Experimental Research on the Impact of Interest Rate on Real Estate Market Transactions

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1. Introduction

Since 1998 when National Development and Reform Commission published No. 23 Document «A notice of State Council about Deepening the Reform of City House System and Accelerating the House Construction» (1998) and the housing commercialization reform started, real estate has been developing an important pillar of China’s economy. Since the beginning of the twenty-first century, the market price of commercial house has achieved a growth rate of 8.27% per year and reached the highest rate of 17.76% in 2005. In 2019, the average price was 4.41 times of that in 2000, and the annual sales area also amounted to 9.21 times of that in 2000. In 2019, China’s national sales of commercial house have reached 159,725 billion, an increase of 6.5% compared to the previous year, with sales hitting a new record high. The real estate industry is growing rapidly, driving the development of many related industries such as the construction industry, service industry and property service industry. The healthy development of this industry has an important impact on the development of China’s national economy.

In 2020, the Shanghai Real Estate Research Institute selected 80 cities in the world, half from developing countries and half from developed countries, to study the housing price to income ratio. The results show that the top
three are Hong Kong, Shenzhen, and Beijing. Their housing price to income ratio are 46.3, 43.5, and 41.7. Among the top 10, there are 7 Chinese cities. Guangzhou, in 10th place, has a housing price to income ratio of 34.1. Currently, the average housing price to income ratio prevailing internationally is between 3 and 6 times [1]. It is obvious that the housing price to income ratio in China has far exceeded the normal level. In the report of the 19th Party Congress, General Secretary Xi Jinping put forward that "Houses are for living in and not for speculative investment". In order to curb the rapid growth of housing prices and maintain a reasonable economic development, the government has introduced a series of policies to regulate housing prices in recent years.

The Chinese central government has issued relevant policies involving interest rates more than ten times since 2008. The mainstream home purchase method in China is mortgage loan, and interest rates can effectively regulate the supply and demand of funds in the real estate market. Therefore, as the cost price of real estate transactions, interest rates can help regulate the real estate market [2]. Ahrend found that the loose interest rate policy of the Federal Reserve would have a significant impact on the house prices in the United States [3]. While Lu studied the role of monetary policy on regulating house prices in China, and it was found that in the long run, price-based monetary policies such as interest rates can effectively regulate house prices; in the short run, interest rates cannot effectively regulate house prices, but will show a regulating effect over time [4]. Some scholars believe that controlling mortgage interest rates will weaken the fluctuation of real estate prices and promote the stability of the real estate market [5]. Further research on the role of interest rate policy and investigation of the effect of interest rates on real estate market transactions are conducive to stabilizing the real estate market and guiding market economic behavior.

2. Literature Review

There are numerous studies on the impact of interest rate policy on the real estate market, which are mainly divided into two perspectives: deposit interest rate and lending interest rate. However, most of the studies focus on lending rate as a regulatory tool, while few literature study the effect of deposit interest rate on regulating housing prices, and only macro panel data is used to do empirical studies. It has been found that the long-term effects of deposit interest rate policy are effective in regulating house prices. The effect of deposit rate policy on the real estate market has been studied at both national and local levels, and there are regional differences in the effect of deposit interest rate.

In the nationwide research in China, Wang conducted a study based on panel data from 2000 to 2011 and found that changes in deposit interest rates had a weak impact on house prices due to the limitations of China’s interest rate policy and the lack of sensitivity of China’s real estate market to interest rate changes [6]. Using data from 2005 to 2011, Xu et al. found that the depressive effect of deposit interest rates on housing prices exceeds the money supply when comparing price-based monetary instruments and money supply instruments [7]. In regional relative studies, Hua analyzed data from 2004 to 2011 of Beijing and concluded that the deposit interest rate does not have a significant effect on housing prices [8]. Zhang studied the Xi’an real estate market and found that the deposit interest rates and real estate prices in Xi’an are negatively correlated in the short term and positively correlated in the long-term under the premise of inflation [9].

Many scholars have studied the relationship between lending rate and housing price changes, most of whom did research from the perspective of housing buyers. Using the VAR model analysis, Xie and Lu found that the increase in lending rate would consistently cause a decrease in housing prices [10]. The findings of Wei regarding the impact of lending rate on housing price are consistent with Xie and Lu, but the effect of fine-tuning bank loan interest rates remains relatively small for markets where housing prices are growing too fast [11]. Iacoviello and Minetti empirically analyzed the impact of lending interest rates in Finland, Germany, Norway and the United Kingdom through VECM model and VAR model respectively. It was found that the increase of benchmark interest rate led to the decline of house prices, and the higher the degree of interest rate marketization, the greater the impact of interest rate on house prices [12]. Kim decomposes the overall effect of interest rates on house prices into the direct effect of interest rates and the indirect effect of interest rates due to the intermediation effect of loans. His study of the real estate market in South Korea found that the intermediate impact of major cities accounted for 78.3% of the total impact, mainly due to the surge in loans caused by the recent lack of housing supply and panic buying. After controlling the loan variables, the interest rate was positively correlated with house prices [13]. From the perspective of developers, Ibuquerque finds that expansionary monetary policies such as lowering interest rates have still had a significant impact on housing prices since the Great Financial Crisis, but the housing supply response has fallen sharply [14]. Zheng et al. found that in the short term, lowering lending rates caused housing prices in Beijing-Tianjin-Hebei region to fall briefly before rising temporarily. In the long term, interest rate changes had a significant effect on housing price regulation in Beijing where the housing price to incomes ratio is high, but no significant effect in Tianjin, Shijiazhuang, and Tangshan where the housing price to incomes ratio is low, meaning there are regional differences [15]. The research of Toal also shows that there is a certain regionality in the U.S. monetary policy. The adjustment of monetary policy has a certain regulatory effect on the southeast and central regions of the United States, but the regulatory effect in other regions is not ideal [16].

Some scholars have also analyzed the real estate market from both supply and demand perspectives. Kau et al. conducted a corresponding study on the relationship between interest rates and housing prices from the perspective of microeconomics. It is found that interest rates mainly affect the demand side of the real estate market and have a dampening effect on housing prices [17]. On the contrary,
significant in the long-term [21]. Increasing lending rate had a significant effect on housing prices of both real estate developers and consumers. It is found that five northwestern provinces of China from the perspectives of lending rate policy on housing prices in provincial capitals in price fluctuations [20]. Zheng et al. studied the changes of interest rate shocks accounts for 26.2–28.7% of housing price fluctuations [20]. Zheng et al. studied the changes of lending rate policy on housing prices in provincial capitals in five northwestern provinces of China from the perspectives of both real estate developers and consumers. It is found that increasing lending rate had a significant effect on housing prices in provincial capitals in the short term, and not significant in the long-term [21].

Scholars have studied the impact of lending rate on housing prices from a variety of perspectives, but the conclusions of relevant studies are not entirely consistent due to various factors such as different research methods and macro data selection. Some studies have found that there is no regional difference in the impact of lending rate on housing prices [22]. Some studies have suggested that interest rates in other countries also have an impact on housing prices [23]. Some other scholars’ studies found that the impact of lending rate on housing prices was not significant [24]. For example, Wang and Guo conducted a study on the impact of lending rate policy on housing prices by constructing a VAR model based on quarterly data from 1998 to 2007 in the overall Chinese market, and found that there is a negative impact of interest rate on housing prices. But in the long run, it appears that the dynamic impact it produces may gradually diminish and eventually return to the origin [25]. Shi et al. analyzed data for New Zealand over the period 1999–2009 and found that real interest rates were significantly and positively correlated with real house prices, suggesting that higher policy interest rates may not be effective in curbing real house prices. However, timely and appropriate government intervention would limit house price bubbles [26].

Combing the relevant studies of domestic and foreign scholars, it can be found that there is no consistent conclusion about the effect of deposit interest rate and lending rate on housing prices, and most of them are developed based on panel data of the whole country or some regions within a certain period of time. But there are many factors affecting the real estate market, besides the two types of interest rates, it is also influenced by the level of economic development, geographical regions, inflation, residents’ income, consumers’ expectation, statistical methods of macro data, and the frequency of data publication. Many factors, such as the difference in the study area, the difference in time selection, and the statistical way of data, may affect the final results of the study. Therefore, it is difficult to completely eliminate the influence of external factors by using panel data to analyze the influence of a single factor on the real estate market, which will result in errors in the analysis results.

To address this issue, this paper draws on the research ideas of Bu and Yan [27] and Zhang et al. [28] and uses the method of experimental economics to conduct the research. Experimental economics applies the method of experimentation to the field of economics research. In the field of real estate, Northcraft and Neale were the first to use experimental economics method to study the pricing problem [29], and some scholars have also studied the behavior of oligarchic developers [30], the matching mechanism of public rental housing [31], housing market information transmission [32], and property tax policy testing [33] based on economic experiments. By sorting out the application of experimental economics approach in the real estate field, it can be found that this approach has features that are not available in empirical studies of macro data at the level of policy testing and microsubjects.

This paper will simulate a relatively actual real estate transaction market in an experimental setting. We set deposit interest rate and lending rate as independent variables, and control irrelevant variables to directly observe the real estate transaction process. The experimental approach can compensate for the shortcomings such as statistical errors in macro data, while avoiding the effects of regional characteristics on real estate market transactions. Applying this method to study the effect of interest rates on real estate market transactions will help focus on the behavior and transaction process of traders in real estate market transactions from a microperspective, help understand the mechanism of the effect of policy regulation on real estate market, and provide a basis for guiding housing prices back to rationality at individual level.

3. Materials and Methods

3.1. Problem Definition. Monetary policy is a necessary tool used by countries around the world to regulate their economies. Interest rate represents the ratio of interest to principal in a certain period of time and is one of the common tools of monetary policy. At present, the interest rate market system in China has not yet been formed, and the interest rate market is only in the money market. In the credit activities between financial institutions and enterprises and residents, the deposit and lending interest rates still belong to the official rates designated by the central bank. Therefore, the interest rate is an exogenous variable for the real estate market, separate from the real estate market. At the same time, due to the huge demand for funds in the real estate industry, the behavior of real estate developers and home buyers are affected by bank loans. Interest rates have a guiding role in the economic behavior of home buyers by affecting their purchase funds, loan size and psychological expectations, which in turn affects real estate market prices and has an impact on the investment costs and investment scale of real estate developers, with an important role unmatched by other economic factors.

Therefore, this paper applies an experimental economics approach to study the impact of interest rate changes on real estate transactions, including variables such as house price, transaction volume, willingness to trade and bubble index,
by establishing a simulated experimental environment for real estate transaction markets and controlling for extraneous variables.

3.2. Research Objective. The rapid growth of China's real estate industry, while playing a huge role in promoting the development of the national economy, has also caused problems such as overheated real estate investment and high real estate prices. Real estate prices, especially residential prices, are closely related to people's lives. Whether or not to achieve "dwellers possess houses" is related to the long-term stability of society. Reasonable real estate prices are not only related to the healthy and stable development of China's real estate market, to some extent, it represents the development direction of China’s real estate industry, and is more related to the long-term development of China's economy.

In the real estate market, changes in interest rates constantly affect the behavior of consumers, investors and developers. At the same time, interest rates have the characteristics of being remunerative, easy to control and indirect compared to other monetary policies. Moreover, the interest rate is more flexible and has a wider range of adjustment, thus it is more suitable for regulating the real estate market and has been an important tool for the government to macroregulate the real estate market in the last decade or so. To formulate a reasonable policy for controlling real estate prices, it is necessary to focus on analyzing the status and role of interest rates in regulation according to the market situation, and to analyze in depth how interest rate changes in monetary policy affect the fluctuations of real estate prices in China and determine the extent of their impact.

This study takes the impact of interest rates on real estate market transactions as the research theme, and analyzes the impact of interest rates on real estate market prices and transactions in China from the experimental results, in order to enrich and improve the theory of the impact of interest rate policy on real estate prices in China, and propose policy recommendations accordingly, which will help the relevant departments to use interest rate tools more scientifically and effectively to regulate the real estate market, keep real estate prices stable, and thus ensure the healthy development of the real estate market.

3.3. Experimental Design. This paper undertakes online experiment on Veconlab created by University of Virginia. The experimental market environment is set up as follows.

3.3.1. Market System Design. The market subject is those who are willing to buy and sell in real estate market, and participants can have willingness of buying and selling at the same time and they can trade with each other. The market objects are houses and bank deposits randomly assigned to market participants, with funds calculated as “ten thousand yuan.”

3.3.2. Recruiting Experiment Participants. It has been shown that when conducting economics experiments, there is no significant difference in the experimental results between the student group and the community [33]. In order to save experimental costs and control the process conveniently, a total of 83 senior students of Beijing Forestry University with basic knowledge of real estate finance courses were recruited as subjects to conduct the experiment, and the subjects were coordinated according their time to set up four groups of experiments: two groups of deposit interest rate experiment with the numbers of 20 and 23, and two groups of lending rate experiment, with the number of 21 and 19 respectively.

3.3.3. Experiment Data Design. To fit the actual real estate trading market and create a random state of market traders' assets, two experimental object types are set for each of the deposit rate group and the lending rate group. In addition, to fit the actual situation, the initial bank deposits and house assets of the lending rate traders are set to be less than the deposit rate group. Comparative analysis between deposit interest rate and lending rate groups is not conducted in this study, so the difference in initial assets between the two does not affect the conclusions.

(1) Deposit interest rate group: type 1: bank deposit 600, house 3; type 2: bank deposit 800, house 2; type 3: bank deposit 1000, house 1
(2) Lending rate group: type 1: bank deposit 100, house 2; type 2: bank deposit 200, house 1; type 3: bank deposit 300, house 0

Traders in each group of the experiment were randomly assigned 3 types of experimental initial assets in equal proportions.

3.3.4. Trading Rules Design. Two-way auction: in each round of the transaction, both sides give the number of houses to be bought and sold and their respective prices based on the assets owned and the lending interest rate set, and submit their offers. After all offers have been submitted, the results of the transactions will be determined in chronological order of submitting the offers, with an unlimited number of transactions. A total of 15 trading rounds were conducted in the experiment. The deposit interest rate group does not involve the loan purchase transaction method.

3.3.5. Profits Calculating. The market subjects obtain profits in five ways: (1) buying and selling houses to obtain the difference. (2) Bank deposit interest income. Each experimental group is set a fixed level of deposit interest rate, and deposit and lending interest shall be calculated by compound interest. (3) Rent out the house for rent. In order to simplify the rental behavior of the real estate market, the experiment defaults that unsold houses are in the rent. Each round of the transaction period rent simulates the actual market rent fluctuations situation, randomly determined according to 60, 100, 140 and 180 thousand yuan per set, and rental income can also generate interest income from bank
deposits. (4) This experiment set that each round of the market subject can get a fixed wage of 70,000 yuan. (5) At the end of the 15th round, the unsold houses are in accordance with the residual value of 1 million yuan/set at the end of the period for settlement. It is worth noticing that in both lending experiment groups, the interest and principal generated by the trader’s rounds of home purchase loans need to be repaid at the end of the period and shall be regarded as liabilities before the repayment.

According to the above experimental design, the deposit interest rate and lending interest rates were controlled as independent variables, and 4 experimental groups were set up for trading. The parameters of each group are shown in Tables 1 and 2.

4. Data Analysis

4.1. Construction of Statistical Indicators. During the transaction process of the experimental subjects, the Veconlab experimental platform automatically saved the data generated. In order to further analyze the impact of the control variables of each experimental group on the real estate market transactions, this article refers to the basic principles of market transactions and the existing research results to construct 8 indicators to facilitate the measurement of impact effects, including Quantity, Average Trading Price, Bid Quantity, Offer Quantity, Expected Price, Bubble Index, Price Amplitude and Influential Effect.

4.1.1. Quantity. Quantity refers to the number of houses sold at the end of each round of real estate market transactions, denoted by Q.

4.1.2. Average Trading Price. Average Trading Price refers to the average value of housing prices in all trading after each round of transactions. The formula for calculating the ATP is

\[ ATP_t = \frac{\sum_{t=1}^{15} \sum_{i=1}^{Q_t} Q_i P_{ti}}{Q_t}. \]  

Among them, \( ATP_t \) represents the average housing price of the \( t \)-round transaction, and each group of experiment has 15 rounds of transaction, so \( t \) is an integer between 1 and 15. \( Q_t \) represents the volume of the \( t \)-round transaction. \( Q_i \) and \( P_{ti} \) represent the housing price in the \( t \)-round and the \( i \)-th transaction, and \( i \) is an integer between 1 and \( Q_t \).

4.1.3. Bid Quantity. Bid Quantity refers to the quantity of houses for which the trader has a willingness to buy and submits it in the transaction system in each round of transactions, denoted by BP.

4.1.4. Offer Quantity. Offer Quantity refers to the quantity of houses for which the trader has the willingness to sell and submits it in the transaction system in each round of transactions, denoted by OP.

4.1.5. Expected Price. Expected Price refers to the trader’s estimate of the current housing value, expressed by the average value of the quotations submitted by all traders who plan to buy and sell the house in each round of transactions. The calculation formula is

\[ EP_t = \frac{\sum_{m=1}^{n_b} BP_{tm} Q_{tm} + \sum_{m=1}^{n_o} OP_{tm} Q_{otm}}{\sum_{m=1}^{n_b} BP_{tm} + \sum_{m=1}^{n_o} OP_{tm}}. \]  

\( EP_t \) represents the expected price of the \( t \)-th round, \( t \) represents the \( t \)-th round in each experiment, and \( m \) is the \( m \)-th price offerer. \( n_b \) represents the number of people who are willing to buy a house and make a quotation in each round, and \( n_o \) represents the number of people who are willing to sell a house and make a quotation in each round. \( BP_{tm} \) is the quotation of the \( m \)-th prospective purchaser in the \( t \)-th round, and \( OP_{tm} \) is the quotation of the \( m \)-th prospective seller in the \( t \)-th round. \( Q_{tm} \) is the bid quantity of the \( m \)-th trader in the \( t \)-th round, and \( Q_{otm} \) is the offer quantity of the \( m \)-th trader in the \( t \)-th round.

4.1.6. Bubble Index. There are many studies on the real estate market bubble, and the unanimous definition of it is that the housing price is out of the equilibrium price of the market and continues to rise caused by the real estate market speculation [34]. The real estate market bubble measurement methods are also relatively diverse. This article refers to the formula constructed by Bu et al. [27], who also uses experimental economics to study the real estate market bubble. The formula has strong explanatory power and is compatible with the processing method of the experimental data in this article, which is expressed as

\[ BI_t = \frac{ATP_t - P^*_t}{P^*_t} \times 100\%. \]  

\( BI_t \) refers to the bubble index generated by the \( t \)-th round of trading, \( ATP_t \) represents the average trading price of the \( t \)-th round, and \( P^*_t \) represents the theoretical house price of the \( t \)-th round (The theoretical housing price in the current period is expressed by the residual value and the net present value of the expected rent).

4.1.7. Price Amplitude. Price Amplitude also refers to the method of constructing indicators by Bu et al. [18], which is used to measure the difference between the average trading price of each trading session in the 15 rounds of experimental trading and the maximum and minimum value of the theoretical housing price, expressed by a formula for:

\[ PA = \frac{\text{Max}(ATP_t) - P^*_t}{P_1} - \frac{\text{Min}(ATP_t) - P^*_t}{P_1}. \]  

\( ATP_t \) represents the average trading price of the \( t \)-th round, and \( P^*_t \) represents the theoretical house price of the \( t \)-th round, \( P_1 \) represents the theoretical house price of the first round.
4.2. Experimental Data Analysis on Deposit Interest Rate.
This study conducted two sets of experiments on the deposit interest rate. Low deposit interest rate group and high deposit interest rate group are set up according to different deposit interest rate of 1.5% and 3.5%. Low deposit interest rate group and high deposit interest rate group are set up according to different interest rate levels. The average trading price of the two groups show an inverted “U” shape, deviating from the theoretical price at the beginning of the transaction, and falling down towards the theoretical price at the end of the transaction. Traders’ irrational speculation psychology motivates them to quote and trade at prices that exceed the theoretical value after the start of the transaction, in order to make profits from buying low and selling high at the end of the period. As the residual value at the end of the period is fixed, the period for traders to make profits is shortened as the trading progresses, and the cost of speculation increases, so the quoted and traded prices gradually decrease later and get close to the theoretical price at the end of the period, resulting in an inverted “U” shape.

However, in terms of the degree of deviation from each transaction round, the low deposit interest rate group is higher than the high deposit interest rate group, probably due to the lower cost of house purchase and the higher profit of speculative behavior at low deposit interest rate level. After calculating the price amplitude indicator, we find that the price amplitude of the low deposit interest rate group is

| Group                  | Population | Round | Deposit interest rate (%) |
|------------------------|------------|-------|---------------------------|
| Low deposit interest rate group | 20         | 15    | 1.5                       |
| High deposit interest rate group | 23         | 15    | 3.5                       |

4.1.8. Influential Effect. In order to compare the effects of independent variables in the experimental group on regulating housing prices, the concept of speed is cited, and the speed at which the average trading price in each round of transactions converges to the theoretical price is used to measure the effect of independent variables in stabilizing housing prices. The formula for calculating the influence effect can be expressed as

\[ IE_{(t,s)} = \frac{(ATP_t - P_s^*) - (ATP_s - P_t^*)}{t - s} \]

where \( IE_{(t,s)} \) refers to the effect of independent variables on controlling housing prices, \( t, s \) respectively represent the \( t \)-th and \( s \)-th rounds of transactions, \( ATP_t \) and \( ATP_s \) respectively represent the average trading price of the \( t \)-th and \( s \)-th rounds, and \( P_t^* \) and \( P_s^* \) represents the theoretical house price of the \( t \)-th and \( s \)-th rounds.

Table 1: Experimental parameter settings of the deposit interest rate group.

| Group                  | Population | Round | Deposit interest rate (%) |
|------------------------|------------|-------|---------------------------|
| Low deposit interest rate group | 20         | 15    | 1.5                       |
| High deposit interest rate group | 23         | 15    | 3.5                       |

Table 2: Experimental parameter settings of the lending rate group.

| Group                  | Population | Round | Deposit interest rate (%) | Down payment ratio (%) | Lending rate (%) |
|------------------------|------------|-------|----------------------------|------------------------|-----------------|
| Low lending rate group   | 21         | 15    | 1.5                       | 30                     | 4.35            |
| High lending rate group  | 19         | 15    | 1.5                       | 30                     | 5.74            |
1.21, while the price amplitude of the high deposit interest rate group is 1.54, which coincides with the trend of the two charts, reflecting the relatively larger change of house prices at higher deposit interest rate level. At the low deposit interest rate level, the average house price transaction value deviates far from the theoretical price. At the high deposit rate level, the average trading price deviates less from the theoretical price in the early period, and it increases rapidly in the middle and later period, when the degree of deviation from the theoretical price is large, but the duration is short, and finally it falls rapidly in the middle and later period, and the trading price converges to the theoretical price faster and earlier than the low interest rate level group. In comparison, at the high deposit interest rate level, although the real estate market price fluctuations in the similar period is large, in general the price level is lower, which is more conducive to controlling the market price level and helps maintain the stable operation of the real estate market.

Table 3: Statistical indicators of low deposit interest rate group.

| Round | ATP (thousand yuan) | Q | EP (thousand yuan) | BP | OP | BI (%) |
|-------|---------------------|---|-------------------|----|----|-------|
| 1     | 2000.00             | 5 | 1760.00           | 1.94 | 0.50 | 39    |
| 2     | 2155.00             | 3 | 2128.40           | 1.00 | 0.31 | 52    |
| 3     | 2500.00             | 4 | 2302.90           | 1.00 | 0.50 | 80    |
| 4     | 2560.00             | 3 | 2580.00           | 0.94 | 0.75 | 88    |
| 5     | 2675.00             | 1 | 2690.00           | 0.88 | 0.56 | 101   |
| 6     | 2800.00             | 2 | 2732.10           | 0.81 | 0.63 | 115   |
| 7     | 2830.00             | 3 | 2772.30           | 0.88 | 0.56 | 122   |
| 8     | 2895.00             | 2 | 2798.50           | 0.88 | 0.38 | 132   |
| 9     | 2930.00             | 1 | 2862.90           | 0.56 | 0.31 | 141   |
| 10    | 2850.00             | 3 | 2818.20           | 0.50 | 0.50 | 140   |
| 11    | 2800.00             | 2 | 2609.30           | 0.50 | 0.88 | 142   |
| 12    | 2625.00             | 2 | 2587.20           | 0.19 | 1.44 | 133   |
| 13    | 2390.00             | 1 | 2463.00           | 0.13 | 1.44 | 118   |
| 14    | 1990.00             | 1 | 1821.00           | 0.88 | 1.50 | 87    |
| 15    | 1000.00             | 4 | 1137.50           | 1.00 | 1.25 | 99    |

Note. The missing data is compensated according to the mean value compensation method. When the last round of transactions is unsuccessful, the housing price is compensated according to the residual value of 1000.

Table 4: Statistical indicators of high deposit interest rate group.

| Round | ATP (thousand yuan) | Q | EP (thousand yuan) | BP | OP | BI (%) |
|-------|---------------------|---|-------------------|----|----|-------|
| 1     | 1450.00             | 11| 1325.10           | 2.48 | 1.09 | 26    |
| 2     | 1500.00             | 9 | 1457.00           | 1.74 | 0.70 | 31    |
| 3     | 1625.00             | 9 | 1512.30           | 2.43 | 0.57 | 43    |
| 4     | 1760.00             | 6 | 1534.20           | 2.26 | 0.61 | 56    |
| 5     | 1860.00             | 5 | 1678.20           | 2.30 | 0.61 | 67    |
| 6     | 2025.00             | 5 | 1981.00           | 1.57 | 0.26 | 83    |
| 7     | 2200.00             | 6 | 2049.50           | 1.74 | 0.30 | 100   |
| 8     | 2500.00             | 6 | 2205.50           | 1.61 | 0.26 | 129   |
| 9     | 2832.20             | 4 | 2455.20           | 1.26 | 0.30 | 162   |
| 10    | 2800.00             | 3 | 2618.90           | 1.04 | 0.52 | 162   |
| 11    | 2550.00             | 2 | 2558.60           | 1.00 | 1.26 | 141   |
| 12    | 1925.00             | 3 | 2244.70           | 0.78 | 1.52 | 84    |
| 13    | 1300.00             | 4 | 1802.20           | 1.17 | 1.39 | 25    |
| 14    | 1060.00             | 6 | 1496.70           | 1.17 | 1.04 | 3     |
| 15    | 990.00              | 1 | 1290.80           | 0.96 | 0.96 | −3    |

Note. The missing data is compensated according to the mean value compensation method. When the last round of transactions is unsuccessful, the housing price is compensated according to the residual value of 1000.

Table 5: Descriptive statistics of deposit interest rate groups.

| Group               | Statistics  | ATP (thousand yuan) | EP (thousand yuan) | BP  | OP  | BI (%) |
|---------------------|-------------|---------------------|-------------------|-----|-----|--------|
| Low deposit interest rate group | Mean       | 2466.70             | 2.47              | 2415.50 | 0.81 | 0.77   | 99    |
|                     | Standard deviation | 495.10             | 1.20              | 483.50  | 0.41 | 0.41   | 41    |
| High deposit interest rate group | Mean       | 1891.80             | 5.33              | 1880.70 | 1.57 | 0.76   | 74    |
|                     | Standard deviation | 572.70             | 2.65              | 439.50  | 0.56 | 0.41   | 53    |
Figure 3 shows the fluctuations of the speed at which the transaction prices to theoretical prices over the transaction round 3–13 at different deposit interest rate levels, and the magnitude of the fluctuations can reflect the effect of the independent variable, deposit interest rate, on housing price changes. The effect lines of both experimental groups float around the zero line, and the positive or negative slope of each point of the curve indicates a change in the direction of convergence of transaction prices to theoretical prices, with positive numbers being divergence and negative numbers convergence. As can be seen from Figure 3, the effect on the convergence of housing prices is greater when the level of deposit interest rate is high, and increasing the level of deposit interest rate is more conducive to regulating the degree of housing prices deviation from theoretical prices.

Nonparametric testing refers to a method used to test whether the data comes from the same overall hypothesis when the overall distribution is unknown [35]. Mann–Whitney U-test, also known as “Mann–Whitney rank sum test”, was proposed by Mann and Whitney in 1947. The null hypothesis of the test is that the two samples are from two populations that are identical except for the population mean. The purpose is to test whether the means of the two populations are significantly different [36]. When the P value of the test is less than 5% confidence, the original hypothesis is considered to be less than 5%, the original hypothesis is rejected, and the two samples are significantly different. On the contrary, the original hypothesis is accepted, and the two samples are not significantly different. In order to test the impact of different experimental groups of
deposit interest rates on the average trading price, quantity, expected price, bid quantity, and offer quantity, we treated the data of two experimental groups with different deposit interest rates as multiple independent samples that did not affect each other, and used the software Stata22.0 to perform Mann–Whitney U-test. The results are shown in Table 6.

As can be seen from the tables, for the average trading price indicator, there is a significant difference between the high deposit interest rate group and the low deposit interest rate group, indicating that the deposit interest rate has an effect on housing prices. Combined with the fact that the average trading price decreases with the increase of deposit interest rate for the two experimental groups in Tables 3–5, it is clear that there is a significant suppression effect of deposit interest rate on housing price. There is a significant difference between the effect of the high deposit interest rate group and the low deposit interest rate group on the desired price, consistent with the findings reflected in the difference in means in Table 5. Table 6 shows that for the quantity and the bid quantity, the two experimental groups are also significantly different, with high values of 0.003 and less than 0.001. Combining Tables 3 and 4, it is clear that the interest rate level has a significant contribution to the transaction behavior in the real estate market. The higher the interest rate level is, the more frequent the market transaction is. While there is no significant difference in the number of sets to be sold by traders in the market at 1.5% and 3.5% interest rate levels, indicating that the interest rate level does not play a significant role in consumers’ willingness and behavior to sell their house.

4.3. Experiment Data Analysis of Lending Rate. This study also conducts two groups of lending rate experiments, which are divided into low lending rate group and high lending rate group according to the difference between lending rate 4.35% and 5.74%, and the values of relevant statistical indicators for both groups are shown in Tables 7 and 8, and the mean and standard deviation values of each statistical indicator are shown in Table 9. Figure 4 demonstrates the changes in the mean price and the theoretical price of each round of transaction during the trading process of both groups.

As can be seen from Tables 7–9, in the same trading rounds, the average trading prices of the two experimental groups have their own high and low levels, but the overall average prices are similar at $2,195,600 and $2,222,300 respectively. While the standard deviation of the average trading price of the high lending rate group is 116.50, much larger than that of the low lending rate group at 62.55. By calculating the price amplitude index, it is revealed that the price amplitude of the high lending rate group is 2.72 and the low lending rate group is 1.34, indicating that price fluctuations are relatively frequent when the lending rate level is high. Traders’ expected housing price in the market is the same as the average trading price, again similar for both groups.

Comparing the quantity between the two experimental groups in each round, it can be seen that the quantity in the low lending rate group is relatively more than in the high deposit rate group, and on the contrary, the indicator Bid Quantity is less. This indicates that in a market with high lending rates, real estate market traders have a strong willingness to buy, but the actual quantity is somewhat suppressed. As in the case of the deposit rate group, this is also due to the speculative mentality of traders. When the lending rate is high, the cost of purchasing a house is high and traders are then eager to gain profits by buying and selling more houses, which results in high trader buying activity. In Table 9, the mean values of the offer quantity for the two experimental groups are 0.48 and 0.43 respectively, with little difference in standard deviation, which does not reflect the effect of lending interest rate level on traders’ willingness and behavior to sell their houses.

The results of descriptive statistics for the two sets of lending rate experiments show that market traders are quite optimistic about the expected trend of housing prices.
Compared to the low lending rate level, the high market interest rate level results in relatively higher transaction costs and stronger willingness of traders to buy a house, but the selling behavior is not significantly affected and is still at a low level, so the actual quantity is lower and the real estate market price changes are relatively larger. The mean value of

**Table 6: Nonparametric test of intergroup indicators of deposit interest rate.**

| Group                                      | ATP | Q  | EP | BP | OP |
|--------------------------------------------|-----|----|----|----|----|
| Low deposit interest rate group and high   | 0.007 | 0.001 | 0.003 | <0.001 | N/A |

**Table 7: Statistical indicators of low lending rate group.**

| Round | At (thousand yuan) | Q | E (thousand yuan) | B | O | BI (%) |
|-------|-------------------|---|-------------------|---|---|--------|
| 1     | 1275.00           | 3 | 1094.60           | 1.81 | 0.33 | −11    |
| 2     | 1425.00           | 1 | 1264.50           | 1.33 | 0.29 | 1      |
| 3     | 1720.00           | 5 | 1480.80           | 1.43 | 0.29 | 24     |
| 4     | 1800.00           | 2 | 1625.60           | 1.48 | 0.29 | 32     |
| 5     | 2000.00           | 2 | 1780.90           | 1.29 | 0.33 | 50     |
| 6     | 2300.00           | 2 | 2080.00           | 1.19 | 0.33 | 76     |
| 7     | 2500.00           | 7 | 2316.50           | 0.86 | 0.38 | 96     |
| 8     | 2730.00           | 2 | 2430.50           | 0.81 | 0.43 | 119    |
| 9     | 2825.00           | 5 | 2700.00           | 0.57 | 0.57 | 132    |
| 10    | 2900.00           | 2 | 2748.10           | 0.62 | 0.52 | 144    |
| 11    | 2900.00           | 3 | 2747.50           | 0.52 | 0.48 | 150    |
| 12    | 2885.00           | 3 | 2697.70           | 0.48 | 0.62 | 156    |
| 13    | 2750.00           | 4 | 2605.30           | 0.43 | 0.81 | 151    |
| 14    | 1891.30           | 2 | 2438.70           | 0.29 | 0.81 | 78     |
| 15    | 1032.50           | 0 | 1672.50           | 0.76 | 0.67 | 0      |

**Table 8: Statistical indicators of high lending rate group.**

| Round | At (thousand yuan) | Q | E (thousand yuan) | B | O | BI (%) |
|-------|-------------------|---|-------------------|---|---|--------|
| 1     | 450.00            | 3 | 815.90            | 5.32 | 0.26 | −69    |
| 2     | 1020.00           | 1 | 728.90            | 3.68 | 0.16 | −28    |
| 3     | 1500.00           | 3 | 1111.70           | 2.26 | 0.32 | 8      |
| 4     | 1950.00           | 2 | 1391.90           | 1.74 | 0.26 | 43     |
| 5     | 2400.00           | 2 | 1933.20           | 1.74 | 0.16 | 80     |
| 6     | 3025.00           | 1 | 2551.10           | 1.58 | 0.21 | 132    |
| 7     | 3650.00           | 2 | 2952.60           | 1.11 | 0.26 | 186    |
| 8     | 4100.00           | 1 | 3406.10           | 1.42 | 0.32 | 229    |
| 9     | 4150.00           | 2 | 4002.20           | 1.05 | 0.58 | 241    |
| 10    | 3325.00           | 0 | 4031.40           | 1.00 | 0.53 | 180    |
| 11    | 2500.00           | 1 | 3228.90           | 1.42 | 0.63 | 116    |
| 12    | 2000.00           | 1 | 2513.30           | 1.16 | 0.68 | 77     |
| 13    | 1200.00           | 1 | 1809.40           | 0.89 | 0.74 | 9      |
| 14    | 1070.00           | 1 | 1223.70           | 1.58 | 0.74 | 1      |
| 15    | 995.00            | 1 | 1012.00           | 1.63 | 0.58 | −4     |

**Table 9: Descriptive statistics of lending rate groups.**

| Group                      | Statistics | AT (thousand yuan) | Q  | E (thousand yuan) | B  | O  | BI (%) |
|----------------------------|------------|--------------------|----|-------------------|----|----|--------|
| Low lending rate group     | Mean       | 2195.6             | 2.87 | 2112.2             | 0.92 | 0.48 | 80     |
|                            | Standard deviation | 625.5             | 1.71 | 558.7             | 0.45 | 0.18 | 0.59   |
| Low lending rate group     | Mean       | 2222.3             | 1.47 | 2180.8             | 1.84 | 0.43 | 80     |
|                            | Standard deviation | 1165.0             | 0.81 | 1107.6             | 1.14 | 0.21 | 0.94   |
the bubble index is the same for both groups of experiments, but the standard deviation in high lending rate level is 0.94, which is much larger than that of the low lending rate group, so the bubble index also illustrates the phenomenon of high market price volatility at high lending rate levels. But the effect of changes in the level of lending interest rates on selling behavior is small, compared to buying behavior.

Figure 4 shows the changes of the average trading price and the theoretical price in different lending rate levels. The average trading prices of both groups show an inverted “U” shape, which is also the result of irrational competition. As can be seen from the graph, the average trading price deviates from the theoretical price to a great extent and at a fast rate at high lending rates as the transaction progresses. In contrast, at low deposit rate levels, the average trading price deviates from the theoretical price to a low degree and at a slow pace. However, the deviation of the average trading price from the theoretical price is relatively early at high lending rate levels, and converges to the theoretical price at a later stage before the low lending rate group. In comparison, although the price fluctuations in the real estate market are large in the adjacent period at the high lending rate level, the deviation period is short in general, and the interest rate level plays a more significant role in regulating house price fluctuations and is more conducive to stabilizing the operation of the real estate market.

Figure 5 illustrates the fluctuations of the speed at which the transaction prices to theoretical prices over the transaction round 3–13 at different lending rate levels. The magnitude of the fluctuations captures the effect of the lending rate on housing price changes. It can be seen that there is a significant difference in the effect of the two groups of experiments. Both groups of effect lines float around the zero line, but the effect on housing price convergence is greater at high lending rate levels, further reflecting the fact that increasing the level of lending rate is more conducive to regulating the extent to which housing price deviates from theoretical prices.

In order to test the influence degree of lending rate in different experimental groups on various indicators of market trading, the data of the two experimental groups with different lending rates were considered as multiple independent samples which have no influence on each other, and the Mann–Whitney U-test was conducted using Stata 22.0 software, and the results are shown in Table 10. There is a significant difference between the group with high lending rates and the group with low lending rates, indicating that lending rates have a significant impact on traders’ purchasing behavior. This result is consistent with the results of descriptive statistics: the level of lending rate significantly suppresses the transaction quantity and significantly promotes the willingness and behavior of traders to purchase house. The fact that there is no significant difference between the average trading price, expected price and offer quantity by traders in the market at different lending rate levels indicates that lending rate level has little effect on housing prices and consumers’ selling behavior. This finding is consistent with the results of Tak et al. [15] and Xu [17], but also contradicts the results of many scholars, which deserves further study.

5. Discussion

Based on the above data analysis results, the relationship between interest rate and real estate market transactions is further discussed.

First, from the perspective of deposit interest rate, high interest rate is more conducive to house price suppression and market stability. Under the low deposit interest rate, the opportunity cost of house purchase is low, and the initial purchase intention of house buyers is strong. Therefore, the price is significantly higher than the theoretical price from the first round, which directly leads to a decrease in the willingness to purchase and a frequent fluctuation of prices. Meanwhile, a small number of speculators are eager to get income from the
real estate market turmoil, thus continuing to drive up the price and produce real estate market bubbles, which is not conducive to the healthy development of the real estate market. Therefore, under the high deposit interest rate, the purchase opportunity cost is relatively high, buyers are more rational in real estate investment, and the real estate price is low and stable, which can effectively curb the problem of real estate overheating. At the same time, it provides traders with a stable and healthy economic environment, boost traders’ market confidence, improve the trading volume and promote the stable and prosperous development of real estate.

From the perspective of lending interest rate, the real estate market is also more stable under high lending interest rate. High interest rates raise the cost of buying houses, making traders more rational in making decisions and preventing bubbles in the housing market. Although the house prices rose more in the first half of the experiment, which was mainly due to the fact that before the experiment, the high lending interest rate reduced the traders’ willingness to buy houses, resulting in the initial house price being far lower than the theoretical price, and the traders’ willingness to buy became very strong. In addition, some speculators were eager to gain profits by buying more houses at a lower price when the transaction opportunity cost was high. Therefore, house prices rose rapidly at the beginning. However, in the later stage of the experiment, due to the high opportunity cost of house purchase, traders gradually turned to rational decision-making, and the trading volume decreased. At the same time, the house price quickly approached the theoretical price and returned to the normal price earlier than the low deposit interest rate group. Therefore, the effect of controlling price convergence is better.

Besides, regardless of the deposit and lending interest rate level, it has no significant impact on the traders’ willingness to sell in the experiment, indicating that property owners prefer to leave assets in their hands, which is not affected by the interest rate level. It is worth noting that an important influence object of lending interest rate is real estate manufacturers. When the lending interest rate increases, real estate manufacturers will reduce capital investment, so as to reduce the real estate supply, and the house price may rise. In this study, the research object is the real estate market trader, and the seller is the individual who owns the real estate, so the situation may change in the macro situation.

Overall, the deposit and lending interest rates have promoted the stability of the real estate market by increasing the purchase cost. However, raising the deposit interest rate is more conducive to curb house prices, promote the volume of real estate transactions and realize the rational allocation of real estate resources, while raising the lending interest rate is more suitable to solve the problem of real estate overheating and reduce the activity of real estate transactions. In addition, this study pays more attention to the investment property of the house. For rigid demand buyers with housing needs, the impact of interest rate policy adjustment is small. When carrying out interest rate policy reform and adjustment, the two types of buyers should be distinguished.

6. Conclusion

Real estate has both consumer and speculative attributes. Active speculative activities generated for this reason can make the real estate transaction market create much bubble,
resulting in real estate prices higher than the true value. But the bubble will not increase all the time and will fluctuate around the true value of the asset to a certain extent, and stable house price fluctuation is important to maintain the overall stability of the real estate market. This paper intends to study the impact of two instruments, deposit and lending rates which are adopted by the government to regulate housing price, on real estate market transactions. The experiment uses experimental economics to obtain experimental data, descriptive statistics and nonparametric tests by setting parameters and simulating actual real estate market transactions by using an online experimental platform.

The results show that: (1) the level of deposit interest rate has a significant inhibitory effect on housing price and a significant facilitating effect on the quantity of real estate transactions and house-buying behavior of traders. The higher the level of deposit interest rate is, the better the effect of the deviation of regulating housing prices from theoretical price is and the better the effect of suppressing market bubbles is. (2) The level of lending rate has a significant inhibiting effect on the quantity of real estate transactions and a significant promoting effect on the house-buying behavior of traders, but the effect on housing price and market bubbles is not significant. The higher the level of lending rate is, the better the effect of the deviation of regulating housing prices from theoretical price is. (3) The effect of deposit interest rate and lending rate regulation policies on the house selling behavior of market traders is not significant.

The Central Economic Work Conference of China in 2020 emphasized the need to solve the outstanding housing problems in large cities. Local governments need to take into account local conditions, implement city-specific policies, and execute multiple policies simultaneously to promote the stable and healthy development of the real estate market. The research in this paper shows that high level of deposit and lending interest rates are more conducive to regulating the extent to which housing prices deviate from theoretical price. Therefore, in order to regulate housing price bubbles, the government can help promote real housing prices return to rationality by increasing the level of interest rates.

The high level of interest rates has a significant contribution to the buying behavior of market traders, while the effect on the selling behavior of traders is not significant, indicating that the speculative mentality of market traders is still prevalent and they are not very sensitive to changes in interest rates. Therefore, it is necessary for the government to adopt stricter regulatory measures besides interest rate tools to combat traders’ speculative psychology, such as limiting the number of purchases and purchase conditions. In addition, deposit rates can significantly boost the quantity of real estate market transactions when they are at a high level, while lending rates have the opposite effect. Based on this, the government can raise the level of regional deposit interest rates to help revitalize regional fixed assets and improve the efficiency of resource use; while at the necessary stage of regulating housing prices, the government can raise the level of lending interest rates to suppress the activity of real estate market transactions and keep the rational development of the market economy. [28–36].

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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