



INSTITUTO
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**EMPIRICAL STUDY ON THE IMPACT OF INTERMEDIATE TARGET OF
MONETARY POLICY ON REAL ESTATE MARKET PRICES IN CHINA**

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Master in Finance

Supervisor:

Lu í Miguel da Silva Laureano, Assistant Professor, Iscte - University Institute of
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Resumo

Nos últimos anos, os preços no mercado imobiliário continuaram a aumentar. Em 2019, o preço médio de uma casa comercial foi de 9310, 28 yuan/m², e o preço médio de uma casa foi de 9287 yuan/m². A indústria imobiliária é uma indústria de capital intensivo. Por conseguinte, o governo começou a ponderar se os objectivos de intermediação da política monetária teriam um impacto nos preços dos imóveis.

Em primeiro lugar, este artigo apresenta uma revisão e um resumo da literatura e das teorias relevantes sobre a escolha dos objetivos de intermediação da política monetária e sobre o impacto da oferta de dinheiro e das taxas de juro nos preços imobiliários.

Em segundo lugar, o artigo faz uma análise teórica baseada na análise da literatura relevante e chega à conclusão preliminar de que a oferta de dinheiro tem um efeito positivo sobre os preços da propriedade, enquanto as taxas de juro têm um efeito negativo sobre os preços da propriedade. Em terceiro lugar, os dados reais sobre a oferta monetária, as taxas de juro e os preços imobiliários na china para o período 1996-2019 são analisados a partir de uma perspectiva descritiva. Seguidamente, foram seleccionadas como variáveis de estudo empírico o preço médio do mercado nacional de habitação comercial, M1, M2 e a média ponderada das taxas de empréstimo interbancário a 30 dias. Estes dados são então utilizados para quantificar o impacto dos objetivos de intermediação da política monetária nos preços da propriedade na china. Os resultados mostram que tanto a oferta monetária como as taxas de juro, como objectivos de intermediação da política monetária, têm um impacto a longo prazo nos preços imobiliários.

Por último, o estudo apresenta propostas políticas correspondentes.

Palavras-chave: oferta monetária; taxa de juro; preços imobiliários; política monetária.

Código de classificação JEL: E4; R2

Abstract

In recent years, China's real estate market prices have been rising continuously, with the 9,310.28 yuan/m² of average price of commercial housing and 9,287 yuan/m² of residential housing by 2019. The real estate industry is a capital-intensive industry. Thus, the Chinese government began to consider whether the intermediary target of monetary policy has an impact on real estate prices.

Firstly, this paper reviews and summarizes the literature and related theories on the selection of the intermediary target of monetary policy and the influence of money supply and interest rate on real estate prices.

Secondly, based on the review of relevant literature, this paper makes a theoretical analysis and draws a preliminary conclusion: money supply has a positive impact on real estate prices, while interest rates have a negative impact on real estate prices.

Thirdly, this study sorts out the actual data of money supply, interest rates and real estate prices of 1996-2019 China and analyzes them in the descriptive perspective. Next, this study chooses the average price of national commercial housing market, M1, M2 and the 30-day weighted average interest rate of interbank lending as the empirical research variables, and carries out processing on these data. Then, it quantifies the impact of monetary policy intermediary target on real estate prices in China. According to the results, both money supply and interest rates, as the intermediary target of monetary policy, will have a long-term effect on real estate prices.

Finally, this study put forward the corresponding policy recommendations.

Keywords: Money Supply, Interest Rates, Real Estate Prices, Monetary Policy.

JEL Classification Codes: E4; R2

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Introduction

The first chapter of this thesis is the introduction.

The first section of this chapter will introduce the background and significance of the topic selection. The second section is the literature review. This section mainly systematically expounds and summarizes the relevant literature at home and abroad on the selection of the intermediary target of monetary policy and the impact of the intermediary target of monetary policy on real estate prices. Next, the research methods and software used in this thesis and the content of the full text are described.

1.1. Background of Topic Selection and Significance of Research

Before starting the research on the influence of the intermediary target of monetary policy on the real estate prices in China, it is necessary to understand the background and the significance of topic selection.

1.1.1. Background of Topic Selection

In 1998, China abolished the welfare housing distribution policy and began to carry out the housing commercialization reform. With the continuous development of China's economy, the real estate industry also achieved rapid development. At present, China's real estate industry has become one of the pillar industries of China's economic development. As Zhou (2014) mentioned that Every year, the real estate sector contributes about 5% to China's GDP and contributes an average of 1.5 percentage points to GDP growth.

However, while the rapid development of the real estate sector has brought benefits to China's economy, it has also brought a series of social problems. As of 2019, the average price of commercial housing in China was 9,310.28 yuan per square meter. The rapid rise in real estate prices has somewhat run counter to the ultimate goal of monetary policy, which is to maintain prices stability. The real estate market bubble caused by the excessive expansion of housing prices has even affected China's financial stability and financial security to a certain extent.

Therefore, the development of real estate has been the focus of attention of the Chinese government and all sectors of society. How to use monetary policy to effectively control soaring housing prices has become an important research topic for the People's Bank of China.

1.1.2. Significance of Research

As one of the two main subjects of the asset market, the real estate is as financial as the products of the capital market and will make sensitive responses to the changes of the monetary policy. As Ding (2009) mentioned in her doctoral dissertation: ‘Judging from the development experience of various countries, monetary policy has a very important impact on the development of the real estate industry’. When the central bank's monetary policy changes slightly, real estate prices will occur frequent or big fluctuations and these bring certain influence on real economy and finance. Therefore, it is of great theoretical significance to study the impact of monetary policy on real estate prices.

It is also of great practical significance to study the effect of the intermediate target of monetary policy on the real estate prices. On the one hand, the real estate market has contributed greatly to the development of China's economy. On the other hand, the rapid rise of real estate prices and land prices in China has also caused a series of social problems. In regulating the real estate market, monetary policy is a commonly used tool by the central monetary authority. But how will the formulation and implementation of monetary policy affect the real estate prices, and to what extent? The following will be analyzed from both theoretical and empirical perspectives.

China government divides the monetary policy objective into three levels: final target, intermediate target, and operational target. Among them, intermediate target is an important indicator variable to judge the intensity and effect of monetary policy. At present, M2, the broad measure of money supply, is set by the People's Bank of China as an intermediary target for monetary policy. However, there are also many scholars in China who believe that for the current economic environment in China, the interest rates can well serve as the intermediary target of monetary policy. This will be explained in more detail below.

Therefore, this research will take interest rates and money supply as the proxy variables of monetary policy intermediary target, from both theoretical and empirical aspects, analyze the impact of intermediate target of monetary policy on real estate pricing in China. This study will try to provide some feasible and effective measures for central bank in regulating the real estate market in China after theoretical and empirical analysis.

1.2. Related Literature Review

Most researches show that monetary policy has a certain impact on real estate prices through money supply, interest rates, credit, and other channels. Different scholars put forward different views on the degree and depth of its influence from different perspectives.

This chapter will systematically elaborate and summarize the existing research results on the selection of monetary policy intermediary objectives and the impact of monetary policy intermediary target on real estate prices and so as to provide theoretical guidance for

the follow-up research of this research.

1.2.1. Selection of Intermediate Objectives of Monetary Policy

Which economic index to be chosen as the intermediate target of monetary policy is crucial for the central bank to regulate monetary policy. Historically, the choice of intermediary target is mainly divided into two theories: one is the theory of prices intermediary target, represented by interest rates; another one is the quantitative intermediary target theory, represented by the money supply.

Keynesianism states that interest rates can have a key impact on the aggregate demand of the society, so it advocates taking interest rates as the intermediate target of a country's monetary policy. McCallum (1983) held the view that short-term interest rates, especially the federal funds rates, could better reflect the changes of monetary policy. Bernanke (1992), and Blinder (1992) agreed with McCallum's view. In addition, they studied the economic data of the United States before 1979 and concluded that there was a high correlation between the changes of the federal funds rates and the unemployment rate and the inflation rate. Therefore, they considered that the federal funds rates could better serve as the intermediary target of monetary policy. After analyzing the evolution of monetary policy tools and intermediary target in China and the United States, Yang (2017) stated that using the broad money supply M2 as the intermediary target of China's monetary policy has failed to achieve the ideal effect. Therefore, she makes a conclusion that the role of price-type indicator in monetary policy regulation should be enhanced. Cai et al. (2014), from the perspective of the efficiency of the action mechanism of interest rates, used the four-variable SVAR model, pulse corresponding function and variance decomposition method, and finally arrive at a result that China's future monetary policy intermediary target interest rates transfer.

Monetarists, represented by Friedman, argued that the money supply at all levels should be regarded as the intermediate target of a country's monetary policy. Estrella (1997), and Mishkin (1997) hold the view that it is feasible to use a cyclically adjusted broad amount of money as an intermediary target. Chinese scholars Su (2008) used growth rate of money supply, growth rate of loan, the one-year-loan-interest-rate, inflation rate and Chinese GDP to build a SVAR model and did the empirical research. He drew a conclusion that in the monetary policy system, the quantitative control mechanism is more important than the price mechanism, so the central bank in the money supply as the monetary policy intermediary goal that conclusion is more reasonable. Fu (2013) believed that firstly, the effectiveness of money supply as the intermediary target of China's monetary policy was gradually decreasing. Secondly, its measurability and controllability were poor. And finally, its correlation with the final target was not high. However, the current economic and financial environment in China

did not enable China to change the intermediary target. Wang (2006) evaluated the operating environment of China's monetary policy from three perspectives: financial system structure, interest rates marketization process and central bank independence, and believed that under the current political and economic financial environment of China, money supply should continue to serve as the intermediary target of monetary policy.

The concept of Aggregate Financing to the Real Economy (AFRE) was first put forward at the Central Economic Work Conference of China in December 2010, which attracted extensive attention from Chinese policy authorities and academic circles. Many Chinese scholars have put forward their own views on whether it is suitable as a quantitative intermediary target of monetary policy. Yin (2011) believed that the monitoring of AFRE has sufficient theoretical basis and it is suitable for the intermediary goal of monetary policy. Chen et al. (2016) took GDP, M2 and social financing scale as the core variables to construct SVAR model, and used impulse response analysis and variance decomposition to analyzed the effectiveness of Aggregate Financing to the Real Economy. They found that AFRE can reflect the financial support of the financial system to the real economy in energy consumption, and its effectiveness is better than M2. Sheng (2012) also compared the role of AFRE and M2 in the transmission mechanism of monetary policy, and again proved the conclusion that the effectiveness of social financing scale is better than M2. Zhang (2013), and Jiang (2013) compared the advantages and disadvantages of Aggregate Financing to the Real Economy and money supply as the intermediary target of monetary policy. He referred that 'When external shocks come from the commodity market, the effectiveness of money supply as the intermediary target of monetary policy is better than that of social financing scale, and social financing scale is only of reference significance'.

As Yang (2017) referred, 'The dynamic evolutions of monetary policy tools and intermediary target selections of the central bank always match their social and historical background and are closely related to the macroeconomic situation and the development stage of the financial market.' Scholars all over the world have different views on the choice of the intermediary target of monetary policy. The choice of one or several economic variables as the intermediary target of monetary policy still needs to be concluded by each country according to its national conditions and development.

1.2.2. The Impact of Money Supply on Real Estate Prices

At present, M2 is set China's intermediary target for monetary policy by the central bank. Therefore, this part will sort out relevant literature on the influence of monetary policy intermediary target, which takes money supply as proxy variable, on real estate prices.

Compared with interest rates, foreign scholars started to study the relationship between

money supply and real estate prices relatively late. Most scholars believe that the fluctuation of money supply has an impact on the real estate price, and that the impact is significant.

Hoffmaister and Schinasi (1994) found that real estate prices were affected by a series of financial factors, including money supply, resident income, expected price changes and costs. Also, the authors found that these effects would change in different time periods. Lastrapes (2002) made an empirical study on the monthly data of the real estate market and money supply in the United States from 1968 to 1999, and found that money supply not only had a positive impact on the real estate prices, but also had a certain impact on the real estate sales. Szpino (2005) selected the data from the first quarter of 1980 to the third quarter of 2004 in Europe to establish the VEC model and concluded that the fluctuations of housing prices were obviously affected by the changes of money supply.

A series of studies which focus on the impact of the money supply on real estate pricing also have been done in China.

Wang (2009), and Han (2009) established a three-way diagonal BEKK model, which is based on the broad money supply M2, to empirically study the fluctuation effect of the real estate prices and the economic growth of the money supply. They found that the co-movement between money supply and real estate prices change sharply. Hu (2009) also selected M2 as the proxy variable of money supply, introduced the amount of completed real estate investment, the sales volume of commercial housing, the real estate prices and the real estate price index as the control variables to establish the VAR model, and studied the impact of the change of money supply on the real estate market. At the same time, she believed that the change of money supply will have a certain impact on the real estate market by affecting the credit scale of commercial banks. Therefore, she introduced two variables, real estate development loans and personal housing loans, for quantitative analysis. The results show that 'the change of money supply has a significant impact on real estate prices both in the long term and in the short term. The increase in the money supply has expanded development loans to property companies and personal loans, accelerating the rise in China's real estate prices.

In terms of the influence channels of money supply on real estate prices, Li (2013) believed that the money supply influences the real estate prices through multiple channels. He selected housing prices index, the residences prices and land transaction index of time series data from 1998 to 2008 and used these data to study the effect of M2 on these indexes. Finally, he concluded that M2 causes the increases of housing rental prices, land transaction prices and housing sales prices, among which M2 has the greatest impact on the land transaction prices, followed by the housing sales prices. Zhou (2014) constructed the VAR model with GDP, M2, interest rates and housing prices as the core variables, and concluded

that there is a long-term stable and positive equilibrium relationship between money supply and housing prices. She also found that the increase of GDP and income would also promote the housing prices to some extent, but the contribution rate to the rise of the housing prices of these two variables was not as high as that of money supply.

Li (2011), and Ying (2011), analyzed the relationship between house prices and money supply of China, the United States and Japan, respectively and found that there is a long-term equilibrium relationship between the amount of money and house prices in these three countries.

However, some scholars consider that the change of money supply has no significant impact on real estate prices. Qian (1998) selected the monthly data of China's money supply and asset prices from 1994 to 1997 for a statistical study and found that though there was a correlation between money supply and asset prices in China, though it was not significant. Dai (2009), and Zhang (2009) also believed that the impact of money supply on the supply and demand of real estate was relatively weak, and the impact on real estate investment and real estate prices was not significant.

1.2.3. The Impact of Interest Rates on Real Estate Prices

When discussing the impact of monetary policy on real estate prices, foreign scholars are more based on the perspective of the interest rates. Most scholars believe that there is a negative correlation between interest rates and real estate prices, that is, the rise of the interest rates leads to the decline of real estate prices.

Iacoviello (2002) selected macroeconomic data of six European countries and established a VAR model with five different variables, which are namely real estate prices, GDP, inflation rate, broad money supply and interest rates. The research proved that the increase in interest rates has a negative impact on house prices in various countries. Reichert (1990) analyzed the impact of interest rates on real estate prices from both theoretical and practical perspectives. In terms of theory, he argues, 'higher lending rates raise the cost of capital for home purchases and the cost of financing investments, and have a negative impact on house prices'. From a practical point of view, he used the quarterly data from 1975 to 1987 in the United States to establish the C-D production function model to prove the view that the increase of loan interest rates will reduce the real estate prices.

Pavlov (2004), and Wachter (2004) assumed that investors were risk neutral and that people borrowed money from banks for house purchase. They built a model of housing loan interest rates and real estate prices and then analyzed the model. The results showed that loan interest rates had a positive impact on housing prices. Goodhart (2007), and Hofmann (2007) also reached a similar conclusion by studying the impact of interest rates on real estate prices

in Japan. They selected the relevant data of Japan from 1972 to 1998, and drew the conclusion that the changes of interest rates will influence real estate prices fluctuation, and the increase of interest rates will lead to the rise of real estate prices.

Chinese scholars' conclusions on the relationship between interest rates and real estate prices are not uniform.

Many Chinese scholars believe that the interest rates have a negative impact on real estate prices, but the impact of interest rates policy on real estate prices is not as significant as the change of money supply on real estate prices. Zhou (2006) constructed the relationship model of real estate prices, interest rates and exchange rates in China, and used the corresponding data in 12 cities in China to do the empirical research. The research results show that interest rates and real estate prices have a negative relationship. Zhang et al. (2006) studied the relationship between real estate prices, bank real estate loan interest rates and mortgage loan interest rates from a practical perspective on the basis of improving the existing theoretical model of real estate loans. They found that the central bank can restrain the rise of real estate prices to some extent by raising the interest rates of housing loans. Lee et al. (2007) used Chinese monthly data from June 1998 to August 2007 to analyze how the adjustments of interest rates affect the real estate market. Their analysis showed that the short-term rise in interest rates will inhibit the development of real estate investments and real estate prices. However, in the long run, the increase of interest rates will boost the domestic real estate development loans and real estate prices' rise, and then promote the real estate prices go up.

There are also some scholars who believe that there is no obvious relationship between interest rates and housing prices. Liang (2006), and Gao (2006) found that real estate investment had a small and insignificant response to interest rates. Liu (2014) used commercial housing sales price as the dependent variable, the long-term-loan-rate, urban per capita disposable income and M2 as independent variables to build the VAR model. All of data come from the first quarter of 2003 to the fourth quarter of 2013 of China's Liaoning province. He concluded that interest rates policy will do little to curb the rises in house prices for Liaoning province.

1.3. Research Methods

In order to analyse the impact of money supply and interest rates on real estate pricing in China and compare the difference between both factors, three research methods are mainly selected: theoretical research method, comparative research method and empirical analysis method.

Theoretical Research Method is to sort out and summarize several relevant newspapers, papers and related literature at home and abroad, find out the relationship between the

intermediary objective of China's monetary policy and real estate price in theory.

This paper will also compare the effect of different levels of Money Supply and interest rates on China's housing prices.

Finally, this study will base on theoretical research, use different empirical analysis software such EVIEWS, and EXCEL to do the quantitative research of China's data.

1.4. Framework

According to the research ideas, this thesis can be divided into the following six chapters:

Chapter one is this Introduction. Firstly, this thesis introduces the background of topic selection and significance of research. Then, this thesis introduces the relevant literatures at home and abroad and summarizes them. Finally, this thesis puts forward the research framework and research method for research.

Chapter two is the theoretical analysis of the impact of the intermediate target of monetary policy on the real estate prices. This chapter mainly includes two parts. The first part is to define some basic concepts involved in this thesis, including the concept of monetary policy, the concept of intermediary goals of monetary policy and the choice of intermediate target of China's monetary policy. The second part is a brief description of the concept of interest rates, money supply and Aggregate Financing to the Real Economy and the research mechanism of how these three economic variables affect the real estate prices.

The third chapter is descriptive statistical analysis of money supply, interest rates and real estate prices in China. The fourth chapter will talk about the data used in this thesis and its processing. These two chapters provide the data premise for the following chapter — the empirical research.

Chapter five is model building and empirical analysis. This chapter includes the ADF test, VAR model building, co-integration analysis, granger causality test and other methods.

The final chapter is the conclusion and policy recommendations. According to the theoretical and empirical results, the thesis draws the corresponding conclusions and tries to put forward the corresponding policy recommendations.

Theoretical Foundation Analysis

This chapter is the theoretical analysis of the impact of the intermediate target of monetary policy on the real estate prices. Firstly, it will introduce the concept of monetary policy and its intermediate target. Secondly, it is going to state which financial index will be selected as the intermediate target of China's monetary policy. Finally, it will introduce money supply, interest rates and aggregate financing to the real economy, and will analyze the impact of the three variables on housing prices.

2.1. Description of Monetary Police

Before studying the impact of monetary policy intermediary target on real estate prices in China, it is necessary to define some basic concepts involved in this thesis. At the same time, according to the national conditions and economic conditions of different countries, the intermediary objectives of monetary policies are also different. Therefore, after introducing the basic concepts, this part introduces and sorts out the intermediary target selection of China's monetary policy, which provides theoretical support for the following research.

2.1.1. Monetary Policy

Monetary policy refers to "policies adopted by monetary authorities to control and regulate the money supply and a variety of related general terms to achieve certain macroeconomic goals". (Ding, 2009)

Monetary policy generally falls into two categories. One is expansionary monetary policy, which is often used when the economy is depressed. In this time, in order to stimulate consumption and promote economic development, the central bank usually takes corresponding measures to increase the money supply and reduce interest rates. Another one is contractionary monetary policy, which is often used in overheated economy or severe inflation. The central bank often takes steps to raise interest rates, reduce the money supply and gradually loosen the overheated economy, keeping prices within reasonable limits.

Monetary policy generally has four ultimate objectives: price stability, full employment, economic growth, and balance of payments. But in real economic life, the policy tools used by the central bank in the implementation of monetary policy usually cannot directly act on these ultimate goals. Therefore, central Banks have inserted two sets of financial variables between their instruments and their ultimate goals, one called intermediate goals and the other called operational goals. That is, the application of monetary policy has a transmission

progress.

Monetary Policy → Operational Goals → Intermediary Goals → Ultimate Goals.

2.1.2. Intermediate Objectives of Monetary Policy

The intermediate objective of monetary policy is a financial index which is interrelated with the ultimate objective of monetary policy (Yang, 2017). It can effectively measure the effect of monetary policy on the financial variables. It is the channel and bridge of monetary policy transmission.

The intermediate objectives of monetary policy must satisfy three characteristics, that is, measurable, controllable, and correlative. Testability means that the central bank can make more accurate statistics on the economic variables as the intermediate target of monetary policy. Controllability means that the central bank can control the selected intermediate target of monetary policy within its determined or expected range. Correlation means that economic variables as intermediate objectives of monetary policy need to be closely related to the ultimate objectives of monetary policy. In addition to satisfying three characteristics, the choice of intermediate objectives of monetary policy should also be combined with the specific national conditions.

From the practice of central Banks of different countries, there are mainly two intermediate targets of monetary policy. One is quantitative index, represented by the money supply at all levels. Monetarist economists, represented by Friedman, conducted empirical research on American data and found that there was a causal relationship between the change of money supply and economic activities, and that the velocity of money circulation was stable in the long term. Therefore, money supply can be the intermediate target condition of monetary policy. The second is the price-type index, represented by the interest rate. The Keynesian school believes that interest rate is the key intermediate variable in the transmission mechanism of monetary policy. It can effectively connect macro and micro economy, so it is the most appropriate intermediary target of monetary policy. According to the financial market conditions in the United States, the long-term interest rate is basically in line with the criteria of testability, and the central bank can conduct better regulation.

From the practice of monetary policy in developed countries, the evolution of intermediate objectives of monetary policy is not smooth sailing. Its evolution has experienced many changes and iterations in terms of quantity and price selection. Take the United States for example. After World War II, the Federal Reserve used interest rate targets as an intermediary indicator in the hope of recovering the American economy. However, in the 1970s, to alleviate stagflation, under the guidance of monetarist economic theory, money

supply gradually replaced interest rate and became the intermediary target of monetary policy. In the 1980s, with the development of financial liberalization, it became difficult for the Federal Reserve to control the money supply, and the effectiveness of money supply as the intermediary target of monetary policy weakened. The Federal abandoned the money supply index and adopted real interest rate as the intermediary target of monetary policy.

2.1.3. The Choice of Intermediate Target of China's Monetary Policy

With the change of China's economic environment and the change of the central bank's regulation mode, the intermediate target of China's monetary policy is also changing constantly (Wang, 2006).

Before the implementation of the Reform and Opening-up Policy, China used to use cash program and loan scale as intermediate targets of monetary policy.

In 1996, money supply and credit scale were formally introduced by the People's Bank of China as the intermediary target of monetary policy. In 1998, the People's Bank of China abolished its direct control over the scale of credit, and the role of money supply as an intermediary target in China became clearer. At present, the central bank uses a series of monetary policy tools, mainly open market operations, to regulate the economy by adjusting the intermediary target of broad money supply M2.

However, due to the rapid development of China's financial market and the continuous increase of financial innovation, the variety and quantity of financial products are becoming more and more abundant, and the boundary between M0, M1 and M2 of money supply at all levels will become increasingly blurred. In addition, with the continuous development of financial innovation, the demand for money becomes unstable, and the effectiveness of the money supply as an intermediary target is also compromised. Under the current economic and financial environment, most Chinese scholars begin to discuss the feasibility of other economic indicators as the intermediary target of monetary policy.

Some scholars believe that the development of China's interest rate liberalization has created the basic conditions for the People's Bank of China to use the price-based intermediary target, and the interest rate tool can well serve as the intermediary target of monetary policy.

Suo (2006) believed that at the beginning of financial innovation, the variance of total demand was more impacted than the variance of money demand, so money supply was preferred as the intermediary target. However, once financial innovation enters the period of rapid development, money demand becomes unstable, resulting in money demand shock greater than total demand shock. Currently, interest rate is a better intermediary target of

monetary policy. By constructing the VAR model, Yang (2017) proved that the impact of the national interbank pledged Repo rate and the Shanghai interbank offered rate, SHIBOR, on the interpretation of the change of the ultimate goal of monetary policy was in line with the expectation of China's economic theory and could play a role in the transmission mechanism of monetary policy. Cai et al. (2014), established SVAR model by using the data from 1996Q1 to 2013Q3, to analyse the contribution rate and specific effect of interest rate and money supply on the ultimate goal of China's monetary policy. The results show that the conditions of interest rate as the intermediate target of China's monetary policy are becoming mature. Chen et al. (2016) after studying the transformation of monetary policy intermediary objectives in the process of financial innovation in the United States, the United Kingdom, Canada and Japan, put forward the view that China is also in the process of financial innovation, and the intermediary objectives of monetary policy should be transformed from quantitative to price.

In addition to the interest rate, which is the price-type intermediate target of monetary policy, the topic of whether the scale of social financing is suitable to replace the money supply as the intermediate target of monetary policy is also widely concerned by policy authorities and academic circles. This concept was first put forward at China's Central Economic Work Conference in October 2010.

Jiao et al. (2012) compared the correlation and causality between the aggregate financing to the real economy, M2 and the scale of credit with the final goal of monetary policy, and found that the effect of the aggregate financing to the real economy was better than that of the scale of credit and M2, which can be considered as the intermediary goal of monetary policy in the future. However, after the controllability and correlation comparison between the scale of social financing and the money supply, Zhang and Jiang (2013) believed that the effectiveness of the scale of social financing as an intermediary target of monetary policy was not higher than that of money supply. There was no theoretical and empirical support to show that it was the most suitable to replace money supply with scale of social financing as an intermediary target of monetary policy. However, Zhong (2011) stated in the published journal that AFRE still does not have the conditions to become an intermediary target of monetary policy, but it can be used as an important indicator for post-test.

To sum up, although the effectiveness of money supply as an intermediary target of monetary policy is gradually declining, it does not mean that money supply has lost its role in monetary policy regulation. At present, China's economic and financial environment makes it impossible for China to change the intermediary target, so it is still necessary to adopt this target at present or in the future. At the same time, with the continuous progress of China's

interest rate liberalization reform, the economic conditions for interest rates to be the intermediary target of monetary policy are becoming more and more mature. Therefore, China can consider establishing a hybrid monetary policy system with interest rate and money supply as the intermediary target simultaneously, and the two are complementary. Therefore, this thesis attempts to take money supply and interest rates as the intermediary target of monetary policy to explore the impact of these two economic variables on the prices of the real estate market in China.

2.2. The Impact Mechanism of Money Supply on the Real Estate Market Prices

The real estate market itself has the characteristics of capital-intensive industries with high commodity unit price and huge amount of capital needed. These characteristics determine that the property market will be naturally affected by the total amount of money issued. The amount of money supplied by the monetary authorities will act on all aspects of the property market. Based on this, this section mainly discusses the influence factors of money supply on the real estate market price, theoretically.

2.2.1. Bank Credit Channel

The financial support of commercial Banks is very important to the development of Chinese real estate industry. Commercial Banks participate in the real estate market mainly by providing capital for real estate enterprises and real estate mortgage loans for consumers. When the central bank increases the money supply, commercial Banks have more loanable funds and are more likely to obtain mortgage loans in the credit market.

On the one hand, the increase in money supply allows banks to relax the credit conditions for individuals, and consumers can get more funds to buy houses, which increases the demand for houses. In addition, some potential consumers who are in need of housing but lack the capital can also obtain mortgage loans in the credit market to buy commercial houses. This makes this potential consumption into the real purchase demand, and further stimulate the real estate market to increase the housing demand.

On the other hand, the possibility for real estate developers to obtain loans also increases, so that real estate companies can use more funds to develop the real estate, and the supply of the real estate market increases. However, as real estate developers have to go through a series of steps, such as land purchase, construction and delivery, etc. for land development, it will take a lot of time, leading to the fact that the elasticity of the impact of money supply changes on the real estate market supply is far less than the elasticity of the real estate market demand. Therefore, the supply of the real estate market is basically

unchanged in the short term, which increases the effective demand in the real estate market and thus promotes the rise of the housing prices. On the contrary, when the money supply decreases, the loanable capital of commercial Banks will also decrease, which will cause the real estate prices to drop through the influence on the supply and demand of the real estate market. Its mechanism of action is as follows:

Money Supply↑— Loanable Capital Level↑—Real Estate Demand↑—Real Estate Price↑

Money Supply↓—Loanable Capital Level↓—Real Estate Demand↓— Real Estate Price↓

2.2.2. Interest Rates Channel

The high price of real estate leads to the homebuyers' need to obtain financial support from Banks and other financial institutions in the form of mortgage loans, and then pay the principal and interest to financial institutions on schedule in accordance with the agreement. Hence, the cost to consumers of buying a home comes mainly from the interest rate on their mortgage.

In a money market, when the money supply changes, if the demand for money remains constant, the balance of money supply and demand is disturbed. When the money supply increases, the market interest rate will be lowered, and the lending interest rate will also be lowered, thus reducing the cost of buying a house for consumers. This stimulates the current demand for homes, which in turn drives up prices. In addition, as speculative consumers participate in the real estate market to invest, they will consider the expected rate of return. When interest rates fall in line with the increase in the money supply, the expectation that house prices will rise in the future stimulates speculative demand and causes house prices to rise.

Therefore, when the increase of money supply leads to the decrease of interest rate, it will stimulate the demand for house purchase and thus cause the rise of real estate prices. On the contrary, when the money supply decreases, the interest rate will rise and the housing demand will be retained, thus causing the real estate prices to fall. Its mechanism of action is as follows:

Money supply↑—Interest Rates↓— Loan Amount ↓—Housing Cost↓— Housing Demand↑—Real Estate Price↑

Money supply↓—Interest Rates↑— Loan Amount↑—Housing Cost↑—Housing Demand↓—Real Estate Price↓

2.2.3. Tobin's Q Theory

Tobin's Q theory is a famous coefficient proposed by economist James Tobin in 1969, namely "Tobin's Q" coefficient, 'which is used to reveal the relationship between the stock market and an investment. Q is the ratio of the market value of capital to its replacement cost (Zhou, 2014). If $Q < 1$, that is, when the market value of an asset is less than its replacement cost, the price of buying off-the-shelf capital products is lower than that of newly generated capital products. Hence, the enterprise will reduce its investment in new investment products, which makes the capital demand reduce. On the contrary, when $Q > 1$, i.e. the market value of the asset is greater than its replacement cost, it is more advantageous for the enterprise to buy newly produced capital products. Therefore, the enterprise will increase the demand for investment. In conclusion, the higher the Q, the higher the investment demand.

The Tobin Q effect also has an impact on housing prices. When a central bank eases monetary policy, the money supply increases and interest rates fall, leading to a rise in stock prices. In this period, the market value of real estate is greater than the replacement cost of real estate, so the Q value of real estate enterprises rises accordingly. Under the effect of Tobin's Q theory, the investment expenditure of real estate enterprises increases, which leads to the rise of real estate demand and housing prices. Its mechanism of action is as follows:

Money Supply $\uparrow$ —Interest Rate $\downarrow$ — Stock Price $\uparrow$ — Q Coefficient $\uparrow$ — Business Investment $\uparrow$ —Real Estate Demand $\uparrow$ — Real Estate Price $\uparrow$

Money Supply $\downarrow$ —Interest Rate $\uparrow$ — Stock Price $\downarrow$ — Q Coefficient $\downarrow$ — Business Investment $\downarrow$ —Real Estate Demand $\downarrow$ — Real Estate Price $\downarrow$

2.2.4. Wealth Effect

The wealth effect originates from Franco Modigliani's life cycle hypothesis. According to Franco, the level of people's consumption expenditure depends not only on current income, but also on total income over the whole life cycle, including current income, expected future income, and the stock of wealth people have (Mishkin, 1976).

As an important asset, real estate is one of the main forms of wealth held by residents. When the money supply increases, interest rate changes lead to an increase in the value of financial assets held by residents, thereby increasing their lifetime available wealth. These series of mechanisms promote the consumption of durable goods such as housing, which leads to the rise of housing prices. Its mechanism of action is as follows:

Money Supply $\uparrow$ — Interest rates $\downarrow$ — Stock Price $\uparrow$ —Life Wealth $\uparrow$ — Real Estate Consumption $\uparrow$ —Housing Price $\uparrow$

Money Supply $\downarrow$ — Interest Rate $\uparrow$ — Stock Price $\downarrow$ — Life Wealth $\downarrow$ — Real Estate

Consumption↓— Housing Price↓

In addition, Miskin (1976) referred that ‘the long-term boom or bust of the real estate market will also affect the buyers' expectations of the future and their marginal propensity to consume, thus affecting the consumption expenditure, which is known as the indirect wealth effect.’

2.2.5. Balance Sheet Effect

In the credit market, there exists information asymmetry between Banks and real estate supply and demand, which leads to moral hazard and adverse selection.

When the increase of money supply causes the decrease of interest rates, on the one hand, it reduces the financial expense including interest in the operational processes of enterprises; on the other hand, as a good asset, when the real estate’s prices rise, its mortgage value will increase accordingly, thus effectively improving the balance sheet of the real estate developer. When corporate balance sheets are improved, corporate net worth will increase, loan risks borne by lenders will be reduced, adverse selection and moral hazard problems will be alleviated, and it will be easier for enterprises to obtain loans, which will promote the increase of investment demand, thus increasing the demand for real estate and stimulating the rise of housing prices. Its mechanism of action is as follows:

Money Supply↑— Interest rates↓— Collateral Price↑— Financial Cost↓— Real Estate Property Enterprise Net Value↑—Balance sheet Performance↑ —Loans Available↑—Property Demand↑—Housing Price↑

Money Supply↓— Interest rates↑— Collateral Price↓— Financial Cost↑— Real Estate Property Enterprise Net Value↓—Balance sheet Performance↓—Loans Available↓—Property Demand↓—Housing Price↓

2.3. The Impact Mechanism of Interest Rates on the Real Estate Market Prices

Interest rates usually refers to the ratio between the amount of interest and the principal in a certain period (usually refers to a year) (Gu and Zhang, 2014). It is affected by economic average profit rate, capital supply and demand situation, price fluctuation level, international economic environment and other factors. Its essence is the price of capital, and it is affected by the supply and demand of capital in the capital market. As a capital-intensive industry, real estate prices are deeply affected by interest rate changes.

2.3.1. Discounted Cash Flow Model

According to the discounted cash flow model, the evaluated value of any assets should be

equal to the accumulated net present value of the expected future earnings of the assets. As an important fixed asset, the real estate price can also be calculated by a discounted cash flow model (Lin and Fan, 2013).

According to the discounted cash flow model, the real estate price can be divided into two parts. The first one is the sum of the rental income within a period of time, and the second is the income from future real estate transfer. Writing it in terms of a formula, the value of the real estate (cumulative present value P_0) is:

$$P_0 = \sum_{i=1}^n \frac{D_i}{(1+r)^i} + \frac{P_n}{(1+r)^n} \quad (1)$$

Where, P_n stands for the price distribution of the real estate in the n^{th} year;

D_i stands for the rental income of the real estate in the i^{th} year, expressed in terms of the market interest rate ‘ r ’;

N stands for the holding period (years) of the real estate (Lin and Fan, 2013).

According to the above discounted real estate cash flow model, it is not difficult to find out that the real estate price is negatively correlated with the interest rate level. That is, the higher the market interest rate is, the lower the real estate price is. This is because the higher the market interest rate is, the less the present value of the property rent and transfer income received by the real estate holder in each period, the smaller the accumulated net present value is, and the lower the real estate price is.

2.3.2. From the Perspective of Supply and Demand

Firstly, we discuss from the perspective of the real estate supplier - real estate development enterprises. Lin and Fan (2013) confirmed that most of the capital sources of real estate enterprises are direct or indirect bank loans in China.

The change of market interest rates will affect the development intention of real estate development enterprises through affecting their cost of capital, and then will have a certain impact on the real estate supply. When the market interest rates rise, the cost of capital of real estate development enterprises will increase, so the profits obtained by enterprises will decrease, their investment and development willingness will be greatly weakened, so the real estate supply will decrease correspondingly, and the housing price will rise. On the contrary, when the market interest rates decrease, the cost of capital needed by real estate development enterprises decreases and the enterprises can obtain more profits. This has boosted the willingness of companies to invest and develop real estate, which has led to an increase in the supply of real estate and a fall in housing prices. Its mechanism of action is as follows:

Interest Rate↓— Cost of Capital↓— Profit↑— Development Willingness↑—the Real Estate Supply↑—Housing Price↓

Interest Rate↑— Cost of Capital↑— Profit↓— Development Willingness↓—the Real Estate Supply↓—Housing Price↑

Secondly, from the demand side of real estate, buyers, whether in developed countries or developing countries, but especially in developing countries, the main purchase vehicle of real estate is by means of a mortgage loan (Chai, 2015). Therefore, the decline of loan interest rate will also reduce the purchase cost of homebuyers, thus stimulating the demand for housing and increasing the housing price. On the contrary, when the loan interest rate rises, the purchase cost of homebuyers increases correspondingly, the purchase demand is curbed, and the housing price falls accordingly. Its mechanism of action is as follows:

Interest rate↓ —Housing cost↓ —Housing willingness↑ —Real Estate Demand↑—Real Estate Price↑

Interest rate↑ —Housing cost↑ —Housing willingness↓ —Real Estate Demand↓—Real Estate Price↓

In conclusion, the change of interest rates will have an impact on the supply and demand of real estate, and ultimately affect the change of real estate prices. However, the specific direction of change depends on the interest rate elasticity of the real estate supply side and the demand side. Some scholars in previous studies indicated that compared with the real estate supply, the demand is more flexible to the interest rate, and the change of interest rate has a more significant impact on the real estate demand (Liu, 2014).

2.4. Aggregate Financing to the Real Economy

Aggregate Financing to the Real Economy (AFRE) refers to the total amount of funds obtained by the Real Economy from the domestic financial system in a certain period (monthly, quarterly or annual). It is an incremental concept (Sheng, 2012). According to Chai (2015), AFRE mainly consists of the following three aspects: one is all of the capital that has support on the real economy from financial institutions, covering the domestic currency and foreign currency loans, trust loans, entrusted loans, corporate bonds held by the financial institutions and non-financial enterprise shares, the compensation of insurance company and the investment real estate, etc. The second is the direct financing obtained through the credit or service of financial institutions in the formal financial market by using standard financial instruments, including undiscounted bank acceptance bills, domestic stock financing of non-financial enterprises and corporate bond financing, etc. The third one is other financing, including loans from small loan companies, network loan companies and other private

financial institutions.

For real estate enterprises, their capital for real estate financing mainly comes from bank loan funds. Since 2000, Chinese real estate companies have received about 80% of their funds each year directly or indirectly from banks. Also, bank credit is an important part of aggregate financing to the Aggregate Financing to the Real Economy. Therefore, we can take bank credit as the representative variable for the Aggregate Financing to the Real Economy and prove how AFRE affects the change of real estate prices by studying the impact of bank credit on real estate prices.

Bank credit will affect the real estate prices in two ways.

On the one hand, bank credit affects the real estate enterprises' access to funds through the change of credit availability and loan attitude, thus affecting the real estate supply and finally influencing the real estate prices. Its mechanism of action is as follows:

Bank credit $\uparrow$ —Credit Availability and Lending Attitude $\uparrow$ —Real Estate Business Accesses to Funds $\uparrow$ —Housing Supply $\uparrow$ —Housing Prices $\downarrow$

Bank credit $\downarrow$ — Credit Availability and Lending Attitude $\downarrow$ —Real Estate Business Accesses to Funds $\downarrow$ —Housing Supply $\downarrow$ —Housing Prices $\uparrow$

On the other hand, real estate enterprises need to spend capital cost, which mainly depends on interest rates, when they obtain funds through bank credit. Therefore, the change of interest rates will also affect real estate enterprises' capital cost through bank credit, and ultimately affect the prices of real estate. This study has explained above that the interest rates will affect the real estate prices from the respect of cash flow discount model and the impact of interest rate changes on the real estate supply and demand. This study will not repeat it here.

Because the concept of the Aggregate Financing to the Real Economy is relatively new, there is still a lack of clear index system and statistical calibers. As this study mentioned above, the topic which whether AFRE can replace the money supply as the intermediary target of monetary policy, the topic has received keen attention. However, most scholars still believe that currently this view lacks theoretical and empirical support. Therefore, this study will no longer take AFRE as the intermediary target of monetary policy to discuss its impact on the real estate prices in China.

2.5. Summary of the Chapter

This chapter first expounds the concept of monetary policy and its intermediate objectives, and the reasons for choosing the two economic variables of money supply and interest rate

as the intermediate objectives of monetary policy. On this basis, this chapter further clarifies the influence of money supply and interest rate on Chinese real estate price from the perspective of theoretical mechanism.

The money supply will affect the real estate prices through the bank credit channel, the interest rate channel, the Tobin Q effect channel, the wealth effect channel and the balance sheet channel. And this effect is positive, that is, the increase of money supply will promote the rise of real estate prices.

In terms of interest rates, this research first analyzes the impact of interest rates change on real estate prices from the discounted cash flow model and draws the conclusion that real estate prices are negatively correlated with interest rates level. That is, the higher the market interest rates are, the lower the real estate prices are. Then, from the perspective of real estate supply and demand, the change of interest rates will have an impact on the supply and demand of real estate, and ultimately affect the change of real estate prices.

In terms of the aggregate financing to the real economy, since bank credit is an important part of social financing scale, this study takes it as a representative variable of it. And this study through studying the impact of bank credit on real estate prices, to discusses how AFRE changes the real estate prices. However, due to the lack of theoretical and empirical support for whether AFRE is suitable as an intermediary target of monetary policy, this study will not discuss AFRE in the following chapters.

CHAPTER 3

Descriptive Statistical Analysis

The previous chapter theoretically analyzed the impact of money supply and interest rates on real estate prices, while this chapter will conduct descriptive statistical analysis on money supply, interest rates and real estate prices in China.

In addition, in this chapter, the money supply and 7-day interbank offered rate at various levels in different periods in China will be compared with the average prices of commercial housing in China, so as to further study the impact of the change of money supply and interest rates on the change of real estate prices in China.

3.1. Descriptive Statistical Analysis of Money Supply at All Levels in China

According to the definition made by IMF and the actual situation in China, the People's Bank of China divides the money supply into the following three levels:

1. M0 = Cash in circulation;
2. M1 = M0+ Current Deposits of Enterprises + Deposits of Government Agencies and Organizations in the Army + Deposits of Rural Areas + Deposits of Credit Cards Held by Individuals;
3. M2 = M1+ Urban and Rural Residents' Savings Deposit + Enterprise Deposit with Fixed Nature + Foreign Currency Deposit + Trust deposit (Wenjing Zhou, 2014);

Among them, M1 is the narrowly defined amount of money, which is highly liquid and is the key target of the national central bank. M2 is the broad quantity of money.

YEAR	Amount			Growth					
	billion yuan			M0		M1		M2	
	M0	M1	M2	billion yuan	%	billion yuan	%	billion yuan	%
1996	880.2000	2,851.4800	7,609.4900						
1997	1,017.7600	3,482.6300	9,099.5300	137.5600	15.63	631.1500	22.13	1490.0400	19.58
1998	1,120.4200	3,895.3700	10,449.8500	102.6600	10.09	412.7400	11.85	1350.3200	14.84
1999	1,345.5500	4,583.7300	11,989.7900	225.1300	20.09	688.3600	17.67	1539.9400	14.74
2000	1,465.2700	5,314.7200	13,461.0300	119.7200	8.90	730.9900	15.95	1471.2400	12.27
2001	1,568.8800	5,987.1590	15,830.1900	103.6100	7.07	672.4390	12.65	2369.1600	17.60
2002	1,727.8030	7,088.1790	18,500.6970	158.9230	10.13	1101.0200	18.39	2670.5070	16.87
2003	1,974.5900	8,411.8570	22,122.2800	246.7870	14.28	1323.6780	18.67	3621.5830	19.58
2004	2,146.8300	9,596.9700	25,410.7000	172.2400	8.72	1185.1130	14.09	3288.4200	14.86
2005	2,403.1700	10,727.8800	29,875.5700	256.3400	11.94	1130.9100	11.78	4464.8700	17.37
2006	2,707.2620	12,602.8100	34,557.7900	304.0920	12.65	1874.9300	17.48	4682.2200	15.67
2007	3,037.5230	15,256.0080	40,344.2210	330.2610	12.20	2633.1980	21.05	5786.4310	16.74
2008	3,421.8960	16,621.7130	47,516.6600	384.3730	12.65	1365.7050	8.95	7172.4390	17.78
2009	3,824.7000	22,144.5800	61,022.4500	402.8040	11.77	5522.8670	33.23	13505.7900	28.42
2010	4,462.8170	26,662.1500	72,585.1800	638.1170	16.68	4517.5700	20.40	11862.7300	18.95
2011	5,074.8460	28,984.7700	85,159.0900	612.0290	13.71	2322.6200	8.71	12573.9100	17.32
2012	5,465.9810	30,866.4230	97,414.8800	391.1350	7.71	1881.6530	6.49	12255.7900	14.39
2013	5,857.4440	33,729.1050	110,652.4980	391.4630	7.16	2862.6820	9.27	13237.6180	13.99
2014	6,025.9530	34,805.6410	122,837.4810	168.5090	2.88	1076.5360	3.19	12184.9830	11.01
2015	6,321.6580	40,095.3440	139,227.8110	295.7050	4.91	5289.7030	15.20	16390.3300	13.34
2016	6,830.3870	48,655.7240	155,006.6670	508.7290	8.05	8560.3800	21.35	18778.8560	11.33
2017	7,064.8600	54,379.0150	169,023.5310	234.1730	3.43	5723.2910	11.76	14016.8640	9.04
2018	7,320.8400	55,168.5900	182,674.4200	256.2800	3.63	789.5750	1.45	13650.8890	8.08
2019	7,718.9470	57,600.9150	198,648.8820	398.1070	5.44	2432.3250	4.41	15974.4620	8.74
AVERAGE	3,782.7203	22,479.6985	70,042.5287	297.3368	9.99	2380.4102	14.18	8306.0605	15.32

Table 3.1: China's Money Supply at All Levels from 1996 to 2019

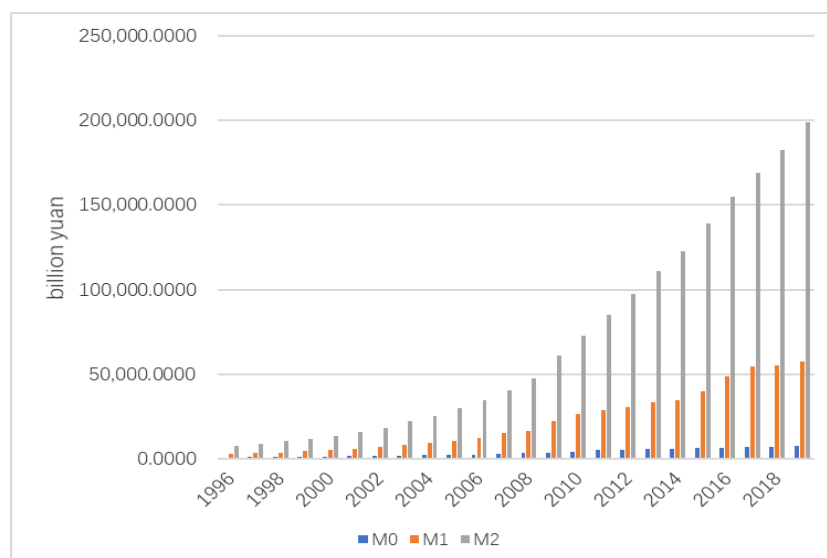


Figure 3.1: China's Money Supply at All Levels from 1996 to 2019

Source: The above data are from the CEInet Economic Statistical Database¹. Chart produced by the author.

It is not difficult to see from Table 3.1 and Figure 3.1 that from 1996 to 2019, all levels of China's money supply have been increasing every year. Among them, M0 has the smallest base and the most stable growth, with an average growth rate of 9.9% in 24 years. The growth rate of M1 is in the middle, with a 24-year-average-increase of 2380.41 billion yuan, which is 8 times that of M0, and about 0.3 times that of M2. M2 has a largest base and a fastest growth rate. The amount of M2 of 1996 is 7609.49 billion yuan while that of 2019 is 198648.88 billion yuan. Its average increase in 24 years is 8306.06 billion yuan and its average growth rate of 15.32%. Especially after 2008, M2 growth rate is particularly rapid. In 2012, China's narrow measure of money supply (M1) exceeded 30 trillion yuan for the first time, and in 2013, its broad measure of money supply (M2) exceeded 100 trillion yuan for the first time. By the end of 2019, China's narrow money supply M1 has exceeded 55 trillion yuan, while the broad money supply M2 is close to 200 trillion yuan.

¹ <https://www.ceicdata.com/en>

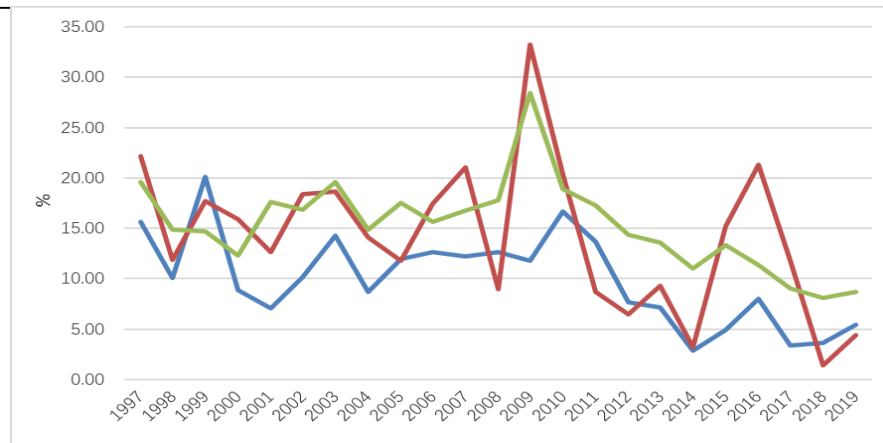


Figure 3.2: Trend in the Year-on-year Growth Rate of China's Money Supply from 1997 to 2019

Source: The above data are from the CEInet Economic Statistical Database. Chart produced by the author.

According to Figure 3.2, it is not difficult to see that the growth rates of M0, M1 and M2 all show a fluctuating trend. Among them, M1 has a large fluctuation range, which is clearly greater than that of M2 and M0. From 1996 to 2006, the growth rate of M1 was relatively stable and fluctuated around 15%. Influenced by the domestic and foreign economic environment, the growth rate continued to decline after exceeding 20% in 2007, and dropped by 12 percentage points in 2008. Then sharply increased to 33.2% in 2009, with an increase of more than 24 percentage points. From 2010 to 2019, the fluctuation ranges of China's narrow measure of money supply (M1) has been quite large, with the difference between the highest value (21.4% in 2016) and the lowest value (1.5% in 2018) of the ten years being nearly 20 percentage points.

From 1996 to 1998, the growth rate of M2 fluctuated greatly. From 1998 to 2008, the growth rate of M2 was stable and fluctuated around 15%. After that, the growth rate of M2 began to fluctuate sharply. After reaching the peak in 2009 (28.5%), it began to show a downward trend. In 2017, the growth rate was less than 10%, with only a slight recovery in 2012 and 2015. From 2017 to 2019, China's broad money supply (M2) showed a trend of slow rise.

3.2. Descriptive Statistical Analysis of Interest Rates

In 1996, China's interbank offered rate (IBM) market began to make substantial progress in interest rate liberalization. Inflation and economic growth have become the main targets of interest rate adjustments, and the role of interest rates in the economic development has been increasingly strengthened.

Year	Regular Deposit		Lending		
	1 year	2 years	1 year	1-5 years Containing 5 years	more than 5 years
1996	9.16	9.79	11.24	13.84	14.21
1997	7.12	7.54	9.81	11.36	12.06
1998	5.03	5.24	7.55	8.69	9.18
1999	2.92	3.1	6.09	6.54	6.8
2000	2.25	2.43	5.85	6.03	6.21
2001	2.25	2.43	5.85	6.03	6.21
2002	2.02	2.28	5.39	5.64	5.82
2003	1.98	2.25	5.31	5.58	5.76
2004	2.03	2.33	5.36	5.63	5.83
2005	2.25	2.7	5.58	5.85	6.12
2006	2.35	2.83	5.86	6.17	6.47
2007	3.21	3.8	6.72	7.07	7.34
2008	3.92	4.46	7.17	7.47	7.59
2009	2.25	2.79	5.31	5.76	5.94
2010	2.3	2.89	5.36	5.8	5.98
2011	3.28	4.17	6.34	6.7	6.85
2012	3.24	4.06	6.27	6.64	6.79
2013	3	3.75	6	6.4	6.55
2014	2.97	3.71	5.96	6.36	6.51
2015	2.12	2.72	4.97	5.37	5.52
2016	1.5	2.1	4.35	4.75	4.9
2017	1.5	2.1	4.35	4.75	4.9
2018	1.5	2.1	4.35	4.75	4.9
2019	1.5	2.1	4.35	4.75	4.9

Table 3.2: The Legal Deposit and Lending Rates of Different Maturities of Chinese Financial Institutions

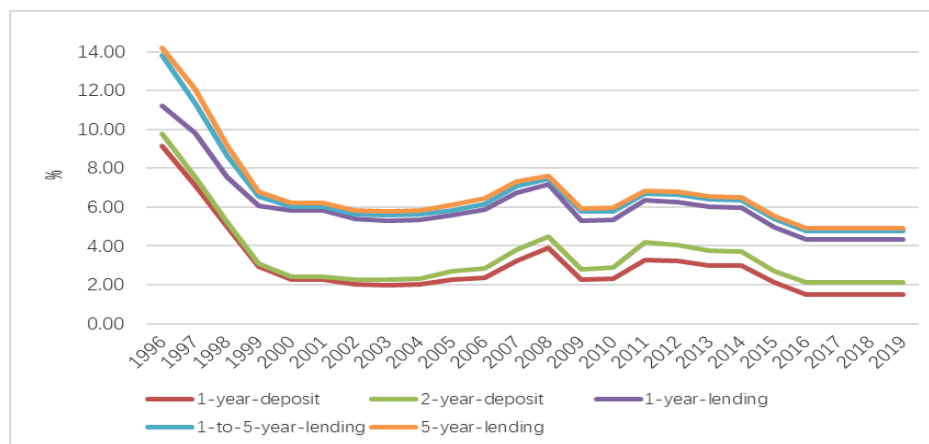


Figure 3.3: China's Legal Deposit and Loan Interest Rates of Financial Institutions for Different Maturities from 1996 to 2019

Source: The above data are from the CEInet Economic Statistical Database. Chart produced by the author.

From 1996 to 2019, the deposit and loan interest rates of Chinese financial institutions with different maturities moved in basically the same direction, all of which were in the general trends of sharp decline, with occasional upward trends.

From 1996 to 2003, the central bank of China's made several negative adjustments for the interest rates. In 1996 to 1997, the 1-year and 2-year statutory deposit rates of financial institutions decreased from 9.16% and 7.79% to 7.12% and 7.54%, respectively. In terms of loan interest rates, the legal loan interest rates of financial institutions for 1 year, 1 to 5 years

(including 5 years) and more than 5 years decreased from 11.24%, 13.84% and 14.21% to 9.81%, 11.36% and 12.06%, respectively. In July 1997, the Asian financial crisis broke out, which had a partial negative impact on China's economy. During this period, deposit and loan interest rates have dropped sharply. The one-year-deposit-rate of financial institutions decreased to 2.92% in 1999, while the two-year-deposit-rate decreased to 3.10%. During the same period, the official one-year-lending-rate fell by 3.72 percentage points. The legal lending rates for maturities of one to five years (including 5 years) and over five years fell by 4.82 and 5.26 percentage points, respectively. On November 1, 1999, the central bank began to collect 20% deposit interest tax and deposit and loan interest rates were in a slow downward trend. In 2003, the level of deposit and loan interest rates had reached their historical low levels. Among them, the one-year-deposit-rate had fallen to less than 2.0%, and the two-year-deposit rate had fallen to 2.25%. During the eight years from 1996 to 2003, the one-year-deposit-rate fell by 7.18 percentage points and the two-year-deposit-rate by 7.54 percentage points. The official lending rates of financial institutions for 1 year, 1 to 5 years (including five years) and more than 5 years dropped by 5.93 percentage points, 8.26 percentage points and 8.45 percentage points, respectively.

From 2004 to 2008, the Chinese government frequently used monetary policy tools to rein in the re-overheating economy and promote healthy development of the investment market. During this period, the central bank raised deposit and lending rates for financial institutions nine times. In 2004, the legal deposit rate of 1 year and 2 years for financial institutions was 2.03% and 2.33%, respectively, compared with 3.92% and 4.46% in 2008. China's financial institutions deposit and loan interest rates showed a steady rise. The legal lending rate of financial institutions for 1-year, 1-5 years (including 5 years) and over 5 years increased from 5.36%, 5.63% and 5.83%, in 2004, to 7.17%, 7.47% and 7.59% in 2008, respectively.

The growth level began to decline. In order to achieve the goal of maintaining growth, the central bank implemented a moderately loose monetary policy during this period. The one-year-short-term deposit rate and two-year-short-term deposit rate of financial institutions decreased from 3.92% and 4.46%, in 2008, to 2.25% and 2.79% in 2009, respectively, both by 1.67 percentage points. The legal lending rates of 1-year, 1-5 years (including 5 years) and over 5 years for financial institutions decreased from 7.14%, 7.47% and 7.59% to 5.31%, 5.76% and 5.94%, respectively, with reductions of 1.83 percentage points, 1.71 percentage points and 1.65 percentage points.

From 2010 to 2015, the deposit and loan interest rates of China's financial institutions generally showed a steady decline, with some occasional upward trends. At the beginning of 2009, the economy recovered and the central bank began to raise the legal deposit and lending

rates in order to reduce market liquidity and curb inflation. In 2011, the one-year-deposit interest rate of financial institutions rose to more than 3%, and the loan interest rates of financial institutions of different maturities also exceeded 6%. In 2015, the 1-year and 2-year legal deposit rates of financial institutions were 2.12% and 2.72%, respectively. The 1-year-deposit-rate and 2-year-deposit-rate dropped, on average, by only 0.02 percentage points and 0.01 percentage points during these six years. In terms of lending, the legal loan interest rates of financial institutions are 4.97% for one-year, 5.37% for one to five years (including five years), and 5.52% for more than five years. During these six years, the legal lending rates of financial institutions for the three different maturities were cut by an average of about 0.06 percentage points.

Since 2016, deposit and lending rates have not changed significantly due to the steady development of China's economy. The one-year and two-year statutory deposit rates for financial institutions remained stable at 1.5% and 2.1%, respectively. And the legal interest rates of financial institutions were kept at 4.35%, 4.75% and 4.90%, respectively for one-year loans, 1-5 years (including 5 years) loans and over-5-year-loans.

3.3. Analysis of the Trend of Real Estate Prices in China

Since the implementation of the Reform and Opening-up Policy, China's real estate industry has been booming, and housing has become a key consumer goods for residents. The real estate industry accounts for a large proportion of GDP and is the main component of national wealth. In 2019, according to the CEInet Statistics Database, the GDP of China is 99086.51 billion Yuan, while the added value of the real estate industry is 6963.15 billion Yuan, accounting for 7.03% of the GDP of the year. It is not hard to see that the real estate industry plays a pivotal role in the national economy.

Year	Housing Sales Area		Average Selling Price			
	Commercial Housing Sales Area (10 thousand m ²)	Residence Sales Area (10 thousand m ²)	Amount		Growth	
			Commercial Housing (Yuan / m ²)	Residence (Yuan / m ²)	Commercial Housing %	Residence %
1996	7900.41	6898.46	1806.40	1604.56	%	%
1997	9010.17	7864.30	1997.00	1790.00	10.55	11.56
1998	12185.30	10827.10	2063.00	1854.00	3.30	3.58
1999	14556.53	12997.87	2063.00	1857.00	-0.48	0.16
2000	18637.13	16570.28	2112.00	1948.00	2.87	4.90
2001	22411.90	19938.75	2170.00	2017.00	2.75	3.54
2002	26808.29	23702.31	2250.00	2092.00	3.69	3.72
2003	33717.63	29778.85	2359.00	2197.00	4.84	5.02
2004	38231.64	33819.89	2778.00	2608.00	17.76	18.71
2005	55486.22	49587.83	3167.66	2936.96	14.03	12.61
2006	61857.07	55422.95	3366.79	3119.25	6.29	6.21
2007	77354.72	70135.88	3863.90	3645.18	14.77	16.86
2008	65969.83	59280.35	3800.00	3576.00	-1.65	-1.90
2009	94755.00	86184.89	4681.00	4459.00	23.18	24.69
2010	104764.65	93376.60	5032.00	4725.00	7.50	5.97
2011	109366.75	96528.41	5357.10	4993.17	6.46	5.68
2012	111303.65	98467.51	5790.99	5429.93	8.10	8.75
2013	130550.59	115722.69	6237.00	5850.00	7.70	7.74
2014	120648.54	105187.79	6324.00	5933.00	1.39	1.42
2015	128494.97	112412.29	6793.00	6473.00	7.42	9.10
2016	157348.53	137539.93	7476.00	7203.00	10.05	11.28
2017	169407.82	144788.77	7892.00	7614.00	5.56	5.71
2018	171464.60	147789.59	8726.00	8553.00	10.57	12.33
2019	171557.87	150144.32	9310.00	9287.00	6.69	8.58

Table 3.3: China's commercial housing sales, from 1996 to 2019

Source: The above data are from the CEInet Economic Statistical Database. Chart produced by the author.

Table 3.3 shows that the sales area of commercial housing in China increased from 790.041 million square meters in 1996 to 1715,578 million square meters in 2019, with a cumulative increase of 163,67 million square meters over the past two decades. In 1996, China's residential sales area was 168,98 million square meters, accounting for 87.32 percent of the commercial housing sales area. In 2019, the area of residential sales in China increased to 1501.4432 million square meters, more than 20 times the area of residential sales in China in 1996 and accounting for 88.28 percent of the area of commercial housing sales.

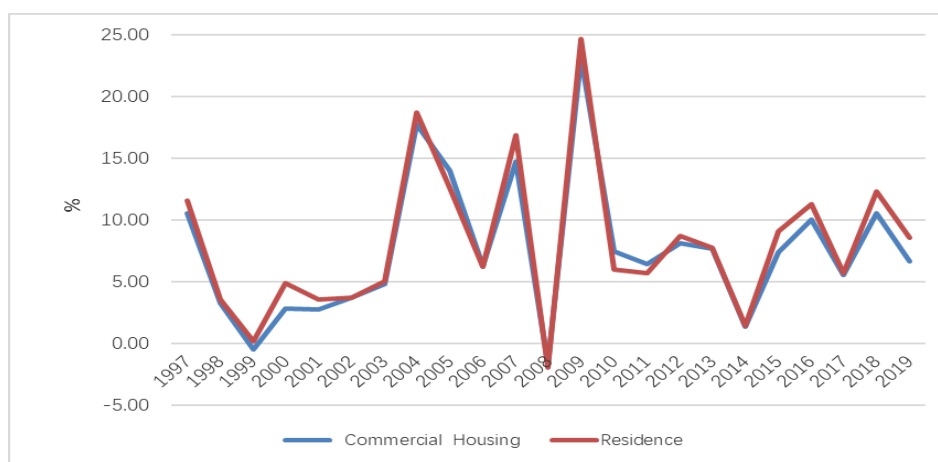


Figure 3.4: The Growth of Average Selling Price of Real Estate in China

Source: The above data are from the CEInet Economic Statistical Database. Chart produced by the author.

China's property boom has been accompanied by a steady rise in property prices. According to Table 3.2, the average market price of commercial housing in China in 1996 was 1806.4 yuan/m², and the average market price of residential housing was 1604.56 yuan/m². By 2019, the average price of commercial housing rose to RMB 9,310.28 per square meter, about 5.15 times of that in 1996. The average residential market price also rose to 9,287 yuan per square meter, about 5.79 times that of 1996.

From 1996 to 1998, to deal with the overheating of the real estate market, the Chinese government began to restrict bank credit funds into the real estate market, and the growth rate of real estate prices slowed sharply. In 1998, China abolished the welfare housing distribution and implemented the housing commercialization reform. In 1999, when the Asian financial crisis broke out, the real estate prices still rose, but the growth rate dropped sharply, and even reached negative growth in 1999. China's real estate prices then rose steadily until 2003. During the four years from 1999 to 2003, the price of commercial housing increased by an average of 76.5 yuan per square meter per year, while the price of residences increased by an average of 85 yuan square meters per year.

From 2004 to 2007, along with the prosperity of the economic cycle and the upsurge of real estate investment, China's real estate prices developed rapidly. During this period, the average prices of commercial housing and residences in China increased over 13% on average. In spite of several policies introduced by the Chinese government to curb excessive investment in real estates and stabilize the prices, the real estate prices still show a trend of rapid development.

In 2008, Chinese real estate prices turned negative for the first time in nearly two decades as a result of the financial crisis. In this year, the growth rates of average prices of commercial housing and residences were -1.65% and 1.90%, respectively. However, in 2009, despite the impact of the financial crisis, large-scale investment demand withdrew from the real estate market, while the new rigid demand on a larger scale promoted the rise of China's real estate prices in 2009. The growth rate of commercial housing price and residences' price reached the peak at this time, which were 23.18% and 24.69%, respectively.

After that, from 2010 to 2019, the government began to comprehensively regulate the housing price, and the growth rate of China's real estate prices began to flatten out. Except for the growth rate of commercial housing prices and average residential prices in 2014, which were 1.39% and 1.42% respectively, the growth rate of the rest fluctuated between 5% and 11%.

From the above analysis, it can be concluded that China's real estate industry has been

developing rapidly during these years. Although the development speed has slowed down in recent years due to the impact of the economic situation and the national macro-policy regulation, real estate prices have been on the trend of continuous rise.

3.4. The Impact of Money Supply and Interest Rates on Real Estate Prices

This section will carry out statistical analysis on the changes of China's real estate prices based on different levels of money supply and interest rates to provide theoretical and overall trend basis for empirical analysis and research in the following chapter.

3.4.1. The Impact of Money Supply on Real Estate Prices

First, this section will compare the trend of money supplies with the trend of real estate prices in China from 1996 to 2019.

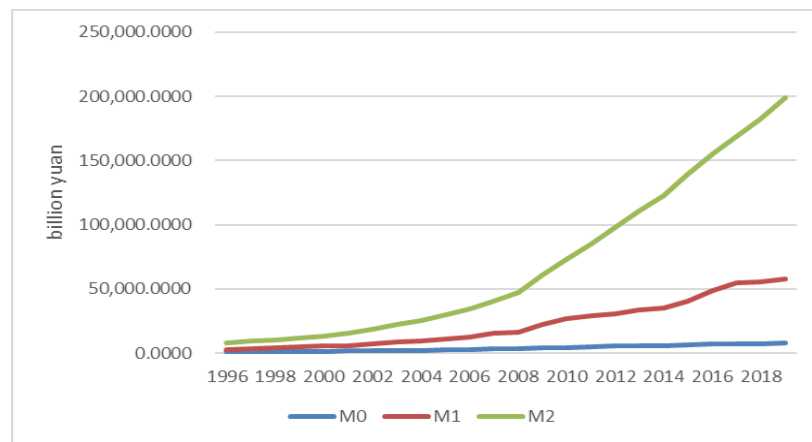


Figure 3.5: China's Different Levels of Money Supply from 1996 to 2019

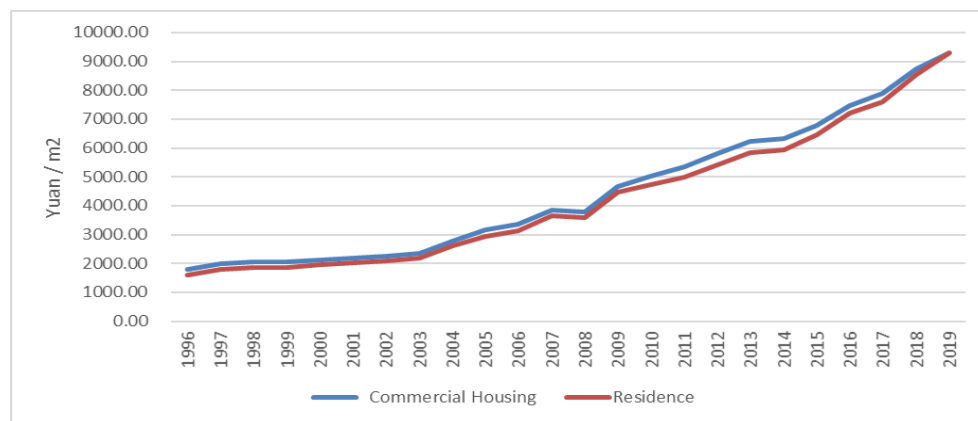


Figure 3.6: The Average Price of Commercial Housing and Residences in China from 1996 to 2019

Source: The above data are from the CEInet Economic Statistical Database. Chart produced by the author.

This part will analyse the general effect of money supplies on Chinese's housing prices, and the statistical analysis will be shown in the next chapter.

By comparing the figure 3.5 and figure 3.6, overall, the three levels of money supply and the two different housing prices have the same trend and they all rise rapidly from 1996 to 2019. But for some years, the correlation was not significant.

For example, from 1998 to 1999, three levels of money supply increased significantly. In 1999, the growth rates of M2, M1 and M0 were 14.74%, 17.67% and 20.09%, respectively. In the same period, due to the impact of the Asian financial crisis, the average price of commercial housing and residence dropped, by 10 yuan and 3 yuan per square meter, respectively. Similarly, affected by the American subprime mortgage crisis, the average price of commercial housing and residence declined from 3863.9 10 yuan/m² and 3645.18 yuan/m² in 2007 to 3800.00 yuan/m² and 3576.00 yuan/m² in 2008, respectively. However, the three levels of money supply still show an increasing trend year by year.

From 2003 to 2004, China's monetary authorities have shifted from a previously prudent monetary policy to a tighter one, and the money supply of the three levels began to fall from the high level. The growth rates of M0, M1 and M2 decreased from 14.28%, 18.67% and 19.58% in 2003 to 8.72%, 14.09% and 14.86% in 2004, respectively. But since 2003, the rapid development of the real economy and the influx of foreign capital brought a new round of expansion for China economy. During this period, with the demand of investment the real estate prices present a rapid development, with the average price of commercial housing and residence increasing 13.92% and 13.69%, respectively.

In other years, the change of money supply at all levels is basically consistent with the change of Chinese real estate prices.

3.4.2. The Impact of the Interest Rates on Real Estate Prices

Second, this section will compare the trend of interest rates with the trend of real estate prices in China from 1996 to 2019.

Again, by comparing Figure 3.3 shown in Chapter 3.2 and Figure 3.6 shown in Chapter 3.4.1, it is not difficult to find that interest rates and real estate prices generally present an opposite trend. In 1996, the one-year legal deposit and loan rates of Chinese financial institutions were 9.16% and 11.24%, respectively. However, in 2019, both interest rates have dropped to 1.50% and 4.35%. In the same 24 years, the average price of commercial housing in China has increased by 4.15 times, and the average market price of residences has also increased by 4.79 times.

As we mentioned above, from 1996 to 2003, the People's Bank of China's made several negative adjustments to the interest rates. In 1996, the one-year and two-year legal deposit

rates of Chinese financial institutions were 9.16% and 9.79%, but by 2003, both deposit rates were reduced to 1.98% and 2.55%, respectively. In terms of loan interest rates, in 1996, the legal loan interest rate of financial institutions for one year was 11.24%, the legal loan interest rate for one to five years (including five years) was 13.84%, and the legal loan interest rate for more than five years was 14.21%. In 2003, the legal loan interest rates for three different maturities was reduced to 5.31%, 5.58% and 5.76%, respectively. On the other hand, since the Chinese government abolished the welfare housing distribution system in 1998, the real estate prices in China have been on the rise, with the average price of commercial housing and residences rising from 18,06.4 yuan/square meter and 1,604.56 yuan/square meter in 1996 to 2,359.00 yuan/square meter and 2,197 yuan/square meter in 2003, respectively. Therefore, it can be preliminarily concluded that at this stage, the change of interest rates seems to be negatively correlated with the change of real estate prices in China.

From 2004 to 2007, the Chinese government frequently used monetary policy tools to curb the overheated economy and promote the healthy development of the investment market. During this period, the deposit and loan interest rates of different maturities showed a rising trend. Taking the one-year legal loan interest rate of financial institutions as an example, the deposit interest rate was 5.36% in 2004, but 6.72% in 2007. At the same time, along with the prosperity of the economic cycle and the surge of real estate investment, China's real estate is also on the rise. The average price of commercial housing and residences in China rose from 2,778 yuan/square meter and 2,608 yuan/square meter in 2004 to 3,863.90 yuan/square meter and 3,645.18 yuan/square meter in 2007. The increases were 1085.90 yuan/square meter and 1038.18 yuan/square meter respectively in 3 years. Different from the previous stage, in this stage, the change of interest rate and the change of China's real estate prices show a certain positive correlation.

Then from 2008 to 2009, also affected by the negative impact of the global financial crisis, the central bank implemented a moderately loose monetary policy during this period, and deposit and loan rates declined. In 2008, real estate prices showed negative growth for the first time in nearly 20 years, with the average prices of commercial housing and the residences growing at -1.65% and -1.90%, respectively. Although influenced by the financial crisis, large-scale investment demand withdrew from the real estate market, and the new rigid demand on a larger scale contributed to the rise of China's real estate prices in 2009. Therefore, from 2008 to 2009, there was a certain negative correlation between interest rates changes and real estate prices changes.

From 2010 to 2015, the deposit and loan interest rates of China's financial institutions generally showed a steady decline, with occasional upward trend. Taking the over-five-year lending rate of Chinese financial institutions as an example, the over-five-year lending rate

of Chinese financial institutions was 5.98% in 2010, rose to 6.85% in 2011, and then declined slowly, to 5.52% in 2015. During this period, China's real estate prices continued to rise, with the average growth rate of both commercial housing price and residence price exceeding 6% in the six years, except that the decline rate slowed down from 2013 to 2014. Therefore, we can conclude that in this stage, the change of interest rates is associated with a negative effect for the change of real estate prices.

Since 2016, China's deposit and loan interest rates have not changed significantly, while the real estate prices in China still show a trend of rapid rise. Over the four years, the average price of commercial housing in China increased by an average of 8.22%, while the average price of residences increased by more than 9.47%. Therefore, we can think that in this stage, the real estate prices change does not seem to be affected by the deposit and loan interest rates.

To sum up, there is a certain correlation between the change of interest rates and the changes of real estate prices in China, and the correlation is negative.

3.5. Summary of the Chapter

This chapter firstly carried on the descriptive statistical analysis for Chinese three levels of money supply, interest rates and real estate prices. Then, compared the money supplies with real estate prices and interest rates with real estate prices in the same period. It provided a preliminary probe into China's money supply and interest rates change on the influence of the real estate prices from the angle of descriptive statistics and will provide the guidance for the next empirical part.

From 1996 to 2019, China's money supply at all levels increased year by year. Among them, M0 has the smallest growth range and the slowest growth rate, followed by M1. M2 has the largest growth range and the fastest growth rate. From 1996 to 2019, the deposit and loan interest rates of Chinese financial institutions of different maturities showed a general sharp decline, with an occasional upward trend. During these 24 years, China's real estate prices also rose rapidly, only falling in 1999 due to the Asian financial crisis and in 2008 due to the US subprime mortgage crisis.

After comparing money supply with real estate prices and interest rates with real estate prices from 1996 to 2019, this chapter comes to two conclusions. First, the changes of money supply at all levels are basically the same as the changes of real estate prices. That is, the increases of money supply seem to stimulate the rises of real estate prices. Second, there is a certain negative correlation between interest rates changes and real estate prices changes in China. Looks like the decline of interest rates leads to the rise of real estate prices.

Data Selection and Processing

Before doing the empirical analysis, it is necessary to select and process the data of the selected variables.

4.1. Selection of Data

The purpose of this research is to study the influence of money supply and interest rate as intermediate targets of monetary policy on the price of the real estate market in China. As mentioned above, in 1996, money supply, combined with credit scale, were officially introduced by the People's Bank of China as intermediary targets of monetary policy. At the same time, since June 1, 1996, the People's Bank of China no longer carried out the upper limit management on the inter-bank offered rate. Instead, the inter-bank offered rate was determined by the borrowing parties themselves according to the market demand and supply of funds, which marked the substantive progress of China's interest rate liberalization.

Therefore, this study selects the quarterly data of the average housing price of China, the narrow measure of money supply M1, the broad measure of money supply M2 and the 30-day weighted average interest rate of inter-bank lending, as the applied data of the empirical research variables used. The sample period will run from 1996 to 2019 (both inclusive).

Data were obtained from CEInet Statistics Database and the official Database of the People's Bank of China.

The software used in the empirical research is EXCEL and EVIEWS 9.0.

4.1.1. Real Estate Market Prices Data

When considering the real estate price index, there are three representative alternative indexes, namely the State Housing Prosperity Index (REIC), the housing price index and the average housing price of China.

The REIC selects relevant indicators of real estate such as investment, capital, area and sales, and uses the growth rate cycle method to compile the data, excluding the influence of seasonal factors (including random factors). However, since it uses 2012 as the base year, the index fails to reflect the impact of money supply and interest rate on the price of China's real estate market after the change of intermediary target of China's monetary policy and the process of interest rate liberalization in 1996.

The housing price index, also known as the housing sales price index, can reflect the rise and fall of the housing price. It is a relative number, while the money supply and interest rate

indicators we choose are absolute numbers, so they are discarded.

Finally, considering the availability and representativeness of the data, this study takes the average housing price of China as the real estate price index and names it as HP. Since quarterly average housing price data cannot be directly obtained, the quarterly average housing price is calculated by dividing the quarterly real estate sales volume by the quarterly real estate sales area. All the data are derived from the CEInet Statistics Database.

4.1.2. Money Supply Data

We have mentioned above that there are three levels of current money supply in China: cash in circulation (M0), narrow money supply (M1) and broad money supply (M2). In this research, the narrow measure of money supply and the broad measure of money supply M2 are taken as the representatives of the intermediate target of monetary policy.

M1 and M2 data are derived from the monthly data published by the CEInet Statistics Database and summed up the data of the three months within the quarter as the quarterly data.

4.1.3. Selection of Interest Rates Data

At present, China has not realized the real interest rate liberalization, and various interest rates have different influences on the real estate market price. In the selection of interest rate data mainly we have the following three indicators: the first one is the interest rate of national debt; the second is the one-year deposit rate; and the third is the interbank offered rate in the money market.

In most articles which study the influence of interest rate on real estate price, the inter-bank offered rate is usually taken as the representative of interest rate index. It is because that the interbank offered rate is sensitive to the macroeconomic situation, so it can timely reflect the capital tightness of financial institutions, which is one of the important bases for the central bank to judge the situation of capital supply and demand and determine the trend of monetary policy.

In this thesis, comprehensively considering the transaction scale, marketization degree and sensitivity to market influence of inter-bank offered rate, the 30-day weighted average interest rate of inter-bank offered rate is selected as the proxy variable of interest rate, and the monthly data is averaged on a quarterly basis, represented by R.

4.2. Data Processing

After selecting the data, it is not possible to use them directly for empirical analysis. The data needs to be processed in a series of ways.

4.2.1. Seasonal Adjustment of Data

In the study of financial time series, the phenomenon that seasonal change causes the regular change of time series usually happens, which often covers up some objective laws in normal economic development. Hence, before the analysis of financial time series, it is necessary to make seasonal adjustments to the time series to eliminate the influence of seasonal factors on the data. After that, the underlying trend cycle between economic variables can be well displayed.

Census X12 method is adopted in this study to make seasonal adjustment on the quarterly data of HP, M1, M2 and R. The software automatically determines the seasonal filtering and trend filtering, thus obtaining the seasonally adjusted images of each indicator, which are respectively represented by HP_SA, M1_SA, M2_SA and R_SA. The adjusted trend graph is as follows:

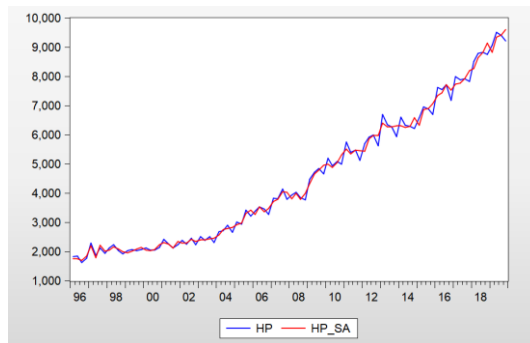


Figure 4.1 Adjusted Trend Graph of HP

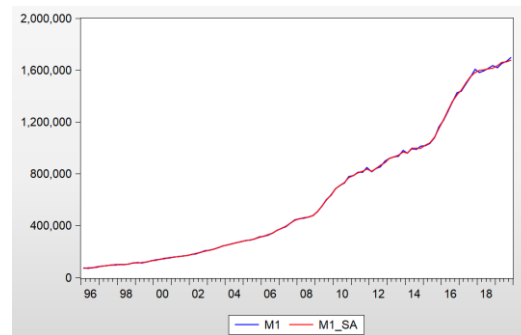


Figure 4.2 Adjusted Trend Graph of M1

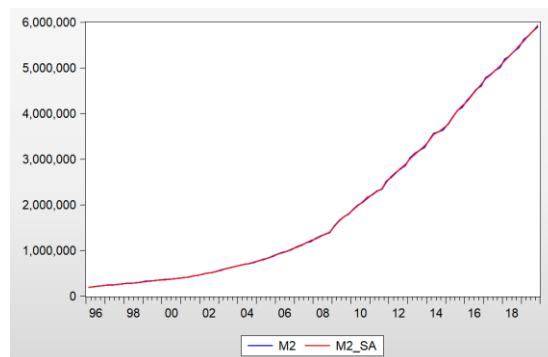


Figure 4.3 Adjusted Trend Graph of M2

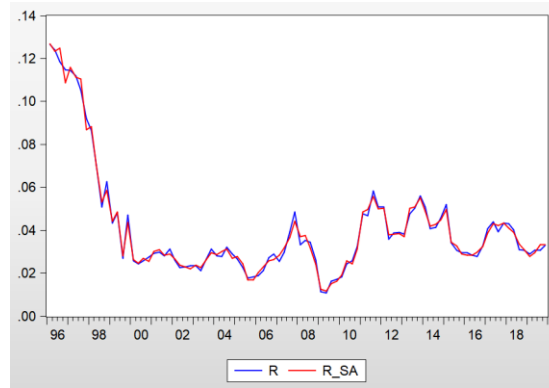


Figure 4.4 Adjusted Trend Graph of R

4.2.2. Logarithmic Processing of Data

After seasonal adjustment of the data, we take the natural logarithm of each data value to remove the heteroscedasticity of the data itself.

HP_SA, M1_SA, M2_SA and R_SA of the study data were defined as LNHP, LNM1, LNM2 and LNR respectively after taking natural logarithms.

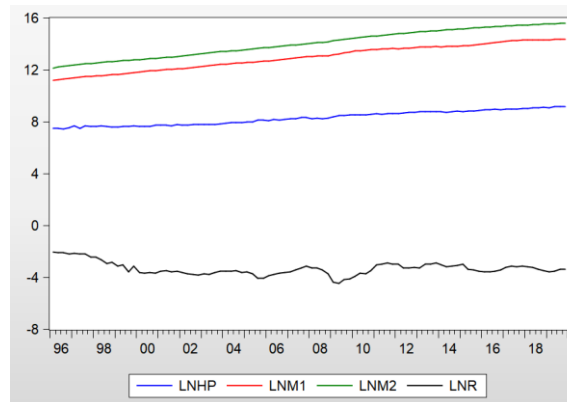


Figure 4.5: The Graph of the Four Variables after Logarithmic Processing

4.3. Data Processing

This chapter expounds selection of data of the money supply, interest rates and real estate prices. After discussing, this study takes the average housing price of China as the real estate price index; takes the narrow measure of money supply (M1) and the broad measure of money supply (M2) as the representatives of the intermediate target of monetary policy; takes the 30-day weighted average interest rate of inter-bank offered rate as the proxy variable of interest rates.

After that, considering the seasonality and heteroscedasticity of financial time series, the data are processed seasonally and logarithmically in this chapter.

Empirical Analysis

In this chapter, this study will conduct empirical research on the selected and processed data.

5.1. Correlation Analysis and Stationarity Test

Before the estimation of model, it is necessary to do the correlation analysis and stationarity test.

5.1.1. Correlation Analysis

First of all, we conduct correlation analysis on the data to measure the degree of correlation between money supply, interest rate and real estate price.

	LNHP	LNLM1	LNLM2	LNLR
LNHP	1			
LNLM1	0.988252	1		
LNLM2	0.991533	0.998266	1	
LNLR	-0.19458	-0.28447	-0.25983	1

Table 5.1: The Table of Correlation Coefficient between Each Two Sets of Data

The calculation formula of correlation coefficient is as follows:

$$r(X,Y) = \frac{Cov(X,Y)}{\sqrt{Var[X]Var[Y]}} \quad (2)$$

Where, $Cov(X, Y)$ is the covariance of X and Y , and $Var[X]$ is the variance of X , $Var[Y]$ is the variance of Y .

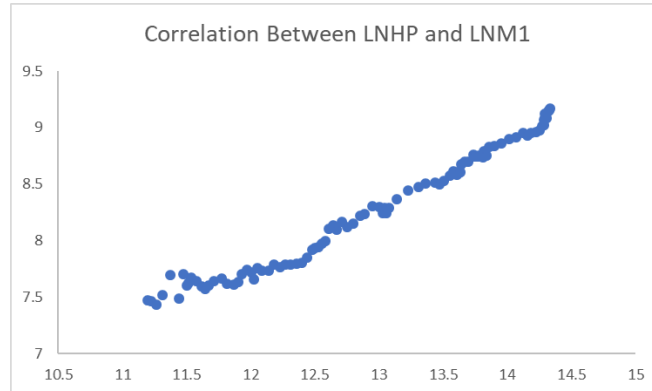


Figure 5.1: The Correlation Between LNHP and LNLM1

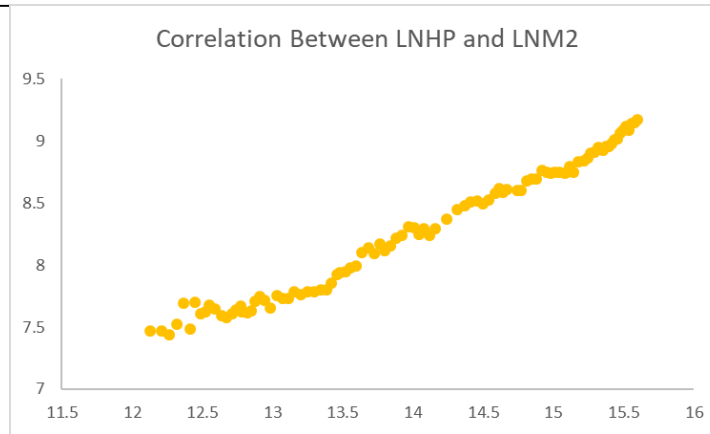


Figure 5.2: The Correlation Between LNHP and LNM2

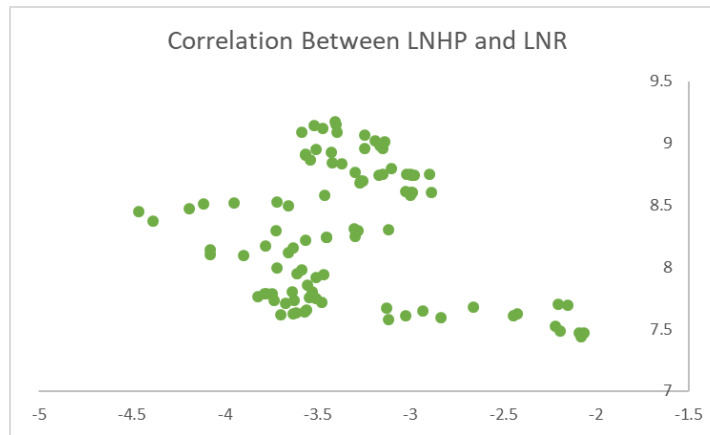


Figure 5.3: The Correlation Between LNHP and LNR

From the Figures, we can see that there is a high positive correlation between house sales price and money supply, in which the correlation coefficient of LN_HP and LN_M1 is 0.988252, while the coefficient of LN_HP and LN_M2 exceeds 0.99. This means that the change of real estate price is highly positively correlated with the change of money supply. When the money supply increases, so do property prices.

We can also make a verdict that housing sales price has a negative correlation to the 30-day weighted average interest rate of inter-bank offered rate, but the correlation coefficient is only 0.19458. Nevertheless, the real estate price and interest rate data of scatter plot show that these two variables still have a certain correlation. As a result, the real interest rate index is retained in the empirical research.

5.1.2. Stationarity Test

In real life, most macroeconomic variables have the non-stationarity, so in order to avoid the emergence of false regression problem, it is necessary to make a unit root test on the data used before other tests, in order to judge the stationarity of time series. Roughly speaking, if the mean value of a time series has no systematic change (no trend), the variance has no

systematic change, and the periodic change is strictly eliminated, then this time series is a stationary time series, and the modeling can be continued. On the contrary, if the time series is non-stationary, difference processing or co-integration analysis methods are needed. In this part, the ADF method will be used as unit root test on the data.

The full name of the ADF test is the Augments Dickey-Fuller Test. This test is to determine whether the sequence has unit root: if the sequence is stable, there is no unit root; Otherwise, there is a unit root.

Consider an AR (p) model:

$$Y_t = c + \alpha_1 y_{t-1} + \alpha_2 y_{t-2} + \dots + \alpha_p y_{t-p} + \varepsilon_t \quad (3)$$

And the AP(p) form is written in the following form for the unit root test:

$$\Delta Y_t = c + \rho y_{t-1} + \sum_{i=2}^p \phi_i \Delta Y_{t-(i-1)} + \varepsilon_t \quad (4)$$

Among them: $\rho = (\sum_{i=1}^p \alpha_i) - 1$; $\phi_i = - \sum_{j=i+1}^p \alpha_j$

H0: $\rho=0$; H1: $\rho=1$

Therefore, the H0 hypothesis of ADF test is the existence of unit roots. If the obtained significance test statistics are less than three confidence degrees (10%, 5%, 1%), the null hypothesis should be rejected with a certain confidence (90%, 95, 99%).

The test results are as follows:

VARIABLE	ADF	Prob.	CRITICAL VALUE 1%	CRITICAL VALUE 5%	CRITICAL VALUE 10%	CONCLUSION
LN_HP	-2.930809	0.1580	-4.062040	-3.459950	-3.156109	NON-STATIONARY
DLN_HP	-6.872914	0.0000	-4.062040	-3.459950	-3.156109	STATIONARY
LN_M1	-0.027275	0.9954	-4.062040	-3.459950	-3.156109	NON-STATIONARY
DLN_M1	-4.680520	0.0014	-4.062040	-3.459950	-3.156109	STATIONARY
LN_M2	0.430285	0.9990	-4.059734	-3.458856	-3.155470	NON-STATIONARY
DLN_M2	-4.157416	0.0075	-4.059734	-3.458856	-3.155470	STATIONARY
LN_R	-3.217672	0.0874	-4.059734	-3.458856	-3.155470	NON-STATIONARY
DLN_R	-5.295766	0.0002	-4.059734	-3.458856	-3.155470	STATIONARY

Table 5.2: Variable Stationarity Test Table²

Based on the ADF test results, we can conclude that under the confidence level of 1%, 5% and 10%, the values of ADF statistics are larger than the critical values for LN_HP, LN_M1 and LN_M2 data, which indicates that these three series of data have unit roots. That is, they are all non-stationary. And the ADF statistic value of data LN_R is also greater than its critical value at 1% and 5% confidence level, but at 10% confidence level, the statistic value is less than its critical value. Therefore, the time series of LN_R is stable at 10% confidence level.

² where the letter D represents the first-order difference sequence of the original sequence.

After taking the first-order difference for each time series, the value of ADF statistic obtained is less than the critical value of the variable series obtained at the confidence level of 1% and 5% and 10%, and the series becomes stable. Therefore, the time series of the four variables is a first-order integral series.

5.2. Estimation of Model

In practice, especially in macroeconomic finance such as monetary policy analysis, Vector Auto-regression Mode (VAR model) has been widely used. The modeling idea is to construct the model by taking each exogenous variable as a function of the lag values of all endogenous variables.

5.2.1. The Optimal Lag Length

When studying the impact of economic policies on macroeconomic variables, a vector autoregressive model, namely VAR model, is usually constructed. In the VAR model, each variable takes its lag variable as the explanatory variable, and through the establishment of a model system composed of multiple equations, the linear lag characteristics of multivariate stationary time series can be reflected (Haiying Liu and Huaxin Zhang, 2013).

Before building the model, it is necessary to judge the optimal lag order. In this paper, the multi-criteria joint determination method is used to make the judgment, and the lag length is the eighth order automatically selected by the system.

Lag	LogL	LR	FRE	AIC	SC	HQ
0	110.4534	NA	1.05E-06	-2.419396	-2.306790	-2.374030
1	745.4046	1197.749	8.13E-13	-16.48647	-15.92344	-16.25964
2	791.7751	83.25613	4.09E-13	-17.17671	-16.16325*	-16.76841*
3	811.8571	34.23074*	3.75E-13*	-17.26948*	-15.80560	-16.67972
4	820.7018	14.27213	4.46E-13	-17.10686	-15.19255	-16.33563
5	834.7645	21.41360	4.74E-13	-17.06283	-14.69810	-16.11014
6	850.6429	22.73499	4.89E-13	-17.06007	-14.24491	-15.92591
7	865.6880	20.17417	5.19E-13	-17.03836	-13.77278	-15.72274
8	881.6039	19.89481	5.47E-13	-17.03645	-13.32045	-15.53937

Table 5.3: VAR delay Lag Length Determination Result

According to the decision results, LR criterion, FRE criterion and AIC criterion choose order 3 as the optimal lag order of the VAR model in this paper, while SC criterion and HQ criterion choose order 2 as the optimal lag order of the VAR model. Therefore, order 3 is selected as the optimal lag length in this study.

5.2.2. Co-integration Test

In the study of multiple non-stationary time series, we need to pay attention to whether the

variables formed by linear combinations of several non-stationary time series variables are stationary variables. If several variables have a co-integration relationship, it means that these variables have a long-term relationship.

The Johansen Test is a common method to analyze the long-term stable relationship between non-stationary economic variables. For non-stationary variables, the co-integration test can be performed only if they have the same single integral sequence. Therefore, before establishing the error correction model, the Johansen co-integration test is carried out for the sequence.

Because the ADF test results show that the variables to be tested have a random trend, the option “the Intercept (no trend) in CE and test VAR”, which it is assumed that the constituent variables of Y contain a linear trend (the linear trend variable is expressed in the form of time t), and the co-integration vector contains an intercept term, is selected in the ADF assumption. At the same time, considering that the data frequency in this paper is of quarterly type and the lag period set by the co-integration test needs to be set as M-1, the lag length is set as 3. The test results are as follows:

Hypothesized No. of CE(s)	Eigenvalue	Trace Stastic	5% Critical Value	Prob.
None*	0.278200	62.21816	47.85613	0.0013
At most 1*	0.151892	32.22551	29.79707	0.0258
At most 2*	0.112184	17.06873	15.49471	0.0287
At most 3*	0.064373	6.121553	3.841466	0.0134

Table 5.4: Trace Statistics Test Results of LnHP, LnM1, LnM2 and LNR³

According to the trace statistics test results, the trace statistics value calculated under the null hypothesis ‘NONE’, which means that there is no co-integration relationship, is 62.21816, which exceeds the critical value of 47.85613, and the p value is 0.0013<0.05. Therefore, the null hypothesis is rejected, namely, there is a co-integration relationship between LNHP, LNM1, LNM2 and LNR. The result also shows that trace test indicates 4 cointegrating eqn(s) at the 0.05 level. Hence, linear regression can be performed on these 4 variables.

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Stastic	5% Critical Value	Prob.
None*	0.278200	29.99265	27.58434	0.0241
At most 1*	0.151892	15.15678	21.13162	0.2781
At most 2*	0.112184	10.94718	14.26460	0.1569
At most 3*	0.064373	6.121553	3.841466	0.0134

³ Trace test indicates 4 cointegrating eqn(s) at the 5%level.

Table 5.5: The Maximum Eigenvalue Results ⁴

The maximum eigenvalue test results are a bit different from the trace statistic test results. According to maximum eigenvalue results, the null hypothesis NONE is still rejected at the critical value of 5%, believing that there is a co-integration relationship between LNHP, LNM1, LNM2 and LNR. However, the next null hypothesis, “At most 1”, indicates that there is at most one co-integration relationship. At the critical value of 5%, the maximum eigenvalue statistic calculated under this assumption is 15.15678, less than the critical value of 21.13162, and the p value is 0.2781>0.05. Therefore, this null hypothesis can be accepted, and it is indicated that there is a cointegrating eqn(s) between the four variables at the 0.05 level.

According to the test results, the co-integration equation between variables as follows:

$$\text{LNHP} = -2.973809\text{LNM1} + 2.162609\text{LNM2} - 0.443540\text{LNR} \quad (5)$$

(0.62809) (0.56605) (0.07193)

This equation (5) draws the following conclusions:

Firstly, there is a negative long-term equilibrium relationship between M1 and HP, with a significant coefficient of 2.97, which means that when the money supply increases by 1 unit, the real estate price changes by 2.97 units. This result is contrary to the previous theoretical analysis, which is probably because the effect of M1 is overwritten by the positive influence of broad money supply M2 on housing price. Hence the negative influence appears.

Secondly, there is a positive long-term equilibrium relationship between the broad money supply M2 and the real estate price, with a coefficient of 2.16, which indicates that every increase of 1 unit of money supply will bring an increase of 2.16 units of real estate price. This conclusion is consistent with the previous theoretical analysis conclusion. This conclusion is contrary to the conclusion drawn in the second chapter from the perspective of theoretical mechanism: the increase of money supply will drive the rise of real estate prices. However, the absolute value of M1’s coefficient is 2.97, which is larger than the absolute value of M2, 2.16. Therefore, it is inferred in this study that the effect of M2 on housing price is covered by the positive effect of narrow money supply on housing price, so the negative effect appears.

Finally, there is a negative correlation between HP and R, with the correlation coefficient of -0.44. In the long run, when interest rate increases by 1 unit, it will bring a decrease of 0.44 units in the real estate price, which is consistent with the inverse relationship between interest rates and real estate prices analyzed in the chapter 2.

⁴ Max-Eigenvalue test indicates 1 cointegrating eqn(s) at the 5%level.

5.2.3. Vector Error Correction Model

According to the co-integration test, there is a long-term equilibrium relationship between the four variables.

To clarify the correlation between money supply, interest rates and real estate prices, the following part further establishes a vector error correction model that links short-term volatility and long-term equilibrium to further clarify the influence direction between them. The VEC vector error correction model is essentially an error correction term added to the VAR model. The error correction equation is as follows:

$$\begin{aligned}
 D(LNHP) = & -0.01917 \text{ CointEq1} - 0.541833 D(LNHP(-1)) - 0.149999 D(LNHP(-2)) \\
 & (-0.03927) \quad (-0.11549) \quad (-0.13538) \\
 & [-0.48810] \quad [-4.69163] \quad [-1.10794] \\
 + & 0.045178 D(LNHP(-3)) - 0.008309 D(LNM1(-1)) + 0.209327 D(LNM1(-2)) \\
 & (-0.11587) \quad (-0.47557) \quad (-0.53509) \\
 & [0.38992] \quad [-0.01747] \quad [0.39120] \\
 - & 0.49942 D(LNM1(-3)) - 0.065378 D(LNM2(-1)) + 0.392428 D(LNM2(-2)) \\
 & (-0.42588) \quad (-0.66494) \quad (-0.72687) \\
 & [-1.17267] \quad [-0.09832] \quad [0.53989] \\
 + & 0.672646 D(LNM2(-3)) - 0.071851 D(LNR(-1)) - 0.005171 D(LNR(-2)) \\
 & (-0.56491) \quad (-0.0337) \quad (-0.03602) \\
 & [1.19072] \quad [-2.13208] \quad [-0.14357] \\
 - & 0.001238 D(LNR(-3)) + 0.002098 \\
 & (-0.03722) \quad (-0.01896) \\
 & [-0.03325] \quad [0.11062]
 \end{aligned} \tag{6}$$

R-squared	0.324709	0.66455	0.517608	0.289447
Adj. R-squared	0.21216	0.608642	0.437209	0.171022
Sum sq. resids	0.168582	0.011227	0.006329	2.134705
S.E. equation	0.04649	0.011997	0.009008	0.165433
F-statistic	2.885054	11.88642	6.438012	2.444129
Log likelihood	159.3554	283.9759	310.3395	42.57682
Akaike AIC	-3.159899	-5.86904	-6.442164	-0.621235
Schwarz SC	-2.776149	-5.48529	-6.058413	-0.237485
Mean dependent	0.017916	0.032848	0.035657	-0.012924
S.D. dependent	0.052377	0.019177	0.012007	0.181698

Table 5.6: The Test Results of Each Equation in the VEC Model

The determination coefficient of this equation is 32.47%, which means the overall goodness of fit is general, with the small AIC value (-3.159899), small SC value (-2.776149) and the logarithmic likelihood value of the equation (159.3554), the goodness of fit of the equation can still be considered is better.

The coefficient of the error correction term is -0.01917, indicating that when the short-

term fluctuation deviates from the equilibrium relationship from the long-term equilibrium state, the change of the current period price will be corrected reversely at the speed of 0.01917 to adjust it to the equilibrium state.

The equation also draws a conclusion that the first-order difference $D(LNHP)$ of real estate price is negatively correlated with the first-order difference $D(LNHP(-1))$, $D(LNM1(-1))$, $D(LNM2(-1))$ and $D(LNR(-1))$ of the four variables in the first period. It is still negatively correlated with $D(LNHP(-2))$ and $D(LNR(-2))$ of the previous two phases, while it is positively correlated with $D(LNM1(-2))$ and $D(LNM2(-2))$ of the previous two phases.

5.3. Granger Causality Test, IRF and Variance Decomposition

Most of the results of single-equation model can be analyzed by considering other parameter estimates, while the results of VEC model need to be analyzed by means of Granger causality analysis, impulse response function and variance decomposition and other tools.

5.3.1. Granger Causality Test

The Johansen Test determines that there is a long-term equilibrium relationship between the four variables, but whether there is a statistical mutual influence relationship between each variable still needs to be determined by Granger causality study.

Granger causality essentially uses the VAR model to test the significance of a set of coefficients. Granger causality can be used to test whether all the lags of one variable have an effect on the current value of another or several variables. If the influence is significant, it indicates that the variable has granger causality with respect to another variable or several other variables; Conversely, there is no causal relationship. The common test method is granger causality test. The lag length selects the default second order. Granger causality test results are as follows:

Pairwise Granger Causality Tests
Date: 12/06/20 Time: 16:09
Sample: 1996Q1 2019Q4
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
LN1 does not Granger Cause LNHP LNHP does not Granger Cause LN1	94	2.50320 3.57895	0.0876 0.0320
LN2 does not Granger Cause LNHP LNHP does not Granger Cause LN2	94	3.72108 1.50454	0.0281 0.2277
LN3 does not Granger Cause LNHP LNHP does not Granger Cause LN3	94	3.35004 0.37715	0.0396 0.6869
LN2 does not Granger Cause LN1 LN1 does not Granger Cause LN2	94	2.41950 2.20738	0.0948 0.1160
LN3 does not Granger Cause LN1 LN1 does not Granger Cause LN3	94	6.37778 5.62900	0.0026 0.0050
LN3 does not Granger Cause LN2 LN2 does not Granger Cause LN3	94	5.16683 1.24855	0.0075 0.2919

Table 5.7: Granger Causality Test Results

Based on the test results, it can be concluded that when the value of F-Statistic of the null hypothesis, which 'LN1 is not the Granger cause of LNHP', is 2.50320 and the corresponding P value is 0.0876, greater than 0.05 but less than 0.1. It is indicating that the null hypothesis cannot be rejected at the confidence level of 5%, that is, LN1 is not the Granger cause of LNHP. The null hypothesis that LN1 is the Granger cause of LNHP can be rejected at 10% confidence level.

On the contrary, when the null hypothesis is "LNHP is not the Granger cause of LN1", the corresponding F-Value is 3.57895 and the P-Value is 0.0320, less than 0.05, indicating that the null hypothesis is rejected at the confidence level of 5%, that is, LNHP is the Granger cause of LN1.

Following the same analytical method, the following conclusions can be drawn: At 5% confidence level, LN2 is the Granger cause of LNHP; But LNHP is not the Granger reason for LN2. At 5% confidence level, LN3 is the Granger cause of LNHP, but LNHP is not the Granger cause of LN2. At the 10% confidence level, LN2 is the Granger cause of LN1, but LN1 is not the Granger cause of LN2. At 5% confidence level, LN3 and LN1 are granger causes. At 5% confidence level, LN3 is the Granger cause of LN2; LN2 is not the Granger reason for LN3.

Whether it is the narrow measure of money supply M1 or the broad measure of money supply M2, there is a significant causal relationship between these two variables and the selling price of houses. That is, an increase in the money supply drives up the selling prices

of houses. At the same time, the change of housing sales price will affect the narrow measure of money supply M1, but not the broad measure of money supply M2.

There is also a causal relationship between the interest rate and the housing sale price, which indicates that the change of the interest rate can also cause the change of the housing sale price, but the change of the housing sale price will not affect the change of the interest rate.

The interest rate also has a significant causal relationship with the money supply. If the interest rate changes, the narrow money supply M1 and broad money supply M2 will also fluctuate in the same period. However, the change of broad money supply will not affect the interest rate change, and only the change of narrow money supply M1 will lead to the interest rate fluctuation in the same period.

5.3.2. Impulse Response Analysis

In empirical studies, the whole process of the influence of the change of one variable in the model on itself and another variable is what we need to focus on. Impulse response analysis is to analyze the effect of the change or impact of each endogenous variable on itself and other endogenous variables, which can be characterized by the impulse response function (IRF). An impact of the i th endogenous variable not only directly affects the i th endogenous variable, but also passes to other endogenous variables through the dynamic structure of the model. The impulse response shows how the perturbation of one variable affects all variables through the model, and the variables interact with each other and eventually feeds back to themselves. Therefore, impulse response analysis is needed to further influence the impact on real estate prices when money supply and interest rate are randomly disturbed.

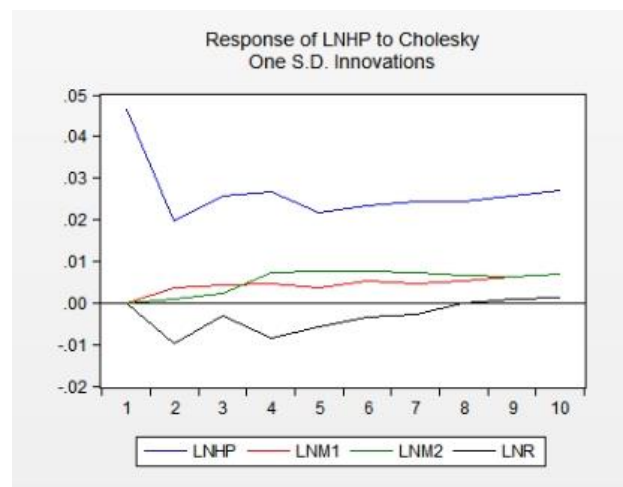


Figure 5.4: Graph of Response of LNHP to Choelesky One S.D. Innovations

As can be seen from Figure 5.4, the impact of housing sales price on itself reached its peak in the first phase, approaching the level of 5%, after that it saw a sharp drop, to less than

2 percent in the second phase. In the third stage shock is slightly strengthened and then the oscillation convergence process appears. On the whole, the selling price of housing has a significant positive impact on itself. This result indicates that the rise in real estate prices leads to a rising expectation among real estate consumers, which leads to a further rise in real estate prices.

The positive impact of the money supply on house sales prices is a gradual upward process. When a positive impact is given to LNM1 and MLN2, real estate prices begin to rise after a lag of about one period. Then in the second phase, the narrow measure of money supply LNM1 peaked at close to 0.5%. The impact of LNM2, a broad measure of money supply, keeps climbing as the number of tracking periods increases, and reaches its peak in the fourth period, approaching 1%. Both of them presented a stable positive state after reaching the peak. Finally, the impact of narrow measure of money supply (M1) on housing sales prices disappeared in the ninth period, while the impact of broad measure of money supply (M2) on real estate prices disappeared in the tenth period. This result shows that the increase of money circulation does drive the increase of house selling price, and the influence is more significant.

According to the trajectory of the impulse response value of LNR, it is not difficult to find that after giving a positive impact to the interest rate, the real estate price begins to decline in the first lag period and reaches a small value of -1% in the second lag period, and then fluctuates up and down in the negative area all the time. It begins to slowly rise after reaching the value of 0 in the eighth phase. This means that the rise of interest rate will reduce the real estate price, which will have a positive impact on the real estate price after the 8th period.

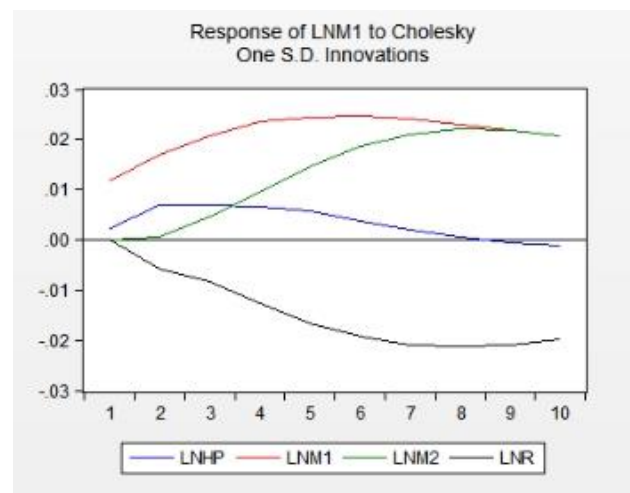


Figure 5.5: Graph of Response of LNM1 to Choelesky One S.D. Innovations

As can be seen from the function graph, the impact of LNHP on LNM1 is not significant, with the maximum impact size is less than 1%, indicating that the direct impact of housing

price on the narrow money supply variable is not significant. During period 1st to 7th, the impact of LNHP on LNM1 was positive, while it turned negative after period 8. This indicates that the increase in the year-on-year growth rate of real estate prices will also increase M1, but it will have a negative impact on M1 after the 8th phase.

The narrow measure of money supply M1 has a significant positive impact on itself, so as the broad measure of money supply M2 has. On the other hand, LNR has been exerting a negative impact on LNM1, and over time, this impact becomes more pronounced as time goes on. It indicates that the decline of RMB interest rate will pull the rise of narrow measure of money supply M1.

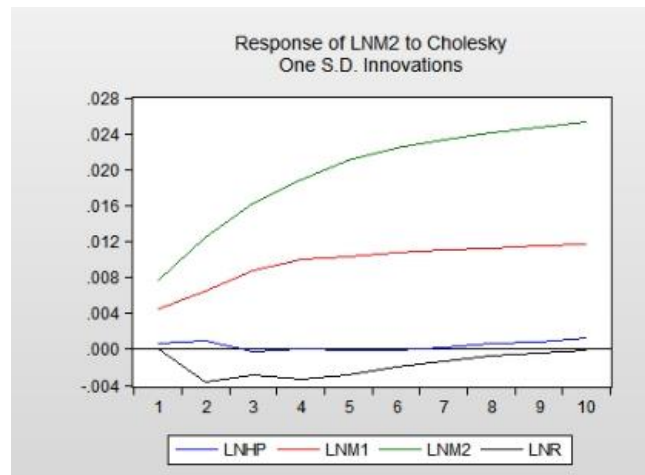


Figure 5.6: Graph of Response of LNM2 to Choelesky One S.D. Innovations

It can be seen from the Figure 5.6 that the value of impact function of LNM2 by LNHP fluctuates around 0 all the time. Therefore, the change in real estate prices only has a little significant impact on the increase or decrease of M2, the same as M1.

The impulse response of LNM1 and LNM2 to the LNM2 increases gradually with the extension of time, and is the lowest value in the first lag period, 0.4% and 0.8%, respectively. After rising to a certain degree, the rise decreases, and tends to be stable after the fourth and fifth phases respectively. On the other hand, LNR has a negative impact on the narrow measure of money supply LNM2, which keeps falling until the 10th period when it approaches 0. This indicates that the decline of RMB interest rate will pull the rise of narrow measure of money supply M1.

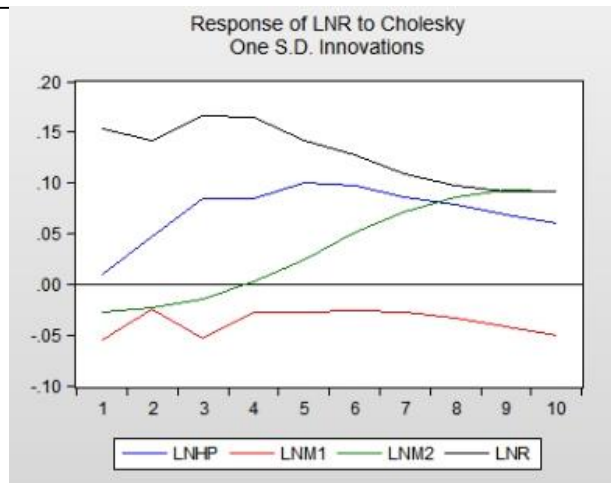


Figure 5.7: Graph of Response of LNR to Choelesky One S.D. Innovations

It can be seen from the function chart that, after being impacted by 1 standard deviation unit of LNHP, LNR presents an upward trend from the first period, reaches the peak of 10% in the fifth period, and then presents a stable downward trend. This shows that the rise of real estate prices can promote the rise of interest rates in the short term and have a sustained positive pulling effect in the long term.

LNR has a significant positive impact on itself. After a one-unit positive shock to the interest rate, its own impulse response is 10% in phase 1, then reaches a maximum of 18% in phase 3, then drops sharply, and reaches a minimum of 10% in phase 10. This indicates that the interest rate has a positive effect on itself, which is most significant at the beginning. As time goes by, the effect is most significant at the beginning, and gradually decreases as time goes on.

The impact of narrow M1 and broad M2 on interest rates is opposite. Both had a negative impact on interest rates in the first period. However, the impulse response function of LNM2 presents an increasing trend, and presents a positive influence after reaching 0 in the fourth phase. The impact of LNM1 on LNR is always in the negative interval.

5.3.3. Variance Decomposition

Next, the influence of money supply index and interest rate index on the selling price of commercial housing will be further investigated. The variance decomposition will be used to analyze the situation that the selling price of commercial housing is explained by various variables, as shown in the following table:

Variance Decomposition of LNHP:					
Period	S.E.	LNHP	LN1	LN2	LN3
1	0.046490	100.0000	0.000000	0.000000	0.000000
2	0.051587	95.94765	0.480829	0.032448	3.539077
3	0.057896	95.85308	0.902217	0.178499	3.066205
4	0.064915	93.28113	1.189989	1.348611	4.180268
5	0.069246	91.92486	1.308298	2.414401	4.352442
6	0.073735	91.11271	1.677974	3.168051	4.041262
7	0.078167	90.75231	1.856943	3.668937	3.721806
8	0.082322	90.59020	2.091394	3.962800	3.355601
9	0.086748	90.43374	2.414656	4.119453	3.032150
10	0.091351	90.21725	2.741365	4.283026	2.758364
11	0.096012	89.82215	3.141990	4.507803	2.528055
12	0.100765	89.27635	3.570042	4.842156	2.311454
13	0.105501	88.58973	3.982097	5.314020	2.114150
14	0.110141	87.78568	4.369644	5.904435	1.940244
15	0.114665	86.92983	4.703763	6.575731	1.790680
16	0.119020	86.07800	4.977928	7.279743	1.664327
17	0.123191	85.28054	5.196769	7.965880	1.556812
18	0.127181	84.57259	5.366507	8.597396	1.463502
19	0.131000	83.96774	5.498193	9.153054	1.381012
20	0.134670	83.46414	5.602771	9.625842	1.307246

Table 5.8: Table of Variance Decomposition of LNHP

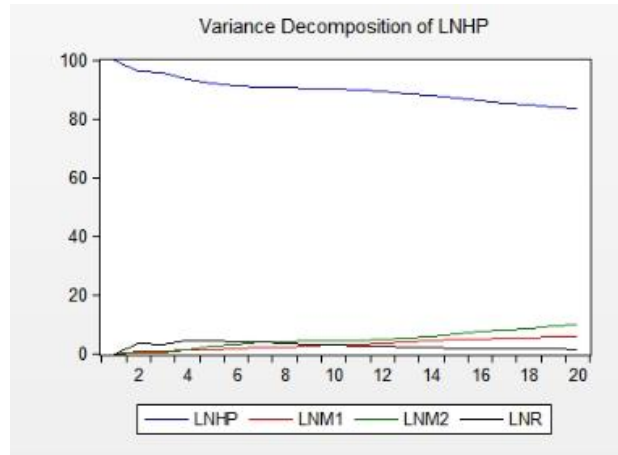


Figure 5.8: Trend Chart of Variance Decomposition of LNHP

As shown, the variance contribution rate of LNHP gradually decreased from 100% in the 1st phase to 83.46% in the 20th phase. LNM1 and LNM2 gradually increased with the increase of the number of lagged periods, from 0% at the beginning to 5.60% and 9.63% respectively in the 20th period. On the other hand, the contribution of LNR showed a trend of first increasing and then decreasing, which was 0% in the first phase, gradually decreasing after reaching the maximum value of 4.35% in the fifth phase, and the contribution rate in the 20th phase was 1.31%. At the same time, it is not difficult to find that the contribution rate of LNM2 to LNHP is the highest, followed by LNM1, and the minimum is LNR.

5.4. Stationarity Test of Model

Before carrying out the impulse response analysis, it is necessary to test the stationarity of

the built model. Only after passing can the impulse response analysis be carried out in the next step. If the model is non-stationary, the reliability of the analysis results will also be affected.

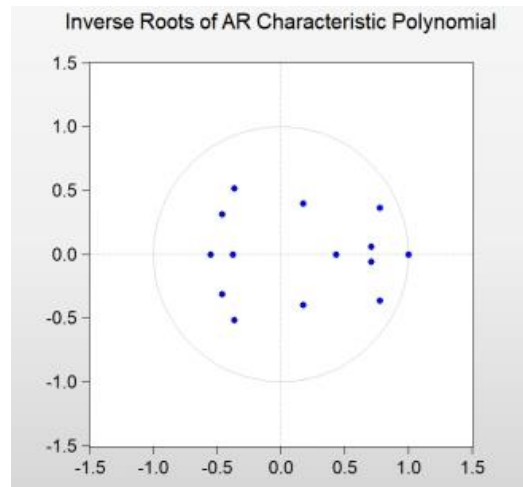


Figure 5.9: Inverse Roots of AR Characteristic Polynomial

Based on Figure 5.9, the VEC model established by us has a total of 14 characteristic roots, and the results of each characteristic root are scattered in the unit circle, with no characteristic roots outside the circle. This indicates that the established VEC model is stable and can be used for further impulse response analysis.

5.5. Analysis of Empirical Results

In this chapter, the data of money supply, interest rate and real estate price was selected, and conduct seasonal and logarithmic processing were fished to eliminate the influence of seasonal factors on the data and remove the heteroscedasticity of the data itself. Then the model was built and tested. Through the above series of empirical studies, the following conclusions were drawn:

Firstly, LNM1, LNM2 and LNR are all Granger causes of LNHP, so changes in money supply and interest rate will have a direct impact on real estate prices. But the direction and degree of the influence of the two economic variables on the real estate price are different.

Secondly, the influence of the 30-day weighted average interest rate on the average price of real estate in China is negative and weak. However, in the long run, the change of the 30-day weighted average interest rate of inter-bank lending lags behind the tenth period, which will begin to have a positive impact on the real estate price. This is consistent with the conclusion of the cointegration equation.

Finally, the money supply has a continuous positive effect on the housing price, and the change of broad money supply M2 has a more significant and far-reaching impact on the real estate price than the change of narrow money supply M1. However, from the co-integration

equation, we can find that the correlation coefficient of M1 is negative and its absolute value is greater than the absolute value of the correlation coefficient of M2, which is in contradiction with the conclusion to some extent. We can understand that money supply M1 and M2 have mutual influence, so the long-term relationship between them and real estate price needs to be analyzed separately. But from this we can still infer that the control of money supply is an indispensable means to control the stability of real estate prices.

5.6. Summary of the Chapter

Based on the VEC model, this chapter uses relevant data to quantify the impact of monetary policy intermediary targets on real estate prices in China, which is the core chapter of the whole thesis. According to the empirical research results, both money supply and interest rate, as intermediate targets of monetary policy, have long-term effects on real estate prices, but the effect of money supply is positive, while the effect of interest rate is negative and weaker than that of money supply. Therefore, for monetary policy, the effect of money supply on the growth of real estate price is more significant.

It is the result of this empirical analysis that provides the empirical basis for the corresponding policy recommendations in the next chapter.

Policy Recommendations

This thesis analyzes the influence of money supply and interest rates, as the monetary policy intermediary goals, on China's real estate price from theoretical perspective. From the empirical analysis performed we reached the following conclusions.

Money supply has a continuous positive effect on housing prices. Moreover, the change of broad money supply M2 has a more significant and far-reaching impact on real estate prices than the change of narrow money supply M1. The influence of the interest rates on the price of real estate in China is negative and weak. In the following paragraphs, policy recommendations will be put forward from the five perspectives to promote the steady development of the real estate market and make its price fluctuate stably within a certain range.

6.1 Policy Recommendations

1. Strengthen the Control of Money Supply

Through theoretical mechanism, descriptive statistics and empirical analysis, it is not difficult to find that the growth of money supply plays an important role in promoting housing price inflation. There is a sustained, significant and positive relationship between money supply and housing price. This rule can also be found from the previous data of China. Since 1996, China's money supply has been greatly increased, and the real estate market has also seen a surge in prices. Therefore, reasonable money supply is the key to control the real estate speculation. The monetary authorities should strengthen the control of the money supply to prevent the excessive money from causing the abnormal rise of the housing price and the real estate price bubble.

Secondly, the change of broad money supply M2 has a more significant and far-reaching impact on real estate prices than the change of narrow money supply M1. Therefore, in the macro-control of the real estate market, the monetary authorities should focus on M2.

2. Promote interest rate liberalization

With the continuous advancement of China's financial deepening, financial innovation will further promote the further development of China's finance. In this background, it becomes more difficult to define the various levels of the money supply. From various aspects, the effectiveness of money supply as an intermediary target of monetary policy in China is gradually decreasing. As a stable economic variable, interest rate satisfies the testability,

controllability and correlation of the intermediate objective of monetary policy, so it can cooperate well with the money supply and act as the intermediate objective of monetary policy.

In the elaboration of the theoretical mechanism, this study holds that the real estate price is negatively correlated with the interest rate level. This conclusion can also be proved by empirical results, but the negative correlation effect is weak. This may be due to China's long-term direct regulation of interest rates and the degree of interest rate liberalization is relatively low. Although China is currently promoting the process of interest rate liberalization, but this process needs to take a long time. In addition, the regulation of interest rates also has a certain lag.

Therefore, the central bank should further promote the development of interest rate liberalization, accelerate the pace of interest rate liberalization in the financial system reform, and establish a sound interest rate liberalization mechanism based on the benchmark interest rate of the central bank, with the interest rate in the money market as the intermediary and determined by market supply and demand.

3. Monetary Policy Should Pay Attention to Housing Prices

Most scholars still hold a negative attitude in this regard, arguing that monetary policy should not pay too much attention to real estate prices. However, it is not difficult to find from the current reality of China that the real estate industry has become one of the pillar industries in the development of China's national economy, and its added value accounts for an increasing proportion of GDP. Therefore, it is necessary for the state to consider the current situation of the real estate market and make scientific and reasonable decisions when formulating monetary policies to regulate the market economy.

4. The Forward-looking Nature of Monetary Policy

The change of money supply and interest rate has a lag effect on the housing sales price. Therefore, the effect of monetary policy regulation on the real estate price is not necessarily immediate. Thus, the government and monetary authorities should not only study the changes of the current monetary policy variables on the real estate price, but also make reasonable predictions on the future economic development trend on this basis. At the same time, it is also necessary to coordinate with the introduction of tax policies, fiscal policies, industrial policies and other policies to jointly control the vicious rise of real estate prices.

5. Correctly guide buyers' expectations

In the impulse response analysis, this thesis finds that not only the money supply and interest rates have certain impacts on the real estate prices, but also the real estate prices have a significant positive impact on themselves. This means that the rise of the real estate prices make the real estate consumers have an expectation of rising, which will have a certain impact

on the supply and demand of the real estate market, and finally lead to the further rise of the real estate prices.

Therefore, the government should use administrative, legal, financial and other means to correctly guide the expectations of consumers and investors, regulate the behavior of participants in the commercial housing market, and prevent the risk of a real estate bubble.

6.2 Summary of the Chapter

This chapter is mainly based on the previous analysis on the impact of monetary policy intermediary target on China's real estate prices, to put forward some policy suggestions for using and improving China's monetary policy intermediary target impact and regulating China's real estate prices.

This chapter puts forward five suggestions: First, in terms of money supply, monetary authorities should strengthen the regulation of money supply to prevent the excessive issuance of money from leading to the rise of housing prices. Second, in terms of interest rates, monetary authorities should further promote the development of interest rate marketization and accelerate the pace of interest rate marketization in financial system reform. Third, the government should pay attention to real estate prices when designating monetary policy. Fourthly, the government and monetary authorities should make a reasonable forecast on the future economic development trend based on the changes of current monetary policy variables on real estate prices. Fifth, it is necessary to correctly guide the expectations of home buyers.

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