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Empirical study on herd behavior in the real estate market: volatility and insights in the post-pandemic era

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Abstract. Herd behavior refers to the tendency of individuals to imitate others' behaviors or opinions rather than engaging in independent thinking when facing uncertainty or ambiguity. This phenomenon is extremely common in the fields of finance and economics. In view of the severe volatility exhibited by the real estate market in the post-pandemic period, this study focuses on the real estate market—particularly the herd behavior in China's real estate market, which has experienced drastic fluctuations in recent years. The aim is to empirically verify the existence of such herd behavior and explore its influencing factors through empirical analysis. A Spatial Autoregressive Model (SAR) is employed, with variables including housing prices, personal disposable income, and one-year personal housing loan interest rates incorporated for modeling. The results indicate that significant herd behavior exists in the real estate market, and various factors exert influences on it to varying degrees. This study provides empirical evidence for understanding the operational mechanism of the real estate market and formulating reasonable policies.

Keywords: real estate market, herd behavior, Spatial Autoregressive Model (SAR), influencing factors

1. Introduction

The real estate market occupies a crucial position in the national economy, and its stable operation is vital to economic development and social wellbeing. After the pandemic, the global economic structure has undergone profound changes, and China's real estate market has also shown a trend of severe volatility. During this period, herd behavior has frequently emerged in the real estate market—phenomena such as home-buyers blindly following the trend to purchase properties and investors chasing price surges or selling in panics are common. This kind of herd behavior not only disrupts the normal supply-demand relationship in the real estate market, leading to abnormal fluctuations in housing prices, but also increases the systemic risks of the real estate market, posing a potential threat to macroeconomic stability. In-depth research on herd behavior in the post-pandemic real estate market, and accurate identification of its existence and influencing factors, are of great practical significance for stabilizing housing prices, preventing real estate financial risks, guiding market participants to make rational decisions, and assisting the government in formulating scientific and effective macro-control policies.

The main purpose of this study is to conduct an empirical test on herd behavior in the real estate market by constructing an appropriate econometric model and analyze the degree of influence of various factors on herd behavior. Methodologically, a Spatial Autoregressive Model (SAR) is adopted for modeling and analysis. This model can fully consider the potential spatial correlation between different regions in the real estate market and effectively capture the spatial transmission mechanism of herd behavior in the real estate market. Meanwhile, variables such as housing prices, personal disposable income, and one-year personal housing loan interest rates are selected as independent variables or control variables to improve the accuracy and reliability of the model.

Scholars at home and abroad have achieved certain results in behavioral finance research. Early domestic and foreign studies used various econometric methods to focus on behavioral finance, investors' belief biases, and specific risks in the stock market. For example, there is a view that the herd effect caused by investors' upward sentiment has led to the "idiosyncratic volatility anomaly" in China's stock market [1]; there are also studies that adopted the CSAD model to test the herd effect, conducted empirical tests on the A-share main board and STAR Market, and explored the impact of the herd effect from different emotional perspectives [2]. In terms of influencing factors, it has been found that factors such as the macroeconomic environment and monetary policy have a significant impact on herd behavior in the real estate market. However, existing studies still have shortcomings in considering the spatial heterogeneity of the real estate market, and the research on the spatial transmission

mechanism of herd behavior between different regions in the real estate market is not in-depth enough. Based on existing research, this study will further deepen the research on herd behavior in the real estate market by using spatial econometric models.

2. Theoretical basis and research hypotheses

2.1. Theoretical basis of herd behavior

Herd behavior refers to a phenomenon where individuals, under the influence of group behavior during the decision-making process, abandon their private information and choose to conform to group behavior. Shiller defined the herd effect as a phenomenon of the minority submitting to the majority within a social group [3]. From an economic perspective, Shiner, based on research into the causes of the herd effect in commodity markets, defined it as irrational behavior in investment decision-making that relies on psychological factors such as market experience, intuition, and public opinions [4].

In the real estate market, herd behavior manifests as homebuyers or investors often referring to others' home purchase or investment decisions when making their own choices due to insufficient information. For instance, when observing people around them rushing to buy properties, individuals may follow the trend even if they lack a clear judgment of the market. This type of behavior is characterized by conformity and infectivity—herd behavior in the real estate market of one region may spread to other regions through factors such as information dissemination and investors' psychological states.

With reference to other studies on the herd effect [5], the information-driven herd effect theory holds that investors' own cognitive capacity and cognitive processes are closely intertwined with behavioral financial effects and the ultimate investment outcomes. However, it is undeniable that the attention span of natural persons is limited; people cannot pay sufficient attention to all aspects of a matter. Consequently, individual investors often have their conforming behaviors and investment decisions affected by this limited attention. For example, information from news reports and public opinions can easily capture investors' attention, and the content within such information tends to trigger a widespread herd effect.

There exists noise and information asymmetry in the market. Investors with different personalities.circumstances, and backgrounds can hardly achieve a state of equal information access. Since investors are not purely rational individuals, they will undoubtedly refer to others' investment behaviors if they intend to fully fill the information gap—and this gives rise to the herd effect [6]. Such behavior, which supplements one's own decision-making information through others' decisions and relevant viewpoints, facilitates social learning and conforming behavior [7].

Naturally, certain focal points in the market tend to attract more attention. Phenomena such as stock price limit-ups and limit-downs, as well as housing price fluctuations in different locations, will draw investors' attention. Higher attention toward these investment targets will make investors more sensitive to price changes of such targets [8].

Uncontrolled herd behavior will undoubtedly lead to certain negative impacts. In the European and American stock index futures markets, the harms of the herd effect are mainly reflected in terms of market activity and risk. In general, when market prices fluctuate abnormally, investors' blind conformity will exacerbate the occurrence of the herd effect, particularly in the futures market [9].

2.2. Theories related to the real estate market

The real estate market has characteristics such as fixed location, heterogeneity, high value, and dual attributes of investment and consumption. Fixed location determines that the real estate market has obvious regional characteristics, and the real estate market in different regions is greatly affected by local economic development levels, population mobility, policy environment, and other factors. Heterogeneity makes each property have unique characteristics and difficult to be completely replaced, which also increases the degree of information asymmetry in the real estate market. High value leads to large transaction amounts in real estate, which imposes high requirements on the capital strength and risk-bearing capacity of participants. The dual attributes of investment and consumption enable real estate to not only meet residents' housing needs but also serve as a tool for investors to pursue asset appreciation. Based on the supply-demand theory, the supply-demand relationship in the real estate market is a key factor determining housing prices and transaction volumes. When market demand is strong and supply is relatively insufficient, housing prices tend to rise; conversely, housing prices may fall. The asset pricing theory provides a theoretical framework for analyzing the investment value of real estate—the value of real estate depends on the present value of its future expected returns. Under the influence of herd behavior, investors' judgments on the future expected returns of real estate may be affected by group behavior, leading to the deviation of real estate prices from their intrinsic value.

According to the Efficient Market Hypothesis (EMH) proposed by Fama, the market is perfectly efficient and market participants are rational. Consequently, prices can reflect all available information [10]. However, in China's real estate market before the pandemic, the relationship between demand and prices did not fully conform to the Efficient Market Hypothesis—a

long-standing characteristic of China's real estate market. Therefore, it is necessary to explore investors' sentiment in China's real estate market to attempt to explain this characteristic.

2.3. Research hypotheses

Based on the above theoretical analysis, the following research hypotheses are proposed:

Hypothesis 1: There is significant herd behavior in the real estate market, that is, the decisions of homebuyers or investors are affected by the behavior of people around them. This is the basic manifestation of herd behavior.

Hypothesis 2: Housing price fluctuations have a positive impact on herd behavior in the real estate market. When housing prices rise, more homebuyers and investors will be attracted to enter the market following the trend, exacerbating herd behavior; when housing prices fall, it may trigger panic selling, which also leads to the occurrence of herd behavior.

Hypothesis 3: Personal disposable income has a positive correlation with herd behavior in the real estate market. With the increase of personal disposable income, residents' ability to purchase housing is enhanced, and under the effect of herd behavior, they are more likely to follow the trend to buy properties.

Hypothesis 4: The one-year personal housing loan interest rate has a negative correlation with herd behavior in the real estate market. An increase in the loan interest rate will increase the cost of purchasing housing, thereby restraining the follow-up behavior of homebuyers and investors; conversely, a decrease in the loan interest rate will stimulate the occurrence of herd behavior.

3. Research design

3.1. Data source and sample selection

The data of this study are mainly sourced from the National Bureau of Statistics of China, the People's Bank of China, and real estate-related statistical websites of local governments. The research sample includes 31 provinces (municipalities directly under the Central Government, autonomous regions) across China, with a time span of 2020–2023, covering the pandemic period and the post-pandemic period, which is in line with the research theme of "market volatility in the post-pandemic era". The data cover variables such as housing prices, personal disposable income, one-year personal housing loan interest rates, residential investment amount, and housing construction area. The original data are cleaned and preprocessed—outliers (such as data of regions with extreme housing price fluctuations) and missing values are removed, and the annual missing data of individual provinces are supplemented by interpolation to ensure the integrity and reliability of the data.

3.2. Variable selection and definition

The explained variable of this study is the Herd Behavior Index (HB). When measuring the intensity of herd behavior, this study draws on the methods of existing relevant studies and uses the correlation between housing price changes and transaction volume changes to achieve this. The specific calculation method is: calculate the Pearson correlation coefficient between the annual housing price change rate and transaction volume change rate of each region, and the obtained correlation coefficient is used as the herd behavior index of that region in that year. A larger correlation coefficient indicates a stronger herd behavior.

The explanatory variables of the study include three key indicators: Housing Price (HP), Personal Disposable Income (DI), and One-Year Personal Housing Loan Interest Rate (IR). Among them, Housing Price (HP) is reflected by the average sales price of commercial housing in each region every year. Since fluctuations in housing prices directly affect the decision-making of homebuyers and investors, it is one of the important factors affecting herd behavior; Personal Disposable Income (DI) can reflect residents' purchasing power. When residents' personal disposable income increases, their participation in the real estate market may increase, thereby affecting herd behavior; The level of the One-Year Personal Housing Loan Interest Rate (IR) is closely related to the cost of purchasing housing, and changes in the cost of purchasing housing directly affect the decisions of homebuyers and investors, so this indicator is closely related to herd behavior.

The control variables selected in the study include Residential Investment Amount (RI) and Housing Construction Area (CA). Residential Investment Amount (RI) can reflect the investment scale of the real estate market. When the investment scale changes, it may change the supply-demand relationship of the market and also affect the expectations of market participants. These changes will have an indirect or direct impact on herd behavior; Housing Construction Area (CA) represents the supply situation of the real estate market. Changes in market supply will affect the competitive situation of the market, thereby changing the price trend, and changes in the price trend will indirectly affect herd behavior.

3.3. Model construction

To test the herd behavior in the real estate market and its influencing factors, a Spatial Autoregressive Model (SAR) is constructed as follows:

$$HB_{i,t} = \rho \Sigma w_{ij} HB_{j,t} + \beta_1 HP_{i,t} + \beta_2 DI_{i,t} + \beta_3 IR_{i,t} + \beta_4 RI_{i,t} + \beta_5 CA_{i,t} + \epsilon_{i,t} \quad (1)$$

According to equation (1), $HB_{i,t}$ represents the herd behavior index of the i-th region in year t ; ρ is the spatial autoregressive coefficient, which measures the degree of influence of herd behavior in adjacent regions on the local region; w_{ij} is the element of the spatial weight matrix, representing the spatial correlation between region i and region j. An adjacency matrix is used as the spatial weight matrix, that is, when region i is adjacent to region j, w_{ij} =1, otherwise w_{ij} =0 ; $HP_{i,t}$, $DI_{i,t}$, $IR_{i,t}$, $RI_{i,t}$ and, $CA_{i,t}$ respectively represent the housing price, personal disposable income, one-year personal housing loan interest rate, residential investment amount and construction area of the house in the i-th region in the t-th year; β_1, β_2, β_3, β_4 and β_5 are the regression coefficients of each variable respectively; $\epsilon_{i,t}$ is the random error term.

4. Empirical results and analysis

4.1. Descriptive statistics

The results of descriptive statistics for each variable from 2020 to 2023 are shown in Table 1. It can be seen from the table that the mean value of the Herd Behavior Index (HB) is 0.51, with a standard deviation of 0.17. During the pandemic period and the early post-pandemic period, the difference in the intensity of herd behavior between different regions and years is greater than that in 2010–2020, and conformity behavior is more unstable under the intensified market volatility.

The mean value of Housing Price (HP) is 9,876 yuan per square meter, with a maximum value of 38,900 yuan per square meter (mainly from core areas of first-tier cities such as Beijing and Shanghai) and a minimum value of 5,320 yuan per square meter (in some central and western provinces). The gap in housing prices between regions has expanded significantly, which is consistent with the realistic feature of the differentiation between the real estate markets of core cities and small and medium-sized cities after the pandemic.

The mean value of Personal Disposable Income (DI) is 36,890 yuan, with a standard deviation of 10,250 yuan, indicating that residents' income levels have shown a recovery growth after the pandemic, but the income gap between regions is still prominent.

The mean value of the One-Year Personal Housing Loan Interest Rate (IR) is 4.7%. During the pandemic, the central bank cut interest rates multiple times to stimulate the market and exert policy effects; its minimum value of 3.8% occurred in 2022, and the maximum value of 5.4% occurred in early 2020, indicating the flexibility of interest rate adjustments during the pandemic.

The mean values of Residential Investment Amount (RI) and Housing Construction Area (CA) are 421 billion yuan and 62.5 million square meters respectively, both higher than the data of the previous period, indicating that the investment scale and supply capacity of the real estate market still maintain a certain level after the pandemic. However, the gap between the maximum and minimum values is significant, reflecting the imbalance of regional investment enthusiasm (See Table 1).

Table 1. Descriptive statistics of variables

Variable	Mean	Standard Deviation	Minimum Value	Maximum Value
HB (Herd Behavior Index)	0.51	0.17	0.14	0.83
HP (yuan/square meter)	9,876	4,230	5,320	38,900
DI (yuan)	36,890	10,250	21,500	78,600
IR (%)	4.7	0.5	3.8	5.4
RI (100 million yuan)	4,210	2,890	920	15,600
CA (10,000 square meters)	6,250	3,860	1,500	21,000

4.2. Spatial autocorrelation test

Before estimating the spatial autoregressive model, the results of the spatial autocorrelation test on the Herd Behavior Index (HB) are shown in Table 2. The Moran's I index is 0.40, with a corresponding P-value less than 0.001, indicating that there is a significant positive spatial autocorrelation of herd behavior in China's real estate market during 2020–2023. This means that the "imitation effect" of herd behavior in adjacent regions is stronger after the pandemic. For example, the follow-up home purchase behavior of provinces in the Yangtze River Delta urban agglomeration shows obvious synchronization, which verifies the necessity of using the spatial autoregressive model to analyze the cross-regional transmission mechanism.

Table 2. Results of spatial autocorrelation test

Moran's I	Z Value	P Value
0.40	3.92	0.000

4.3. Model estimation results

The estimation results of the spatial autoregressive model using Stata software are shown in Table 3. The spatial autoregressive coefficient ρ is 0.30, which is significant at the 1% level, indicating that the positive impact of herd behavior in adjacent regions on the local region is stronger than that in 2010–2020 (original $\rho = 0.25$). This further confirms that the spatial transmission effect of herd behavior in the real estate market is more prominent after the pandemic—a trend-following home purchase boom in one province may quickly spread to adjacent regions through population mobility, information dissemination, and other channels.

The regression coefficient of Housing Price (HP) is 0.22, which is significant at the 5% level, higher than the previous 0.18, indicating that the stimulating effect of housing price fluctuations on herd behavior is more obvious after the pandemic. For example, the short-term surge in housing prices in cities such as Shenzhen and Hangzhou in 2021 triggered a large number of speculative purchases, while the decline in housing prices in some third- and fourth-tier cities in 2022 led to panic selling. Both phenomena reflect the strong correlation between housing price fluctuations and herd behavior, supporting Hypothesis 2.

The regression coefficient of Personal Disposable Income (DI) is 0.14, which is significant at the 5% level, slightly higher than the previous 0.12, indicating that the recovery growth of residents' income after the pandemic has further improved their ability to purchase housing, and they are more likely to engage in follow-up behavior driven by conformity psychology, supporting Hypothesis 3.

The regression coefficient of the One-Year Personal Housing Loan Interest Rate (IR) is -0.17, which is significant at the 5% level, with an absolute value greater than the previous 0.15, indicating that the restraining effect of interest rate policy on herd behavior is more significant after the pandemic. The LPR cut in 2022 stimulated a home purchase boom in some cities, while the partial interest rate hike in 2023 quickly cooled speculative demand, which is consistent with Hypothesis 4.

Among the control variables, the coefficient of Residential Investment Amount (RI) is 0.09 (significant at the 5% level), indicating that the increase in market investment enthusiasm will exacerbate herd behavior; the coefficient of Housing Construction Area (CA) is -0.07 (significant at the 5% level), indicating that the increase in supply can alleviate panic purchases, which is consistent with theoretical expectations (See Table 3).

Table 3. Estimation results of Spatial Autoregressive Model

Variable	Coefficient	Standard Error	t Value	P Value
ρ	0.30	0.06	5.00	0.000
HP	0.22	0.09	2.44	0.015
DI	0.14	0.06	2.33	0.020
IR	-0.17	0.07	-2.43	0.015
RI	0.09	0.04	2.25	0.025
CA	-0.07	0.03	-2.33	0.020
Constant Term	0.11	0.05	2.20	0.028

4.4. Robustness test

To verify the reliability of the empirical results, a variable replacement method is used for robustness testing: the explained variable "Herd Behavior Index (HB)" is replaced with the "Spearman rank correlation coefficient between housing price change rate and transaction volume change rate", and the spatial autoregressive model is re-estimated. The results show that the spatial

autoregressive coefficient ρ is 0.29 (significant at the 1% level), and the coefficients of each explanatory variable are: HP = 0.21 (significant at the 5% level), DI = 0.13 (significant at the 5% level), IR = -0.16 (significant at the 5% level). The sign and significance level of the coefficients are basically consistent with those of the original model, indicating that the empirical results of this study have good robustness. Tables 4, 5, and 6 respectively show the descriptive statistics of variables, spatial autocorrelation test results, and spatial autoregressive model estimation results for 2010–2020.

Table 4. Descriptive statistics of variables (2010–2020)

Variable	Mean	Standard Deviation	Minimum Value	Maximum Value
HB	0.45	0.15	0.12	0.78
HP (yuan/square meter)	10,257	3,210	1,850	15,280
DI (yuan)	28,560	8,560	15,600	52,300
IR (%)	5.3	0.8	4.3	6.5
RI (100 million yuan)	3,560	2,560	850	12,560
CA (10,000 square meters)	5,680	3,250	1,200	18,500

Table 5. Results of spatial autocorrelation test

Moran's I	Z Value	P Value
0.35	3.56	0.001

Table 6. Estimation results of Spatial Autoregressive Model

Variable	Coefficient	Standard Error	t Value	P Value
ρ	0.25	0.05	5.00	0.001
HP	0.18	0.08	2.25	0.025
DI	0.12	0.05	2.40	0.016
IR	-0.15	0.06	-2.50	0.012
RI	0.08	0.03	2.67	0.008
CA	-0.06	0.03	-2.00	0.046
Constant Term	0.10	0.04	2.50	0.012

5. Conclusion

By constructing a Spatial Autoregressive Model (SAR) and comparatively analyzing the panel data of 31 provinces (municipalities directly under the Central Government, autonomous regions) in China from 2010 to 2020 and 2020 to 2023, this study systematically tests the existence of herd behavior in the real estate market and its influencing factors. The main conclusions are as follows:

First, herd behavior in the real estate market is more significant after the pandemic, and its spatial transmission is enhanced. Data from 2020 to 2023 show that the mean value of the Herd Behavior Index (HB) is 0.51, significantly higher than the 0.45 in 2010–2020, indicating that market uncertainty during the pandemic and post-pandemic period has exacerbated the conformity psychology of homebuyers and investors. The spatial autocorrelation test (Moran's I = 0.40) and model estimation results ($\rho = 0.30$) further confirm that the "imitation effect" of herd behavior in adjacent regions is stronger after the pandemic, and the cross-regional transmission mechanism within urban agglomerations such as the Yangtze River Delta and the Pearl River Delta is more prominent, verifying the strengthened characteristic of the spatial correlation of herd behavior in the real estate market during the volatile period.

Second, the intensity of the role of core influencing factors has changed after the pandemic. The positive impact of Housing Price (HP) fluctuations on herd behavior has increased (the coefficient increased from 0.18 to 0.22), reflecting the intensified differentiation of housing prices between core cities and small and medium-sized cities after the pandemic, and short-term price changes are more likely to trigger follow-up purchases or sales; the positive impact of personal Disposable Income (DI) has slightly increased (the coefficient increased from 0.12 to 0.14), indicating that the recovery growth of residents' income has improved their ability to purchase housing, and combined with conformity psychology, it has further amplified herd behavior; the restraining effect of the one-year personal housing loan Interest Rate (IR) has become more significant (the absolute value of the coefficient increased from 0.15 to 0.17), indicating that the flexible interest rate adjustment policies during the pandemic (such as

the LPR cut in 2022 and partial interest rate hike in 2023) have had a more prominent effect on guiding rational market decisions; among the control variables, the positive impact of Residential Investment (RI) amount and the negative impact of housing Construction Area (CA) have remained stable, but the imbalance of regional investment enthusiasm and supply capacity after the pandemic has further amplified the difference in their effects on herd behavior.

Based on the new characteristics of herd behavior in the post-pandemic real estate market and changes in influencing factors, the following targeted policy recommendations are proposed:

Firstly, strengthen information disclosure in the real estate market: Establish and improve the information release mechanism of the real estate market, publish timely and accurate information such as housing prices, supply-demand relationships, and market dynamics, reduce information asymmetry in the market, and reduce blind follow-up behavior of homebuyers and investors due to insufficient information.

Secondly, improve the real estate market regulation policy: Implement differentiated regulation policies according to the characteristics of the real estate market and the influencing factors of herd behavior in different regions. For regions with rapidly rising housing prices and obvious herd behavior, the loan interest rate can be appropriately increased and purchase restriction policies can be strengthened to curb speculative housing demand; for regions with a sluggish market, measures such as reducing loan interest rates and providing housing purchase subsidies can be adopted to stimulate reasonable housing demand and stabilize market expectations.

In a addition, guide residents to purchase housing rationally: Through publicity and education, media guidance, and other methods, improve residents' understanding of the real estate market, enhance their risk awareness and rational decision-making ability. Guide residents to make housing purchase decisions based on their actual needs and economic strength, and avoid blind follow-up investment and consumption.

Finally, optimize the supply structure of the real estate market: Reasonably adjust the scale of residential investment and housing construction area, increase the supply of indemnificatory housing and small- and medium-sized housing according to market demand, meet the housing needs of residents at different levels, promote the balance between supply and demand in the real estate market, and reduce herd behavior caused by supply-demand imbalance.

This study still has the following limitations. First, the variable dimension needs to be expanded. The existing model does not include pandemic-specific variables (such as the intensity of pandemic prevention and control in various regions, changes in residents' savings rates, and the implementation of real estate enterprises' "guaranteed delivery" policies). These factors may indirectly affect herd behavior by influencing market expectations, and relevant variables can be supplemented in future studies to improve explanatory power.

Second, the characterization of spatial effects can be further refined. Although the Spatial Autoregressive Model (SAR) has captured the transmission between adjacent regions, it does not distinguish the differential impact of "geographical adjacency" and "economic connection" (such as population mobility and capital flow) on herd behavior. In subsequent studies, an "economic distance weight matrix" or Spatial Durbin Model (SDM) can be used to deeply analyze the heterogeneous mechanism of spatial spillover.

Third, the sample segmentation is insufficient. The study only uses provincial-level data as samples and does not distinguish between first-tier, new first-tier, and third- and fourth-tier cities. The characteristics of herd behavior in cities of different levels may have significant differences after the pandemic (for example, speculative herd behavior is stronger in core cities, while panic herd behavior is more prominent in small and medium-sized cities). In the future, samples can be refined to prefecture-level cities to reveal the impact of urban hierarchy differences on herd behavior.

In general, this study provides empirical evidence for understanding herd behavior in the volatile post-pandemic real estate market. Future studies can further expand the analysis dimension in combination with new market trends to provide more detailed theoretical support for precise regulation.

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