

On the Effectiveness and Externalities of the Home Purchase Restriction Policy in China

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In order to curb the soaring house prices, the Chinese government has been focusing on macro-control of real estate on the demand side. Among them, the Home Purchase Restriction (HPR) is one of the most commonly used policy tools, and its influence has attracted the attention from both the public and the academia. Although many scholars have studied the effectiveness of the home purchase restriction policy, there is no universal conclusion and the empirical research on the externalities of this policy is scarce. Based on the daily transaction micro-data of the real estate sales market, the rental market and the land market, this paper uses the difference-in-difference model to evaluate the effectiveness of the HPR more accurately, further integrates the relevance of each market into the analytical framework and explores the externalities of the HPR on the real estate rental market and the land market. The empirical results show that the HPR lowers the house price by 10.12%, which is higher than the estimation results of previous studies; and increases the rent by 25.09%, while decreases the residential land price by 9.08%, with no significant impact on industrial and commercial land prices. A series of robustness tests and counterfactual analysis, such as PSM-DID, all support the reliability of the empirical results. The externalities of the HPR indicates that the policy is not conducive to improving the welfare of people with the rigid housing demand, and may trigger the “soft resistance” of the local government. Therefore, the government should focus on how to promote the supply-side structural reform on the land market and real estate market on the basis of strengthening the local tax system.

Keywords: home purchase restriction, policy effectiveness, policy externalities, difference-in-difference model

1. Introduction

“Everyone has a home to live in” is the inevitable requirement of building the moderately prosperous society in an all-round way in China, and it is also a reflection

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that China is now overcoming the unbalanced and insufficient development so as to ensure all people can enjoy the shared prosperity and acquire more sense of gain during the joint development. The concept of “home is used for residence rather than speculation, rent and buying are of parallel importance” was officially proposed in the reports of the 19th National Congress of the Communist Party of China and became a long-term arrangement of housing system. The earlier regulation policies are implemented from the perspective of supply side, which includes adjusting the housing structure by enlarging the development of affordable housing. However, such policies are not that efficient. Under this background, China begins to turn to demand side management (Fan, 2016). On January 10th, 2010, the central government issued “11 national policies” to elevate the ratio of down payment by housing loan from 30% to 40% in the hope that the house price could be declined by means of restriction on housing loan. But it failed to curb the house price either.¹ As such, the central government introduced the toughest “new 11 national policies” in history on April 17th, 2010, requiring that “the local people’s governments may adopt temporary measures to limit the number of house-purchase within a certain period of time”.² As of 2014, a total of 46 large and middle cities had implemented the home purchase restriction policies, which covered nearly all economic central cities nationwide and in different regions. It not only exerted the policy effect in the real estate market, but also expanded the extensive boundary of its policy influence to other key market areas in close relation with the real estate sales market.

On the one hand, as one of the key policies regarding the macro-control of real estate market at present and in the near future, how about the effect on curbing house prices delivered by homepurchase restriction policies? Although some empirical studies have discussed the question, no consistent conclusions are reached. In terms of the data hierarchy of the regression samples and the definition of core explanatory variables, the model setting in the traditional research fails to match the actual situation of the implementation of the home purchase restriction policy, and the accuracy is obviously insufficient, thus interfering with the evaluation results of the policy. On the other hand, what is ignored but of important research value is that, will home purchase restriction policy exert externalities on other key market areas apart from real estate sales market, such as the real estate rental market and land market in direct connection with sales market in particular? Although existing literature has discussed the effect of the purchase restriction policy on house price, the externalities of the purchase restriction policy has been less concerned by scholars, and the real estate sales market and other related market fields have not been incorporated in the analysis framework. Several studies even fail to provide sufficient micro empirical evidence. The possible

¹ Notice on Promoting the Stable and Healthy Development of the Real Estate Market by the General Office of the State Council.

² Notice on Curbing the Rapid Rise of House Price in Some Cities Resolutely.

mechanisms of externalities lie in the following aspects. (1) In real estate rental market, in order to seek temporary solution to housing, a large number of people who are in actual demand of a house but are unqualified to purchase house turn to rent house for residence in a short term (Zhu and Yan, 2013). (2) In land market, house restriction policy obviously inhibits the demand in real estate sales market and at the same time, the supply side of housing market will be affected as well, as evidenced by the obvious weakened willingness of developers to buy land and build houses. It will further lead to the adjustment of supply demand relationship in land market and the significant decrease of the land price (unit price). Considering the relevance to local governments' land financial revenue (Tao, 2009; Yang *et al.*, 2014), it may trigger local governments' "soft resistance" against the restriction policy.

The contributions of this paper include three aspects. (1) This paper provides more accurate micro empirical evidence for the effectiveness of the purchase restriction policy. Based on the micro-data of daily transactions in three types of markets, this paper constructs a difference-in-difference model refined to districts, counties and daily transactions, which is matched with the actual situation of purchase restriction policy, so as to evaluate its policy effect in an accurate and scientific approach. The results show that the purchase restriction policy would obviously inhibit the house price, and the influence on house prices is bigger than the estimated results in the past empirical papers. Therefore, as the most essential policy tool for macro-control of real estate at the current stage, the effectiveness of purchase restriction policy has been significantly underestimated for a long time. (2) This paper innovatively extends to other market areas besides the real estate sales market, namely, the two most directly related to the real estate sales market—the real estate rental market and the land market, and analyzes the externality effect of the purchase restriction policy. As shown in the results, purchase restriction policy would cause significant rise of rent and obvious decline of the land price. (3) This paper also pays attention to the heterogeneity effect of three regions and two dimensions of land transfer model. The results indicate that the effectiveness and externalities happen in eastern China more often in comparison with central and western China; and the restriction policy's externalities are further reflected in the marketized land transfer ways as "bidding, auction and listing" in land market.

The following structures are: the second section is the literature review and research hypothesis; the third section is the empirical strategy and data specification; the fourth section shows the empirical results; the fifth and sixth section introduces the robustness tests and heterogeneity test respectively; and the last section is the conclusion and policy implication.

2. Literature Review and Research Hypotheses

The existing literature on the purchase restriction policy has two obvious

deficiencies in the aspects of policy effectiveness and policy externalities, which affects the accuracy and depth of analysis and evaluation.

2.1. Policy Effectiveness

A core dispute is that whether purchase restriction policy could effectively curb the house price. Some scholars hold that the restriction policy can hardly to do so (Qiao, 2012; Wang and Huang, 2013; Han *et al.*, 2014; Tang and Liang, 2016). Tang and Liang further point out that the effectiveness may be offset by the policy escape of “fake divorce”. Others regard that whether the purchase restriction policy can curb the house price depends on certain preconditions like the reduction of consumer demand caused by the purchase restriction policy, the cost and expectation of developers’ intertemporal adjustment of supply (Liu *et al.*, 2012), policy enforcement (Zhang and Zheng, 2013) as well as the period of policy taking effect (Deng *et al.*, 2014).

The common characteristic of the above empirical researches is that the regression test is done on the basis of the monthly house price index (hereinafter referred to as “house price index”) in 70 mid-and-large cities or the mean value of urban house prices per year. Conversely, this paper refers to the daily transaction data in real estate sales market to construct the difference-in-difference model refined to district, county and daily transaction, so as to estimate the restriction policy’s effect on curbing house prices. To be specific: (1) This paper achieves accurate match with the implemented scope of purchase restriction policy. The most majority of cities adopting purchase restriction only choose part of districts and counties under their jurisdiction as the implementation targets. But when the house price data at the city level are adopted to conduct the regression test, the non-restriction districts and counties are actually included into the policy implementation, thus producing the error in estimating the effect of purchase restriction. (2) This paper refrains from bringing about the possible error of indirect measurement data. Two kinds of house price data and their measurement approaches have certain defects in the current application, which results in measurement inaccuracy of both of them and even the serious deviation from the actual house price (Wu *et al.*, 2014). (3) This paper uses daily high-frequency data which could better reflect the immediate effect of the purchase restriction policy. Owing to the numerous real estate transactions are made on a daily basis, in comparison with the monthly or annual average value, the frequent daily transaction data on real estate sales is more in line with the actual real estate transaction frequency. Thus, the immediate policy effect of adopting home purchase restriction policy on house prices can be accurately reflected.

This paper holds that the purchase restriction policy would curb the demand in real estate sales market, which moves down the short-term demand curve while brings no change to short term supply curve. Therefore, the short-term equilibrium price of the

real estate sales market would drop.

In summary, we put forward the first hypothesis to be tested.

Hypothesis 1: As for the real estate market, the purchase restriction policy has the effectiveness of curbing the house price.

2.2. Policy Externalities

Apart from the real estate sales market, purchase restriction policy will exert significant externality impact on other market areas. For example, it is conducive to easing the side effect on technological innovation due to the rise of house prices (Yu and Zhang, 2017), and will bring about the phenomenon known as “divorce for house purchase” (Fan, 2016; Tang and Liang, 2016).

This paper first focuses on the externalities of purchase restriction policy on the real estate rental market. In terms of the 46 cities adopting purchase restriction policy, the vast majority of them emphasize the restrictive house purchase conditions regarding the households without local registrations. So, both local households who have owned one or more sets of houses and the non-local registration households are unqualified to buy house.¹ The latter, however, are not allowed to purchase any house even though they have no real estate in the city. As is often the case, such “non-house owners” belong to the kind in actual rigid demand for housing. Also, cities with purchase restriction policy include the first and second-tier, large-and-medium-sized cities with a large number of migrant population, and their rigid real housing demand is more robust. Hence, due to the purchase restriction policy, the speculative demands of real estate investment will be curbed, and quite a few households will turn to rental market to seek temporary solutions to housing. Once the supply demand relation changes in the real estate rental market, namely the demand rises and the short-term supply remains unchanged, the equilibrium price of the rental market in the short term will be increased significantly.

In summary, we put forward the second hypothesis to be tested.

Hypothesis 2: For real estate rental market, the purchase restriction policy has the externalities which will significantly drive up rent.

The third hypothesis is about the purchase restriction’s externalities on land market. The supplier of real estate (that is, developer enterprises) would adjust their supply behaviors at each stage according to the present and future demand in the real estate sales market (Wang and Huang, 2013). Therefore, from the views of market supply and demand, purchase restriction policy would significantly curb the demand in real estate sales market, at the same time, developers as the supply side will react to the policy. When real estate development enterprises observe the obvious drop in the demand

¹ According to papers on purchase restriction policies, the house purchase conditions of non-local registered households are often linked with the local tax payment and social security payment. If no certificate of the above two payments are provided, they are not allowed to purchase house in that city.

of real estate sales market, they will make rational behavioral decisions to reduce the development and supply of real estate so as to avoid possible “oversupply”. As residential land is the basic factor input for the “production” of real estate development enterprises, it will further lead to the decline in the demand for residential land market. Under the condition that the supply of residential land market stay unchanged in the short term, the short-term equilibrium price of residential land market will significantly decline. However, as the purchase restriction policy does not have a significant impact on the supply-demand relationship between the industrial land market and the commercial land market, the short-term equilibrium price of the industrial land market and the commercial land market will not change significantly.

In summary, we put forward the third hypothesis to be tested.

Hypothesis 3: For land market, the purchase restriction policy has the externalities on the significant decrease of real estate land price while it has no significant impact on commercial land price and industrial land price.

3. Empirical Strategy and Data Description

3.1. Empirical Strategy

This paper adopts the difference-in-difference model to analyze the changes of house prices, rents and land prices in cities with purchase restriction policies before and after the implementation of such policies in comparison with cities without purchase restriction, as is shown in formula (1).

$$Y_{ijt} = \alpha x_{ijt} + \beta Policy_{jt} + \mu_j + \lambda_t + \varepsilon_{ijt} \quad (1)$$

Among them, the subscript j stands for the district or county where the i transaction information lies in. The subscript t stands for the transaction date (year, month, day); Y_{ijt} is the explanatory variable which stands for the unit price of real estate sales, real estate unit rent and the unit land price of various types of utilization (residential land, industrial land and commercial land) upon transaction; $Policy_{jt}$ is the core explanatory variable. When district or county j implements the purchase restriction policy on the date of t , $Policy_{jt}$ is 1, otherwise is 0. The estimation coefficient β reflects the purchase restriction policy's impact on house price, rent and land price. In addition, other control variables as X_{ijt} is included in this paper with an aim to control other factors' influence on house price. In the meantime, fixed effect μ_j and daily fixed effect λ_t are controlled to capture the heterogenous factors and the common factors that are unable to be observed. And ε_{ijt} stands for error term. It can be seen that the model is extended to the level of districts, county and daily condition.

Because the house prices, rents and land prices in cities are not only subject to

purchase restriction policies, but also dependent on the socio-economic development condition there, it is necessary to introduce some key control variables to the above empirical models as follows. (1) Other control variables at the city level including per capita GDP, total population, average expenditure, and administration coverage, which are used to depict the economic development, total amount of population, residents' consumption level and the housing supply respectively. (2) Other control variables at the residential level include greening rate and floor area ratio, which are used to control other factors influencing the real estate sales price and rent. (3) Other control variables including land source, way of supply, land scale and the convenience degree of nearby areas, which are used to control other factors influencing the land transfer prices.¹

3.2. Variable and Data Description

House price and rent data. Housing sales transaction unit price and rental transaction unit price are directly derived from the daily transaction micro-data in the real estate sales and real estate rental market (2005—2013),² recorded in the “sofang.com”. Similar to real estate sales transaction data, real estate rental transaction data also has four advantages applicable to the analysis of the effect of purchase restriction policies.³

Land price data. Residential land transaction unit price, industrial land transaction unit price and commercial land transaction unit price are directly coming from the daily transaction micro-data in the land market (2007—2013). Such data are from the “landchina.com”.⁴

Other control variables. The data of control variables at city level are derived from

¹ Land sources include existing construction land and new construction land; land supply modes involve allocation agreement, bidding, auction and listing and other modes; land grade is from 1-18 level; the convenience of nearby areas are measured by the minimum distance between plot and KFC or Macdonald's. The closer the distance is, the more convenience it is.

² The transaction price, residence coverage, community name, transaction date, greening ratio in a community and floor area ratio are recorded in the daily micro transaction data in real estate sales and rental market. Also, the selection of the sampling date is due to that some restricted cities began to ease or cancel the purchase restriction policy since 2014. Therefore, in order to avoid the underestimation of the impact brought by purchase restriction policy, data in 2014 or the upcoming years will not be adopted.

³ Both real estate sales transaction data and the real estate rental transaction data are from “sofang.com”. The transaction information of such two types of data are basically the same, so the advantage of them are similar.

⁴ China's land website: <http://www.landchina.com/>. The public land transaction data are from the *Regulations on the Transfer of State-Owned Land Use Right through Bidding, Auction and Listing (Trial)* implemented since the date of August 1th, 2006. It specifies that the authoritative department at the municipality and county government must publish any land using right transfer plan earlier and make the result of land transfer public. Therefore, we have opportunities to get access to the details of each land transfer result, including the details of district and county government, plot, coverage, land usage, land grade, transfer mode and land transaction price.

the *China Statistical Yearbook for Regional Economy*, *China City Statistical Yearbook* and CEIC database; control variables at the residence level are directly from the real estate sales and rental transaction data at the “soufang.com”, which include greening ratio and floor area ratio.

Table 1. Descriptive Statistics

Variable name	Unit	Sample size	Mean value	Standard deviation	Minimum	Maximum
City level data						
House price logarithm	yuan/m ²	2600	7.9674	0.5609	6.5709	10.6961
House price increase	%	2600	11.3898	13.5760	-225.3201	94.3221
Logarithm of GDP per capita	10 thousand yuan	2608	10.0411	0.7268	7.7807	12.1896
Logarithm of expenditure per capita	10 thousand yuan	2563	9.2683	0.3641	8.2399	10.4118
Logarithm of total population	10 thousand people	2611	5.8311	0.7115	2.7973	8.1107
Logarithm of administrative area	km ²	2609	9.1710	0.9798	3.9103	10.2866
Ratio of the secondary industry	%	2608	53.2134	11.8972	8.0696	90.2328
Ratio of the tertiary industry	%	2608	43.5912	10.6753	6.0961	87.0302
Latitude (1999)	—	2611	32.9001	6.6102	18.2501	50.2513
Longitude (1999)	—	2611	114.7602	6.8110	84.8902	131.1614
Average altitude (1999)	m	2611	439.8231	528.0902	1.3020	3120.5115
Average slope (1999)	%	2611	0.7014	0.6721	0.0099	5.0789
Micro-transaction data						
Logarithm of residential sales transaction unit price	yuan/ m ²	907997	9.8830	0.7541	1.9459	20.4666
Logarithm of residential transaction unit rent	yuan/m ²	85947	8.0600	0.5041	7.0901	9.1378
Logarithm of residential use transaction unit price	10 thousand yuan/ hm ²	369669	5.9632	1.2178	3.8067	9.1676
Logarithm of industrial land transaction unit price	10 thousand yuan / hm ²	220917	5.1992	0.6195	3.8067	9.1547
Logarithm of commercial land transaction unit price	10 thousand yuan/hm ²	191819	6.0654	1.1930	3.8067	9.1674
Floor area ratio	—	778745	2.3975	1.2146	0.4000	8.3700
Greening ratio	%	797420	37.45	0.0979	0.1000	70.0000
Convenience degree of nearby areas	km	782405	2.3470	1.4122	0.0031	6.9248

4. Empirical Result

4.1. Effectiveness Analysis of Purchase Restriction Policy

We first evaluated the inhibitory effect of purchase restriction policy on house price based on formula (1). And column (1) and column (2) in Table 2 are the estimated results without and with other control variables. It is can be seen that when other control variables are added in column (2), the house price in areas with purchase restriction is significantly down by 10.12% in comparison with that in non-restricted areas, and the absolute value and significance level of the estimated coefficient are elevated to some degree relative to the results in column (1). So, the purchase restriction policy has the effect of significantly curbing the house price.

Table 2. Purchase Restriction Policy's Impact on Transaction House Prices and Rents

	(1)	(2)	(3)	(4)
	Transaction unit price of residential house sales		Residential transaction unit rent	
Daily purchase restriction in district and county	-0.0919** (0.0462)	-0.1012*** (0.0273)	0.2517*** (0.0651)	0.2509*** (0.0752)
County and district fixed effect	yes	yes	yes	yes
Daily fixed effect	yes	yes	yes	yes
Other control variables	no	yes	no	yes
Adjustment of R ²	0.6038	0.6219	0.3317	0.3714
Sample size	907747	719120	106932	73324

Notes: ***, ** and * respectively stand for 1%, 5% and 10% in terms of the significance level. No other control variables are added in column (1) and column (3); in column (2) and (4), other control variables come from city and residence level; in parenthesis are the clustering robust standard errors of districts and counties; the district and county fixed effect and daily fixed effect are controlled.

4.2. Externalities Analysis of Purchase Restriction Policy

Real estate rental market. First, this paper examines the externality effect of the purchase restriction policy on the real estate leasing market. The column (3) and (4) in Table 2 respectively lists the regression results without and with other control variables. On the basis of adding other control variables in column (4), the influence coefficient of the purchase restriction policy remains positive, and the absolute value of the influence coefficient increases to a certain extent. Viewed from the impact degree, the rent in purchase-restricted areas rises significantly by 25.09% in comparison with non-purchase-restricted areas. This can be explained that many people will “seek to rent instead of purchase” to satisfy their housing demands, which will increase the rental demands in real estate rental market. And given that the rental supply remains

stable, the supply-demand relation will change in rental market and drive up the rent. Therefore, the purchase restriction policy exerts side effect on the actual rigid demand for housing besides curbing the speculative demand for real estate investment.

Land market. Next is the externalities of purchase restriction policy on the land market. According to the empirical results shown in Table 3, the odd column is the regression results without other control variables included in the regression, and the even column is the regression results with adding other control variables included in the regression. The regression result in column (2) indicates that the purchase restriction policy gives rise to the significant decline of the transaction price of residential land. And in the view of impact degree, the residential land price in purchase-restricted areas is significantly down by 9.08% in comparison with those areas without purchase restriction. However, the regression results in column (4) and (6) show that the purchase restriction policy has no significant impact on the price of industrial and commercial land. Based on the above analysis, the reason may be that the policy effect of purchase restriction is transmitted from the real estate sales market to the residential land market. The low house price makes the real estate developers' demand for residential land drops, which results in the decline of residential land price when the supply of urban residential land is relatively stable.

Table 3. Purchase Restriction Policy's Impact on Land Price

	(1)	(2)	(3)	(4)	(5)	(6)
	Residential land transaction unit price	Residential land transaction unit price	Industrial land transaction unit price	Industrial land transaction unit price	Commercial land transaction unit price	Commercial land transaction unit price
Daily purchase restriction in district or county	-0.0820*** (0.0335)	-0.0908*** (0.0300)	-0.0072* (0.0041)	-0.0058 (0.0179)	-0.0448 (0.0385)	0.0000 (0.0361)
County or district fixed effect	yes	yes	yes	yes	yes	yes
Daily fixed effect	yes	yes	yes	yes	yes	yes
Other control variables	no	yes	no	yes	no	yes
Adjustment of R ²	0.4959	0.6326	0.4501	0.6396	0.3197	0.4902
Sample size	369658	369658	220888	220888	191796	191796

Notes: ***, ** and * stand for the significance level as 1%, 5% and 10% respectively. No other control variables are added in column (1), (3) and (5); in column (2), (4) and (6), other control variables come from city and plot level; in parenthesis are clustering robust standard errors of districts and counties; the district and county fixed effect and daily fixed effect are controlled.

5. Robustness Test

5.1. Parallel Trend Hypothesis Test and Dynamic Time Trend

Based on the difference-in-difference model test above, the purchase restriction

policy could significantly pull down the house price and exert a series of externalities, which causes the rent in real estate rental market to rise significantly and the real estate land price in land market to drop significantly. One of the key conditions to support the difference-in-difference model is the hypothesis of “parallel trend” (Besley and Case, 2000). In order to study this question, this paper adds some dummy variables before and after the implementation of purchase restriction. To be specific, we take one month as a unit and add some new dummies including the third month before the implementation of purchase restriction as *pre 3*, the second month before the policy implementation as *pre 2* and also *pre 1*; the current month of the implementation of purchase restriction as *post 0*, the first month following the implementation as *post 1*, along with *post 2* and *post 3* and other dummy variables. All of these are added into the regression equation. The period before-acts as the benchmark group.

Table 4 illustrates the results of regression. The column (1)~(3) show the regression result concerning house price, rent and residence land price. It is obvious that prior to the implementation of purchase restriction policy, the house price, rent and the residence land price don't drop significantly in comparison with that of control group, which is in line with the hypothesis of “parallel trend” in the difference-in-difference model. Besides, following the implementation of the purchase restriction policy, the change of the two groups of samples began to show significant differences. The house price and residence land price in the treatment group drops significantly relative to that in the control group, and the rent in the treatment group rises significantly in comparison with that in the control group. Such trend is continuous to some extent. In column (4)~(5), based on the regression result of industrial land price and commercial land price, no significant differences occur before and after the implementation of the purchase restriction policy by both control and treatment group, indicating that such policy brings no significant external influence on industrial land price and commercial land price. The above empirical results verify the robustness of the major conclusions in this paper.

Table 4. Parallel Trend Hypothesis Test and Dynamic Time Trend

	(1)	(2)	(3)	(4)	(5)
	Residence sale transaction unit price	Residence transaction unit rent	Residence land transaction unit price	Industrial land transaction unit price	Commercial land transaction unit price
<i>pre3</i>	0.0257* (0.0139)	-0.0929 (0.0572)	-0.0714 (0.0229)	0.0013 (0.0169)	0.0024 (0.0311)
<i>pre2</i>	0.0254* (0.0153)	0.0813 (0.0599)	-0.0709 (0.0395)	-0.0020 (0.0184)	0.0019 (0.0334)
<i>pre1</i>	0.0232 (0.0220)	0.1017 (0.0632)	-0.0624 (0.0431)	-0.0017 (0.0176)	0.0018 (0.0392)

	(1)	(2)	(3)	(4)	(5)
	Residence sale transaction unit price	Residence transaction unit rent	Residence land transaction unit price	Industrial land transaction unit price	Commercial land transaction unit price
<i>post0</i>	-0.0901** (0.0355)	0.2014** (0.0790)	-0.0882*** (0.0200)	-0.0078 (0.0186)	0.0011 (0.0378)
<i>post1</i>	-0.1024*** (0.0288)	0.2327*** (0.0725)	-0.0808*** (0.0234)	-0.0091 (0.0175)	0.0022 (0.0404)
<i>post2</i>	-0.1013*** (0.0296)	0.2520*** (0.0708)	-0.0775*** (0.0278)	-0.0077 (0.0184)	0.0017 (0.0332)
<i>post3</i>	-0.0930** (0.0381)	0.1905** (0.0783)	-0.0896*** (0.0344)	-0.0083 (0.0189)	0.0026 (0.0384)
Fixed effect in district and county	yes	yes	yes	yes	yes
Monthly fixed effect	yes	yes	yes	yes	yes
Other control variables	yes	yes	yes	yes	yes
Adjustment of R ²	0.6220	0.3719	0.6331	0.6427	0.4964
Sample size	719120	73324	369658	220888	191796

Notes: ***, ** and * stand for the significance level as 1%, 5% and 10% respectively. In column (1) and (2), other control variables are at city and residence level; in column (3)–(5), other control variables are at city and plot level. In column (1)–(5), values in parenthesis are clustering robust standard errors of districts and counties; the district and county fixed effect and daily fixed effect are controlled.

5.2. PSM-DID Method

In order to further guarantee the reliability of core conclusions, Propensity Score Matching (PSM) is used to select a suitable control group for treatment groups.¹ It is pivotal to select appropriate pre-treatment variables for match analysis. There are three types of match variables herein. Firstly, main factors which will influence the implementation of purchase restriction policy, namely house price and its growth.² Secondly, other factors which may simultaneously affect the demand for house purchase and house price, rent and land price and other explained variables such as per capita GDP, industrial structure, population size, per capita income level and administrative area. Thirdly, geographical factors are used for controlling the climate

¹ Due to the shortage of match variables at the district and county level, we chose to do PSM at the city level.

² According to the *Notice on the General Office of the State Council on further Improving the Regulation and Control of the Real Estate Market*, “All provincial capitals in municipalities directly under the central government and cities with excessively high or excessively rapid house prices shall, within a certain period of time, strictly formulate and implement measures to restrict the purchase of housing”. Therefore, The residence price, growth of house price and the administrative level of municipalities directly under the central government, are the three most important foundations for the implementation of the purchase restriction, but the purchase restriction list has basically included all cities listed separately under the central government and provincial capitals.

condition and livability degree of cities and factors as city construction land plan involving geographical location and landform.¹ The parallel conditional hypothesis test results of matched samples reflect that the parallel conditional hypothesis of PSM is basically satisfied.² Upon completion of the above match, the original 46 treatment group cities are reserved and a total of 159 control group cities are selected to match with them.

Table 5 shows the empirical result of the effect of purchase restriction policy estimated by PSM method. According to the result by difference-in-difference estimation after PSM match. (1) The house prices in purchase-restricted cities are significantly down by 11.29% in comparison with non-purchase-restricted cities. Compared with the estimation coefficient as 10.12% without PSM match during benchmark regression, the estimation coefficient is increased to some extent. Therefore, the self-selection issue fails to affect the benchmark regression result in terms of the purchase restriction effectiveness, instead, it intensifies the effectiveness; (2) The rents and residence land prices in purchased restricted cities are significantly increased by 23.07% and decreased by 8.70% in comparison with the non-purchase restricted cities. However, the industrial and commercial land prices will not have significant changes, which is basically consistent with the estimation coefficient in the benchmark regression result. As the above mentioned, PSM-DID result shows that the conclusion in this paper is robust enough.

Table 5. PSM-DID Regression Result

	(1)	(2)	(3)	(4)	(5)
	Residence sales transaction unit price	Residence transaction unit rental fee	Residence land transaction unit price	Industrial land transaction unit price	Commercial land transaction unit price
City daily purchase restriction	-0.1129*** (0.0250)	0.2307*** (0.0652)	-0.0870*** (0.0431)	-0.0035 (0.0162)	0.0023 (0.0669)
City fixed effect	yes	yes	yes	yes	yes
Daily fixed effect	yes	yes	yes	yes	yes
Other control variables	yes	yes	yes	yes	yes

¹ Among them, the geographical location is measured by the latitude and longitude of the control city's geographical center of mass, and the terrain is measured by the average altitude and slope of the city. Of the above match variables, the economic variables at the city level are derived from the *China City Statistical Yearbook*. The data of urban longitude, latitude, elevation and slope variables in the geographic information variable are based on the Chinese Digital Elevation Model (DEM) offered by Google Earth and extracted by Arcgis software.

² Due to the space limitation, parallel condition hypothesis test result of match variables are not include in the main text, but are retained on request.

	(1)	(2)	(3)	(4)	(5)
	Residence sales transaction unit price	Residence transaction unit rental fee	Residence land transaction unit price	Industrial land transaction unit price	Commercial land transaction unit price
Adjustment of R ²	0.7195	0.4016	0.7023	0.7810	0.5402
Sample size	590177	47624	240569	143782	122785

Notes: ***, ** and * stand for the significance level as 1%, 5% and 10% respectively. In column (1) and (2), other control variables come from city and residence level; in column (3)~(5), other control variables come from city and plot level. In column (1)~(5), in parenthesis are clustering robust standard errors of districts and counties; the district and county fixed effect and daily fixed effect are controlled.

5.3. Policy Spill-over Effect Test

When the policy intervention has an impact on the treatment group, it may also produce spill-over effect on individuals from the control group. Then, estimation bias may be caused with the trend of the control group as the basis of the counterfactual trend of the treatment group. In this paper, implementing the purchase restriction policy in a city will affect the real estate market in the neighbor cities: it is possible that the purchase restriction policy will produce the transfer of market demand between regions, resulting in the rise of house prices in non-purchase restricted cities, thus underestimating the effect of the purchase restriction on house prices. This cannot influence the major conclusions in this paper, but makes the conclusions further consolidated; it is also possible that affected by the purchase restriction policies in nearby cities, house buyers in non-purchase restricted areas expect the decline of house price, which will lead to the reduction of the demand in real estate market along with the house price decrease. Hence, it may overestimate the effectiveness of the policy in curbing house prices and thus seriously threaten the major conclusions of this paper.

To this end, we identify the non-purchase restricted cities geographically next to (sharing the common boundary) the 46 purchase-restricted cities by using the software of Arcgis. They are excluded from the regression samples and tests are repeated. Results show that, the curbing effect of the purchase restriction policy on the house price is not disturbed by the spillover effect of the policy, and the benchmark regression result remains robust. As a matter of fact, according to the study by Zhang *et al.* (2018), the purchase restriction policy causes the trans-regional transfer of the real estate market demand and drive up the house price in the non-purchase restriction cities, which supports the major conclusions of this paper.

5.4. Implementation Status of the Humanely and Randomly Generated Purchase Restriction Policy

For purpose of examining the extent to which the omitted variables in the benchmark regression affected the regression results, this paper randomly assigns the implementation status of the purchase restriction policies in each district and county (Chetty *et al.*, 2009; Ferrara *et al.*, 2012; Li *et al.*, 2016). Given the process of generating the above random data, the artificially constructed dummy variables of the purchase restriction policy should not yield estimates significantly different from zero. The result shows that in the regression of house price, rent and land price for commercial and residential use, the influence coefficients obtained from randomly designated purchase restricted areas and counties are concentrated around zero, which further verifies the reliability of the main conclusions of this paper.¹

6. Heterogeneity Test

6.1. Three Regions

In order to study the purchase restriction policy's impact differences in various regions, we divide the samples into east region, central region and west region. Table 6 lists the regression result by regions. According to the regression result in column (1), in real estate sales market, the purchase restriction policy has significant inhibitory effect on house price in eastern region. Based on the regression result in column (2)~(3), purchase restriction policy exerts more significant externalities on rent and residence land price in eastern region, extending to real estate rental market and land market. The regression results in column (4)~(5) match with the benchmark regression result in this paper, an indication that the purchase restriction policy doesn't have significant impact on industrial land price and commercial land price and no obvious regional differences exist. The above heterogeneity analysis results are reflected in both significance level and absolute value of the influence coefficient.

There are two possible reasons. (1) Obvious regional differences exist in terms of the implementation extent of policy. Although the purchase restriction policy is implemented in all places, the policy is more strictly enforced in eastern region than the central and western region, so the purchase restriction policy will have a more obvious impact on the relevant market areas in eastern region. (2) The degree of marketization has obvious trans-regional differences. The degree of marketization in the eastern region is much higher than that in central and western regions and the mechanism that market relation determines price is complete (Wang *et al.*, 2017),

¹ Picture of three placebo tests are retained on request.

involving the three types of markets underscored in this paper. Therefore, although the purchase restriction policy has an impact on the market supply and demand in central, eastern and western region, compared with the central and western region, the house price, rent and residential land price in east region have more obvious changes due to the externalities of the purchase restriction policy.

Table 6. Regression Result of Three Regions

	(1)	(2)	(3)	(4)	(5)
	residence sales transaction unit price	residence rental transaction unit price	residence land transaction unit price	industrial land transaction unit price	commercial land transaction unit price
Eastern region	-0.1041*** (0.0365)	0.2529*** (0.0904)	-0.0913** (0.0527)	-0.0044 (0.0360)	0.0039 (0.0581)
Central region	-0.0902** (0.0523)	0.1917*** (0.0709)	-0.0610** (0.0307)	-0.0030 (0.0960)	0.0024 (0.0690)
Western region	-0.0880** (0.0441)	0.1729* (0.0920)	-0.0609* (0.0367)	0.0049 (0.0563)	0.0113 (0.0799)

Notes: ***, ** and * stand for the significance level as 1%, 5% and 10% respectively. In column (1) and (2), other control variables come from city and residence level; in column (3)~(5), other control variables are at city and plot level. In column (1)~(5), values in parenthesis are clustering robust standard errors of districts and counties; the district and county fixed effect and daily fixed effect are controlled.

6.2. Land Transfer Method

At present, there are many land transfer methods such as agreement, bidding, listing and auction in the land transaction market. Different land transfer methods varied a lot in terms of the marketization degree (Tao *et al.*, 2009; Yang *et al.*, 2014).¹ Therefore, it is necessary to categorize them into multiple sub-samples and test the externalities on residence land price exerted by purchase restriction policy. Table 7 offers the regression results accordingly. It is clear from the column (1) that excluding the very few samples of non-market transfers through appropriation and lease, the estimation result is basically in line with the benchmark regression result in this paper. Namely, the purchase restriction policy has a significantly negative effect on the residence land price. We further divide the samples into agreement transfer and transfer by “bidding, auction and listing” for regression. It is noticeable from the results in column (2) and (3) that from the view of significance level or coefficient absolute value, the purchase

¹ In order to improve and standardize the land transfer system, the State Council specified that the land transfer may adopt agreement, bidding and auction as the land transfer methods and specified the procedures accordingly in the *Interim Regulations on the Grant and Transfer of State-Owned Land Use Rights in Cities and Towns* in 1990. In May 2002, the listing method was incorporated into the public land transfer in the *Provisions on the Grant of State-Owned Land Use Right through Bidding, Auction and Listing*.

restriction policy has more significant impact on resident land transfer price by “bidding, auction and listing” than that by agreed residence land transfer price. In addition, according to column (4)~(6), in spite of the significant decline in the land transfer price “bidding, auction and listing” to some degree, from the view of estimation coefficient’s significance and the absolute value, the purchase restriction policy has a significant effect on the bidding and auction of the residence transfer price, yet a limited impact on the listed residence land price.¹

Table 7. Land Price Regression Result based on Different Land Transfer Methods

	(1)	(2)	(3)	(4)	(5)	(6)
	residence land transaction unit price					
	Excluding transfer by appropriation and rental	Agreement transfer	Transfer via bidding, auction and listing	Bidding transfer	Auction transfer	Listing transfer
district and county	-0.0912***	-0.0744*	-0.0917***	-0.0935**	-0.0928***	-0.0668*
Purchase restriction	(0.0291)	(0.0327)	(0.0320)	(0.0292)	(0.0321)	(0.0372)
District and county fixed effect	yes	yes	yes	yes	yes	yes
Daily fixed effect	yes	yes	yes	yes	yes	yes
Other control variables	yes	yes	yes	yes	yes	yes
Adjustment of R ²	0.6430	0.5335	0.5186	0.7798	0.5223	0.5261
Sample size	362633	194458	167915	3662	41062	123191

Notes: ***, ** and * stand for the significance level as 1%, 5% and 10% respectively. In column (1)~(6), other control variables are at the city and plot level. Values in parenthesis are clustering robust standard errors of districts and counties; the district and county fixed effect and daily fixed effect are controlled.

An important explanation is that, in the process of agreement transfer, the local government and specific land using party negotiate with each other and jointly set the land transaction price together with other conditions. Local government enjoys absolute right of controlling the land users and land price, making it difficult to reflect the supply-demand relation in the land market by agreed land transfer price. As the relatively complete and marketized transfer method, the price of land transfer by “bidding, auction and listing” is mainly determined by the market (Zhao and Yang, 2015). When purchase restriction policy brings about the externalities on and leads to the drop in demand in the residence land market in comparison with the supply, the transfer price of residence land via “bidding, auction and listing” may go down significantly. But even if we use such method, the transfer price by listing may be

¹ Based on the benchmark regression result, the home purchase restriction policy only has significant influence on residence land price but no significant influence on industrial land price and commercial land price.

subject more to the government administrative interference in comparison with bidding and auction, and may be more difficult to be adjusted according to the supply-demand changes in land market. Therefore, purchase restriction policy only exerts limited externalities on the transfer price by listing. As some studies indicate, listing transfer in disguised form has acted as a tool for local governments to select land-use objects for targeted land transfer. (Cai *et al.*, 2013; Wang and Yang, 2016).

7. Conclusion and Policy Implication

How to curb the continuous and rapid rise of real estate prices by way of macro-control policies is an important issue which urgently needs to be discussed and solved in China. As one of the most important real estate regulation methods in the recent period and at the current stage, can purchase restriction policies significantly curb the rising house price? Besides, does purchase restriction policy exert externalities on other key markets and fields—real estate rental market and land market? A comprehensive assessment of the effectiveness and externalities of the purchase restriction policy is instrumental in optimizing policy measures to further stabilize the real estate market.

First, we need to look at the policy effectiveness of the purchase restriction policy. As the result indicates, the purchase restriction policy significantly curbs the house price. And the influence on house price is bigger than the estimated result from previous studies, meaning that the effectiveness of the purchase restriction policy is significantly underestimated. Second, we should notice the externalities of the purchase restriction policy. This paper uses two kinds of micro-transaction data on real estate rental and land to incorporate the connection between real estate sales and real estate rental, land market into the empirical analysis framework, which compensates for the shortage of the existing studies. According to the results, the purchase restriction policy has important externalities on other markets and fields apart from the real estate sales market. Firstly, for the real estate rental market, purchase restriction policy has driven up the rental fees significantly. Secondly, purchase restriction policy has led to the decrease of residence land price, yet exert no significant influence on industrial land and commercial land. In addition, this paper conducts heterogeneous analysis from two dimensions. Firstly, as for three major aspects including house price, rent and residence land price, the purchase restriction policy has higher effects on eastern region instead of the central and western region. Secondly, in terms of the land transfer method, purchase restriction policy has more influence on the transfer price of residence by “bidding, auction and listing”, especially that of the residence land by bidding and auction.

The following implications are concluded based on the facts and the empirical analysis result herein. First, the control and regulation effect of the purchase restriction policy on house price is not clear in the mid-and-long term. When the policy influence

is extended to land market, the land market demand with the real estate developers as the subject will be significantly decreased, thus bringing negative impact on land financial revenue of different cities. Despite that the central government has issued a series of macro-control measures of real estate market involving the purchase restriction policy, in order to avoid the huge financial burden arising from it, the local government may adopt ways such as negative response or “soft resistance”. In reality, it is more likely to ease or unlock the house purchase restriction the land finance in cities which rely more on land finance. So, strengthening the development of local taxation system and creating new financial sources for local governments is the key to solving this problem. Second, the most fundamental is to adhere to the land supply side reform. As an essential measure to curb the excessively rapid rise of house price from the demand side, the purchase restriction policy has certain positive significance in the short term by restraining the speculative demand of real estate investment. But if we only conduct reform from the demand side and not try to find the rooted cause from supply side, it is easy to get trapped in the circulation of “price rise-purchase restriction-restriction release-rebound”, and also difficult to achieve the control and regulation positioning of restricting the house purchase speculative demand. Therefore, while performing purchase restriction from the perspective of demand, it is necessary to deepen the reform of land and real estate from supply side, and find solutions to the difficulty of control and regulation of the real estate market in the mid-and long-term.

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