The Interaction Mechanism of Real Estate Market of Typical Cities in China: Analysis Based on VAR Model

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Abstract. As an important part of the national economy, the real estate market is closely related to macro policies, investor confidence, etc., and at the same time shows regional heterogeneity. This study explores the real estate market in four typical cities in China (Beijing, Xi'an, Xiamen, and Chengdu) and analyzes the correlation between real estate prices, sales area, real estate development investment, market investor confidence, and money supply. Through analysis based on the VAR model, it is found that the real estate markets in different cities present their own specific interactive influence patterns. The various factors in Beijing are more closely related and have a continuous impact; other cities have similar characteristics, and the impact of each factor is somewhat different. Therefore, when formulating real estate macro-management policies, it is necessary to consider the market characteristics of different cities and the comprehensive impact of external factors to formulate more targeted strategies and mitigate the potential impact of market fluctuations on the economy.

Keywords: VAR; real estate market; house prices; policy; sentiment.

1. Introduction

As an important part of the national economy, the real estate market has many related industries upstream and downstream of the industrial chain. It also has certain investment attributes and the influencing factors are relatively complex. First of all, the real estate market is crucial to the economic growth and stability of a country or region. It not only drives the development of many upstream and downstream industries, but also plays a key role in residents' employment and consumption. Secondly, the real estate market also has a wide range of social impacts. Housing is one of the basic needs of human beings. Therefore, the supply and demand of the real estate market are not only related to the economic level, but also related to people's quality of life and social well-being, involving housing accessibility, Issues in social inequality, housing policy, and urban development and planning. Finally, real estate, as an important real estate, has more and more investment attributes in recent years. Therefore, the price of the real estate market will be affected by market speculation factors. At the same time, the fluctuations in the real estate market will also affect the wealth level of residents, thus indirectly Affects their consumption and demand for other investment assets.

China's real estate market has experienced major changes in the past 20 years. Market supply and demand have been continuously adjusted, transaction activity has experienced substantial changes, different regional markets have significant diversification characteristics, and real estate-related regulatory policies have had a significant impact on the market. After experiencing a period of rapid rise in housing prices, the real estate market across China has gradually returned to calm. Under a series of regulatory policies, the market has faced increasingly severe challenges, and sluggish transactions have become more common in recent years. Data from the National Bureau of Statistics of China show that in May 2023, Beijing's second-hand housing price index turned from rising to falling, falling 0.6% month-on-month; entering June, Beijing's second-hand housing prices fell 0.7% month-on-month. It can also be seen from the market transactions that Beijing's second-hand housing price index fell by 0.6% month-on-month. The housing market has experienced a significant cooling process. According to statistics from the official website of the Beijing Municipal Housing and Urban-Rural Development Commission, since April 2023, the transaction volume of Beijing's second-hand housing market has fallen for three consecutive months. In June, 11,607 second-hand

houses were signed online in Beijing, down 10.6% month-on-month. The transaction volume was only half of March. The cumulative online signing volume in the first half of the year was 84,332 units.

In this context, this article attempts to conduct an in-depth study of the correlation between factors related to the real estate market. It hopes to analyze the mutual feedback between the influencing factors in different cities by constructing a VAR model on real estate market prices, transactions, investments and related policy factors in typical cities. mechanism to provide relevant policy recommendations for the healthy and stable development of China's real estate market.

2. literature review

Scholars have done a lot of research on the correlation between factors related to the real estate market. [1] Higgins (2013) describes the reasons behind the increase in risk and debt, as well as the easy availability of credit. The study quantifies the rise of high-risk loans and the subsequent defaults, bankruptcies, and foreclosures that affected expectations and led to a plummet in housing prices. [2] Tan et al. (2017) constructs a Dynamic Stochastic General Equilibrium (DSGE) model, incorporating public expectations about monetary policies to analyze the anomaly of "the more regulation, the more rise" in China's housing market. [3] Deng et al. (2022) show that as short-term investors exit the market, market returns become less predictable and volatile. Prices also become less dispersed cross-sectionally. The study explains the role of short-term transactions in the inefficient real estate market. [4] Deng et al. (2023) investigate the effectiveness of different policies or policy portfolios as long-term mechanisms for regulating house prices. They incorporate the real estate sector into the Dynamic Stochastic General Equilibrium (DSGE) model. [5] Lan et al. (2023) uses a two-stage resale restriction policy implemented in China as an exogenous shock on speculation chances in the second-hand housing market. They find that a sudden reduction in future resale opportunities directly causes a significant decrease in house transaction prices and trading volumes. [6] Li and Wang (2023) utilize data from listed real estate firms in China to examine how macro-prudential policies affect systemic risk. [7] Yemba et al. (2023) employ the data-rich Factor Augmented VAR (FAVAR) to investigate potential grammar issues and conduct a thorough analysis of their study. Now Some literature has studied the relationship between real estate market prices and transactions and related factors from aspects such as macro policies, real estate investment, and market sentiment. However, most of the existing studies only focus on the influence of a certain type of factors, and few studies study the interaction between factors from a systematic perspective. At the same time, China's real estate market has obvious regional characteristics, and the real estate markets in different cities vary greatly. Most of the previous studies were conducted from a macro perspective and ignored the differences between cities. Therefore, this article selects four typical cities in China located in different locations to study the interaction mechanism of real estate-related factors, which is innovative.

3. Data and models

3.1. Variable selection and data sources

There is a significant correlation between factors related to the real estate market. For example, the supply and demand theory of micro commodities determines the relationship between supply, demand and price in the real estate market: investors' confidence in future development will affect the demand for the real estate market. Monetary policy The degree of tightness will also affect the demand for home purchases and the investment willingness of developers, thereby affecting the real estate market. In order to quantitatively characterize the relationship between real estate market prices and investment, sales, macro monetary policy and investor sentiment, this article selects residential prices in 100 cities, Commercial housing sales area, real estate development investment, M2 and investor confidence index are used to reflect internal and external changes in the real estate market at different levels, as shown in Table 1. In order to simultaneously examine the differences in real estate

markets between different cities, this article also selects Beijing, Xi'an, Xiamen and Chengdu as research objects. Based on data availability, the sample intervals are January 2012 to March 2022 and July 2011 respectively. The data source from July 2022, April 2010 to April 2020, and June 2010 to October 2015 is the Choice database.

Table 1. Variables

variable	variable name	Calculation instructions
real estate prices	Price	Characterized by the year-on-year growth rate of housing prices in 100 cities
Real estate development investment amount	Invest	Characterized by cumulative year-on-year investment in real estate development
Commercial housing sales price	Sale	Characterization of the month-on-year growth rate of commercial housing sales
investor confidence index	Investor	Characterization of year-on-year growth rate of investor confidence index
currency supply	M2	M2 year-on-year growth rate

3.2. Descriptive statistics of data

Table 2. Data Description

variable name	City	maximum value	minimum value	average value	standard deviation	median	variance	kurtosis	Skewness	Coefficient of variation (CV)
price	Beijing	29.553	-3.2	6.57	8.671	2.351	75.181	0.257	1.189	1.32
	Chengdu	5.959	-13.577	-4.392	5.647	-6.495	31.889	-1.15	0.443	-1.286
	Xi'an	10.868	-20.929	-4.118	7.636	-5.771	58.31	-0.61	-0.015	-1.854
	Xiamen	1.686	-26.161	-10.218	7.478	-10.448	55.926	-0.965	-0.281	-0.732
sale	Beijing	262.6	-71.8	10.095	51.47	5.68	2649.128	3.857	1.282	5.099
	Chengdu	216.87	-70.61	16.091	52.776	1.58	2785.329	3.004	1.669	3.28
	Xi'an	266.63	-94.21	7.734	48.184	5.5	2321.717	6.175	1.484	6.23
	Xiamen	299.79	-78.65	7.303	63.333	-7.28	4011.034	5.907	1.749	8.672
invest	Beijing	133.54	-65.67	6.041	16.16	4.86	261.138	34.004	3.437	2.675
	Chengdu	49.91	-19.55	12.512	14.238	12.265	202.714	0.799	0.171	1.138
	Xi'an	101.74	-24.32	11.719	16.754	10.79	280.694	6.428	1.427	1.43
	Xiamen	97.34	-5.43	31.02	26.399	22.61	696.924	0.314	1.034	0.851
Investor		21.2	-8.7	5.541	6.378	5.4	40.68	0.113	0.238	1.151
M2		16.1	8	11.043	2.37	10.8	5.617	-1.249	0.274	0.215

From Table 2, it can be seen that the average price of the four cities is only positive in Beijing, and the other cities are negative, indicating that within the sample interval, only Beijing's housing prices show an increasing trend, while housing prices in other regions have not declined significantly. Judging from the average sales value, Chengdu is much higher than the other three regions. This

shows that the real estate market is greatly affected by location factors and local policies. There are huge differences in real estate sales in different cities; the average investment value also has certain differences among cities. Differences can be found within the sample interval. Beijing's real estate market investment growth rate is slow, while Xiamen's real estate investment growth rate is faster. Investors'fluctuations are larger, which also illustrates the increasing uncertainty in real estate policies. Under this situation, investor information will also produce huge fluctuations; judging from the situation of M2, my country's money supply has always maintained a relatively stable growth rate.

3.3. VAR model

This article will use the vector autoregressive (VAR) model for modeling. The VAR model is a multivariate time series analysis method that can simultaneously consider the endogenous relationship between multiple variables. Assume it is R_ta five-dimensional vector, that is, $\boldsymbol{R_{it}} = \{price_{it}, sale_{it}, invest_{it}, investor_t, M2_t\}$, where $\boldsymbol{i}$ represents the $\boldsymbol{i}$ th city $, \boldsymbol{i} = 1,2,3,4, \boldsymbol{t}$ and represents the time. The form of the VAR model is as shown in formula (1):

$$\boldsymbol{R_{it}} = \varphi_0 + \varphi_1 R_{it-1} + \cdots + \varphi_p R_{it-p} + \varepsilon_{it} \quad (1)$$

Where $\varphi_0$is $\varphi_1 \cdots \varphi_p$the model parameter to be estimated, where pis the lag order of the model, and $\varepsilon_{it}$is the model residual.

Modeling was conducted for the four cities respectively, the model parameters were estimated, and the VAR model was obtained. Based on the VAR model, this article will conduct Granger causality test, impulse response function analysis and variance decomposition. Granger causality test can help us determine the causal relationship between variables, impulse response function can reveal the dynamic influence between variables, and variance decomposition can help explain the source of variance between variables.

4. Analysis of empirical results

4.1. Stationarity test

Table 3. Variable ADF stationarity test results

City	variable	T value	P-Value
Beijing	dprice	- 4.751	0.00 1 ***
	sale	-4.702	0.000***
	dinvest	-10.107	0.000***
Xi'an	dprice	-6.186	0.000***
	sale	-4.27	0.001***
	dinvest	-11.990	0.000***
Xiamen	dprice	-3.289	0.007***
	sale	-12.628	0.000***
	dinvest	-5.263	0.000***
Chengdu	dprice	-3.48	0.009***
	sale	-4.472	0.000***
	dinvest	-12.32	0.000***
	DM2	-9.201	0.000***
	Investor	-3.657	0.005***

The ADF stationarity test found that the year-on-year growth rates of price, invest, and M2 were non-stationary data. After the first-order difference, the variables dprice, dinvest , and DM2 were obtained. Then the ADF test was performed, and it was significantly stationary at the 1% level. The results are as follows As shown in Table 3, all the above variables can be directly modeled by VAR.

4.2. Empirical results

According to information criteria such as AIC, BIC, and SC, the lag orders of the VAR models for the four cities of Beijing, Xi'an, Xiamen, and Chengdu were determined to be 2nd order, 1st order, 1st order, and 2nd order respectively.

4.2.1 Granger causality test

Based on the VAR model, Granger causality test was performed, and the test results of the four cities are shown in Table 4. It can be found that, except for Chengdu, the housing prices in the other three cities are the Granger cause of house sales area; Beijing's real estate market is greatly affected by investor sentiment, and investor sentiment is the Granger cause of housing prices and real estate investment; Xiamen The real estate market in China is greatly affected by prices, and real estate prices are the Granger cause of real estate investment and investor sentiment; housing prices in Xi'an are affected by investor sentiment, and investor confidence is the Granger cause of housing prices. It can be seen that there are great differences in the interaction between real estate market operations among various markets.

Table 4. Granger causality test results

Null Hypothesis:	Chengdu	Xi amen	Xi'an	Beijing
DM2 does not Granger Cause DINVEST	0.8316	0.2426	0.6962	0.3623
DINVEST does not Granger Cause DM2	0.3695	0.6085	0.2110	0.4232
DPRICE does not Granger Cause DINVEST	0.2164	0.0135	0.9165	0.3155
DINVEST does not Granger Cause DPRICE	0.5362	0.5898	0.0386	0.7176
INVESTOR does not Granger Cause DINVEST	0.7793	0.4870	0.4570	0.0988
DINVEST does not Granger Cause INVESTOR	0.0199	0.0562	0.2700	0.8360
SALE does not Granger Cause DINVEST	0.0249	0.0722	0.6056	0.3866
DINVEST does not Granger Cause SALE	0.6361	0.8067	0.9910	0.3253
DPRICE does not Granger Cause DM2	0.6208	0.0058	0.0680	0.0622
DM2 does not Granger Cause DPRICE	0.8778	0.6120	0.5450	0.2827
INVESTOR does not Granger Cause DM2	0.4798	0.8061	0.3849	0.0767
DM2 does not Granger Cause INVESTOR	0.7540	0.0972	0.0142	0.5701
SALE does not Granger Cause DM2	0.8502	0.1086	0.4346	0.0649
DM2 does not Granger Cause SALE	0.6670	0.5164	0.7624	0.7431
INVESTOR does not Granger Cause DPRICE	0.5342	0.8091	0.0064	0.0838
DPRICE does not Granger Cause INVESTOR	0.0451	0.3141	0.2588	0.1368
SALE does not Granger Cause DPRICE	0.2472	0.3920	0.4232	0.2996
DPRICE does not Granger Cause SALE	0.5547	0.0403	0.0363	0.0223
SALE does not Granger Cause INVESTOR	0.1807	0.7143	0.8582	0.5404
INVESTOR does not Granger Cause SALE	0.7037	0.9129	0.9883	0.5040

4.2.2 Impulse response analysis

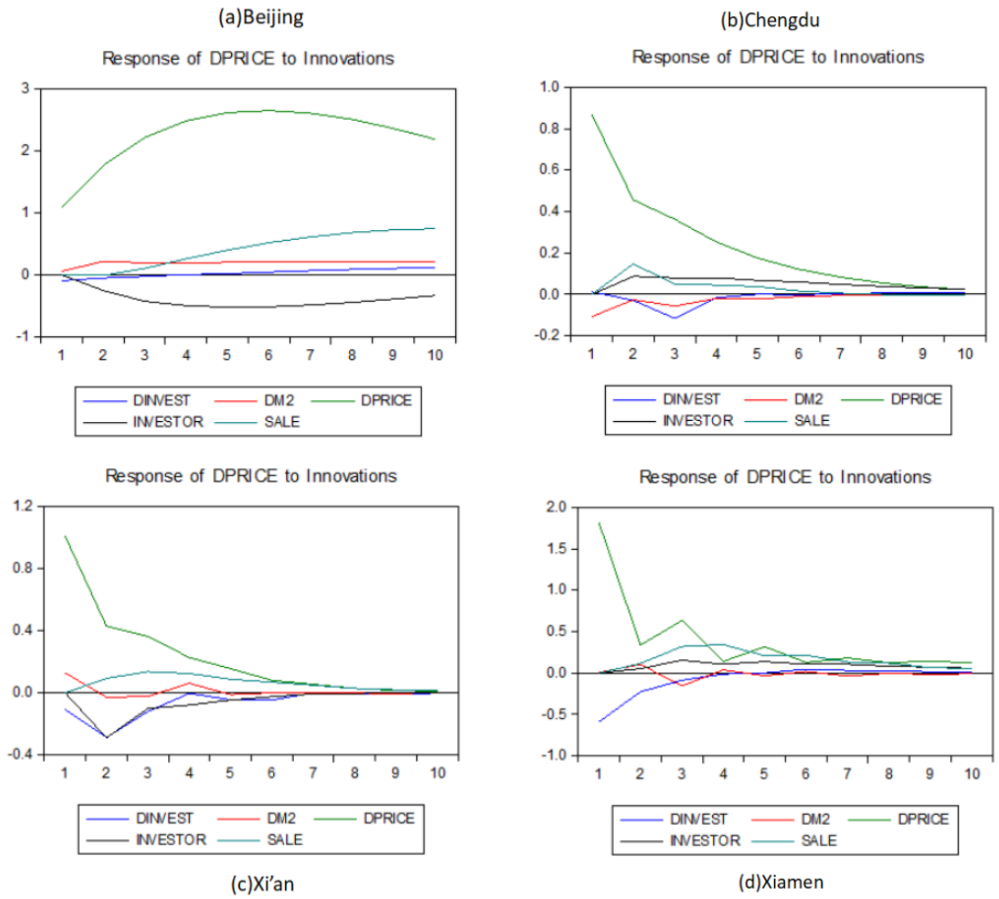

Figure 1. Impulse response analysis results

As shown in Figure 1(a), the impulse response function of Beijing's housing prices is significantly different from that of the other three cities, and the impact is strong and persistent. DINVEST has a relatively limited impact on DPRICE; DM2 has a significant positive impact on DPRICE, although it is small in the initial stage, but then tends to be stable and has a certain long-term impact on price; INVESTOR has a negative impact on DPRICE, that is, when investor confidence is high, they will instead invest in other assets, which will have a crowding-out effect on the real estate market; SALE's impact on DPRICE is always positive and has strong sustainability, that is, the sales situation in the real estate market has a positive effect on housing prices. feedback effect.

As shown in Figure 1(b)(c)(d) , the situation in the other three cities is relatively similar. The impulse response of each factor to housing prices gradually converges to 0 and has no long-term impact. Among them, sale has a significant impact on DPRICE. The positive impact is similar to the conclusion in Beijing; but different from the results in Beijing, investor has a significant positive impact on dprice, and the increase in investor confidence will increase the real estate market price; while the impact of dm 2 and DINVEST is relatively limited.

5. Summary and suggestions

This article studies the relationship between various elements of the real estate market based on the real estate market price (price), sales (sale), investment (invest), investor index (Investor) and money supply (M2) data of four typical large cities in China. interactive effects. It is found that in different cities, the key variables of the real estate market show different interaction characteristics. According to the results of the Granger causality test and impulse response analysis based on the VAR model, it can be found that there is a certain causal relationship between variables in the real

estate market in different cities. However, in different cities, factors such as price, sales, investment, and money supply The degree of impact on the real estate market is not the same. For example, Beijing, as the capital of China, has a closer relationship between various factors and shows a continuous impact, while the characteristics of the other three cities are roughly the same, but the typical factors There are also some differences in impact. Therefore, when conducting macro-management of the real estate market, it is necessary to consider the characteristics of the real estate systems in different cities and combine the impact of external factors such as macroeconomic policies, interest rate changes, and government regulatory policies on the real estate market to better understand the factors behind market fluctuations. reason. In this way, personalized strategies can be formulated based on the characteristics and trends of real estate markets in different cities, and measures to deal with potential risks can be formulated in advance to reduce the impact of uncertainty.

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