HOME PURCHASE RESTRICTION IMPACT ON HOUSE PRICES

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ABSTRACT

With the development of the economy, the real estate industry has increasingly become a major component of China's national economic growth. In this paper, I use a house sales transaction dataset collected from a publicly accessible Chinese real estate website Lianjia to investigate the Home Purchase Restriction (HPR) policy impact on house prices over time. We select data from two cities Nanjing and Chongqing since Nanjing enacted an HPR policy in October 2016 while Chongqing does not have HPR policy in any kind. Using Chongqing as a control group, a difference-in-differences estimation result shows that the negative effect of HPR on house prices starts three months after the policy effective date and continues to dampen the house prices and reaches its strongest effect at around two years after the effective date. However, the negative effect then slightly decreases and remains stable since nine quarters after the HPR effective date.

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1. INTRODUCTION

1.1. Overview

Along with the development trend of the global economy, the real estate industry has increasingly occupied the key breakthrough points of the national economy of various countries (Bardhan & Kroll, 2007). The real estate industry has not only become an essential component of a country's GDP and an indispensable component of the financial system, but it has also become a key aspect of everyone's daily life and stable economic development (Hu and Anthony, 2001; Chang and Wei, 2018). It has become an indispensable way to promulgate regulation policies for the real estate industry to ensure the healthy and stable development of the real estate industry.

DiPasquale and Wheaton (1996) emphasized the significant impact of the real estate industry on the national economy and proposed the importance of government intervention and control on the real estate industry. As a pivotal industry in the national economy, the real estate industry is also reflected in its upstream and downstream industry chains (such as engineering construction, raw materials, energy, and transportation), and its impact on the stock market (Green & Malpezzi, 2003). Therefore, maintaining a healthy and sustainable development of the real estate industry is essential to the stable and rapid growth of a country's economy. Government intervention such as housing policies is one of the most vital means to stabilize the housing market. For example, the subprime mortgage crisis in the United States in 2008 and the banking crisis in Sweden and Japan in the early 1990s were caused by insufficient government intervention or improper supervision (Von Hoffman, 2012).

Although the level of economic development levels in societies around the world differs greatly, governments' efforts in regulating the operation of the real estate industry are

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continuing, and the regulation system such as the credit and the tax system for the real estate market is gradually improving (Habitat, 2008). However, the real estate market in China has not been commercialized for a long time, while the contemporary Chinese housing market originated in 1998. In addition, the Chinese real estate still has a series of problems, such as soaring housing prices, unbalanced supply structure, overheated investment in some cities, and irregular development and transactions (Ahuja, et al. 2010; Ren, et al. 2012; Wu, et al. 2012). In response, the Chinese government enacted a series of housing policies to control housing prices and the stability of the housing market.

1.2. Problem Statement

Studying the impact of housing policies on housing prices is of great significance for finding the stability of housing prices, the steadiness of the housing market, and the balance of economic development. The Chinese government has issued a series of policies to stabilize housing prices. A large number of documents are focused on housing policy issues. However, most research focus on the differences in housing policies and price changes in different periods. Some literature focus on the impact of house purchase restriction policies on housing prices, which enacted in 2010, but there is almost no literature analyzing the time effects of purchase restrictions and does the HPR policy enacted in 2016 have the same effect on housing price? Therefore, we want to fill these gaps, examine the effect of the "new" HPR policy, and identify its changes over time.

1.3. Objectives

This project aims to identify the effect of the House Purchase Restriction (HPR) policy on housing price in China. The followings are specific objectives of this study:

To examine the effect of the "new" HPR policy, which was enacted in 2016, on house prices.

To identify the changes in the impact of HPR policy over time, which allow us to analyze the time effectiveness of the policy.

To analyze the neighborhood effects of the HPR policy on house prices.

To put forward suggestions on the macroeconomic policies on the real estate market

This thesis compares and analyzes the regulatory policies and impacts of China's real estate market in different periods, and points out the problems in China's real estate market regulatory policies and suggestions for improvement. I examine the city of Nanjing to illustrate the impact of China's purchase restriction policy on housing prices.

1.4. Organization

The second chapter presents a literature review. This literature review describes the history and current status of the real estate market in China. In this chapter, I will also introduce the housing policies adopted by China in different stages of housing market in detail.

Chapter 3 introduces the empirical model and data used in this thesis, including variables, data description, and data sources, etc.

Chapter 4 details the results of the regression. Finally, Chapter 5 provides a general conclusion of the thesis, the main findings of the research, and a discussion on future research related to this subject.

2. BACKGROUND

This section discusses previous research related to the Chinese housing market. Firstly, it briefly introduces the history of the China's housing markets. Secondly, this chapter discusses the various policies implemented by China in different stages of housing market, and their effect on housing prices and markets.

2.1. Overview of Chinese Housing Market

In 1998, Chinese government abolished welfare housing allocation and allowed land transactions, marking the formal formation of China's real estate market (Fang, et al. 2016). Subsequently, the Chinese real estate industry has achieved unprecedented speedy development in the following years. The tremendous investment requirements, consumer demand, government support have resulted in the rapid development of the real estate industry (Fung, et al. 2010; Barth, et al. 2012; Chang and Wei, 2018). Ren, et al. (2012) also mentioned that investors would rather invest in housing market and the irrational investment cause housing prices to increase. In addition, the huge demand for houses caused by urbanization and the sharp increase in the population in China, compel the housing prices to expand (Lin, et al. 2018). Finally, government support is another important factor in promoting housing prices because that the real estate industry is an essential component of the Chinese economy and the financial system.

From 2000 to 2019, the average housing price in China rose from 2,112 RMB to 9,310 RMB per square meter, an increase of more than four times[1]. In 2019, housing sales totaled 15.97 trillion RMB, equivalent to 15.8% of China's GDP[2]. Secondly, housing is the largest

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[1] Source: National Bureau of Statistics of China: http://www.stats.gov.cn/
[2] Source: National Bureau of Statistics of China: http://www.stats.gov.cn/

component of the household asset portfolio after food consumption. We can see from Figure 1, in 2019, personal consumption expenditures on housing were about 5055 RMB and 24 percent of household expenditure in China[3]. Thirdly, Chinese local governments heavily rely on land transaction revenues and land use transaction proceeds as pledges to raise debts based on the Local Government Financing Platform (LGFP). Finally, financial institutions are heavily exposed to risks through loans made to households, real estate developers, local governments, and companies that are either explicitly or impliedly backed by real estate properties.
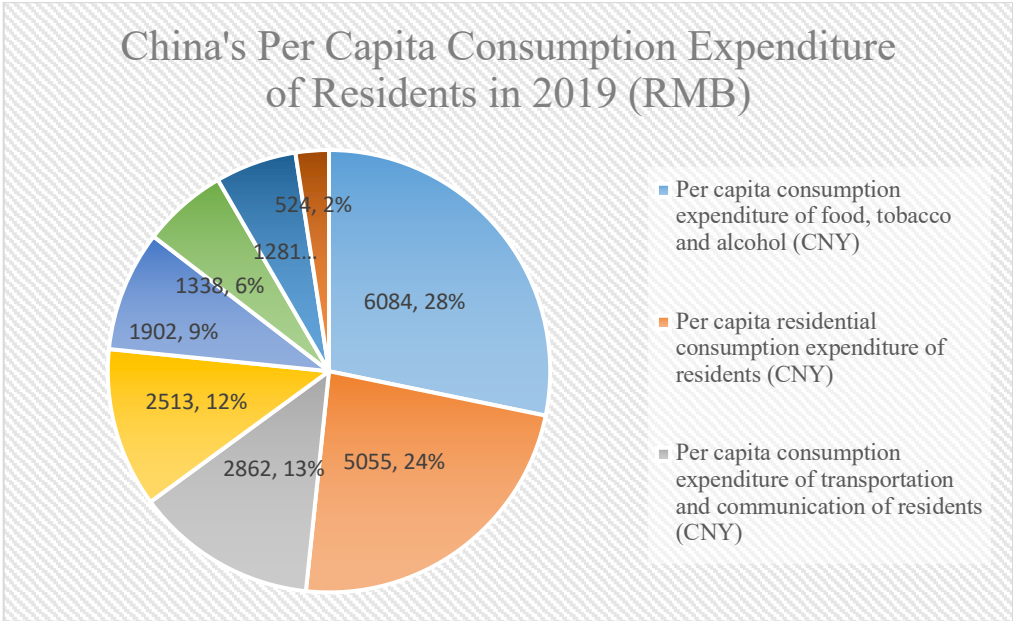
Figure 1. China's Per Capita Consumption Expenditure of Residents in 2019 (RMB). (Source: National Bureau of Statistics of China.)

2.2. Housing Policies in China

As mentioned, in Section 2.1, the modern Chinese housing market and housing commercialization originated in 1998. Prior to 1998 the Chinese government used the welfare housing allocation in housing system, in which buildings and land rights cannot be granted or

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[3] National Bureau of Statistics of China: http://www.stats.gov.cn/

transferred, the government or state-owned enterprises and institutions own all land and housing resources, urban residents can only get housing through government allocation (Yuan & Hamori, 2014). After the implementation of the real estate reform in 1998, China's housing market has entered a stage of rapid development. However, with the development of the housing market, problems such as excessive increases in housing prices and overheated speculation have emerged, which have attracted the attention of the Chinese government. According to the different standards of the housing market, the housing policies in China have gone through the following main stages:

2.2.1. The Housing Policies from 1998 to 2001

In this stage, the Chinese government issued "A Notice on Further Deepening the Reform of the Urban Housing System and Accelerating Housing Construction" and launched a comprehensive housing reform. The notice clearly stated that "promoting the housing industry to become a new economic growth point,"[4] which also marks the urbanization in China. The newly established housing commercialization system began open up China's real estate market (Chang & Wei, 2018). The main purpose of the reform of the urban housing system is to stimulate domestic demand for housing and to develop the real estate industry into a pillar industry of the national economy (Lee & Zhu, 2006; Lardy, 2007). After the release of the housing reform document in 1998, the reform of the urban housing system proceeded rapidly, and corresponding bank credit policies, land management, and other supporting policies were successively introduced, gradually forming a policy framework to encourage housing consumption. The main housing policies at this time stage were as follows:

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[4] Source: The State Council of China: http://www.gov.cn/

a. Housing reform policy in 1998: In the second half of 1998, the policy of housing distribution shifting from physical to monetary compensation was gradually implemented, and as a result, the management of real estate enterprises and commercial housing sales was gradually established and improved.

b. Land policy in 2002: The system related to land transfer and use was improved, and the right to use construction land was gradually transferred from agreement transfer to bidding, auction or listing.

c. Housing supply policy: China gradually established a housing supply management system based on affordable housing: low-income families can rent low-rent housing provided by the government or state-owned enterprises and institutions, low- and middle-income families can purchase affordable housing, and other high-income families can directly buy or lease commercial housing.

d. Tax reduction policy in 2001: It was stipulated that from January 1, 2001, for the houses rented by the government, the property tax and business tax were temporarily exempted, and the business tax was reduced for the individual housing rented at market price (from 5 % to 3%), real estate tax (from 12% to 4%), and personal income tax (from 20% to 10%). For commercial housing and office buildings that were built before June 30, 1998, and have not been sold, are exempted from business tax and deed tax until December 31, 2002[5].

e. The housing loan policy implemented in 1999: Designed to improve housing credit loans and implement provident fund systems. In 1999, the People's Bank of China issued the "Several Opinions on Encouraging Consumer Loans" to increase the ratio of housing loans to

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[5] Source: State Taxation Administration: http://www.chinatax.gov.cn/

housing prices from 70% to 80%. In September 1999, the People's Bank of China adjusted the

time limit and interest rate of personal housing loans, extended the maximum duration of

personal housing loans from 20 years to 30 years, and further reduced the interest rate of

personal housing loans by 10%. In terms of loan interest rates, the central bank lowered the loan

interest rate to 0.54% in February 2002, of which the provident fund loan interest rate for more

than 5 years was lowered from 4.59% to 4.05%, and the housing commercial loan interest rate

was lowered from 5.58% to 5.04%[6].

After 1998, the amount of real estate investment in China has increased year by year,

and its proportion of GDP has continued to increase. The area of newly developed housing

stock in 1998 was 203.87 million square meters, by 2002, it increased to 428 million square

meters, with an average annual growth rate of more than 20%. In 1998, the area of real estate

sales was 121.85 million square meters, and in 2002 it was 268.08 million square meters, the

sales volume increased rapidly[7]. Between 1998 and 2001, driven by a series of favorable

policies, Chinese housing industry has developed rapidly, housing sales prices have increased

steadily, and the housing industry has developed into a pillar industry in China (Wang & Murie,

2000; Feng, 2003; Man, et al. 2011).

2.2.2. The Housing Policies from 2002 to 2007

This is the stage where the housing policies were fully implemented. The Chinese

housing market was booming after 2002, commodity housing prices rose faster, and the risk of

housing bubbles increased (Ren et al., 2012). In response to the above situation, in order to

effectively solve the problem of excessive increase in commercial housing prices and ensure the

[6] Source: The People's Bank of China: http://www.pbc.gov.cn/
[7] Source: National Bureau of Statistics of China: http://www.stats.gov.cn/

healthy development of the real estate market (Zhang & Fung, 2006), the State Council issued the "Notice on Promoting the Sustainable and Healthy Development of the Real Estate Market" on August 12, 2003. It clearly states that the current real estate industry has grown into one of the four pillar industries driving the growth of the national economy. At the same time, it requires all local governments to introduce housing policies to promote the sustained, healthy and orderly development of the real estate market, and prevent the formation and expansion of the real estate bubble.

The Joint Supervision Department of the Ministry of Land and Resources jointly issued the "Notice on Continued Implementation of the Law Enforcement and Supervision Work on the Bid, Auction, and Listing of Commercial Land Use Rights" in March 2004. According to the requirements of this policy, all commercial state-owned land use rights across the country must be transferred through public bidding from August 31 of the current year. At that time, the agreement transfer method generally adopted by various localities was officially suspended. Affected by this policy, the growth rate of China's real estate newly started area in 2004 dropped from 27.82% to 10.43% in 2003[8]. From 2002 to 2007, the proportion of urban real estate development in China's fixed-asset investment also declined from 21.6% to 18.2%[9].

Nevertheless, the price of newly built commercial houses nationwide rose by 17.76% in 2004, far exceeding the increase in the per capita income of urban residents, 8.98%[10]. The real estate market has not abated, and the upward pressure is huge. In this case, the government has expanded the scope and strength of its control, and introduced successive adjustments to the

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[8] Source: National Bureau of Statistics of China: http://www.stats.gov.cn/
[9] Source: National Bureau of Statistics of China: http://www.stats.gov.cn/
[10] Source: National Bureau of Statistics of China: http://www.stats.gov.cn/

order of the housing market. The government adjusted land supply plans and methods, shrunk credit policies, and levied real estate transaction taxes and fees in an attempt to stabilize housing prices. In response to the regulation and control, the growth rate of urban real estate investment slowed down accordingly, and the proportion of real estate in the country's fixed assets began to slowly decline. However, due to the substantial increase in the Chinese urbanization rate at that time, the demand for the housing market continued to increase (Chow & Niu, 2015).

After 2003, the problem of the rapid rise in the sales price of commercial housing is still prominent, even the boom in real estate investment in China was brought under control due to the effects of regulation and control. On March 26, 2005, the Chinese government issued a policy requirement that from June 1, 2006, all newly built proportion of commercial residential units with a floor area of 90 square meters must reach more than 70% of the total development and construction area. This is the "9070" policy that lasted for more than 10 years. At the same time, the government has adopted major measures. Large-scale construction of low-rent housing to solve the housing problem of low-income families; in terms of financial credit, the loan down payment ratio has been greatly increased, and the down payment for the purchase of a second house from September 27, 2007, is required to be no less than 40%. The interest rate is not lower than 1.1 times the benchmark interest rate set by the Bank of China. At the same time, the cost of housing ownership will be increased. It is stipulated that from June 1, 2005, for the sales of less than two years of housing, the full business tax will be levied, and the housing will be sold at the same time. The business tax exemption period increased from 2 years to 5 years.

These intensive regulations suppressed the popularity of real estate in a short period of time (Heng et al., 2009 and Hui et al., 2011). After a short pause, the price of commercial

housing showed a trend of retaliatory increase in housing prices and purchases (Wang & Liu, 2009).

2.2.3. The Housing Policies from 2008 to 2009

In the aftermath of the international financial crisis in 2008, a large amount of international capital investment was withdrawn from China. To stabilize domestic economic growth, the Chinese government issued the "Opinions on Promoting the Healthy Development of the Real Estate Market" in December 2008. The Chinese government decided to invest 4 trillion RMB in the construction of national infrastructure and real estate within two years after 2009 to stimulate economic growth. The two-year investment is mainly used for infrastructure construction, low-rent housing and other affordable housing construction, urban and urban shantytown renovation projects, implementation of nomadic settlement projects. Expansion of pilot projects for rural dilapidated houses by the government at this stage was mainly to increase the construction of affordable housing, requiring the adoption of physical replacement, combined with rental subsidies and other forms to solve the housing problem of urban low-income families. In order to stimulate housing consumption, the government increased its support for owner-occupied and improved housing. The financial policy introduced abolished the credit limit on commercial banks and offered a 30% discount on interest rates for owner-occupied housing loans while reducing the Loan down payment ratio, the minimum down payment at that time was only 20%, and for the first purchase of ordinary houses below 90 square meters, the deed tax rate was reduced to 1%, and stamp duty and land value-added tax were exempted. Individuals who sold ordinary houses for more than 2 years were exempted. The levy of business tax, as a result, reduces the cost of residents buying houses and the cost of holding links (Hui & Wang, 2014).

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The Chinese government stimulated the real estate market through easing credit policies, increasing the supply of guaranteed housing, and reducing or exempting business tax, value-added tax, and other taxes. As a result, China's commodity housing prices have risen sharply. These policies once again stimulate consumption in the real estate market, and investment-oriented house purchases are once again popular (Hui & Wang, 2014). With the aid of a series of favorable policies at this stage, China's GDP growth rate was 9.6% and 9.2% in 2008 and 2009, respectively[11]. The goal of maintaining a minimum growth of the national economy has been achieved. At the same time, a large amount of financial capital has flowed. In the real estate industry, China's real estate market has completely bottomed out and recovered, which also caused the sales price of commercial housing in China to rise sharply in 2009. The average housing price growth rate of commercial housing across the country reached 23.3%, of which Shanghai was as high as 56.7%, this increase greatly exceeds the growth rate of urban residents' per capita disposable income (Ahuja et al., 2010; Ren et al., 2012). With such a proactive fiscal policy and loose monetary policy, the real estate market swept away the downturn at the time (Hui & Wang, 2014).

2.2.4. The Housing Policies from 2010 to 2013

Because of the sharp rise in housing prices in 2009, the main purpose of the government's regulatory policies at this stage is to curb the upward momentum of housing prices (Du & Zhang, 2015; Li et al., 2017). At this stage, the Chinese government promulgated the "National Four Articles" on December 14, 2009, clearly instructing to continue the comprehensive use of land, finance, taxation, and other means to curb the excessive rise of

[11] Source: National Bureau of Statistics of China: http://www.stats.gov.cn/

housing prices in some cities and issued housing purchase restrictions in 2010 to control

housing prices in the Chinese housing market. With this as a sign, the real estate control policy

has changed from stimulating the market to restraining the excessive growth of the real estate

market.

Du and Zhang (2015) and Li et al.(2017) mentationed the real estate control objective at

this stage is mainly to curb the excessively rapid rise in housing prices. At the same time, the

government continues to increase the construction of affordable housing and increase land

supply to increase the supply of ordinary commercial housing and stabilize the market from the

supply side. In order to improve land supply and use efficiency, part of the land supplied at this

stage was mainly used for the construction of low- and medium-priced, small and medium-sized

condominium housing and rental housing. In accordance with the requirements of improving

the housing system, the government continues to increase the construction of affordable

housing, and actively supports affordable housing in terms of land transfer and financial credit

policies. At that time, 4.7 million sets of affordable housing were built nationwide in 2013, and

new 6.3 million sets started[12]. In order to reduce the demand for real estate, the state has

introduced administrative measures to increase the down payment ratio for purchases of houses,

with the down payment ratio of 30% or more for the first house, and no less than 50% for the

second house, and the loan interest rate shall not be lower than 1.1 times of the benchmark

lending rate of the People's Bank of China, And suspended the issuance of loans for residents to

purchase third and above houses, and the exemption period for business tax in housing

transactions was restored from 2 years to 5 years[13].

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[12] Source: National Bureau of Statistics of China: http://www.stats.gov.cn/
[13] Source: The State Council of China: http://www.gov.cn/

Through regulation and control at this stage, the momentum of the Chinese overall housing price increase has been temporarily suppressed, but the regional differentiation is obvious. Housing prices still have a growth momentum, but the growth momentum has slowed down, and as the regulation continues, the upward momentum will continue to slow down. After the introduction of the policy, the real estate overheating momentum has been temporarily controlled (Cao et al., 2015; Du and Zhang, 2015; Li et al, 2017; Sun et al., 2017; Wu and Li, 2018).

2.2.5. The Housing Policies from 2014 to 2016

After 2014, China's economy entered a new normal development stage. Under the policy demands of "steady growth" and "destocking", the government introduced a series of control measures, mainly from relaxing purchase restrictions and loan restrictions, strengthening credit support, and tax relief.

In response to the request to stimulate the real estate market and speed up the progress of destocking, the Central Bank and the China Banking Regulatory Commission jointly announced the "Notice on Further Doing a Good Job in Housing Financial Services" on September 30, 2014. The notice adjusted the commercial housing loan policy, greatly increasing the consumer end of the residential market power. According to the notice, the minimum down payment ratio for the purchase of the first set of ordinary self-owned housing loans is 30%, and the loan interest rate can enjoy a 30% discount on the benchmark interest rate. Subsequently, the Central Bank, the Ministry of Housing and Urban-Rural Development, and the China Banking Regulatory Commission jointly issued a document on March 30, 2015, stipulating that the exemption period for second-hand housing business tax was reduced from 5 years to 2 years, and the minimum down payment for commercial loans for the purchase of a second house The

proportion is reduced to 40%, and the down payment ratio is reduced to 20% for those who use provident fund loans to purchase the first home. According to the central government's directives on stimulating the real estate market and winning the destocking campaign, the Ministry of Finance, the State Administration of Taxation, and the Ministry of Housing and Urban-Rural Development have three the two departments jointly issued the "Notice on Adjusting Preferential Policies for Deed Tax and Business Tax in Real Estate Transactions" on February 17, 2016. According to the requirements of the notice, if the first house is purchased with a floor area greater than 144 square meters, the house deed tax will be reduced from the original 3% to 1.5; the deed tax levied on the purchase of a second home below 90 square meters is reduced from 3% to 1%, and the deed tax for a second home above 90 square meters is reduced from 3% to 2%; all houses over 2 years old are exempted when they enter the market. The levy of business tax, while no longer levying the business tax of non-ordinary residences for more than 2 years.

After the above series of incentive measures, China's real estate market was booming and housing prices and housing sales in first- and second-tier cities and some hotline cities began to accelerate, and housing prices in some areas even increased, such as the average house price in Shanghai raised from 30,000 RMB to 50,000 RMB[14].

2.2.6. The Housing Policies from The End of 2016 to Present

In December 2016, the Chinese government pointed out that it is necessary to suppress real estate speculative behavior. The real estate market control policy has also been changed from the direction of stabilizing growth to preventing financial risks in the real estate market

[14]Source: Lianjia Website: www.lianjia.com

and promoting the reform of the housing system. Many local governments re-enacted the house purchase restriction policy. Regulatory policies have once again shifted from stimulus to tightening ". In order to promote the stable and healthy development of china's real estate market, it is necessary to establish and improve a long-term management mechanism for real estate regulation and control. It is not possible to repeatedly adopt stimulus or restraint measures according to market laws. It is necessary to comprehensively use financial, land, fiscal and taxation, investment, legislation, and other means, and on the premise of insisting on the positioning of "the house is for living, not for speculation", speed up analysis and research and establish a set of suits that suits china's national conditions. The basic system and long-term mechanism of real estate regulation based on the laws of economic and social development can not only effectively suppress the real estate bubble, but also avoid the situation of large fluctuations in housing prices.

In China, administrative methods are frequently used and constantly changing. Compared with the sales market self-adjustment system, it relies more on the current macroeconomic policies of government departments. Since 2008, Chinese real estate industry regulation and control policies have gone through four completely different stages, which makes housing prices show different trends in these four stages. We can see from Figure 2, from 2008 to 2009, due to the effect of the international financial turmoil, the policies and regulations of the real estate industry have stimulated residential consumption and China's economic development. After the rapid increase in house prices, the Chinese government formulated the current policy on commodity housing prices from 2010 to 2013 to resist the trend of housing price increases and curb speculative consumption in foreign exchange. However, from 2014 to 2016, many local governments canceled the HPR policy due to the economic downturn risk.

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After 2006, the housing policies have also changed to curb the rapid increase in house prices. Many local governments have reformulated the HPR policies to limit house purchases. Figure 2 shows that the changes in housing prices in China from 2008 to 2019, we can see that frequent changes in economic policies will lead to the fluctuation of housing prices, which is not conducive to the   stable and healthy development of the real estate market.

The policies focus on suppressing demand instead of increasing supply in China. In previous real estate regulation and control policies, the generally used financial credit means were to increase the down payment ratio or raise the loan interest rate. Administrative enforcement means generally uses purchase restrictions, loan restrictions, and tax policies such as quotas. These methods are ultimately aimed at adjusting and controlling the demand side of house purchases, but the effect on housing price is temporary because the rigid demand and speculative investment of the house always exists. From the effect of its implementation, such administrative compulsory measures have a significant impact on real estate transactions in the short term, but at the same time they have also caused some social problems such as "false divorces". Moreover, once such measures are canceled, house prices will rebound rapidly, so such measures cannot solve the fundamental problems in the real estate market. Therefore, the previous control policies only forced the delay of consumer demand and did not effectively solve the problem of housing price growth. Although these policies impose certain restrictions on real estate speculation and investors in a short period, they also give rigidity.
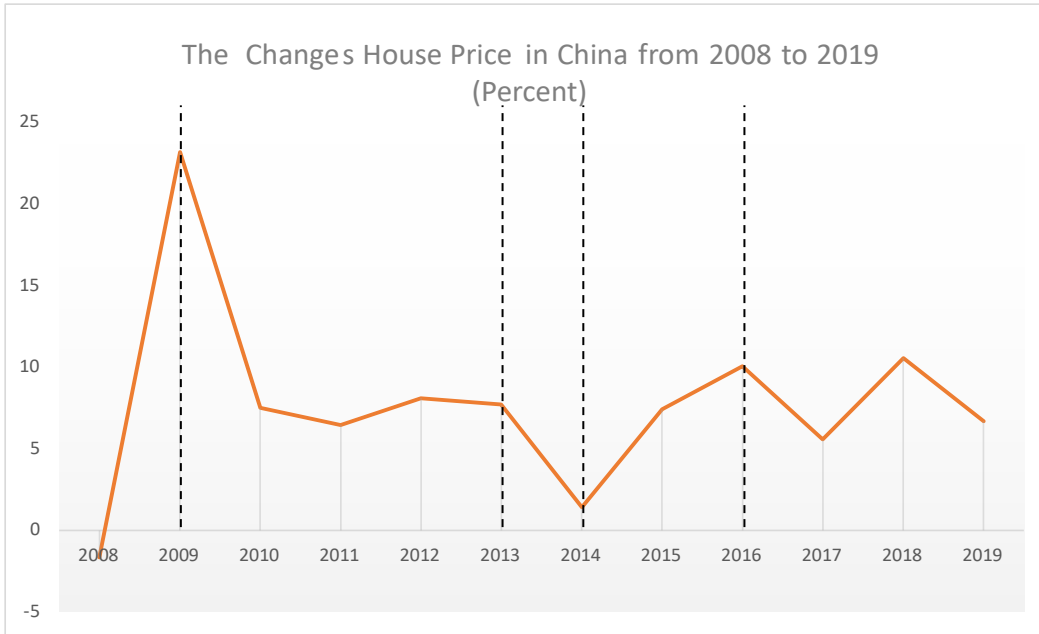
Figure 2. The Changes in Housing Prices in China from 2008 to 2019. (Source: National Bureau of Statistics of China.)

3. EMPIRICAL MODEL

3.1. Introduction

Since 1998 urban land and property markets reform in China, the Chines housing market changed from welfare housing provision system to market oriented system. Housing demand increased dramatically because of the rapid urbanization and economic growth. The portion of total population living in urban areas in China increased from 34.87% in 1999 to 60.31% in 2019. During the same period, the GDP in current US dollar grew from $1.09 trillion to $14.34 trillion, which is approximately a 1200% increase[15]. Lin et al. (2018) mentioned that a 1% increase in the number of people inflow into cities would lead to an increase in the estimated housing prices by 0.31% at the national level. In addition, the steady growth of household income also pushed the demand for housing to a higher level (McQuinn & O'Reilly, 2008; Chow & Niu, 2015).

In the meantime, housing cost increased sharply partly because the skyrocketing land bidding price. Land price consists a large proportion of house price, thus its variation can significantly affect the fluctuations of house price (Leung & Chen, 2006). The local fiscal revenue was largely affected by land sales, which potentially cause the local government intentionally to intervene the housing market to maintain a stable growth in land prices. Sales of land contribute to 5.1% of the local government's total revenue in 1998 and rose sharply to 19.5% in 2016 (NBS, 2010). Wu, et al. (2012) found that between 2003 and 2010, real, constant quality land sale prices in Beijing have increased by nearly 800 percent. All else constant, land

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[15] Source: The world bank https://data.worldbank.org/

sale prices are about 27% higher when a central government-owned enterprise wins a land auction.

The demand-pull and cost-push effects simultaneously drive house prices surge dramatically in the past two decades. Houses have been the prioritized demand for urban residents in China (Yao et al., 2014). The average house price had sharply increased from 4,681 Ren Min Bi (RMB) to 8,736 RMB per square meter from 2009 to 2018[16].

The rising house prices have drawn Chinese government authority's attention on issues with asset bubbles and housing affordability. Excessive house prices may cause a potential housing affordability crisis and further have a severe impact on society, living standards, and the economy. For example, Sun, et al., (2017) highlighted that the increase in house prices may cause a serious burden of living especially for lower and middle-income families. Zhang and Yi, (2018) indicated that from 2012 to 2015, the rise in house prices has polarized, with high-priced housing prices rising, while low-priced housing prices falling. Furthermore, excessive housing prices may indicate bubbles in the real estate market, which have a huge impact on the economy. For example, the real estate bubble caused the Great Recession in the U.S.in 2008 (Mian & Sufi, 2009). Researchers such as Chen and Wen (2017), Glaeser et al. (2017), Song and Xiong (2018), and Wu et al. (2016) were also concerned about the potential housing bubbles, which might eventually burst and damage China's economic system and affect society's social welfare. Ren et al. (2012) and Ahuja et al. (2010) agreed that Chinese houses were mainly regarded as investment goods rather than consumer goods, and house prices had

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[16] Source: Website of National Bureau of Statistics http://www.stats.gov.cn/

gone beyond values based on fundamentals. High house prices may also cause an uneven development among industries. Excessive housing prices attract the attention of investors to the real estate market, which leads to the purchase of speculative housing.

Since 2010, the State Council has started using home purchase restriction (HPR) policies to curb the excessive growth of house prices and speculative demand. The first round of HPR was implemented in 46 major cities. Some researchers find that the HPR effectively lowered house prices and decreased transaction volumes (Cao et al., 2015; Du and Zhang, 2015; Li et al, 2017; Sun et al., 2017). Sun et al. (2017) applies the regression discontinuity design (RDD) technique to a large transaction dataset of resale and rental housing units in Beijing, and find that resale home prices dropped by 17–24 % immediately after the implementation of the HPR. Li et al (2017) examines the responses to the HPR policy for different sizes of houses and finds that compared to medium-sized houses, small- or large-sized houses may face more downward pressure of sale prices. Considering the difference in the change of house prices between cities that have implemented the policy and those that have not implemented the housing purchase restriction policy, Wu and Li (2018) found that the HPR policy had a significant negative effect on house prices through analyzing the changes in average house prices in each city. However, other researchers conclude that government intervention cannot effectively regulate the housing market, and the HPR policy is ineffective in curbing speculative demand (Hui and Wang, 2014, Cao et al., 2015, and Wu and Li, 2018).

The previous studies mainly focus on estimating the impact of the HPR policies which were enacted in 2010. By mid-2015, most cities, except Beijing, Shanghai, Guangzhou, Shenzhen, and Sanya, have abandoned the HPR policy. Then, after house prices rose sharply from January 2016 to September 2016, many local governments re-enacted the HPR policies to

maintain the stability of the housing market and there is not any research focused on evaluating the effectiveness of this "new" HPR policy.

The possible mechanism that the HPR policy has impact on house prices is through two channels:

(1) Leakage effect: households are denied access to extra housing, thus housing demand immediately decreases and households seek other type of investment such as stocks and bonds. Leakages are the withdrawal of fund from the housing market;

(2) Substitution effect: since households are restricted to purchase limited quantity of houses, homebuyers may increase housing quality, i.e. purchase larger and more expensive houses. Thus, compared to lower-priced houses, the demand for higher-priced houses may increase, which concludes a heterogeneous effect in response to the HPR policy among different priced homes.

In this chapter, I investigate the response of the Chinese real estate market to the HPR policies and examine the HPR impact on house prices across the complete distribution of house prices. We analyze the difference between the variations of house prices in Chongqing and Nanjing after the new HPR was enacted by using a difference-in-differences (DID) model. Nanjing is one of the 15 "new first-tier" cities and the second-largest city in the East China region. It re-enacted the HPR on September 26th, 2016[17]. Chongqing is one of the four municipalities directly under the administration of the Central Government of China, and it is the only municipality that has not implemented the purchase restriction policy. Since both Nanjing and Chongqing are large cities in China and they are the only pair of large cities having

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[17] Source: Website of the Nanjing government http://www.nanjing.gov.cn/index.html.

complete data during our study period. We use Chongqing as a control group and Nanjing as a treatment group to disentangle the HPR impact on the housing market. An unconditional quantile regression (UQR) is applied to examine the HPR impact across the conditional house price distribution. The result shows HPR policy has a negative impact on lower-priced houses, whereas a positive impact on higher-priced houses.

This study has three unique features: (1) A UQR is used to analyze the neighborhood effects of the HPR policy on house prices. To the best of our knowledge, this is the first paper that investigates heterogeneity in the neighborhood price effects of HPR policy on the full unconditional distribution of house price, where the HPR impact on higher- vs lower-priced houses is examined. (2) This is the first study that quantitatively examines the effect of the "new" HPR policy, which was enacted in 2016, on house prices. The results and conclusions of this study can provide useful information for policy makers, real estate enterprises and households/consumers who are affected by housing market dynamics. (3) This study provides evidence of changes in the impact of HPR policy over time, which allow us to analyze the time effectiveness of the policy.

The rest of this chapter is arranged as follows: Section 3.2 introduces the current situation of the real estate markets in Nanjing and Chongqing and the basic information about the HPR policy. Section 3.3 and section 3.4 show the descriptions of data and model, respectively.

3.2. Background

3.2.1. Study Areas: Nanjing and Chongqing

Chongqing is a megacity in southwest China. It is one of the four municipalities under the direct administration of central government of China. The municipality has a population of

32.8 million and a total area of 82,400 square kilometers. It is also the only large city that has not implemented the purchase restriction policy. Therefore, in this study, we use Chongqing as our control group. In 2016, real estate development investment for the whole year was 372.595 billion RMB, of which residential investment was 231.997 billion RMB. The total sales area of housing was approximately 179.32 million square meters, and the total value of sales was about 263.5 billion RMB[18].

Nanjing is the capital of Jiangsu province, the second largest city in the East China region. It has 11 districts, an administrative area of 6,600 square kilometers and a total population of about 8.5 million in 2019. In 2016, the investment in real estate development was 184.560 billion RMB, an increase of 29.2% over the previous year. Among them, residential investment was 139.276 billion RMB, an increase of 28.8%. The total sales area of housing for the whole year was about 15.558 million square meters, an increase of 1.0% over the previous year. The total value of house sales was about 276.635 billion RMB, an increase of 56.0%[19].

In comparison, the population density of Nanjing is obviously greater than that of Chongqing, which may also be one of the reasons that the average house price in Nanjing is higher than that of Chongqing. However, house prices in Nanjing and Chongqing maintained an almost uniform growth trend before the implementation of the HPR policy. Figure 3 (a) shows the trend lines of average house prices in Nanjing and Chongqing from September 2015 to May 2019. Those are based on the monthly average house prices we calculated using data collected from Lianjia website. In Nanjing, the average house price is 18,000 RMB per square meter in

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[18] Source: Website of the Chongqing Statistics Bureau http://tjj.cq.gov.cn/
[19] Source: Website of the Nanjing Statistics Bureau http://tjj.nanjing.gov.cn/

September 2015, and 29,000 RMB per square meter in May 2019. The average house prices in Chongqing is 7,000 RMB per square meter in September 2015 and 12,000 RMB per square meter in May 2019. As shown, the sell house prices in Nanjing and Chongqing keep increasing overall, especially before September 2016, the enactment of the new HPR policy. Using the monthly average house price in September 2015 as base, Figure 3 (b) displays the growth rate of the average house price in Nanjing and Chongqing from September 2015 to May 2019. Before the policy implement day, October 2016, the growth rate in Nanjing and Chongqing maintained roughly the same trend. However, the average house price had a significant decrease in Nanjing after the implement of the HPR policy. Therefore, it is reasonable to choose Nanjing as our treatment group and Chongqing as control group to evaluate the effect of HPR policy on housing prices.
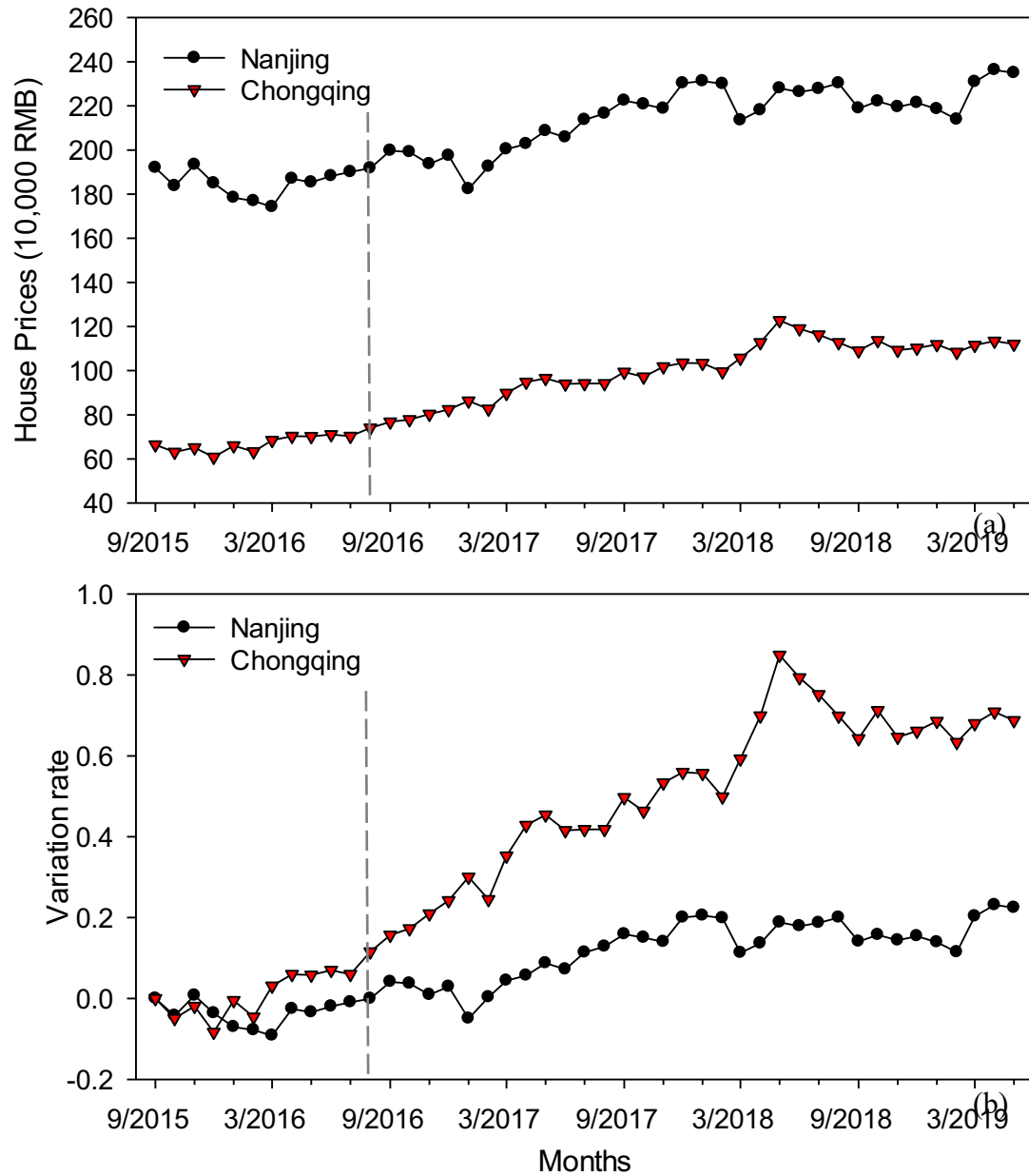
Figure 3. (a) Monthly House Sell Price and (b) Its Growth Rate in Nanjing and Chongqing (from September 2015 to May 2019)

3.2.2. HPR Policy in Nanjing

On October 12th, 2010, the Nanjing Municipal Government issued the "Opinions on Implementing the Macro-control Policies from the Ministry of Housing and Urban-Rural Development and other Ministries and Commissions to Promote the Sustainable and Healthy

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Development of the City's Real Estate Market". It stipulates that Nanjing temporarily restricts the purchase of a third house. It also adjusted the collection of deed tax, which includes: (1) For first-time homebuyers, the deed tax is halved; (2) For individuals who purchase a house with an area of no more than 90 square meters and being the only house in the family, the deed tax is levied at a rate of 1% of the transaction price; (3) For homebuyers that do not meet the above regulations, and not entitled to enjoy the above preferential policies, all deed taxes should be levied at a rate of 3% of the transaction price.

On September 21st, 2014, the Nanjing Municipal Government issued a document that clearly abolished the restriction on housing purchases, and it is no longer necessary to provide proof of being first-time homebuyers to buy a house.

However, on September 26th, 2016, the Nanjing Municipal Government issued the "Notice on Further Regulating the Home Purchase Restriction in the Real Estate Market", in response to the increase in house prices. The main content includes: (1) suspending the sale of houses to non-resident households with one or more houses, including new and second-hand houses; (2) suspending the sale of newly-built houses to resident households with two or more houses.

On October 6th, 2016, the Nanjing Government enacted another HPR policy to strengthen the policy on September 26th, 2016. In the policy, adult singles (including divorced people) with hukou[20] in the city are limited to buy one house. For a family purchasing a house for the first time, the down payment is no less than 30%. The down payment is adjusted to no less than 50% for the following two types of families: (1) A family has mortgage record but

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[20] Hukou is a permanent residence permit. It is created by Chinese Government to record basic information on the household population.

does not currently own a house; (2) A family currently owns a house but does not have mortgage record or has paid off the mortgage. For a family currently owning a house and still paying mortgage, the down payment is no less than 80%. In addition, families owning two or more houses will not be allowed to apply mortgage.

The main purpose of promulgating the purchase restriction policy is to strictly limit speculation and speculative purchases, than to control the excessive growth of house prices. In this study, we focus on evaluation of the new HPR policy which has been implemented since 2016.

3.3. Data Sources

We collected the data from a publicly accessible Chinese real estate website Lianjia[21]. Lianjia is one of the largest real estate agents in China, and its official website provides not only information about houses currently for sale, but also information about previous transactions including sale prices, sale date, housing characteristics, etc. We initially collected 106,862 housing transactions from Nanjing and Chongqing. We first dropped duplicate records in terms of all characteristics and abandoned the observations with incomplete information. We excluded observations with obvious input error. Then, we kept transaction sales from September 2015 to May 2019 since both cities have data in this time range. To avoid potential outlier impact on the analysis, we removed outrageously high/low priced homes by dropping observations with house sale prices three standard deviation away from the mean. After the data cleaning, the sample contains 94,910 observations. Among those, 36,215 (about 38%) were from Nanjing, and 58,695 (about 62%) were from Chongqing.

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[21] Source: Lianjia Website: www.lianjia.com

Table 1 lists major housing characteristics included in this study. The summary statistics of most of the variables are reported in Table 2. The average house price in Nanjing is 207 (10,000 RMB) and 98 (10,000 RMB) in Chongqing over the period from September 2015 to May 2019. A typical house has about two bedrooms, one living room, one kitchen and one bathroom, with fine decoration and the building style is tower-building with steel-concrete structure in Nanjing. However, compared with Nanjing, a standard house in Chongqing usually has two bathrooms and slab-tower combination building style. The average size of a house is 76.77 square meters in Nanjing which is 15.28 square meters less than the one in Chongqing.

Table 1. Definition of Variables.

Variables	Definition
price	Sale price (10,000 RMB Yuan)
bedroom	Number of bedrooms
livingroom	Number of living rooms
kitchen	Number of kitchens
bathroom	Number of bathrooms
area	Size of living area in square meters
arcstyle1	=1, if the building style of the unit is slab-type; 0 otherwise
arcstyle2	=1, if the building type of the unit is tower-building; 0 otherwise
arcstyle3	=1, if the building type of the unit is slab-tower combination; 0 otherwise
arcstyle4	=1, if the building type of the unit is bungalow; 0 otherwise
furnishing1	=1, if the unit is simply decorated; 0 otherwise
furnishing2	=1, if the unit is well decorated; 0 otherwise
furnishing3	=1, if the unit is not decorated; 0 otherwise
furnishing4	=1, if the decoration of the unit is not specified
structure1	=1, if the building structure of the unit is frame structure; 0 otherwise
structure2	=1, if the building structure of the unit is mixed structure; 0 oherwise
structure3	=1, if the building structure of the unit is brick-concrete structure; 0 otherwise
structure4	=1, if the building structure of the unit is steel-concrete structure; 0 otherwise
structure5	=1, if the building structure of the unit is steel structure; 0 otherwise
2016.saleyear	=1, if the sale occurs in 2016, 0 otherwise
2017.saleyear	=1, if the sale occurs in 2017, 0 otherwise
2018.saleyear	=1, if the sale occurs in 2018, 0 otherwise
2019.saleyear	=1, if the sale occurs in 2019, 0 otherwise
NJ	=1, if the building is located in Nanjing; 0 otherwise
After	=1, if the house is sold on or after October 2016; 0 otherwise
P2	=1, if the sale occurs between April 1st, 2016 and June 30th, 2016, 0 otherwise
P1	=1, if the sale occurs between July 1st, 2016 and September 30th, 2016, 0 otherwise
U1	=1, if the sale occurs between October 1st, 2016 and December 31st, 2016, 0 otherwise
U2	=1, if the sale occurs between January 1st, 2017 and March 31st, 2017, 0 otherwise
U3	=1, if the sale occurs between April 1st, 2017 and June 30th, 2017, 0 otherwise
U4	=1, if the sale occurs between July 1st, 2017 and September 30th, 2017, 0 otherwise
U5	=1, if the sale occurs between October 1st, 2017 and December 31st, 2017, 0 otherwise
U6	=1, if the sale occurs between January 1st, 2018 and March 31st, 2018, 0 otherwise
U7	=1, if the sale occurs between April 1st, 2018 and June 30th, 2018, 0 otherwise
U8	=1, if the sale occurs between July 1st, 2018 and September 30th, 2018, 0 otherwise
U9	=1, if the sale occurs between October 1st, 2018 and December 31st, 2018, 0 otherwise
U10	=1, if the sale occurs between January 1st, 2019 and March 31st, 2019, 0 otherwise
U11	=1, if the sale occurs between April 1st, 2019 and June 30th, 2019, 0 otherwise

Table 2. Summary Statistics.

	Nanjing				Chongqing			
Variable	Mean	Std.Dev.	Min	Max	Mean	Std.Dev	Min	Max
price	207.301	96.58269	66	612.5	98.21042	50.52461	27	306
bedroom	2.238686	0.7284543	1	8	2.391907	0.8963372	0	9
livingroom	1.381886	0.5376558	0	4	1.62726	0.5858822	0	4
kitchen	0.9990335	0.0543482	0	3	0.9975637	0.1043122	0	3
bathroom	1.125086	0.3483846	0	5	1.399693	0.5651297	0	6
area	76.77338	28.68837	13.27	380	92.04962	37.43835	14.71	513.83
arcstyle1	0.2402043	0.4272134	0	1	0.0859187	0.2802464	0	1
arcstyle2	0.6678724	0.470983	0	1	0.1453616	0.3524681	0	1
arcstyle3	0.0893552	0.2852598	0	1	0.7545617	0.4303504	0	1
arcstyle4	0.0004694	0.0216613	0	1	0.0011415	0.033767	0	1
furnishing1	0.2237195	0.416742	0	1	0.122668	0.3280586	0	1
furnishing2	0.3785172	0.4850241	0	1	0.3826391	0.4860354	0	1
furnishing3	0.0506972	0.2193817	0	1	0.1924695	0.3942432	0	1
furnishing4	0.3470661	0.4760436	0	1	0.3022234	0.4592254	0	1
structure1	0.0006351	0.0251935	0	1	0.0005111	0.0226023	0	1
structure2	0.0012978	0.0360022	0	1	0.0013289	0.0364302	0	1
structure3	0.1834599	0.3870484	0	1	0.0216373	0.1454973	0	1
structure4	0.8057711	0.3956114	0	1	0.9637277	0.1869684	0	1
structure5	0.0075383	0.0864968	0	1	0.0056564	0.0749964	0	1
2016.saleyear	0.3095402	0.4623105	0	1	0.1863191	0.3893673	0	1
2017.saleyear	0.2300152	0.4208481	0	1	0.310316	0.4626269	0	1
2018.saleyear	0.2285793	0.4199234	0	1	0.3295511	0.4700542	0	1
2019.saleyear	0.1575038	0.3642801	0	1	0.1508987	0.3579532	0	1
After	0.6560817	0.4750208	0	1	0.8351648	0.3710349	0	1
P2	0.0688941	0.2532775	0	1	0.0465287	0.2106288	0	1
P1	0.1046528	0.3061097	0	1	0.0564784	0.2308452	0	1
U1	0.0399834	0.195923	0	1	0.044399	0.2059817	0	1
U2	0.0681486	0.2520041	0	1	0.0882017	0.2835905	0	1
U3	0.0599199	0.2373417	0	1	0.0883721	0.2838377	0	1
U4	0.0518846	0.221797	0	1	0.0676378	0.2511255	0	1
U5	0.0500621	0.2180762	0	1	0.0661044	0.2484667	0	1
U6	0.0579318	0.2336177	0	1	0.0917625	0.2886929	0	1
U7	0.0649455	0.246433	0	1	0.1355311	0.3422929	0	1
U8	0.0567721	0.2314097	0	1	0.0606866	0.2387566	0	1
U9	0.04893	0.2157247	0	1	0.0415708	0.1996081	0	1
U10	0.0844678	0.2780919	0	1	0.0723571	0.2590805	0	1
U11	0.073036	0.2601992	0	1	0.0785416	0.2690243	0	1
Obs.	36,215				58,695			

3.4. Empirical Models

Hedonic price models have been used in housing studies since Lancaster (1966) and Rosen (1974) to explore the determinants of house prices. A hedonic model estimates implicit prices of housing attributes. We embed a DID approach into a hedonic model to estimate the effect of the HPR policy on housing prices. The DID method has been widely used in real estate market analysis (e.g., Cao et al. 2015, Wu and Li 2018, Yan and Ouyang 2018, Zhang and Leonard, 2019). It provides a simple method for studying the treatment effect.

Our baseline model takes the following form:

$$\ln(price) = \beta_0 + \beta_i X_i + \lambda NJ + \eta After + \kappa NJ * After + \mu \tag{1}$$

where X_i represents a matrix containing in its rows the value of housing characteristics, such as the number of bedrooms, the number of living rooms, the number of kitchens and size of the living area, and year of sale dummies; NJ is a dummy variable, which equals one if house i is located in Nanjing, and equals 0 if the house is located in Chongqing; *After* takes the values of 1 if the sale occurs on or after October 2016, and 0 otherwise.

To examine the HPR impact over time, I then estimate a more complicated DID (Difference in Differences) model that decomposes After into different time periods. The model can be specified as the following form:

$$\ln(price) = \beta_0 + \beta_i X_i + \lambda NJ + \sum_{a=1}^{2} \delta_a P_a + \sum_{b=1}^{11} \gamma_b U_b + \sum_{a=1}^{2} \theta_a P_a * NJ + \sum_{b=1}^{11} \varphi_b U_b * NJ + \mu \tag{2}$$

where P_a contains a vector of dummy variable where each element takes the value of 1 if the sale occurs *a-1* to *a* quarters prior to the HPR effective date, and 0 otherwise, U_b contains a vector of dummy variable where each element takes the value of 1 if the sale occurs *b-1* to *b* quarters after the HPR effective date, and 0 otherwise. μ represents the error term.

Models in equations (1) and (2) can be estimated by ordinary least square (OLS) to obtain the mean effect. Further, to evaluate the HPR impact across the complete distribution of house prices, we apply an unconditional quantile regression (UQR) by Firpo et al. (2009).

Unlike the conditional quantile regression by Koenker and Bassett (1978) which measures the differential effect of an independent variable on various quantiles of the dependent variable's conditional distribution, the UQR can be directly used to evaluate the economic impact of a change of the independent variable on various quantiles of the unconditional distribution of $\ln(price)$. Thus, the estimation results generated by UQR is more interpretable, and usually of real interest in economic applications.

A UQR model is based on the concept of influence function (IF), which is a widely used tool in robust statistics (Hampel et al., 1986). An IF can be used as an analytical tool to assess the effect an individual observation on a distributional measure of a statistic, which is defined as the following way:

$$IF(\ln(price), q_\tau) = \frac{\tau - I(\ln(price) \leq q_\tau)}{f_Y(q_\tau)} \tag{3}$$

where τ represents quantile, q_τ is the value of the outcome variable $\ln(price)$ at the τth quantile, $f_Y(q_\tau)$ is the density of $\ln(price)$ at q_τ, and I is the indicator function.

Firpo, et al. (2009) suggested the use of Recentered Influence Functions (RIF), as a tool to analyze the impact of changing in the distribution of an explanatory variable on the unconditional distribution of a dependent variable. RIF simply adds the influence function back to the statistic as follows:

$$RIF(\ln(price), q_\tau) = q_\tau + IF(\ln(price), q_\tau) \tag{4}$$

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The UQR estimate can be obtained by OLS regression on the transformed dependent variable. Similarly, effects at different quantiles can be estimated. For technical details of the regression, please refer to Firpo et al. (2009).

4. ESTIMATION AND RESULTS

The results of the models were regressed using data from Nanjing and Chongqing. First, the results of the OLS Estimation will be discussed and noteworthy findings will be given. Next, the discussion of UQR Estimation Result and Robustness Test Result were presented.

4.1. OLS Estimation Result

First, we analyze the mean effect of HPR policy on house prices using OLS estimation. Tables 3 shows the coefficient estimates for major housing characteristics and Table 4 shows the estimation results for policy interaction terms.

Columns (1) of Tables 3 and 4 show the estimation results of the baseline model in Equation (1). As can be seen, the signs of housing characteristics are as expected, and the magnitude is reasonable. Holding other variables constant, a house is sold at a higher price if it has more bedrooms, living rooms, kitchen, or bathrooms. For example, the number of bedrooms and living room have a statistically significant effect on house prices and their coefficients are 0.0869 and 0.0662 separately. It means the house price increases by 9.08% as estimated if the number of bedrooms increases by one, and increases by 6.84% with one more living room[22]. In addition, holding everything else constant, if the house size increases by 1 square meter, the house price increases by 0.73% and the t-statistic implies that the estimation is statistically significant at 1% level.

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[22] Impact on the house price is calculated by using $e^{\beta} - 1$.

Table 3. OLS Coefficient Estimates-Main Housing Characteristics.

	(1)	(2)	(3)	(4)
	lprice	lprice	lprice	lprice
bedroom	0.0869***	0.0924***	0.0825***	0.0875***
	(0.0020)	(0.0022)	(0.0020)	(0.0021)
livingroom	0.0662***	0.0648***	0.0710***	0.0707***
	(0.0022)	(0.0024)	(0.0022)	(0.0023)
kitchen	0.0072	0.0086	0.0033	0.0034
	(0.0112)	(0.0119)	(0.0109)	(0.0116)
bathroom	0.0035	0.0026	0.0045	0.0044
	(0.0029)	(0.0032)	(0.0028)	(0.0031)
area	0.0073***	0.0073***	0.0075***	0.0074***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
2016.saleyear	0.0077	-0.0580***	-0.0579***	-0.0582***
	(0.0053)	(0.0063)	(0.0061)	(0.0061)
2017.saleyear	0.1643***	0.0986***	0.4239***	0.4239***
	(0.0074)	(0.0081)	(0.0078)	(0.0079)
2018.saleyear	0.3559***	0.2903***	0.5647***	0.5647***
	(0.0074)	(0.0081)	(0.0086)	(0.0087)
2019.saleyear	0.3569***	0.2909***	0.5940***	0.5932***
	(0.0076)	(0.0083)	(0.0076)	(0.0077)
NJ	1.1610***	1.1559***	1.1617***	1.1623***
	(0.0047)	(0.0068)	(0.0065)	(0.0066)
After	0.1886***	0.2508***		
	(0.0058)	(0.0074)		
P2			0.0609***	
			(0.0078)	
P1			0.1038***	
			(0.0074)	
U1			0.1685***	0.1684***
			(0.0079)	(0.0080)
U2			-0.2310***	-0.2312***
			(0.0063)	(0.0063)
U3			-0.1109***	-0.1109***
			(0.0063)	(0.0063)
U4			-0.0533***	-0.0532***
			(0.0067)	(0.0067)
U6			-0.0864***	-0.0864***
			(0.0072)	(0.0072)
U7			0.0427***	0.0429***
			(0.0068)	(0.0069)
U8			0.0521***	0.0524***
			(0.0077)	(0.0078)
U10			-0.0188***	-0.0183***
			(0.0063)	(0.0063)
N	94910	82579	94910	82579
adj. R-sq	0.749	0.739	0.763	0.753

Standard errors in parentheses

Variables arcstyle, furnishing and structure dummies are included but not reported here

* p<0.10   ** p<0.05   *** p<0.01"

Table 4. OLS Coefficient Estimates-Interaction Variables.

	(1)	(2)	(3)	(4)
	lprice	lprice	lprice	lprice
NJXAfter	-0.2111***	-0.2055***		
	(0.0048)	(0.0069)		
NJXP2			-0.0017	
			(0.0102)	
NJXP1			0.0337***	
			(0.0094)	
NJXU1			0.0249**	0.0253**
			(0.0115)	(0.0116)
NJXU2			-0.0234**	-0.0230**
			(0.0095)	(0.0096)
NJXU3			-0.1066***	-0.1062***
			(0.0098)	(0.0098)
NJXU4			-0.1211***	-0.1206***
			(0.0103)	(0.0104)
NJXU5			-0.1499***	-0.1494***
			(0.0104)	(0.0105)
NJXU6			-0.2059***	-0.2054***
			(0.0098)	(0.0099)
NJXU7			-0.3257***	-0.3253***
			(0.0093)	(0.0094)
NJXU8			-0.3365***	-0.3361***
			(0.0103)	(0.0103)
NJXU9			-0.3021***	-0.3015***
			(0.0111)	(0.0112)
NJXU10			-0.3085***	-0.3079***
			(0.0094)	(0.0094)
NJXU11			-0.3106***	-0.3098***
			(0.0095)	(0.0096)
N	94910	82579	94910	82579
adj. R-sq	0.749	0.739	0.763	0.753

Standard errors in parentheses

Variables arcstyle, furnishing and structure dummies are included but not reported here

* $p<0.10$ ** $p<0.05$ *** $p<0.01$"

Without considering the impact of the HPR policy and regional differences, we see that house prices increase year by year. For example, compared to year 2015, the average house price is 0.77% higher in 2016, and 42.89% higher in 2019. The trend may be caused by the increasing number of urban residents, rising household income, and the improvement of family well-being. Compared to Chongqing, the average house price in Nanjing is statistically significantly higher. Without the HPR impact, the average price for houses sold after October 2016 is approximately 20.76% higher than the average price for equivalent houses sold before October 2016. The HPR policy has a significant negative impact on house prices. The coefficient of the interaction term between NJ and After is -0.21, which means holding everything else constant, the HPR decreases house prices by approximately 19.03% on average.

It is possible that before the HPR policy enaction, some homebuyers and sellers may obtain insider information and have started to take action prior to October 2016. To screen out the HPR response prior to the policy effective date, we use the sales before six months prior to the policy implementation date as our control group and run our baseline model again (i.e. we use the sales that occurred before April 2016 instead of the policy effective date as our control group). The results are shown in the second columns of Tables 3 and 4. As we can see, the HPR effect is similar to what we have found in the baseline model. Therefore, regardless of whether some consumers get insider information, it does not have a substantial impact on our results.

We then estimate the model in Equation (2) to investigate if the HPR policy effect changes over time. The OLS regression results are reported in columns (3) in Tables 3 and 4. As we can see, the housing characteristics have similar effects on house prices as we have found in the baseline model. Coefficients for P_a and U_b capture the general trend of house prices over time, typically affected by macroeconomic/regional economic factors. Variables U_5, U_8, and

U_{11} are dropped because of the collinearity problem caused by including both sale year and quarter prior to HPR dummies.

We next focus on the HPR policy interaction terms presented in column 3 of Table 4. Figure 4 visually displays the changes in the HPR effect over time. As can be observed from the regression results, the coefficient of NJXP2 is almost zero (-0.0017) and not statistically significant. It indicates that the HPR policy does not affect the house prices two quarters prior to the policy effective date. A slightly significant positive effect appears a quarter before and after the policy effective date (NJXP1 and NJXU1 in Table 4). It indicates the HPR policy has a positive effect on house prices between a quarter prior to and a quarter after the policy effective date. It is possibly caused by insider purchase or advance purchase affected by the enactment of the HPR policy in other cities. The positive effect occurs a few months after the HPR policy which may be explained by the lag between the purchase agreement date and actual closing date. Since January 2017, the HPR policy consistently has a negative effect on house prices. The coefficient estimates for NJXU2, NJXU3, …, and NJXU11 range from -0.02 to -0.33 and are statistically significant at 1% or 5% level, which corresponds to a downward pressure on house prices varying from 2.3% to 28.5%. The negative impact of the eight quarters/two years after the effective date of the policy is the strongest. The effect then tends to be slightly dampened and remains stable at around 30%.
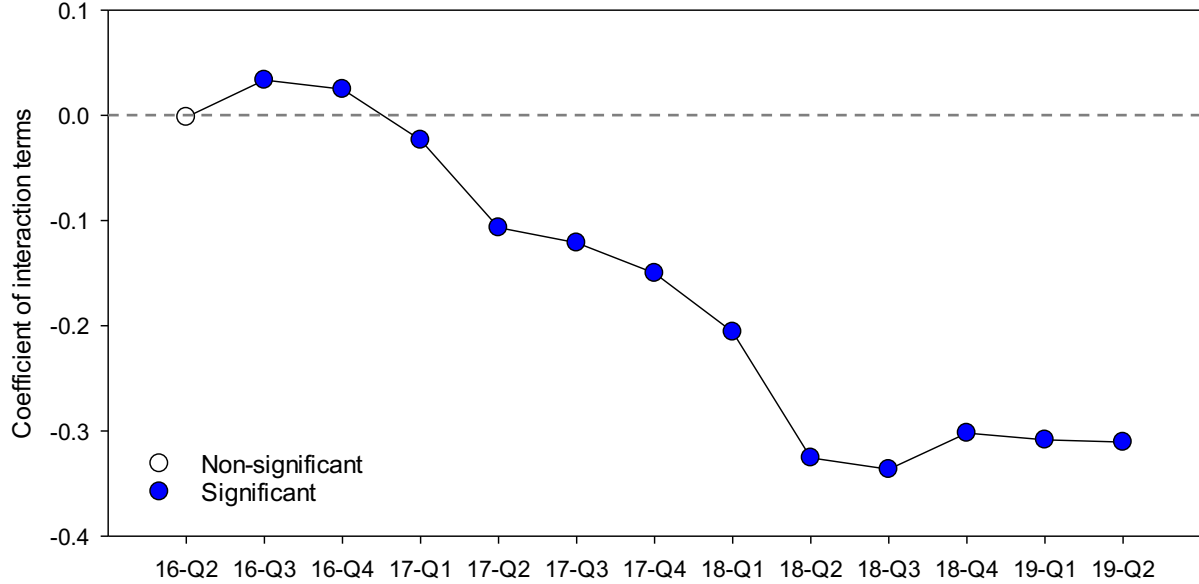
Figure 4. Changes in the Impact of HPR Policy over Time (from April 2016 to May 2019)

To screen out potential insider information impact on house sales, we drop the sales that occurred within six months prior to the policy implementation date and estimate the DID model in Equation (2) again. We observe similar results (columns (4) in Tables 3 and 4). The negative impact appears one quarter after the policy implementation, and the eight quarters/two years after the effective date of the policy is the strongest.

4.2. UQR Estimation Result

We then apply a UQR on Equation (2) to examine the quantile effect of HPR. Tables 5 and 6 exhibit the results for UQR coefficient estimates for housing characteristics and interaction terms, separately. Ten quantiles ranging from 0.1, to 0.9 are estimated. Bootstrapped standard errors are estimated using 500 replications.

Comparing the estimates of housing characteristics across quantile regressions, the effect tends to vary dramatically. For example, holding everything else constant, an additional

bedroom has larger and positive impact on lower-priced houses, and smaller impact on higher-priced homes, and even negative impact on the highest quantile (0.9 quantile) homes. Larger living area is generally preferred by both higher- and lower- priced home buyers. However, for each additional square meter of living area, 0.1 quantile home buyer would like to pay a premium of 0.3% of the house price, while 0.9 quantile home buyers are willing to pay more (1.1% of the home price).

Table 5. UQR Coefficient Estimates-Main Housing Characteristics.

	Q(0.10)	Q(0.20)	Q(0.30)	Q(0.40)	Q(0.50)	Q(0.60)	Q(0.70)	Q(0.80)	Q(0.90)
bedroom	0.1562***	0.1481***	0.1435***	0.1605***	0.1026***	0.0668***	0.0254***	0.0048	-0.0274***
	(0.0054)	(0.0042)	(0.0042)	(0.0055)	(0.0038)	(0.0037)	(0.0039)	(0.0054)	(0.0069)
livingroom	0.2788***	0.1735***	0.1052***	0.0594***	0.0023	-0.0213***	-0.0103***	-0.0052	-0.0009
	(0.0080)	(0.0049)	(0.0042)	(0.0049)	(0.0037)	(0.0035)	(0.0037)	(0.0047)	(0.0062)
kitchen	0.2655***	0.1408***	0.0874***	0.0375	-0.0297*	-0.0844***	-0.1388***	-0.1488***	-0.1578***
	(0.0431)	(0.0294)	(0.0217)	(0.0240)	(0.0171)	(0.0182)	(0.0173)	(0.0216)	(0.0265)
bathroom	0.0269***	0.0539***	0.0710***	0.0567***	0.0451***	0.0020	-0.0621***	-0.1161***	-0.0879***
	(0.0069)	(0.0063)	(0.0063)	(0.0067)	(0.0053)	(0.0051)	(0.0054)	(0.0071)	(0.0091)
area	0.0030***	0.0038***	0.0052***	0.0079***	0.0070***	0.0085***	0.0093***	0.0109***	0.0111***
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0003)
2016.saleyear	-0.0191	-0.0084	-0.0145	-0.0316***	-0.0452***	-0.0722***	-0.0854***	-0.1331***	-0.1280***
	(0.0178)	(0.0110)	(0.0093)	(0.0118)	(0.0102)	(0.0106)	(0.0131)	(0.0156)	(0.0195)
2017.saleyear	0.6483***	0.6360***	0.6194***	0.5891***	0.3313***	0.2083***	0.1224***	0.0552***	0.0273*
	(0.0322)	(0.0213)	(0.0171)	(0.0181)	(0.0118)	(0.0113)	(0.0118)	(0.0130)	(0.0153)
2018.saleyear	0.9291***	0.8863***	0.9068***	0.9016***	0.5318***	0.3847***	0.2429***	0.1458***	0.0821***
	(0.0330)	(0.0232)	(0.0193)	(0.0254)	(0.0144)	(0.0137)	(0.0137)	(0.0144)	(0.0162)
2019.saleyear	0.9461***	0.9366***	0.9533***	0.9632***	0.5702***	0.3800***	0.2599***	0.1687***	0.0929***
	(0.0320)	(0.0216)	(0.0174)	(0.0231)	(0.0127)	(0.0117)	(0.0121)	(0.0140)	(0.0158)
NJ	1.3582***	1.3941***	1.4994***	1.5841***	1.1012***	0.9791***	0.8459***	0.8303***	0.7380***
	(0.0298)	(0.0211)	(0.0193)	(0.0317)	(0.0125)	(0.0135)	(0.0130)	(0.0168)	(0.0187)
P2	0.1344***	0.1178***	0.0880***	0.0579***	0.0297***	0.0242***	0.0218**	0.0355***	0.0344***
	(0.0332)	(0.0213)	(0.0163)	(0.0146)	(0.0101)	(0.0089)	(0.0095)	(0.0105)	(0.0112)
P1	0.2381***	0.1920***	0.1447***	0.0940***	0.0501***	0.0379***	0.0405***	0.0458***	0.0278**
	(0.0329)	(0.0199)	(0.0148)	(0.0142)	(0.0092)	(0.0086)	(0.0091)	(0.0102)	(0.0115)
U1	0.3675***	0.3104***	0.2543***	0.1864***	0.0951***	0.0709***	0.0512***	0.0512***	0.0370***
	(0.0335)	(0.0216)	(0.0174)	(0.0162)	(0.0110)	(0.0100)	(0.0092)	(0.0113)	(0.0118)
U2	-0.1825***	-0.2195***	-0.2618***	-0.3072***	-0.1917***	-0.1500***	-0.1128***	-0.0939***	-0.1021***
	(0.0233)	(0.0171)	(0.0161)	(0.0152)	(0.0103)	(0.0097)	(0.0085)	(0.0092)	(0.0099)
U3	-0.0652***	-0.0849***	-0.0831***	-0.0769***	-0.0386***	-0.0357***	-0.0382***	-0.0396***	-0.0550***
	(0.0215)	(0.0166)	(0.0155)	(0.0146)	(0.0110)	(0.0103)	(0.0085)	(0.0097)	(0.0103)
U5	0.0747***	0.0574***	0.0780***	0.1010***	0.0517***	0.0416***	0.0281***	0.0214**	-0.0040
	(0.0221)	(0.0174)	(0.0161)	(0.0168)	(0.0120)	(0.0104)	(0.0094)	(0.0099)	(0.0113)
U6	-0.0870***	-0.0853***	-0.1251***	-0.1154***	-0.1030***	-0.1050***	-0.0831***	-0.0658***	-0.0547***
	(0.0216)	(0.0168)	(0.0166)	(0.0186)	(0.0141)	(0.0125)	(0.0111)	(0.0106)	(0.0114)
U7	0.0195	0.0591***	0.0545***	0.0995***	0.0912***	0.0495***	0.0323***	0.0130	-0.0183
	(0.0197)	(0.0159)	(0.0158)	(0.0168)	(0.0132)	(0.0122)	(0.0108)	(0.0105)	(0.0116)
U8	0.0453**	0.0683***	0.0507***	0.0763***	0.0732***	0.0609***	0.0399***	0.0448***	0.0275**
	(0.0219)	(0.0183)	(0.0184)	(0.0204)	(0.0156)	(0.0137)	(0.0117)	(0.0125)	(0.0128)
U10	0.0025	-0.0315**	-0.0257*	-0.0340**	-0.0271**	-0.0151	-0.0274***	-0.0287***	-0.0241**
	(0.0181)	(0.0138)	(0.0155)	(0.0163)	(0.0118)	(0.0109)	(0.0104)	(0.0102)	(0.0097)
N	94910	94910	94910	94910	94910	94910	94910	94910	94910

Standard errors in parentheses

The standard errors for unconditional quantile regression are obtained through 500 bootstrap replications.

* p<0.10   ** p<0.05   *** p<0.01

Turning now to the estimates of interaction terms shown in Table 6. The HPR policy has a significant negative impact on lower-priced houses, and a significant positive impact on higher-priced houses across all time periods. The impact on medium-priced homes ranges from negative to positive. We take the 20th, 50th and 80th quantiles to represent low-, medium-, and high-priced houses, respectively, and visually show the changes in the impact of HPR policy by quantiles over time from April 2016 to May 2019 (Figure 5). As can be seen, for lower-priced homes, the HPR policy consistently depressed the house prices throughout the entire period from April 2016 to May 2019, while for higher-priced homes, the HPR policy dramatically increased the house prices. The impact on medium-priced houses started from positive on the 2nd quarter of 2016, quickly decreased to negative on the 2nd quarter of 2017, and stayed negative until the end of the study period. The heterogeneity of the HPR impact across different priced houses may be caused by substitution effect under which home buyers intend to purchase more expensive houses to offset the investment constraint created by the HPR policy.

Table 6. UQR Coefficient Estimates-Interaction Variable.

	Q(0.10)	Q(0.20)	Q(0.30)	Q(0.40)	Q(0.50)	Q(0.60)	Q(0.70)	Q(0.80)	Q(0.90)
NJXP2	-0.1245***	-0.1087***	-0.0845***	-0.0246	0.0369**	0.0594***	0.0581***	0.0761***	0.1015***
	(0.0333)	(0.0224)	(0.0189)	(0.0195)	(0.0169)	(0.0170)	(0.0178)	(0.0226)	(0.0289)
NJXP1	-0.2061***	-0.1607***	-0.0982***	0.0409**	0.1215***	0.1798***	0.1599***	0.1727***	0.1748***
	(0.0327)	(0.0206)	(0.0161)	(0.0186)	(0.0138)	(0.0156)	(0.0162)	(0.0206)	(0.0254)
NJXU1	-0.2695***	-0.2211***	-0.1479***	-0.0249	0.1041***	0.1709***	0.1646***	0.2028***	0.2813***
	(0.0337)	(0.0228)	(0.0202)	(0.0220)	(0.0186)	(0.0193)	(0.0202)	(0.0260)	(0.0379)
NJXU2	-0.3595***	-0.3085***	-0.2349***	-0.0834***	0.0571***	0.1535***	0.1808***	0.2135***	0.2443***
	(0.0284)	(0.0189)	(0.0169)	(0.0189)	(0.0151)	(0.0177)	(0.0171)	(0.0231)	(0.0285)
NJXU3	-0.5036***	-0.4649***	-0.4166***	-0.2621***	-0.0384***	0.1243***	0.1910***	0.2325***	0.2559***
	(0.0287)	(0.0194)	(0.0164)	(0.0195)	(0.0148)	(0.0177)	(0.0186)	(0.0231)	(0.0303)
NJXU4	-0.5864***	-0.5634***	-0.5062***	-0.3303***	-0.0380**	0.1645***	0.2612***	0.3375***	0.2696***
	(0.0303)	(0.0213)	(0.0189)	(0.0198)	(0.0166)	(0.0180)	(0.0196)	(0.0256)	(0.0359)
NJXU5	-0.6733***	-0.6324***	-0.5915***	-0.4145***	-0.0783***	0.1636***	0.2813***	0.3867***	0.3363***
	(0.0294)	(0.0212)	(0.0191)	(0.0223)	(0.0162)	(0.0171)	(0.0189)	(0.0264)	(0.0365)
NJXU6	-0.7892***	-0.7357***	-0.6720***	-0.5008***	-0.1052***	0.1346***	0.2697***	0.3450***	0.3190***
	(0.0289)	(0.0204)	(0.0172)	(0.0217)	(0.0151)	(0.0162)	(0.0179)	(0.0251)	(0.0323)
NJXU7	-0.8863***	-0.8725***	-0.8467***	-0.7260***	-0.3112***	-0.0184	0.1594***	0.2877***	0.3277***
	(0.0280)	(0.0196)	(0.0172)	(0.0231)	(0.0155)	(0.0165)	(0.0168)	(0.0238)	(0.0342)
NJXU8	-0.9262***	-0.8922***	-0.8550***	-0.7208***	-0.2984***	-0.0482***	0.1416***	0.2659***	0.3063***
	(0.0297)	(0.0224)	(0.0193)	(0.0260)	(0.0163)	(0.0177)	(0.0188)	(0.0263)	(0.0344)
NJXU9	-0.8706***	-0.8184***	-0.7984***	-0.6391***	-0.2296***	-0.0091	0.1572***	0.2655***	0.2622***
	(0.0317)	(0.0238)	(0.0204)	(0.0264)	(0.0185)	(0.0185)	(0.0196)	(0.0285)	(0.0356)
NJXU10	-0.9056***	-0.8483***	-0.8287***	-0.6719***	-0.2502***	0.0190	0.1749***	0.2701***	0.3265***
	(0.0294)	(0.0204)	(0.0183)	(0.0226)	(0.0149)	(0.0153)	(0.0158)	(0.0233)	(0.0304)
NJXU11	-0.9245***	-0.9009***	-0.8798***	-0.7265***	-0.2827***	0.0073	0.1554***	0.2985***	0.3984***
	(0.0303)	(0.0214)	(0.0177)	(0.0231)	(0.0152)	(0.0168)	(0.0168)	(0.0228)	(0.0326)
N	94910	94910	94910	94910	94910	94910	94910	94910	94910

Standard errors in parentheses

The standard errors for unconditional quantile regression are obtained through 500 bootstrap replications.

* p<0.10   ** p<0.05   *** p<0.01
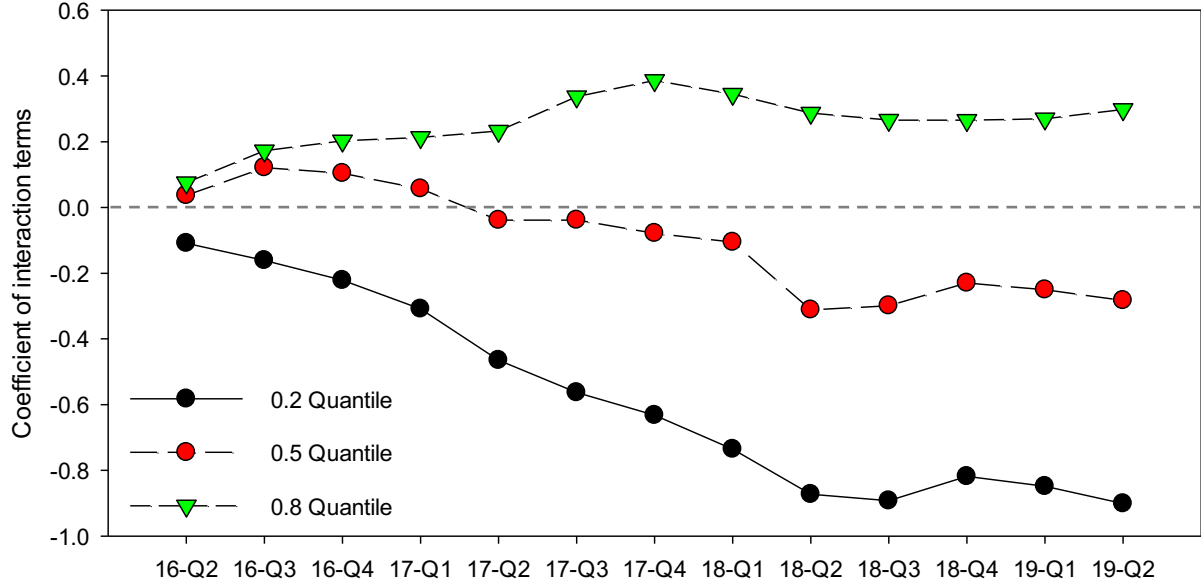
Figure 5. Changes in the Impact of HPR Policy by Quantiles over Time (from April 2016 to May 2019)

4.3. Robustness Test

An important and critical prerequisite for the DID model is the "parallel trend assumption". It means the "common trends" between the control group and treatment group should be the same before the HPR policy is implemented. As we have examined in Figure 3 and Figure 6, before the implementation of the policy, the housing prices of the control group and the experimental group maintained roughly the same growth trend. After the implementation of the policy, the growth trend of the experimental group and the control group changed significantly. Therefore, it is reasonable to use the DID model to analyze the impact of purchase restrictions on housing prices.
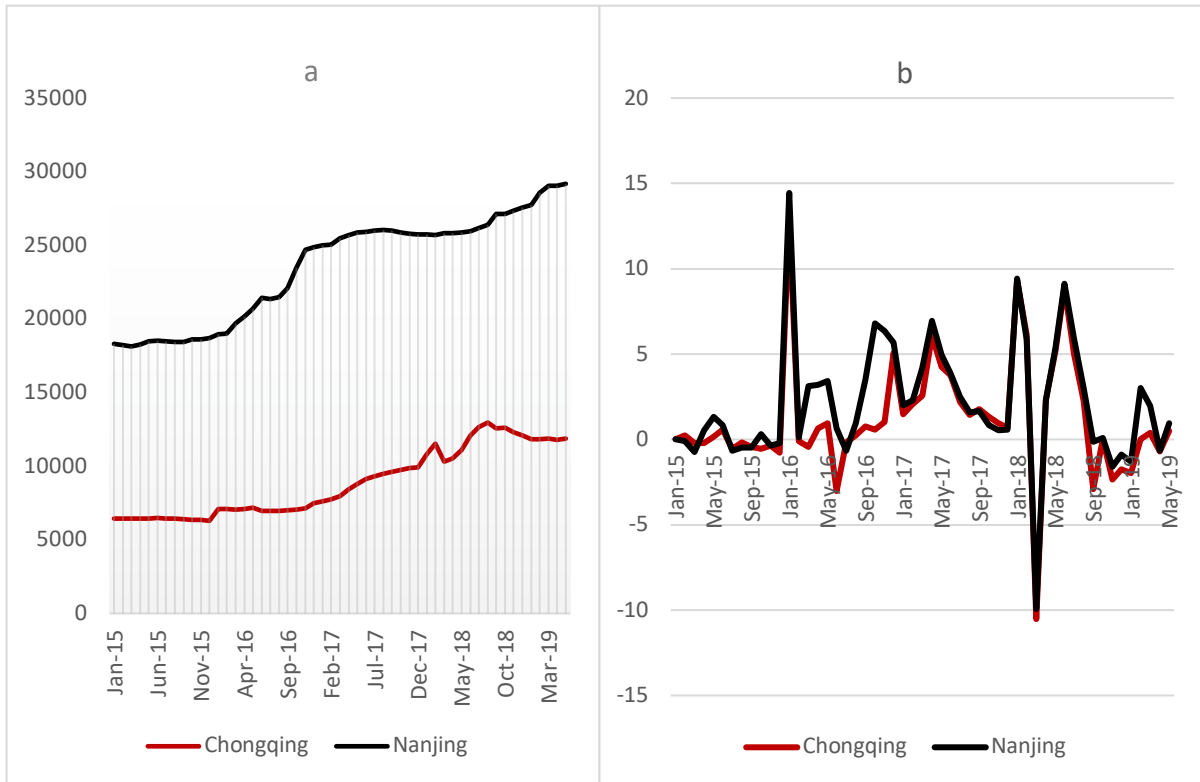
Figure 6. (a) Average House Prices and (b) Its Changes Rate in Nanjing and Chongqing from 2015 to 2019(RMB per Square Meter)

Furthermore, the DID model requires treatment and control groups to be random. In this study, we use a propensity score matching (PSM) method to match each treated unit with a non-treated unit of similar characteristics. We choose the main characteristics of the housing as the covariate of logit regression in the control and experimental groups, and the predicted value as the score. We then use the nearest neighbor matching method for one-to-one matching. We finally estimate models in Equations (1) and (2) using the matched samples obtained from PSM. Table 7 reports the OLS and Table 8 exabits the UQR coefficient estimate result for the interaction terms, separately. The complete estimation results are available from the authors upon request. As we can see, the results in Table 7 and Table 8 are very similar to what we have

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found in Table 4 and Table 6. More importantly, the conclusion we have drawn holds when we use matched samples.

Table 7. OLS Coefficient Estimates-Interaction Variables (Matched Samples).

	(1)	(2)	(3)	(4)
	lprice	lprice	lprice	lprice
NJ	1.1687***	1.1538***	1.1549***	1.1537***
	(0.0086)	(0.0129)	(0.0126)	(0.0126)
After	0.1874***	0.2585***		
	(0.0120)	(0.0151)		
NJXAfter	-0.2052***	-0.1900***		
	(0.0099)	(0.0138)		
NJXP2			0.0256	
			(0.0212)	
NJXP1			0.0543***	
			(0.0197)	
NJXU1			0.0969***	0.0997***
			(0.0252)	(0.0252)
NJXU2			-0.0183	-0.0154
			(0.0197)	(0.0198)
NJXU3			-0.0913***	-0.0888***
			(0.0197)	(0.0197)
NJXU4			-0.1217***	-0.1204***
			(0.0209)	(0.0210)
NJXU5			-0.1605***	-0.1589***
			(0.0210)	(0.0210)
NJXU6			-0.2062***	-0.2048***
			(0.0194)	(0.0194)
NJXU7			-0.3255***	-0.3243***
			(0.0182)	(0.0182)
NJXU8			-0.3237***	-0.3230***
			(0.0204)	(0.0204)
NJXU9			-0.2637***	-0.2628***
			(0.0222)	(0.0222)
NJXU10			-0.2627***	-0.2618***
			(0.0189)	(0.0189)
NJXU11			-0.2268***	-0.2260***
			(0.0192)	(0.0193)
N	22431	19547	22431	19547
adj. R-sq	0.800	0.793	0.809	0.802

Standard errors in parentheses

Variables arcstyle, furnishing and structure dummies are included but not reported here

* p<0.10   ** p<0.05   *** p<0.01"

Table 8. UQR Coefficient Estimates-Interaction Variables (Matched Samples).

	Q(0.10)	Q(0.20)	Q(0.30)	Q(0.40)	Q(0.50)	Q(0.60)	Q(0.70)	Q(0.80)	Q(0.90)
NJXP2	-0.1510**	-0.1649***	-0.1300***	-0.0217	0.0366	0.1033**	0.1398***	0.2084***	0.1643***
	(0.0727)	(0.0517)	(0.0422)	(0.0507)	(0.0388)	(0.0427)	(0.0446)	(0.0478)	(0.0629)
NJXP1	-0.2305***	-0.2162***	-0.1969***	-0.0137	0.1321***	0.2212***	0.3093***	0.2972***	0.3230***
	(0.0740)	(0.0502)	(0.0390)	(0.0458)	(0.0339)	(0.0391)	(0.0402)	(0.0464)	(0.0618)
NJXU1	-0.3318***	-0.3151***	-0.2299***	0.0006	0.0870*	0.2478***	0.4078***	0.5255***	0.6968***
	(0.0748)	(0.0546)	(0.0503)	(0.0588)	(0.0483)	(0.0529)	(0.0556)	(0.0637)	(0.0983)
NJXU2	-0.4069***	-0.3650***	-0.3049***	-0.0940**	0.0032	0.1346***	0.2153***	0.2860***	0.3738***
	(0.0694)	(0.0504)	(0.0410)	(0.0456)	(0.0388)	(0.0385)	(0.0393)	(0.0453)	(0.0605)
NJXU3	-0.5637***	-0.4678***	-0.4404***	-0.2212***	-0.0061	0.1564***	0.2203***	0.2988***	0.3895***
	(0.0648)	(0.0485)	(0.0411)	(0.0483)	(0.0366)	(0.0400)	(0.0408)	(0.0447)	(0.0659)
NJXU4	-0.6745***	-0.6043***	-0.5867***	-0.3425***	-0.0059	0.2194***	0.2949***	0.2774***	0.3592***
	(0.0678)	(0.0527)	(0.0479)	(0.0571)	(0.0397)	(0.0421)	(0.0440)	(0.0485)	(0.0664)
NJXU5	-0.8083***	-0.7357***	-0.7400***	-0.4884***	-0.0543	0.2885***	0.4676***	0.3704***	0.4210***
	(0.0659)	(0.0511)	(0.0487)	(0.0580)	(0.0419)	(0.0389)	(0.0438)	(0.0497)	(0.0678)
NJXU6	-0.9323***	-0.8461***	-0.7441***	-0.5105***	-0.0331	0.2723***	0.3792***	0.3915***	0.3510***
	(0.0613)	(0.0486)	(0.0436)	(0.0590)	(0.0356)	(0.0373)	(0.0398)	(0.0477)	(0.0637)
NJXU7	-0.9798***	-1.0075***	-0.9768***	-0.7942***	-0.2945***	0.0792**	0.2977***	0.3513***	0.3634***
	(0.0590)	(0.0436)	(0.0426)	(0.0555)	(0.0345)	(0.0365)	(0.0370)	(0.0429)	(0.0586)
NJXU8	-1.0465***	-1.0188***	-0.9777***	-0.7496***	-0.2631***	0.0865**	0.2519***	0.3140***	0.4381***
	(0.0656)	(0.0524)	(0.0478)	(0.0581)	(0.0425)	(0.0405)	(0.0410)	(0.0472)	(0.0621)
NJXU9	-0.9043***	-0.9156***	-0.8710***	-0.6278***	-0.1838***	0.1185***	0.2888***	0.3018***	0.4309***
	(0.0675)	(0.0560)	(0.0553)	(0.0725)	(0.0443)	(0.0407)	(0.0445)	(0.0471)	(0.0658)
NJXU10	-0.9883***	-0.9407***	-0.8829***	-0.6177***	-0.2044***	0.1177***	0.2875***	0.3672***	0.4970***
	(0.0619)	(0.0493)	(0.0460)	(0.0599)	(0.0381)	(0.0379)	(0.0387)	(0.0451)	(0.0612)
NJXU11	-0.9460***	-0.9486***	-0.9035***	-0.6249***	-0.2134***	0.1218***	0.3551***	0.4580***	0.5791***
	(0.0640)	(0.0465)	(0.0456)	(0.0535)	(0.0400)	(0.0384)	(0.0377)	(0.0479)	(0.0634)
N	22431	22431	22431	22431	22431	22431	22431	22431	22431

Standard errors in parentheses

The standard errors for unconditional quantile regression are obtained through 500 bootstrap replications.

*p<0.10   ** p<0.05   *** p<0.01

5. CONCLUSION

The real estate industry has become an essential component of a country's GDP and the financial system, but it has also become a key aspect of everyone's daily life and stable economic development. Therefore, it has become an indispensable way to promulgate regulation policies for the real estate industry to ensure the healthy and stable development of the real estate industry. In recent decades, house prices in China have been showing an excessively rapid growth trend. In order to stabilize housing prices and curb speculative demand, the Chinese government has issued a series of policies, the most stringent of which is the HPR policy. I used the DID model to analyze the difference between the change in Chongqing and Nanjing housing prices after the implementation of the new HPR policy in 2016 to obtain the impact of the new HPR on the real estate market.

5.1. Objectives of The Project

This project aims to identify the effect of housing policies on housing price by using the HPR as an exemplification in China. The followings are specific objectives of this study:

To examine the effect of the "new" HPR policy, which was enacted in 2016, on house prices.

To identify the changes in the impact of HPR policy over time, which allow us to analyze the time effectiveness of the policy.

To analyze the neighborhood effects of the HPR policy on house prices.

To put forward suggestions on the policies on the real estate market

5.2. Methodology of the Project

The Hedonic Price Model and the unconditional quantile regression were constructed for this project. We analyze the difference between the variations of house prices in Chongqing and

Nanjing after the new HPR was enacted by using a difference-in-differences (DID) model,

using Chongqing as a control group and Nanjing as a treatment group to disentangle the HPR

impact on the housing market. An unconditional quantile regression (UQR) is applied to

examine the HPR impact across the conditional house price distribution.

5.3. Findings

On average, I find that the new HPR policy has a significant negative impact on house

prices. However, when I decompose the HPR policy impact and examine the policy

effectiveness across the complete distribution of house prices, I find that the HPR policy has a

negative impact on lower-priced homes, and positive impact on higher-priced houses.

From a policy perspective, this study provides some evidence to assess the impact of

government intervention on the real estate market. The immediate purpose of the HPR policy is

undoubtedly to control high house prices and curb speculation and excessive investment.

Purchase restrictions work in a way that controls the demand for housing while supply has yet

to be affected. From what I have found in this study, the HPR policy only achieves the goal of

lowering house prices for the lower-priced houses. Contradictorily, higher-priced homes

experienced even higher prices after the implementation of HPR policy.

Therefore, the HPR policy is partially effective as the government's control measures to

control excessive house prices. However, it should be noted that the HPR policy may increase

the wealth inequality between the rich and the poor. The purchase restriction policy is mainly to

control the excessively rapid price growth on the demand side, but the policy effect maybe

offset by the substitution effect when households upgrade the size and quality of their homes.

To effectively address this issue, the Chinese government should also target the supply factors,

such as ensuring land supply, promoting the development of the rental market, and accelerating the construction of affordable housing.

The results should be viewed in light of the research limitations. I collected data from the Chinese real estate agent Lianjia website, therefore, my dataset may not cover all housing transactions. However, Lianjia, as the largest Chinese real-estate brokerage company, and occupies approximately 55-60% of the real-estate brokerage market. I believe the data collected from Lianjia should greatly represent the housing market. In addition, Chongqing might not be a perfect control group for our study due to the geographical, social and economic differences between the two study cities. However, Chongqing is the only major city in China that has not implemented the new HRR policy. The study provides in-depth information which has not been discovered by previous literature and serves as a pioneer work in analyzing the differential effects of the HPR on higher- vs lower- priced houses.

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APPENDIX

Table A1. PSM Result.

Variable	Sample	Treated	Controls	Difference	S.E.	T-stat
lprice	Unmatched	5.23862805	4.46348019	0.77514786	0.00316414	244.98
	ATT	5.23862805	4.15895303	1.07967502	0.00951845	113.43

Table A2. Balance Test.

Variable	Unmatched / Matched	Mean Treated	Mean Control	%bias	%reduct bias	t-test t	p>t	V(T)/ V(C)
bedroom	U	2.2387	2.3919	-18.8	-27.42	0	0.66*	
	M	2.2387	2.2557	-2.1	88.9	-2.96	0.003	0.80*
livingroom	U	1.3819	1.6273	-43.6	-64.65	0	0.84*	
	M	1.3819	1.4349	-9.4	78.4	-12.33	0	0.76*
kitchen	U	0.99903	0.99756	1.8	2.48	0.013	0.27*	
	M	0.99903	1.0017	-3.2	-78.5	-3.64	0	0.19*
bathroom	U	1.1251	1.3997	-58.5	-83.23	0	0.38*	
	M	1.1251	1.1227	0.5	99.1	0.9	0.366	0.86*
area	U	76.773	92.05	-45.8	-66.53	0	0.59*	
	M	76.773	81.26	-13.5	70.6	-21.26	0	1.04*
2016.saleyear	U	0.30954	0.18632	28.8	44.04	0	.	
	M	0.30954	0.32735	-4.2	85.5	-5.15	0	.
2017.saleyear	U	0.23002	0.31032	-18.2	-26.88	0	.	
	M	0.23002	0.20088	6.6	63.7	9.54	0	.
2018.saleyear	U	0.22858	0.32955	-22.7	-33.46	0	.	
	M	0.22858	0.20594	5.1	77.6	7.39	0	.
2019.saleyear	U	0.1575	0.1509	1.8	2.74	0.006	.	
	M	0.1575	0.16805	-2.9	-59.7	-3.85	0	.
arcstyle2	U	0.66787	0.14536	125.6	194.6	0	.	
	M	0.66787	0.66056	1.8	98.6	2.09	0.037	.
arcstyle3	U	0.08936	0.75456	-182.2	-260.91	0	.	
	M	0.08936	0.093	-1	99.5	-1.7	0.088	.
arcstyle4	U	0.00047	0.00114	-2.4	-3.38	0.001	.	
	M	0.00047	0.00039	0.3	87.7	0.54	0.59	.
furnishing2	U	0.37852	0.38264	-0.8	-1.27	0.204	.	
	M	0.37852	0.36151	3.5	-312.7	4.74	0	.
furnishing3	U	0.0507	0.19247	-44.4	-62.71	0	.	
	M	0.0507	0.04415	2.1	95.4	4.14	0	.
furnishing4	U	0.34707	0.30222	9.6	14.41	0	.	
	M	0.34707	0.39072	-9.3	2.6	-12.19	0	.
structure2	U	0.0013	0.00133	-0.1	-0.13	0.898	.	
	M	0.0013	0.00121	0.2	-166.4	0.31	0.753	.
structure3	U	0.18346	0.02164	55.3	91.37	0	.	
	M	0.18346	0.21035	-9.2	83.4	-9.11	0	.
structure4	U	0.80577	0.96373	-51.1	-82.89	0	.	
	M	0.80577	0.78086	8	84.2	8.28	0	.
structure5	U	0.00754	0.00566	2.3	3.54	0	.	
	M	0.00754	0.00552	2.5	-7.1	3.37	0.001	.