Research on the impact of the US subprime crisis on Chinese real estate-with empirical analysis based on GARCH (1,1) model

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Abstract: The US subprime mortgage crisis is a major crisis in the global financial market in recent years, its scope far beyond the United States, China as the world's second largest economy real estate market has a profound impact. Based on the analysis of Shenwan real estate industry index and the development characteristics of Chinese real estate market, this paper discusses the impact mechanism and consequences of the crisis on Chinese real estate market, and uses GRACH(1,1) model for empirical analysis and test. Through analysis, it is found that the occurrence of subprime crisis has a significant negative impact on Chinese real estate industry, which inhibits the development of Chinese real estate industry to a certain extent. At the same time, Chinese real estate sector is sensitive to market fluctuations. Finally, some relevant policy suggestions are put forward.

Keywords: US subprime mortgage crisis; Chinese real estate market; impact mechanism; GARCH model.

1. Introduction

The US subprime mortgage crisis is a global financial storm at the beginning of this century, which has a profound impact on the global financial market and is an important event that has attracted global attention in recent years. The financial crisis caused by improper financial practices, like an earthquake hidden under the sea, triggered a big tsunami in the global financial market. It not only triggered the collapse of the financial system and economic recession around the world, but also had a profound and lasting impact on the real economy and financial market of various countries, which is still being affected even today.

China, the world's second-largest economy, has not been immune to the crisis. Although Chinese financial system and trading methods are different from those of the United States, where the crisis originated, globalized financial markets made it impossible for China to avoid the shock. In particular, Chinese real estate market, as one of the important pillars of the national economy, has been particularly affected.

2. Selection and processing of sample data

With reference to relevant research on the real estate industry, this paper selects the Shenwan real estate industry index of Shenwan first-level industry as the research object. In order to better prove whether the US subprime crisis has an impact on Chinese real estate industry, the data selection range is from January 1, 2005 to December 31, 2010, which includes the period before the outbreak of the subprime crisis. The sample data of the two periods after the outbreak, with a short interval from the outbreak of the subprime crisis, can reduce the impact of non-subprime crisis factors on the real estate industry, and a total of 1457 sets of data during the sample period. The data processing and model demonstration software are both Eviews 9. This paper uses the financial time series model to explore whether the subprime crisis has an impact on Chinese real estate industry. Therefore, before the demonstration, log-difference processing should be performed on the adopted data to make it smooth to meet the requirements of relevant models:

$$R_t = D_t + \varepsilon_t$$
$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2$$

Among them, R_t is the logarithmic rate of return, P_t is the closing price of the Shenwan Real Estate Industry Index on the t day, and P_{t-1} is the closing price of the Shenwan Real Estate Industry Index on the t-1 st.

3. Model Introduction

In order to better investigate whether the subprime mortgage crisis has a negative impact on Chinese real estate industry, this paper chooses to adopt the GARCH(1,1) model with virtual variables for empirical research. The specific model expression is as follows:

$$R_t = B_1 D_{1t} + \varepsilon_t \quad (2)$$
$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \quad (3)$$

Wherein, Formula (2) is the mean value equation of GARCH(1,1) model, and D_t is a virtual variable, and its corresponding value is 0 in the period before the subprime mortgage crisis, and its corresponding value is 1 after the subprime mortgage crisis. (3) Formula is the variance equation of GARCH(1,1) model, in which α_1 and β_1 are the ARCH and GARCH term coefficients of GARCH model, respectively, to explain the volatility and agglomeration of financial time series. The larger the α_1, the more significant the fluctuation characteristics of this set of time series and the more sensitive to market fluctuations. β_1 is higher, which proves that the fluctuations of the time series have strong aggregation characteristics.

4. Empirical analysis

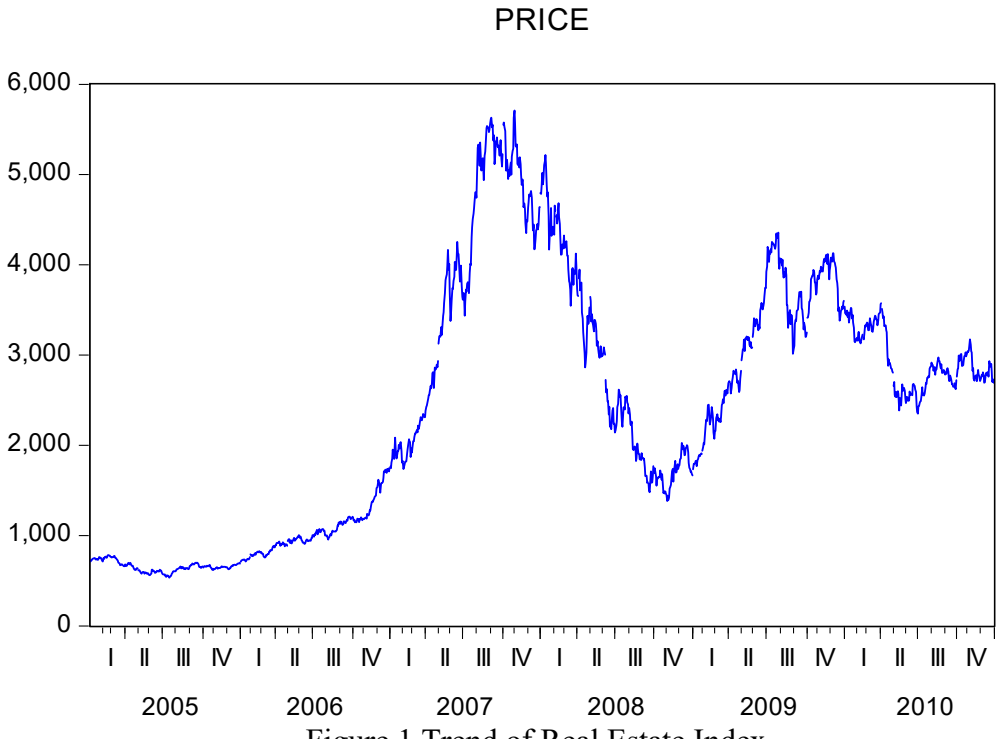


Figure 1 Trend of Real Estate Index

From Figure 1, it can be clearly observed that the real estate industry index as a whole shows a significant M trend of increasing first, then decreasing, and then increasing and then decreasing. Since 2005, the real estate industry index in China has been increasing slowly until the beginning of 2007, and it has reached the maximum value in the sample period. With the outbreak of the subprime mortgage crisis in the United States in April 2007, and gradually shifting to Japan, Europe and other regions, the real estate industry in China has been impacted, and the real estate index has experienced a sharp decline. At the end of 2008, the impact of the subprime mortgage crisis has gradually weakened, and the real estate industry index in China has gradually recovered, and its real estate industry index has gradually increased with time.

4.1 Descriptive Statistics

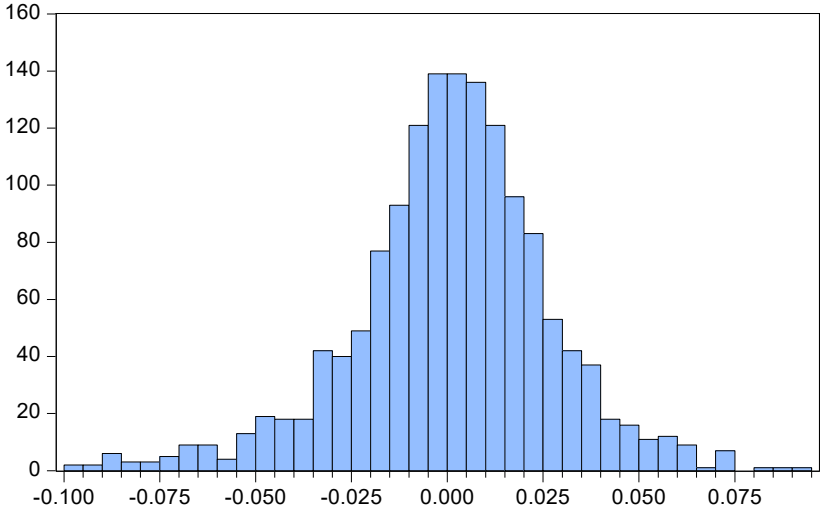


Figure 2 Descriptive statistics of real estate industry

Descriptive statistics are made on the logarithmic rate of return series after logarithmic difference of Shenwan real estate industry index. From the above figure, it can be seen that the average logarithmic rate of return of real estate industry in sample period is 0.000924, which is greater than 0, indicating that the real estate industry returns better in sample period, and its bias coefficient is-0.399863 less than 0, which is a typical left-bias distribution characteristic, while the peak coefficient is 4.365138, which is greater than 3, which has a significant peak distribution characteristic, so there is a typical "peak thick tail" phenomenon in the real estate industry logarithmic rate of return series in sample period.

4.2 Statistical testing

4.2.1 Stabilization test

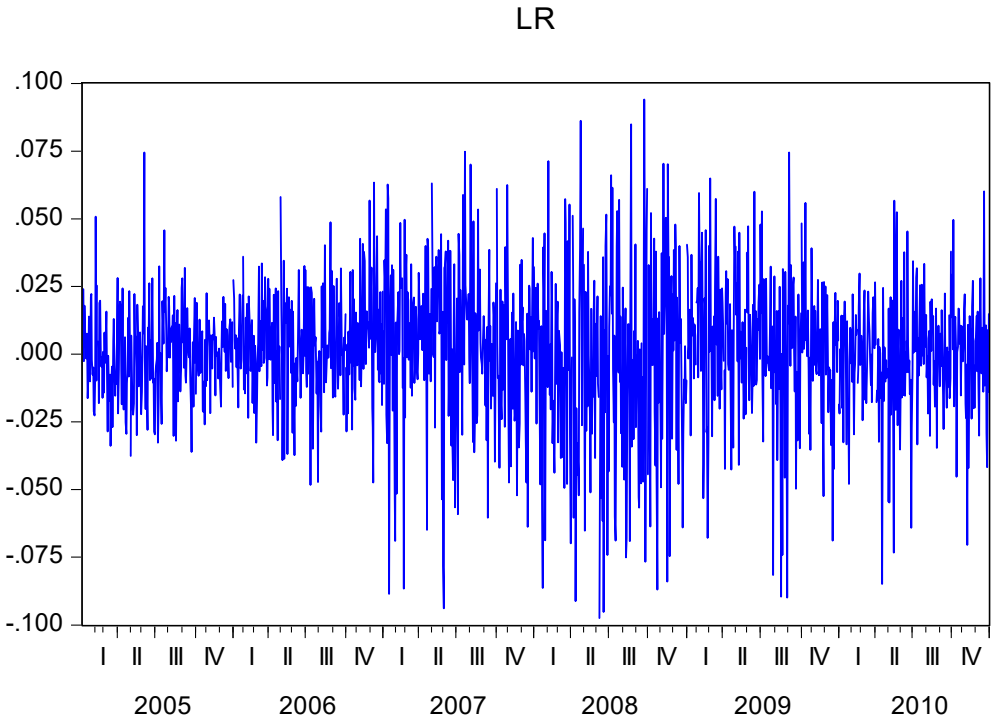


Figure 3 Trend of Logarithmic Yield in the Real Estate Industry

It can be clearly observed from Figure 3 that the logarithmic rate of return series of real estate industry has certain volatility agglomeration, so the volatility agglomeration should be taken as the focus of modeling, and most of the yield data in the sample period fluctuate within a certain range, so the real estate index after logarithmic difference has certain stability characteristics.

In this paper, the unit root test (ADF test) is used to judge the stability of the real estate industry logarithmic rate of return series. The specific test results are as follows:

Table1 augmented Dickey-Fuller Test

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-36.54547	0.0000
Test critical values:	1% level	-3.434636	
	5% level	-2.863320	
	10% level	-2.567766	

From the ADF test results in Table 1, it can be seen that the ADF test statistic is-36.54547, which is significantly less than the test threshold values at the significance levels of 1%, 5%, and 10%, and the corresponding P value of the test statistic is 0.0000, which is significantly less than 0.01. Therefore, at the significance level of 1%, the original assumption of "containing unit roots" is rejected, and there is no unit root in this time series, which is a smooth time series.

4.2.2 Arch Effect Test

From the previous logarithmic rate of return time sequence chart of real estate industry index, we can see that there is obvious fluctuating agglomeration effect in the rate of return sequence. Therefore, we will use Engle's Lagrange Multiplier Method (ARCH-LM) to test the ARCH (heteroscale variance) of the logarithmic rate of return sequence of this asset. According to the ARCH test results in Table 2, the logarithmic rate of return sequence is tested by ARCH-LM. The P value corresponding to the two test statistics is 0.0000, which is significantly less than 0.01, which is significant at the level of

1%. Therefore, the original assumption of "no ARCH effect" is rejected, that is, the logarithmic rate of return sequence has obvious ARCH effect. Therefore, the GARCH(1,1) model can be used to characterize the fluctuation characteristics of the real estate index logarithmic rate of return.

Table2 Arch Effect Test

F-statistic	18.92630	Prob. F(1,1453)	0.0000
Obs*R-squared	18.70866	Prob. Chi-Square(1)	0.0000

4.2.3 Garch model fitting

Then we will adopt the GARCH(1,1) model with virtual variables to fit the real estate index logarithmic rate of return sequence to investigate whether the subprime mortgage crisis has affected the real estate industry in China. The specific parameter estimation results of GARCH(1,1) with virtual variables are shown in the following table:

Table3 GARCH(1,1) Parameter Estimation with dummy variables

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.002179	0.000755	2.884653	0.0039
B	-0.002619	0.001179	-2.220751	0.0264
Variance Equation				
C	3.63E-06	1.52E-06	2.384124	0.0171
RESID(-1)^2	0.036651	0.006308	5.810111	0.0000
GARCH(-1)	0.958553	0.007095	135.1020	0.0000

B is the virtual variable of the mean value equation, C is the constant term of the mean value equation, and the last three rows correspond to the parameter estimation result of the variance equation, C is the constant term of the variance equation, RESID(-1)^ 2 is the parameter of the ARCH term, which represents the fluctuation characteristics of the real estate industry index, and GARCH(-1) is the parameter of the GARCH term, which can describe the fluctuation aggregation of the real estate industry index. It can be seen from the results of parameter estimation that all parameters of GARCH(1,1) model with virtual variables are significant at the significance level of 5%, so the simulation effect of this model is good, and the specific expression of the model is as follows:

$$R_t = -0.002619D_1 + 0.002179$$

$$\sigma_t^2 = 3.63E-06 + 0.036651\varepsilon_{t-1}^2 + 0.958553\sigma_{t-1}^2$$

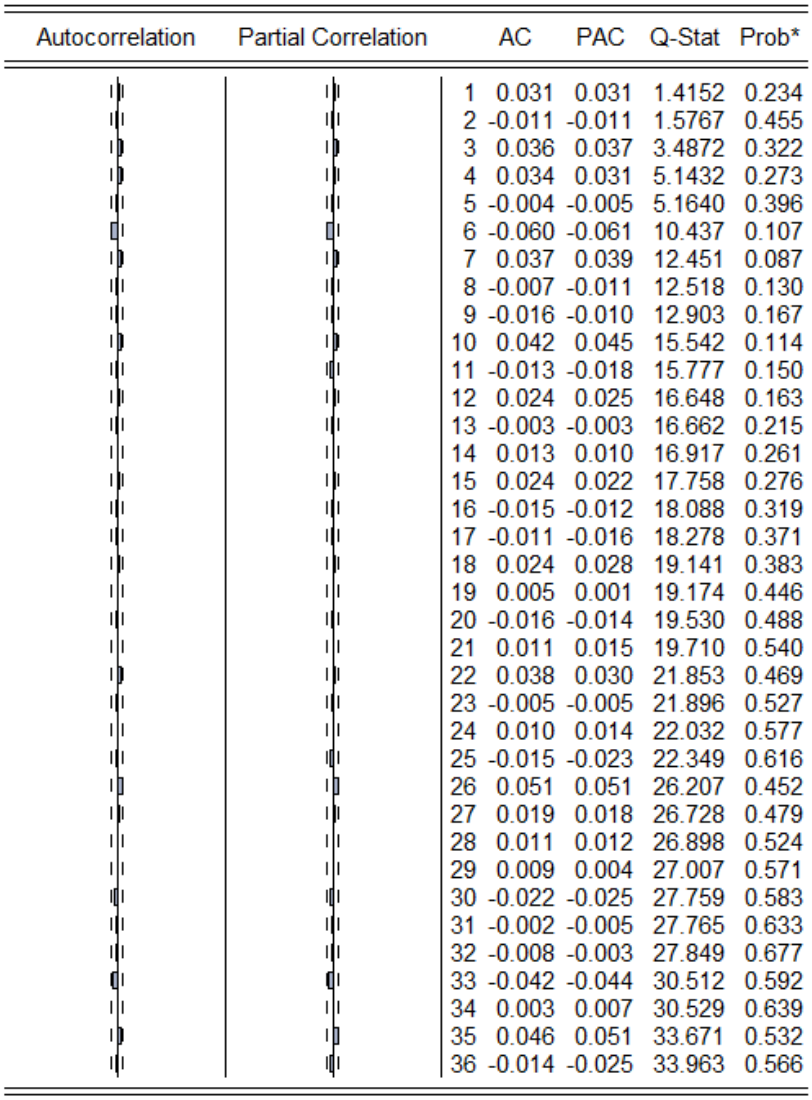
According to the estimation results of GARCH(1,1) model parameters with virtual variables, the parameters of virtual variables are estimated to be-0.002619, and the corresponding P value is 0.0264, which is less than 0.05, which is significant at the significance level of 5%. Therefore, we can get that the subprime mortgage crisis has a significant negative impact on Chinese real estate industry and inhibit the development of Chinese real estate industry to a certain extent. The reason is that although the subprime mortgage crisis originated in the United States, the financial risks are contagious. He will gradually transmit to our country along with the close connection between our country and the American financial market, which will have an impact on our country's real estate industry. Therefore, the outbreak and spread of the subprime mortgage crisis have a significant negative impact on our country's real estate industry and inhibit the development of our country's real estate industry.

From the ARCH parameter RESID(-1)^ 2, the corresponding P value is 0.0000 less than 0.05, which proves that the real estate industry is more sensitive to market fluctuations and the volatility characteristics are more obvious; The result of GARCH parameter GARCH(-1) shows that the real estate industry index has strong clustering fluctuations, that is, it has strong long memory and continuity. The sum of the ARCH coefficient and the GARCH coefficient is close to 1, which

indicates that the fluctuation itself has a continuous impact on the conditional variance, that is, the real estate industry index is prone to high fluctuations and maintains the characteristics for a long time.

4.2.4 Model fitting effect test

In order to verify the fitting effect of GARCH(1,1) with virtual variables, the self-correlation and ARCH effect tests are carried out for the remaining standardized residues of the real estate industry index fitted by the model. The specific test results are as follows:



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.031	0.031	1.4152	0.234
		2	-0.011	-0.011	1.5767	0.455
		3	0.036	0.037	3.4872	0.322
		4	0.034	0.031	5.1432	0.273
		5	-0.004	-0.005	5.1640	0.396
		6	-0.060	-0.061	10.437	0.107
		7	0.037	0.039	12.451	0.087
		8	-0.007	-0.011	12.518	0.130
		9	-0.016	-0.010	12.903	0.167
		10	0.042	0.045	15.542	0.114
		11	-0.013	-0.018	15.777	0.150
		12	0.024	0.025	16.648	0.163
		13	-0.003	-0.003	16.662	0.215
		14	0.013	0.010	16.917	0.261
		15	0.024	0.022	17.758	0.276
		16	-0.015	-0.012	18.088	0.319
		17	-0.011	-0.016	18.278	0.371
		18	0.024	0.028	19.141	0.383
		19	0.005	0.001	19.174	0.446
		20	-0.016	-0.014	19.530	0.488
		21	0.011	0.015	19.710	0.540
		22	0.038	0.030	21.853	0.469
		23	-0.005	-0.005	21.896	0.527
		24	0.010	0.014	22.032	0.577
		25	-0.015	-0.023	22.349	0.616
		26	0.051	0.051	26.207	0.452
		27	0.019	0.018	26.728	0.479
		28	0.011	0.012	26.898	0.524
		29	0.009	0.004	27.007	0.571
		30	-0.022	-0.025	27.759	0.583
		31	-0.002	-0.005	27.765	0.633
		32	-0.008	-0.003	27.849	0.677
		33	-0.042	-0.044	30.512	0.592
		34	0.003	0.007	30.529	0.639
		35	0.046	0.051	33.671	0.532
		36	-0.014	-0.025	33.963	0.566

Figure4 Residual autocorrelation test

The self-correlation test of the standardized residues with the virtual variable GARCH(1,1) fitted to the rest of the real estate industry index is carried out with a lag of 36 steps. From the self-correlation test chart of the lag of 36 periods, it can be seen that the P values of the corresponding test statistics are significantly higher than 0.05 during the whole lag period. Therefore, the self-correlation of the standardized residues fitted to the real estate industry index by the virtual variable GARCH(1,1) has lost under the significance level of 5%.

Table4 Conditional Variance Test of Residual Variance

F-statistic	0.134693	Prob. F(1,1453)	0.7137
Obs*R-squared	0.134866	Prob. Chi-Square(1)	0.7134

Table 4 shows the results of the ARCH effect test on the residual standardization residues of the fitted real estate industry index with the virtual variable GARCH(1,1). It can be seen that the F statistic and the Obs*R-squared statistic are 0.134693 and 0.134866 respectively, and their corresponding P values are 0.7137 and 0.7134 which are significantly larger than 0.05, and the original assumption that "the sequence does not have the ARCH effect" is accepted at the significance level of 5%, so the remaining standardization residues of the fitted real estate industry index with the virtual variable GARCH(1,1) no longer have the ARCH effect.

In summary, GARCH(1,1) with virtual variable can fit the real estate industry index in the sample period, and its fitting effect is objective.

5. Research conclusion and suggestion

This paper constructs GARCH(1,1) model with dummy variables to conduct empirical research on the real estate industry from January 1, 2005 to December 31, 2010 to explore the impact of the US subprime crisis on Chinese real estate industry. The research conclusions are as follows: (1) The outbreak and spread of the subprime crisis had a significant negative impact on Chinese real estate industry, which inhibited the development of Chinese real estate industry to a certain extent. (2) Before and after the subprime crisis, Chinese real estate industry was more sensitive to market fluctuations, the volatility characteristics were more significant, and the real estate industry index had strong aggregate volatility.

Based on the above conclusions, the following suggestions are put forward:

(1) Strengthen supervision and risk management

The Chinese government should continue to strengthen its supervision of the real estate market, especially financial institutions and real estate developers. At the same time, it is necessary to improve the risk management mechanism, strengthen risk assessment, stress testing, monitoring and early warning, and timely detection and response to potential risks.

(2) Promoting a balance between supply and demand in the market

The government should continue to promote the adjustment of the supply and demand structure of the real estate market, and increase support for the housing rental market and the second-hand housing market. At the same time, we should strengthen the management of land supply, regulate the supply reasonably, and avoid the situation of oversupply or insufficient supply in the market.

(3) Promoting innovative development of the real estate market

The government and relevant departments should actively promote the innovative development of the real estate market, encourage the introduction of new technologies and new business forms, and promote the transformation and upgrading of the market. For example, the construction of digital and intelligent real estate trading platforms can be promoted to enhance the convenience and transparency of transactions. At the same time, real estate enterprises are encouraged to innovate products and services to meet the diversified needs of the market.

(4) Strengthen international cooperation and exchanges

China should strengthen cooperation and exchanges with other countries and regions in the real estate market, learn from the successful experience of other countries, and jointly cope with the challenges and risks of globalization. Strengthening international exchanges can promote the flow of capital, technology and talents, and enhance the international competitiveness of Chinese real estate market.

(5) Improving policies and regulations

The government should strengthen the formulation and implementation of policies and regulations on the real estate market to ensure the healthy and orderly development of the market. It is necessary to adjust and improve relevant policies in a timely manner according to market demand and risk conditions, provide a stable and predictable policy environment, and reduce market uncertainties.

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