

Under the above background, this paper starts with the causal relationship between housing prices and land prices, starting from the two typical representative cities of Tianjin and Hengyang, to carry out an empirical analysis of housing prices and land prices, and uses Matlab to build relevant analysis models. To analyze the correlation between housing prices and land prices, to understand how land prices and housing prices function and influence, and provide a reference for the government to reasonably regulate housing prices and land prices.

2. Analysis of the rationality of urban housing prices

Before researching and analyzing the causal relationship between land and housing prices, it is necessary to analyze the rationality of urban housing prices [20]. By studying the rationality model of urban housing prices, the criteria for judging the rationality of housing prices were found, and the relationship between cost, sales area, and per capita GDP in the same region was also drawn [21]. We used the multiple linear regression model to analyze and process the relevant variables, and finally determined the standard for judging the rationality of housing prices. In the process of analysis, only the impact of per capita GDP and cost on housing prices is considered, and the cost of nearly five years is regarded as a fixed value, and the cost of housing prices in the selected cities is equal [22].

Through the summary of the existing real estate economic related research and the existing theoretical analysis, it is concluded that to judge the rationality of housing prices, it is necessary to understand the relationship between housing prices and per capita GDP [23]. To find the profit of real estate, $P=(A-B)*N$, we use y to represent the ratio of the profit of real estate to GDP per capita, that is, $y=P/G$. The obtained data are shown in Table.1 and Table.2.

Table 1. The relationship between housing prices and GDP in Tianjin from 2016 to 2020

Years	2016	2017	2018	2019	2020
GDP(yuan)	50467	56044	63029	68788	76544
Price(yuan)	10323	11377	13222	15050	22310
Y	$0.1154*N$	$0.1227*N$	$0.1384*N$	$0.1534*N$	$0.2327*N$

Table 2. The relationship between housing prices and GDP in Hengyang from 2016 to 2020

Years	2016	2017	2018	2019	2020
GDP(yuan)	16159	21017	25703	32370	34099
Price(yuan)	3089	3599	4032	5002	5398
Y	$0.0055*N$	$0.0285*N$	$0.0402*N$	$0.0618*N$	$0.0703*N$

According to the above data, we fit the variable curve of 'y-x' as shown in Figure 1 and Figure 2.

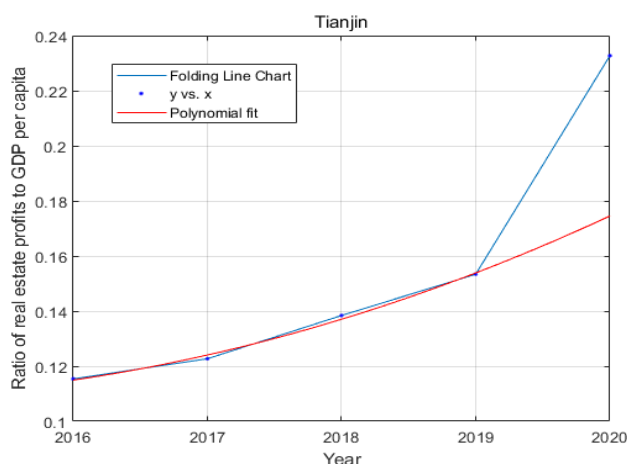


Figure 1. Fitting curve of Tianjin

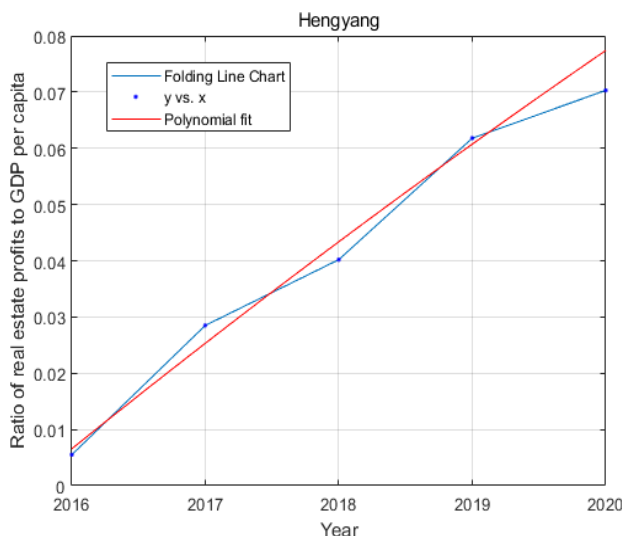


Figure 2. Fitting curve of Hengyang

It can be seen from Figure 1 that the upward trend of the curve in 2016-2020 is slow, while the upward trend in 2020 is steeper. According to the fitting function, the y/N value in 2021 can be obtained as 0.1718. It is obvious that the data obtained in 2020 is 0.2327 and the predicted data is quite different. I can see from Figure 2 that there is a steady upward trend from 2016 to 2020. According to the fitting function, it can be concluded that the value of y/N in 2021 is 0.1102, which is not much different from the data obtained from the image. From the comprehensive consideration of images and data, it is concluded that the overall change trend of housing prices in Hengyang has strong stability, which is a relatively reasonable housing price development trend.

3. Model analysis of the impact of housing price-related control measures

Before analyzing the causal relationship between housing prices and land prices, in order to better understand the development trend of housing prices, this paper conducts a forecast analysis of the development trend of housing prices [24].

We found the average property price data in Tianjin from 2013 to 2020, as shown in Table. 3.

Table 3. Average real estate price data in Tianjin from 2017 to 2020

Years	Price (yuan/square meter)	Years	Price (yuan/square meter)
2013	5300	2017	11377
2014	6683	2018	13222
2015	6776	2019	15050
2016	10323	2020	22310

The GM (1,1) model is established as:

$$\frac{\partial x_1}{\partial t} + 0.205x_1 = 4299 \quad (1)$$

Finding the analog value of x_1 is:

$$x_1 = (5300, 14134.86299, 23753.52912, 34225.53508, 45626.58670, 58039.10618, 71552.82797, 86265.44753) \quad (2)$$

Therefore,

$$S_1 = \sqrt{\frac{1}{n} \sum (x_0 - \bar{x}_0)^2} = 5216.192947 \quad (3)$$

$$S_2 = \sqrt{\frac{1}{n} \sum (e_0 - \bar{e}_0)^2} = 25222.61275 \quad (4)$$

$$c = \frac{S_1}{S_2} = 0.207 \quad (5)$$

According to the index critical value accuracy table, $c=0.207 < 0.35$, indicating that the established model has a first-level accuracy, which can be predicted by $X1(k+1)=26270.73171 * e^{0.205k} - 20970.73171$ [25].

We can get: the house price in 2021 is 23418.3435 yuan/square meter, the house price in 2022 is 30813.7366 yuan/square meter, the house price in 2023 is 37824.6341 yuan/square meter, and the house price in 2024 is 46430.6864 yuan/square meter.

Next, we found the average price of real estate in Hengyang from 2013 to 2020, as shown in Table 4.

Table 4. Average house price data in Hengyang from 2013 to 2020

Years	Price (yuan/square meter)	Years	Price (yuan/square meter)
2013	1769	2017	3599
2014	1800	2018	4032
2015	2871	2019	5002
2016	3089	2020	5398

The GM (1,1) model is established as:

$$\frac{\partial x_1}{\partial t} - 0.2153x_1 = 1791.8 \quad (6)$$

We can get: the house price in 2021 is 6571.56034 yuan/square meter, the house price in 2022 is 7578.93868 yuan/square meter, the house price in 2023 is 8831.92657 yuan/square meter, and the house price in 2024 is 10292.06464 yuan/square meter.

The rapid development of China's society and the rapid increase of social wealth, in the context of China's rapid development, the unilateral rise in housing prices in the long-term trend is an inevitable trend. The reason is very simple, social wealth is increasing at a rate of about 10% per year., the unit currency shrinks at the same rate, and the house price priced in that currency should naturally rise. Then the increase in the amount of money put in by the state makes the supply of social funds very abundant, which directly leads to the rise in housing prices. In the past few years, various national policies to encourage investment and consumption have been introduced, including tax incentives for second-hand housing, strong support for housing loans, and even lower down payment ratios and lower interest rates for mortgages, all of which have guided the flow of funds to real estate.

Looking at the trend of housing prices in recent years, the total development speed of Tianjin and Hengyang in 2019 is higher than that in 20018, and the economic indicators of Tianjin and Hengyang in 2020 are still higher than those in 2019, so the general direction of increase is unchanged. However, the national economy has recently reduced the amount of money put in, canceled the tax preference for second-hand housing, and to a certain extent has curbed real estate speculation, thereby restraining the speed of house price growth.

From the above analysis, we can be sure that the housing prices in Tianjin and Hengyang have room for growth in the next few years, but the growth rate will slow down. At this point, we can be sure that the house price trend in Tianjin and Hengyang in the next four years predicted by the solution of our model is reasonable.

4. The causal relationship model and Matlab analysis of price and land price

Selecting a specific aspect of economic development for quantitative analysis, and reflect changes in economic development through changes in the land transaction price index. To this end, this paper investigates the housing price and land transaction price index in Tianjin from 2013 to 2020, and establishes a model of Tianjin housing price and land transaction price index and year, and then obtains the relationship between Tianjin housing price and transaction price index, and also obtains the change in housing price. the impact of economic development. To explore and analyze the correlation between housing prices and land prices by constructing relevant analytical models.

In order to analyze the causal relationship between house prices and land prices, the following house price and land price data were collected before the analysis, as shown in Table.5.

Table 5. Tianjin house price and land price data

Years	House price (yuan)	Land transaction price index
2013	5300	100.6
2014	6683	102.5
2015	6776	103.8
2016	10323	105.3
2017	11377	109.4
2018	13222	111.6
2019	15050	114.7
2020	22310	117.5

From the above data, we use Matlab software to fit them in pairs, using first-order and second-order polynomials, that is, fitting polynomials:

$$y = a_0 + a_1x + \cdots + a_ix_i (i = 1,2) \quad (7)$$

Using matlab programming, we fit the change curve of housing prices and years in Tianjin, as shown in Figure 3.

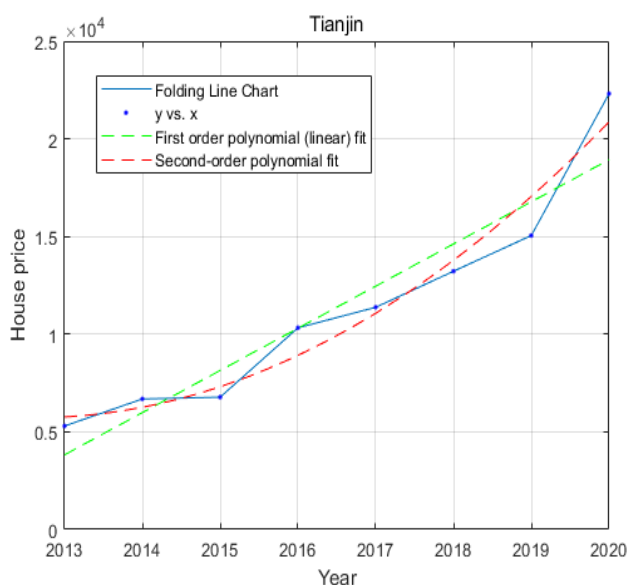


Figure 3. Housing prices and years in Tianjin

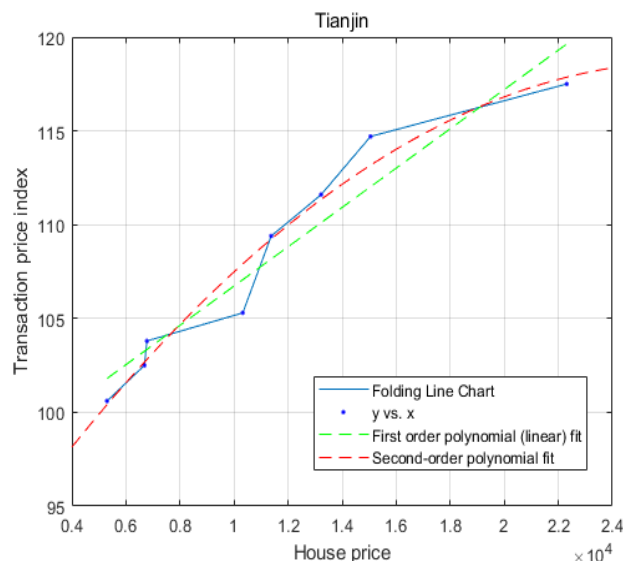


Figure 4. The relationship between the land transaction price index and housing prices

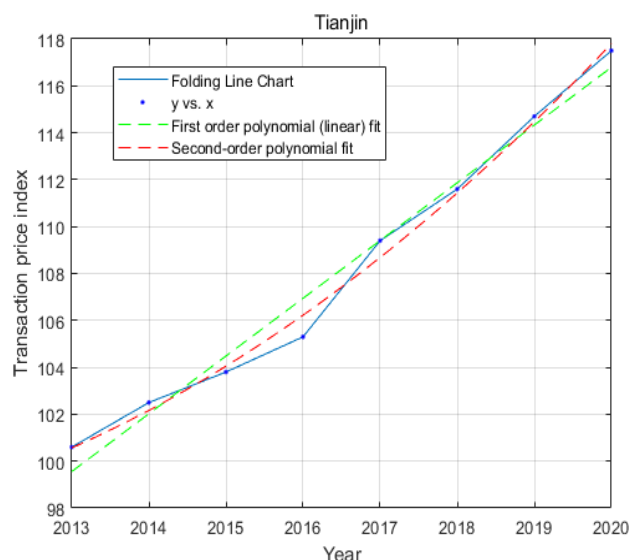


Figure 5. Relationship between land transaction price index and year

Similarly, by fitting polynomials, the relationship between the land transaction price index and the house price and the relationship between the land transaction price index and the year are obtained. The results are shown in Figure 4 and Figure 5.

Through multiple fittings of various data in house prices and land prices, we have obtained an unstable linear relationship, but the overall trend is still positive. If house prices cannot be effectively controlled, the crazy rise may lead to the rise of the land transaction price index. The land transaction price index reflects the average change of land price in time and the relative index of the comprehensive change direction and degree, showing the market situation and development trend of the land market. This shows that the land market will be disrupted. If the rise in housing prices can be effectively controlled, for example, the policy of restricting purchases and loans will be issued, and the interest rates of mortgages should be rationalized and improved.

5. Conclusion

This paper deeply analyzes the relevant factors of the impact of housing prices, builds a nursing analysis model of urban housing prices, and analyzes and demonstrates the rationality of urban housing prices through the rationality analysis model of housing prices. The relevant factors of

housing prices are analyzed. Finally, from the relevant factors and the rational analysis conclusions, the impact relationship between housing prices and land prices is discussed and analyzed, and the Matlab analysis model of housing prices and land prices is constructed. The causal relationship between house prices and land prices is analyzed by the method of equalization, and an unstable linear relationship is obtained, but the overall trend is still positive. Based on this curve relationship, it can be found that if housing prices cannot be effectively controlled, the crazy rise may lead to the rise of the land transaction price index. The land transaction price index reflects the average change of land price in time and the relative index of the comprehensive change direction and degree, showing the market situation and development trend of the land market. This shows that the land market will be disrupted. If the rise in housing prices can be effectively controlled, for example, the policy of restricting purchases and loans will be issued, and the interest rates of mortgages should be rationalized and improved.

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