Effect of the housing purchase restriction policy on the Real Estate Market: Evidence from a typical suburb of Beijing, China

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\textbf{ABSTRACT}

To curb excessive rises in housing prices, the government has instituted a series of macro-control measures in the real estate market. The housing purchase restriction (HPR) policy, one of the most severe policies, aims to curb a rapid rise in housing prices by excluding investment demand for housing. The real estate market of Langfang City was a particularly pertinent case because it is adjacent to Beijing, the capital of China. This study collected 11,597 sets of second-hand housing transaction data from five counties around Beijing in Langfang. A regression discontinuity design was then used to indicate that the HPR policy of Langfang did not significantly reduce the price of second-hand houses in the study area. In addition, the effect of the HPR policy on housing prices had an obvious spatial heterogeneity. Within 500 m of the buffer zone around Beijing, the implementation of the HPR policy significantly increased the price by 8.07%. Within 1000 m of the buffer zone, the implementation of the policy increased the price by an average of 6.70%. Although the HPR policy played a role in reducing the price further than 1000 m, it was not robust. Finally, the paper highlighted that the policy makers should pay attention to the heterogeneity and connection of different cities, balance the relationship between multiple stakeholders, and improve and implement relevant systems, including a real estate tax regime and land spatial planning regime.

1. Introduction

China has undergone rapid and intense socio-economic transformations since the economic reforms of 1978. This process that has been accompanied by rapid land use changes and modifications that have affected all of the sectors of the country’s economy (Liu, 2018a, 2018b). Sustainable land use, as an important basis for economic sustainable development, is a key research focus on the regional to global scale, especially against a background of global change and greater international economic integration (Robinson and Carson, 2015). In the process of urbanization, extensive urban expansion poses a major threat to farmland protection. The increase of agricultural land value caused by the expansion of cities and the distortion of market prices led to the excessive loss of agricultural land. This has had a profound impact on global food security and land degradation. In 2018, China’s total carbon emissions reached 10 billion tons, an increase of 2.3% over 2017, making it the world’s largest carbon dioxide emitter. In addition, urbanization has given birth to the rise of the real estate and construction industries. During the period from 1998 to 2018, the proportion of added value from the real estate and construction industries to the GDP increased from approximately 4%–6.65% and from approximately 11% to about 26%, respectively. Therefore, the rational allocation of residential land is increasingly important for sustainable economic development and social stability because it is related to people’s basic living conditions. In fact, the demand for residential land is actually a type of derived demand that is caused by the demand for housing. Therefore, the healthy functioning of the real estate market based on residential land has become an important economic and social issue that has attracted wide attention. Since the 1998 housing system reform, the real estate industry has been thriving and is now regarded as an important national economic industry with a high correlation and a strong driving force of the economy. From 2008–2017, real estate investment accounted for approximately 17%–20% of the total fixed asset investments, which has an important impact on national economic development. For instance, Hui et al. (2012) pointed out that fluctuations in the macro-economy were caused by fluctuations in housing prices. Liu (2018) proposed that moderate housing price rises can effectively drive economic growth, but excessive housing price rises

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will obviously bring huge dangers to the macro-economy. Zhang and Zheng (2012) stipulated that macroeconomic growth led to one-way growth of housing investments. They also argued that the hypothesis that housing investments lead to economic growth was not valid in China. Many researchers have shown that there is an important interaction between real estate market development and the macro-economy.

In recent years, China's real estate market has gradually exposed a series of problems, among which overheated investments and a housing price bubble caused by a rapid excessive rise in housing prices are particularly serious (Dreger and Zhang, 2013). If a rapid rise of housing prices cannot be effectively controlled, it not only will lead to a decline of living standards but also may cause systemic financial risks that can lead to macroeconomic fluctuations, especially soaring housing prices in some first-tier cities. In addition, related studies have shown that rising housing prices in China have led to the accumulation of wealth from non-homeowners to homeowners, thus exacerbating the wealth inequality between non-homeowners and homeowners (Li and Miao, 2011). However, the problem of an extensive growth mode in the real estate market and the excessive rises in housing prices cannot be solved by an adjustment of the market alone. Therefore, frequent and diversified government intervention is an important feature of the Chinese housing market (Mak et al., 2007; Tian and Ma, 2009). The government's real estate market macro-control policies can be divided into two ideas (Ye and Li, 2018). One governmental technique is to use market-oriented control means, such as financial and fiscal policies. The other technique is using administrative control means, such as purchase restrictions, price restrictions, and sale restrictions. The housing purchase restriction (HPR) policy is regarded as the most effective policy to reduce housing prices.

Research on the HPR policy has focused on empirical analyses of the policy effect, but scholars still debate about its policy effect. The research results of Zhang and Wang (2016) showed that the HPR policy can dampen investment demand, but it is difficult to reduce housing prices, especially in cities with high housing prices. Chen et al. (2019) found that the HPR policy could restrain the price of new housing in the short term, but it could not effectively control the rise of second-hand housing prices. Wang and Huang (2013) conducted an empirical analysis of the HPR policy using panel data of the residential sales price index of 70 large and medium-sized cities from the National Bureau of Statistics, and found that HPR policy could reduce housing prices, but it had a limited impact. Liu et al. (2012) also proposed that investment demand would change the intertemporal demand and supply in the market, which would offset the effect of the purchase restriction policy. Deng et al. (2014) found that the HPR policy had regulatory effects in cities with "excessively rapid rises in housing prices," realizing the original intention of the policy to curb excessive speculation. However, the HPR policy did not show restraint in cities with "excessive house prices." On the contrary, other studies have concluded that the HPR policy had significantly reduced housing prices. Sun et al. (2017) studied the impact of the HPR policy on the transaction of second-hand houses in Beijing. It was found that the HPR policy caused the sale price of second-hand housing to drop by 17 %-24 %. However, where the elasticity of the housing supply was relatively small, the prices affected by the HPR policy dropped more. Zhang et al. (2015) conducted an empirical study on the residential sales price index of Shanghai from January 2005 to February 2015, and the results showed that this measure had a statistically significant negative effect on the sale prices of new houses and second-hand houses in the medium and long term, but this was not obvious in the economic sense. In the above studies, the traditional econometric models (Jia and Meng, 2012; Liu et al., 2013; Zhang and Zheng, 2013) and the difference-in-difference method (Deng et al., 2014; Wu and Li, 2018; Zhang and Zheng, 2013) have been widely used. However, the traditional econometric models have obvious drawbacks that cannot effectively peel off the effects of other policies or the inherent trend in housing price changes. Therefore, the problem of endogenous variables is inevitable. The difference-in-difference method (Gorg, 2007) is a commonly used method of public policy evaluation that makes up for the shortcomings of traditional econometric models to some extent. However, this method requires that the purchase restriction cities of the experimental group and the non-restricted purchase cities of the control group have similar change trends, with the exception of the purchase restriction policies. The high requirements for data lead to limitations in the application of the difference-in-difference method. However, the regression discontinuity design (RDD) overcomes the endogenous problem of variables in traditional methods and the matching problem of samples in the difference-in-difference method (Benavente et al., 2012).

The RDD is a quasi-natural experimental estimation method (Lee and Lemieux, 2010) that has been widely used in public policy evaluation research in recent years. The basic idea of the RDD is that there exists a running variable that can be used as a threshold to divide the experimental individuals and the control individuals. The policy cutoff will appear at the threshold value. By selecting the appropriate critical interval and comparing the average values of the experimental group and the control group, the effect of the HPR policy can be obtained. Currently, only a few scholars have used the RDD to evaluate the HPR policy implementation effect (Sun et al., 2017; Zhang et al., 2015).

Previous studies have primarily focused on a discussion of the first-round HPR policy, and the research area has been limited to first-tier cities. The second-round HPR policy will produce a "learning effect" in the implementation of the first-round policy. More precisely, both the supply and demand sides of the market have then grasped the operation rules and characteristics of the real estate regulation policy, which may result in different effects of the HPR policy on the market. Therefore, to continue to explore the policy effects of the second-round HPR policy, this study uses the RDD to evaluate the effect of the HPR policy in the real estate market of Langfang, a typical suburb of China, based on second-hand housing transaction data. Because the existing scholars have drawn different conclusions based on the real estate markets of different cities, this study suggests that there is a spatial heterogeneity in the effect of the HPR policy. Based on the differences caused by Beijing’s radiation effect on Langfang, the real estate market in Langfang is subdivided to verify the spatial heterogeneity of the implementation effect of the HPR policy.

2. Specifics of Langfang and its HPR policy

2.1. Specifics of Langfang, a typical suburb of Beijing

Under the background of urban-rural transformation and for the support of transportation and communication, strong mutual links between different regions have taken place through flows of production factors, such as labor migration, capital, goods, technology, and information (Li and Xu, 2015; Long et al., 2011). Social and economic relationships between cities are more closely linked than ever before, especially in cities that are geographically adjacent. For example, the people who have had the ‘Beijing vagabond’ experience have stimulated demands for housing in the areas surrounding Beijing because they are unable to afford Beijing housing costs (Yang et al., 2018). Due to the fixed land location of these areas, these different cities are closely connected by mobile elements, which also reflect a series of land use problems such as inefficient land use, decentralized structure, and imperfect function. As a result, this has caused a phenomena of urban land

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1 On April 30, 2010, Beijing promulgated the implementation rules of the “Ten Regulations of the State,” setting off the first wave of restrictions on purchases.

2 In 2016, the housing purchase restriction policies in various regions were introduced intensively again, beginning the second round of purchase restrictions.
use termed the “trici-cities” problem. These problems include such phenomena as the “ghost town,” where work places have empty buildings after work and are deserted at night; the “sleeping city,” with residential areas without industry that are deserted during the day; and the “empty city,” which is characterized by real estate investment and land occupation in the new district and deserted areas during the day and night (Liu et al., 2018). The connection of flow factors and the solidity of land factors among the different cities determine that land use policy should be placed in a unified framework that fully considers the interaction mechanisms of economic activities, land use, and other behaviors between core cities and marginal cities.

Langfang, a prefecture-level city in the Hebei Province, is located between two international cities, Beijing and Tianjin, and this area is known as the ‘Beijing-Tianjin Corridor, Golden Belt.’ The registered population of Langfang was 4.795 million in 2018, and the urbanization rate was 60.01%. Langfang has become the “back garden” of Beijing’s real estate market because of its unique geographical location. Hence, it is a fallback option for young people who cannot afford an apartment in Beijing. Many young people choose to go to work in Beijing during the day and sleep in Langfang at night in order to make a living. Langfang has gradually become a “sleeping city.” Therefore, in addition to rigid and improved demand, Langfang’s real estate market has become an important investment target for some real estate speculators. The research areas selected in this study, Sanhe, Dachang, Xionghe, Guangyang, and Gu’an, are directly adjacent to Beijing and have more obvious investment demand (Fig. 1). Since the reform of the housing system in 1998, the average housing prices in Langfang have risen from 1313 to 10,654 yuan per square meter, with an annual housing price growth rate in 2016 as high as 28%. Therefore, Langfang’s real estate market is getting even hotter.

2.2. HPR policy in Langfang

The HPR policy was first implemented in Beijing in April 2010. In the same year, a total of 48 large- and medium-sized cities implemented this order. However, with the cooling of the housing market, all of the cities, except Beijing, Shanghai, Guangzhou and Shenzhen, had withdrawn from the purchase restriction by December 2014. In 2015, under the main theme of real estate destocking, there was a “retaliatory re-bound” in housing prices. The HPR policy was intensively introduced in various places once again in 2016, opening the curtain for a second round of purchase restrictions. Langfang’s HPR policy was also implemented in the context of a second round of purchase restrictions.

On March 21, 2017, the Langfang government issued the document "Opinions on Further Strengthening of Regulation in the Real Estate Market". This document proposed a regional HPR policy and differentiated housing credit policy restricting local residents who purchased three or more houses from applying for commercial personal loans. In addition, non-local residents were limited to the purchase of a single house, and there was a specific proportion required for the purchase down payment. On June 2, 2017, the Langfang government promulgated “Implementation Opinions on Further Promoting the Stable and Healthy Development of the Real Estate Market in the City”, that proposed 'strictly adjusting housing purchase restrictions'. Compared with the first document, this document significantly increased intensity. In addition, Bazhou and Wen’an were added to the area where the HPR policy was implemented. This document also clearly stipulated that local residents with two or more houses were not allowed buy more houses. Non-local residents who could provide local social insurance payment certificates or tax payment certificates for three years or more were allowed to purchase a set of houses, including new commercial housing and second-hand housing.

2.3. Logic of the HPR policy

The aim of the HPR policy was to regulate housing demand, and the core content is to set different house holding limits based on the household registration setting. The basic logic of the policy is to exclude a certain proportion of consumer groups (primarily investment demanders) outside the market by setting different consumption permit conditions, reducing the total demand in the real estate market, and achieving the purpose of housing price stabilization. Therefore, the most direct impact of the HPR policy is the reduction in demand in the real estate market, especially investment demand. The demand curve shown in Fig. 2 moves from D to D1. However, in the context of the first round of the HPR policy, which “implements, abolishes, and re-implements,” some rigid or improved demanders who initially did not plan to buy a house will change their purchase behaviors due to anticipation of a retaliatory rise in housing prices after the second round of restrictions. Once this happens, the demand curve will move from D1 to D2, indicating that the demander’s reflection on the policy offsets the suppression of demand due to the policy itself.

While the HPR policy regulates demand, suppliers, property developers, and second-hand housing investors will also respond to the policy. The supplier will adjust his behavior based on a series of expectations, including the length of the policy execution cycle, land supply behavior of the government, demand scale changes, or price expectations, and other factors. When a supplier anticipates that the purchase restriction will lower the demand and price, he will consider falling profits and the cost of house holding so as to make an inter-temporal adjustment decision regarding the housing supply. When the cost of house holding is low, the supplier will reduce the housing supply, and the supply curve will move from S to S1. In contrast, when the supplier expects the HPR policy to be implemented for a long time, it will stimulate an acceleration in the housing supply and realize a withdrawal of funds in the short term. The supply curve will move from S to S2. However, this research asserts that the HPR policy, as an administrative means, is less likely to be implemented in a real estate market for a long time. In summary, the role of the HPR policy is closely related to the expectations of the market participants. Once the housing demand and supply that are based on expected situations are adjusted across the period, the effect of the HPR policy will not be significant.

In addition, there is a clear phenomenon of differentiation in the real estate market (Han and Lu, 2018). The demand structures of real estate markets in different regions are different. From the logic of policy, promulgation of the HPR policy has a more serious impact on a market that has greater investment demand, and there is no effect for markets that do not have investment demand. In addition, when faced with different demand structures of the market, supplier’s expectations will also be very different. A fiery situation of investment demand in the real estate market will increase a supplier’s motivation to change the housing supply plan. Therefore, the difference between supply and demand can lead to a spatial heterogeneity of the policy effects.

3. Materials and methods

3.1. Housing price data

In this study, data regarding 11,597 sets of second-hand house in five counties around Beijing in Langfang City from the Lianjia Network were collected. These data included information of the area, floor, orientation, decoration, address, and transaction times of the houses. The spatial distribution of the sample houses is shown in Fig. 1. As a leader of the second-hand housing market in China, the Lianjia Network is the largest real estate source database and contains 60 million pieces of apartment information data from more than twenty cities. In May 2018, the share of the Lianjia Network in the second-hand housing transactions market exceeded 50 %, which is four times that of the second-place transactions network, the 5i5j Network. Concurrently, due to the
openness and transparency of information on various housing intermediary websites, houses of the same quality often have similar prices under the effect of the competition mechanism, and even if there is a certain price difference, it is often related to the business ability of the housing brokers. Furthermore, to prove the representativeness of housing sourcedata to the overall situation of the second-hand housing market in Langfang, this study summarizes the comparative change rate of second-hand housing prices under different building area grades in the data set. In addition, a simple comparison is made with the second-hand housing market in Shijiazhuang, the capital of Hebei Province. Whether below 90 square meters or 90–144 square meters, the change of the average transaction price of second-hand housing in the study

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4 Since the second-hand housing sales price index in Langfang is not within the statistical range of the National Bureau of Statistics, the capital city in the province where the study area is located was chosen as the reference city.
area from 2016 to 2018 is basically consistent with the change trend of the second-hand housing sales price index in Shijiazhuang published by the National Bureau of Statistics, with a correlation coefficient of more than 0.85 (Fig. 3). Therefore, the sample data used in this study accurately reflected the second-hand housing market situation in Langfang.

To describe the location characteristics of the second-hand houses, public service facilities in the Langfang area, such as parks and hospitals, were collected from the Baidu Map. Then, all second-hand houses and public service facilities were geo-coded using Gaode’s application programming interface, and the distance from the sample point to the nearest park (d_park) and hospital (d_hospital) was calculated. The shortest distances between the second-hand houses and the main traffic arteries (d_road) were measured due to the significant impact of commuting factors on the daily life of people. To further explore differences in the HPR policy effects in different locations, 500 m was used as the step size, and samples of second-hand houses in different buffer zones were extracted. In this way, the overall sample model and different buffer sub-sample models of the study area were constructed.

3.2. The regression discontinuity design model

The RDD is a local random experiment near the threshold. It was first used by Thistlethwaite and Campbell (1960), but it did not attract the attention of economists until the late 1990s. Hahn et al. (2001) provided the theoretical basis of RDD in econometrics. Currently, the application of RDD in education, labor, health, political, and regional economics is still in the ascendant stage (Van Der Klaauw, 2008). There are three fundamental components in the RDD: a score, a cutoff, and a treatment. Without these three basic defining features, the RD methodology cannot be employed. In the RDD, all of the individuals in the study receive a score (also known as a running variable, forcing variable, or index), and a treatment is assigned to those individuals whose score is above a known cutoff and not assigned to those individuals whose score is below the cutoff. More specifically, the policy sets a cutoff on the running variable so that the individuals on the right of the cutoff become the treatment group and receive policy intervention, while the individuals on the left side of the cutoff are the control group and do not accept intervention. Hence, a quasi-experiment will be formed near the cutoff. According to the possibility of individual intervention at the cutoff, it can be divided into a sharp RDD (individuals on the right side of the cutoff must be intervened) and a fuzzy RDD (individuals on the right side of the cutoff must not be intervened). In a sharp RDD, it needs to be defined whether or not to accept policy intervention as treatment variable, a 0–1 variable. Individuals on both sides of the cutoff are considered to be similar and comparable, so the difference in outcomes between individuals on both sides is considered to be the effect of policy intervention. Because the RDD is a quasi-experiment with strong internal validity, causal inferences from this method are potentially more credible than those from typical “natural experiment” strategies. However, the RDD only infers causality near the threshold, and its external validity is greatly limited.

This study used the sharp RDD model to analyze the effect of Langfang’s HPR policy. By observing whether there was a jump in housing prices before and after implementation of the HPR policy, the policy’s effectiveness can be judged. The promulgation time of Langfang’s HPR policy, March 21, 2017, was used as the cutoff, and the model was established as follows:

$$\ln(p_i) = \beta_0 + \beta_1 \cdot HPR_i + \sum_{k=1}^{K} \beta_{2k} \cdot Day^k_i + \sum_{k=1}^{K} \beta_{2k+1} \cdot HPR_i \cdot Day^k_i + \sum_{m=1}^{M} \beta_{m+2} \cdot X_{mi} + \epsilon$$

where $p_i$ is the unit price of the second-hand house sample point; $HPR_i$ equals one if the sample point $i$ happened after March 21, 2017, otherwise it is zero; and $\beta_1$ is the main coefficient that reflects the purchase restriction policy effect. When $\beta_1$ is positive, this means that the policy has pushed the price of second-hand houses. When $\beta_1$ is negative, this means that the policy has reduced housing prices. The absolute value of $\beta_1$ represents the extent to which the policy affects a change in housing prices. $Day_i$ is the number of days between the transaction date of the sample point $i$ and the cutoff date. Vector $\beta_2$ captures any pre-existing trend using a $K^{th}$-order polynomial. The cross terms of $Day_i$ and $HPR_i$ can then be constructed. The control variable, $X_{mi}$, includes the basic characteristics of the sample point, such as house area, floor, floor orientation variables, and variables reflecting house location information, including the distance from the nearest park, the distance from the nearest hospital, and the distance from the nearest main traffic arteries. Among them, the classified variables, such as floor and orientation, were included in the model calculation in the form of dummy variables. For more details, please check Table 1. According to the Equation, $\Delta p(\%) = e^{\beta_1} - 1$, the effect direction and degree of the HPR policy on house prices can be calculated.

4. Results

4.1. Trend analysis of housing prices

Fig. 4 shows the time distribution of second-hand housing prices from 2014 to 2019. It is easy to see that the fitting curve of second-hand housing prices approximately conforms to a parabola. The second-hand housing prices increased year by year before the HPR policy was issued, but gradually decreased after the HPR policy was issued. During a period of time after the implementation of the HPR policy, the black sample points are obviously sparse, indicating that the HPR policy reduced the volume of second-hand housing transactions. However, the curve only fits the long-term trend of second-hand housing prices. In addition, the role that the HPR policy played in the in Langfang real estate market cannot be fully explained by simple curve visualization. Therefore, more rigorous proof is needed.

Notes: the black points represent the second-hand house prices at
The implementation of the HPR policy led to a decline of 2.90% (exp(-0.0294) - 1) in housing prices. In addition, the policy effect coefficients of the other polynomials were not significant, but they all displayed negative effects. Thus, the effect of the HPR policy on reducing housing prices was not stable in Langfang. The reason for the failure of the HPR policy may be that the overall rigid demand in the real estate market in Langfang was larger and the investment demand was smaller. In addition, Table 2 shows the estimated results of some control variables. The estimated coefficients of the house_area, d_park, and d_hospital were significantly negative, and the estimated coefficients of d_road were significantly positive. These results demonstrate that, in the five counties of Langfang, the price of second-hand housing decreased with an increase in the building area and the distance to the park and hospital. In addition, the price of second-hand housing increased with an increase in the distance to the nearest main traffic arteries. It was speculated that, compared with public service facilities such as parks and hospitals, there would be noise interference and air pollution in the vicinity of the main traffic arteries.

The above model was constructed based on the date of Langfang’s HPR policy promulgation of March 21, 2017. By considering the time lag from the policy promulgation to the policy effect, the RDD was constructed with lag time of one month, two months, and three months with cutoff points at April 21, May 21, and June 21, 2017, respectively. The results of the models are shown in Table 3. In general, the significance and consistency of the policy effect coefficients of the different lag models were still unstable. Therefore, it cannot be effectively proven that Langfang’s HPR policy can reduce second-hand housing prices. In a comparison of the AIC and BIC information criteria of the different lag models, it was found that the AIC and BIC in the model with the one-month lag were the smallest, but they increased significantly when the control variables were added (Table 4). In addition, compared with the other lag models, the model with a one-month lag had the most stable significant effect. The results showed that the average price of second-hand houses in Langfang decreased by 4.25% one month after the implementation of the policy. In fact, due to the local random constraints of the RDD, it is difficult to effectively estimate the dynamic effects of the HPR. Whether there exists a time lag and how long the policy effect can last in the HPR policy still need to be studied in depth using broader data and more suitable methods.

The sharp RDD results of the effect of HPR policy on housing prices in five counties were then explored. The coefficient of the policy effect was significant at the 10% level in the second-order polynomial regression model without control variables, showing that the implementation of the HPR policy led to a decline of 2.90% (exp(-0.0294) - 1) in housing prices. In addition, the policy effect coefficients of the other polynomials were not significant, but they all displayed negative effects. Thus, the effect of the HPR policy on reducing housing prices was not stable in Langfang. The reason for the failure of the HPR policy may be that the overall rigid demand in the real estate market in Langfang was larger and the investment demand was smaller. In addition, Table 2 shows the estimated results of some control variables. The estimated coefficients of the house_area, d_park, and d_hospital were significantly negative, and the estimated coefficients of d_road were significantly positive. These results demonstrate that, in the five counties of Langfang, the price of second-hand housing decreased with an increase in the building area and the distance to the park and hospital. In addition, the price of second-hand housing increased with an increase in the distance to the nearest main traffic arteries. It was speculated that, compared with public service facilities such as parks and hospitals, there would be noise interference and air pollution in the vicinity of the main traffic arteries.

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The RDD assumes that the samples near the cutoff are random, so it can solve the endogenous problem of variables. The validity of the model should first ensure that there is no problem with running variable manipulation (Imbens and Lemieux, 2008), otherwise the estimation results will be biased. Different from gradual regulation measures in the real estate market, such as a low-rent housing policy and

### Table 1: Variable descriptions and statistics.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Type</th>
<th>Obs</th>
<th>Mean</th>
<th>Std.</th>
</tr>
</thead>
<tbody>
<tr>
<td>price</td>
<td>Transaction price of second-house (RMB/square meter)</td>
<td>cv</td>
<td>11597</td>
<td>19157.48</td>
<td>7209.60</td>
</tr>
<tr>
<td>house_area</td>
<td>House construction area (m²)</td>
<td>cv</td>
<td>11597</td>
<td>81.31</td>
<td>30.97</td>
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<tr>
<td>fl_ground</td>
<td>floor: ground</td>
<td>dv</td>
<td>11597</td>
<td>0.04</td>
<td>0.20</td>
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<td>floor: low level</td>
<td>dv</td>
<td>11597</td>
<td>0.26</td>
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<tr>
<td>fl_middle</td>
<td>floor: middle level</td>
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<td>11597</td>
<td>0.36</td>
<td>0.48</td>
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<tr>
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<td>floor: high level</td>
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</tr>
<tr>
<td>fl_top</td>
<td>floor: top level</td>
<td>dv</td>
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<td>0.06</td>
<td>0.24</td>
</tr>
<tr>
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<td>orientation of the house: northeast</td>
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<td>0.04</td>
<td>0.19</td>
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<tr>
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<td>orientation of the house: west</td>
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<td>11597</td>
<td>0.06</td>
<td>0.24</td>
</tr>
<tr>
<td>or_north</td>
<td>orientation of the house: north</td>
<td>dv</td>
<td>11597</td>
<td>0.09</td>
<td>0.28</td>
</tr>
<tr>
<td>or_southwest</td>
<td>orientation of the house: southwest</td>
<td>dv</td>
<td>11597</td>
<td>0.43</td>
<td>0.20</td>
</tr>
<tr>
<td>or_east</td>
<td>orientation of the house: east</td>
<td>dv</td>
<td>11597</td>
<td>0.08</td>
<td>0.27</td>
</tr>
<tr>
<td>or_southeast</td>
<td>orientation of the house: southeast</td>
<td>dv</td>
<td>11597</td>
<td>0.05</td>
<td>0.21</td>
</tr>
<tr>
<td>or_south</td>
<td>orientation of the house: south</td>
<td>dv</td>
<td>11597</td>
<td>0.60</td>
<td>0.49</td>
</tr>
<tr>
<td>d_park</td>
<td>Distance to the nearest park (m)</td>
<td>cv</td>
<td>11597</td>
<td>2290.19</td>
<td>1008.60</td>
</tr>
<tr>
<td>d_hospital</td>
<td>Distance to the nearest hospital (m)</td>
<td>cv</td>
<td>11597</td>
<td>1722.72</td>
<td>5025.57</td>
</tr>
<tr>
<td>d_road</td>
<td>Distance to the nearest hospital(m)</td>
<td>cv</td>
<td>11597</td>
<td>210.53</td>
<td>113.87</td>
</tr>
</tbody>
</table>

Notes: cv stands for continuous variable; dv stands for dummy variable; the variables reflecting the floor of the house are seven dummy variables generated using the basement as the reference; the variables reflecting the orientation of the house are seven dummy variables generated using the northwest as the reference.
affordable housing policy, the HPR policy has a very clear starting and ending time. In addition, the implementation time of the HPR policy cannot be controlled by local departments. To further illustrate that an individual cannot manipulate the running variable; the density distribution function of the running variable was investigated. If the individual cannot manipulate the running variable; the density distribution curves of the running variables nearly coincided at the cutoff point, and there was no significant jump. The results indicated that an individual did not have precise control over the running variable.

Second, it needed to be ensured that there was a significant jump in housing prices at the cutoff of the implementation of the HPR policy. In this regard, the fitting curves of second-hand housing prices before and after the cutoff were used to make a simple judgment. As shown in Fig. 6, the green curve is the trend of the average price of second-hand houses before the HPR policy, and the red curve is the trend of the average price of second-hand houses after the HPR policy. It can be seen that there is a significant jump in second-hand housing prices at the cutoff on March 21, 2017, so it was reasonable to use a sharp RDD.

Third, the RDD can be regarded as a "local randomized experiment," and its randomness can be tested by investigating whether the distribution of control variables on both sides of the cutoff point is different. The uniform kernel function was used to estimate the nuclear density of each control variable. As shown in Table 5, all of the control variables did not reject the assumption that the distribution of variables before and after the cutoff point was continuous in the non-parametric estimation results. Therefore, there was no significant jump in the distribution of control variables on both sides of the cutoff point, and the model met the requirement of randomness.

### Table 2

<table>
<thead>
<tr>
<th>Policy effect</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>−0.0003</td>
<td>−0.0294*</td>
<td>−0.0273</td>
<td>−0.0026</td>
<td>−0.0205</td>
<td>−0.0206</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.018)</td>
<td>(0.021)</td>
<td>(0.016)</td>
<td>(0.018)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>house_area</td>
<td>−0</td>
<td>−0</td>
<td>−0</td>
<td>−0.0012***</td>
<td>−0.0012***</td>
<td>−0.0012***</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>d_park</td>
<td>−0</td>
<td>−0</td>
<td>−0</td>
<td>−0.0093**</td>
<td>−0.0090**</td>
<td>−0.0090**</td>
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<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>d_hospital</td>
<td>−0</td>
<td>−0</td>
<td>−0</td>
<td>−0.0303***</td>
<td>−0.0302***</td>
<td>−0.0305***</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>d_road</td>
<td>−0</td>
<td>−0</td>
<td>−0</td>
<td>0.1578***</td>
<td>0.1540***</td>
<td>0.1543***</td>
</tr>
<tr>
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<td>(0.034)</td>
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<td>(0.034)</td>
<td>(0.034)</td>
<td>(0.034)</td>
</tr>
</tbody>
</table>

### Table 3

<table>
<thead>
<tr>
<th>Cutoff</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017.3.21</td>
<td>−0.0003</td>
<td>−0.0294*</td>
<td>−0.0273</td>
<td>−0.0026</td>
<td>−0.0205</td>
<td>−0.0206</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.018)</td>
<td>(0.021)</td>
<td>(0.016)</td>
<td>(0.018)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>2017.4.21</td>
<td>−0.0477**</td>
<td>−0.0444*</td>
<td>−0.0403</td>
<td>−0.0398*</td>
<td>−0.0347</td>
<td>−0.0537*</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.029)</td>
<td>(0.036)</td>
<td>(0.022)</td>
<td>(0.029)</td>
<td>(0.035)</td>
</tr>
<tr>
<td>2017.5.21</td>
<td>0.0046</td>
<td>0.0676**</td>
<td>0.0413</td>
<td>−0.0138</td>
<td>0.0393</td>
<td>0.0166</td>
</tr>
<tr>
<td></td>
<td>(0.0214)</td>
<td>(0.032)</td>
<td>(0.040)</td>
<td>(0.022)</td>
<td>(0.033)</td>
<td>(0.040)</td>
</tr>
<tr>
<td>2017.6.21</td>
<td>−0.1025</td>
<td>−0.1525</td>
<td>0.0457</td>
<td>−0.0935</td>
<td>−0.1607</td>
<td>0.0228</td>
</tr>
<tr>
<td></td>
<td>(0.076)</td>
<td>(0.148)</td>
<td>(0.188)</td>
<td>(0.0762)</td>
<td>(0.149)</td>
<td>(0.194)</td>
</tr>
</tbody>
</table>

### Table 4

<table>
<thead>
<tr>
<th>Cutoff</th>
<th>Model 1 AIC</th>
<th>Model 2 AIC</th>
<th>Model 3 AIC</th>
<th>Model 4 AIC</th>
<th>Model 5 AIC</th>
<th>Model 6 AIC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>−1264.87</td>
<td>−1244.46</td>
<td>−1267.27</td>
<td>−1236.66</td>
<td>−1249.19</td>
<td>−1282.05</td>
</tr>
<tr>
<td></td>
<td>(0.076)</td>
<td>(0.076)</td>
<td>(0.076)</td>
<td>(0.076)</td>
<td>(0.076)</td>
<td>(0.076)</td>
</tr>
</tbody>
</table>

4.3. Spatial heterogeneity analysis of the policy effect

Unlike ordinary third-tier cities, Langfang’s geographical location advantage bordering on Beijing has made it a part of the housing demand from Beijing, and it also provides investment opportunities for speculators. As Beijing’s radiation impact on the surrounding areas is directly related to distance, there are differences in the regional real estate market in Langfang. In this study, a multi-ring buffer around Beijing with a step of 500 m was outlined, and the model estimation results of different buffer sub-samples were investigated.

Table 6 reports the statistics of the model estimation results in different buffer ranges. It can be seen that as the distance from Beijing gradually increases, the coefficient of the HPR policy effect changes from positive to negative within the buffer zone in Langfang. More specifically, the HPR policy not only does not reduce housing prices, but also increases housing prices in the near buffer zone, while it reduces the housing prices in the far buffer zone. In addition, it can be seen from the...
model significance results that the model significance tends to be more unstable with an increase in the distance. Next, a focus was placed on the sub-sample models of the 500-m buffer zone and the 1000-m buffer zone with relatively consistent coefficients of policy effect in order to explore the reason why the coefficient of policy effect was positive in some areas.

Due to the limited external validity of the RDD, the selection of optimal bandwidth has a great impact on the estimation results. Mserd was used in this study, which is a common MSE-optimal bandwidth selector for the RDD. From Tables 7 and 9, it can be seen that the optimal bandwidth of the 500-m buffer model and the 1000-m buffer model on one side is 111 days and 103 days, respectively. For the 500-m buffer model, the regression results of the first-order, second-order, and third-order polynomials were significant at different confidence levels. Moreover, the effect of the HPR policy on the housing price was positive, ranging from 5.16 % to 11.89 %, and the average effect of the policy is 8.07 %. The results show that the implementation of the HPR policy increased second-hand housing prices within 500 m around Beijing in Langfang by an average of 8.07 %. To enhance the robustness of the results, the optimal bandwidth was extended to twice its value. As can be seen from Table 6, there were more individuals participating in the model estimation over a wider bandwidth. Different forms of models were significant at different significance levels, and the average policy effect was 8.22 %, which proved that the estimated results under the optimal bandwidth were relatively robust. When the buffer range was extended to 1000 m, 951 individuals participated in the model estimation under the optimal bandwidth. Only the first-order regression model was significant at the 1% level, and the average effect of the policy was 6.70 %, 1.37 % less than the effect of the 500-m buffer zone on the housing price decline. However, the coefficient of HPR policy effect was still positive, except that the coefficient of the second-order model with controlled variables was very small and negative. The results show that the implementation of the HPR policy can promote second-hand housing prices within 1000 m around Beijing in Langfang, but they do not remain stable. When extended to twice the optimal bandwidth, 1476 individuals participated in the model estimation, and the significance of the different models was greatly improved. As shown in Table 10, with the exception of the third-order model, the estimation coefficients of the first-order models and the second-order models were very significant, and the average policy effect was 7.08 %. In conclusion, the policy effect coefficients in the range of the 500-m and 1000-m buffers were both positive, which played a role in increasing second-hand housing prices. By comparing the coefficient of control variables, it was found that the second-hand housing prices within the 500-m buffer were lower with a decrease in distance from hospitals and traffic arteries, while the relationship within the 1000-m buffer was just the opposite. One possible explanation is that, for residents of the Langfang area near Beijing, the hospitals in Beijing are their first choice for medical services. Therefore, the crowded areas, living atmosphere, air quality, and noise pollution around the local hospitals and traffic arteries all restrain the transaction prices of second-hand houses.

This study assumed that people make the five counties in Langfang their alternative choice to buy houses when they cannot afford to buy houses in Beijing. The substitution effect gradually weakens with an increase in the distance from Beijing, resulting in the phenomenon that the closer to Beijing, the greater investment demand. Therefore, the effect of HPR policy on housing prices in Langfang should be more significant in areas closer to Beijing. As for the direction of the policy effect, it depends on the response of both the supply and demand sides to the HPR policy. For the suppliers, the regulation rhythm of the first-round HPR policy tightening first and then relaxing shows that the HPR policy is only a

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### Table 6

Results of the sub-sample models with different buffers.

<table>
<thead>
<tr>
<th>Buffer Distance (meter)</th>
<th>Coefficient of Policy Effect</th>
<th>Model Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>&gt; (6)</td>
<td>6/6</td>
</tr>
<tr>
<td>1000</td>
<td>&gt; (5); &lt; (1)</td>
<td>2/6</td>
</tr>
<tr>
<td>1500</td>
<td>&gt; (4); &lt; (2)</td>
<td>2/6</td>
</tr>
<tr>
<td>2000</td>
<td>&gt; (2); &lt; (4)</td>
<td>2/6</td>
</tr>
<tr>
<td>2500</td>
<td>&gt; (2); &lt; (4)</td>
<td>2/6</td>
</tr>
<tr>
<td>3000</td>
<td>&gt; (2); &lt; (4)</td>
<td>0/6</td>
</tr>
<tr>
<td>5000</td>
<td>&lt; (6)</td>
<td>1/6</td>
</tr>
</tbody>
</table>

Notes: For each sub-sample model in the different buffer ranges, a first-order, second-order, and third-order polynomial RDD with or without control variables was constructed, for a total of six models; For the second column, the values in the brackets is the number of models with an HPR policy effect greater than 0 or less than 0; For the third column, n/6 indicates that n of the six models have significant levels of more than 10 %.

---

### Table 5

Continuity test for the control variables.

<table>
<thead>
<tr>
<th>Control variable</th>
<th>Conventional</th>
<th>Bias-corrected</th>
<th>Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>house_area</td>
<td>0.1402</td>
<td>−0.4849</td>
<td>−0.4849</td>
</tr>
<tr>
<td></td>
<td>(2.046)</td>
<td>(2.046)</td>
<td>(2.288)</td>
</tr>
<tr>
<td>floor</td>
<td>−0.0543</td>
<td>−0.0369</td>
<td>−0.0369</td>
</tr>
<tr>
<td></td>
<td>(0.057)</td>
<td>(0.057)</td>
<td>(0.065)</td>
</tr>
<tr>
<td>orientation</td>
<td>0.0070</td>
<td>0.0160</td>
<td>0.0160</td>
</tr>
<tr>
<td></td>
<td>(0.151)</td>
<td>(0.151)</td>
<td>(0.175)</td>
</tr>
<tr>
<td>d_park</td>
<td>−0.0038</td>
<td>−0.0265</td>
<td>−0.0265</td>
</tr>
<tr>
<td></td>
<td>(0.066)</td>
<td>(0.066)</td>
<td>(0.073)</td>
</tr>
<tr>
<td>d_hospital</td>
<td>0.0290</td>
<td>0.0212</td>
<td>0.0212</td>
</tr>
<tr>
<td></td>
<td>(0.053)</td>
<td>(0.053)</td>
<td>(0.060)</td>
</tr>
<tr>
<td>d_road</td>
<td>0.0059</td>
<td>0.0088</td>
<td>0.0088</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.008)</td>
<td>(0.008)</td>
</tr>
</tbody>
</table>

Notes: robust standard errors in parentheses.

---

This study assumed that people make the five counties in Langfang their alternative choice to buy houses when they cannot afford to buy houses in Beijing. The substitution effect gradually weakens with an increase in the distance from Beijing, resulting in the phenomenon that the closer to Beijing, the greater investment demand. Therefore, the effect of HPR policy on housing prices in Langfang should be more significant in areas closer to Beijing. As for the direction of the policy effect, it depends on the response of both the supply and demand sides to the HPR policy. For the suppliers, the regulation rhythm of the first-round HPR policy tightening first and then relaxing shows that the HPR policy is only a

---

Fig. 5. McCrory test of the running variable.

Fig. 6. The jump in second-hand housing prices based on the RDD.
short-term policy, and suppliers will reduce supply in anticipation of a retaliatory rebound in demand after the end of the purchase restriction, thus driving up house prices. At the same time, because the object of this study is second-hand houses, there is no pressure on the house holding cost for the second-hand housing supplier. Therefore, the supplier will take the behavior of “reluctance to sell” to reduce the number of houses offered during the period of purchaser restriction. Furthermore, as land is a key factor in the real estate market, the government's supply behavior as the monopoly supplier in the urban land market will also affect the expectations of suppliers. As can be seen from Fig. 7, after the implementation of the HPR policy, there was no supply of residential land within 1000 m of the buffer zone. The government's behavior of reducing or even stopping the supply of land will strengthen the expectation judgment of the future real estate market that the demand exceeds the supply, thus increasing the confidence of suppliers to "reluctance to sell" during the purchase restriction period. For the demanders, although the HPR policy directly excludes some investors from the scope of a quasi-purchase, the expectation of a price rise after the end of the purchase restriction will also stimulate some quasi-purchase qualified demanders to buy houses before the price increases. These demanders may not constitute an effective demand for rigidity or improvement until the HPR policy is implemented. The portion due to an increase in demand will offset the portion due to a decline in demand caused by the HPR policy. The common behaviors of both supply and demand will eventually lead to a rise in the second-hand housing prices in the regional real estate market closer to Beijing.

4.4. Causes of HPR policy failure

The above results show that the implementation of Langfang's HPR policy has not effectively reduced the second-hand housing prices in the five counties around Beijing, and even has had the opposite effect within a certain buffer zone. The original purpose of the HPR policy was to control excessive speculation in the real estate market. To some extent, it can be concluded that the HPR policy has failed, and government intervention in Langfang has not resulted in a cooling of the real estate market.

The question of the visible hand of government and the invisible hand of the market has long been debated. But the fact is that the real estate market has been made into a "policy market" that is deeply affected by government intervention. Therefore, the healthy operation of the real estate market requires suitable government intervention on the basis of market supply and demand. In addition, government intervention should respect the objective law, including not only the law of the market but also the law of urban development. The failure of the HPR policy in Langfang is partially due to an inadequate understanding of the law of urban development. Langfang is located in the Beijing-Tianjin-Hebei metropolitan area, and its development is influenced by Beijing, Tianjin, and other core cities. The radiation scope and intensity of core

| Table 7 |

| Model results under the optimal bandwidth (500-m buffer zone). |
|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
| optimal bandwidth | Left of cutoff = 111; Right of cut-off = 111 |
| Policy Effect | 0.1123*** | 0.0817** | 0.0785* | 0.0841*** | 0.0503* | 0.0574* |
| | (0.032) | (0.039) | (0.046) | (0.025) | (0.031) | (0.036) |
| house_area | – | – | – | −0.0016*** | −0.0016*** | −0.0016*** |
| | | | | (0.000) | (0.000) | (0.000) |
| d_park | – | – | – | −0.0396*** | −0.0401*** | −0.0401*** |
| | | | | (0.013) | (0.013) | (0.013) |
| d_hospital | – | – | – | 0.3676*** | 0.3646*** | 0.3657*** |
| | | | | (0.080) | (0.080) | (0.081) |
| d_road | – | – | – | 1.5056*** | 1.4965*** | 1.5014*** |
| | | | | (0.408) | (0.412) | (0.416) |
| Polynomial Order | 1 | 2 | 3 | 1 | 2 | 3 |
| Intersection of Policy and Polynomials | Yes | Yes | Yes | Yes | Yes | Yes |
| Control variable | No | No | No | Yes | Yes | Yes |
| N | 357 | 357 | 357 | 357 | 357 | 357 |
| R² | 0.21 | 0.23 | 0.23 | 0.45 | 0.46 | 0.47 |

Notes: *Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level; robust standard errors in parentheses.

| Table 8 |

| Model results under the 2*optimal bandwidth (500-m buffer zone). |
|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
| 2*optimal bandwidth | Left of cutoff = 222; Right of cut-off = 222 |
| Policy Effect | 0.0826*** | 0.1052** | 0.0932** | 0.0640*** | 0.0731*** | 0.0559* |
| | (0.023) | (0.032) | (0.039) | (0.017) | (0.025) | (0.031) |
| house_area | – | – | – | −0.0018*** | −0.0018*** | −0.0017*** |
| | | | | (0.000) | (0.000) | (0.000) |
| d_park | – | – | – | −0.0446*** | −0.0455*** | −0.0453*** |
| | | | | (0.012) | (0.013) | (0.013) |
| d_hospital | – | – | – | 0.4059*** | 0.4012*** | 0.4018*** |
| | | | | (0.069) | (0.068) | (0.068) |
| d_road | – | – | – | 1.7496*** | 1.7458*** | 1.7385*** |
| | | | | (0.359) | (0.355) | (0.354) |
| Polynomial Order | 1 | 2 | 3 | 1 | 2 | 3 |
| Intersection of Policy and Polynomials | Yes | Yes | Yes | Yes | Yes | Yes |
| Control variable | No | No | No | Yes | Yes | Yes |
| N | 546 | 546 | 546 | 546 | 546 | 546 |
| R² | 0.29 | 0.29 | 0.31 | 0.49 | 0.50 | 0.50 |

Notes: *Significant at the 10% level; **Significant at the 5% level; ***Significant at the 1% level; robust standard errors in parentheses.
cities have objective attenuation laws that lead to different supply and demand characteristics of real estate markets in different locations in Langfang. On the whole, Langfang is still characterized by rigid demand or improvement demand. In this way, it seems that an HPR policy that primarily restrains investment demand is aimless. The difference of policy effects in the different buffer zones fully illustrates the heterogeneity of the real estate market in Langfang, and the heterogeneity of supply and demand is closely related to the distance from Beijing.

In addition, while the priest climbs a post, the devil climbs 10. There are market speculators who are accustomed to exploiting policy gaps at all times. It is not sufficient to restrain speculators in the real estate market by using HPR policy based on the household registration system. According to a large number of media reports, due to strict restrictions on the number of houses held by households under the HPR policy, many speculators break through the restrictions on the number of houses purchased by using false divorces. As a result, the restraint of the HPR policy on investment demand is greatly reduced, and policy failure becomes a foreseeable fact.

Table 9
Model results under the optimal bandwidth (1000-m buffer zone).

<table>
<thead>
<tr>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy Effect</td>
<td>0.0604***</td>
<td>0.0010</td>
<td>0.0030</td>
<td>0.0692***</td>
<td>−0.0002</td>
</tr>
<tr>
<td>(0.023)</td>
<td>(0.027)</td>
<td>(0.018)</td>
<td>(0.019)</td>
<td>(0.023)</td>
<td>(0.025)</td>
</tr>
<tr>
<td>house_area</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−0.004***</td>
<td>−0.0013***</td>
</tr>
<tr>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>d_park</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−0.0334***</td>
<td>−0.0347***</td>
</tr>
<tr>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>d_hospital</td>
<td>−</td>
<td>−</td>
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<tr>
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<td>0.16</td>
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Notes: **Significant at the 5% level; ***Significant at the 1% level; robust standard errors in parentheses.

Table 10
Model results under the 2*optimal bandwidth (1000-m buffer zone).

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<tr>
<th>Model 1</th>
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<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
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Notes: **Significant at the 5% level; ***Significant at the 1% level; robust standard errors in parentheses.

5. Discussion and policy implications

5.1. Comparison with previous studies

The results of this study indicated that the HPR policy cannot significantly reduce housing prices. This is consistent with existing studies (Chen et al., 2019; Liu et al., 2012; Zhang and Wang, 2016). However, there are still some studies that have drawn different conclusions using the RDD. The reason for different conclusions could primarily be due to differences in the real estate market in the research area. The previous studies paid more attention to Beijing (Sun et al., 2017) and Shanghai (Zhang et al., 2015). Because these cities are Chinese international metropolises, the real estate markets in Beijing and Shanghai have high investment intensity, and the HPR policy has a more significant inhibition on investment demand. Additionally, compared with other cities where the HPR policies have been gradually relaxed or canceled, the restrictions on purchases in Beijing and Shanghai have not been relaxed, and the cost to suppliers for intertemporal adjustment is relatively large. Therefore, it is reasonable that the HPR policy can significantly reduce housing prices in first-tier cities. However, as a third-tier city, the development level of the real estate market in Langfang is completely different from first-tier cities. This also proves the spatial heterogeneity in the effect of the HPR policy at the city scale.

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Key Tasks for New Urbanization Construction in 2019″. This document time, the National Development and Reform Commission issued “The Key Tasks for New Urbanization Construction in 2019”. This document made it clear that metropolitan areas will become the focus of development in the future, and metropolitan areas are the last piece in jigsaw puzzle of completing urbanization. Therefore, the scope of future studies should be expanded to include the entire metropolitan area that extends beyond the existing urban administrative boundary. Additionally, it is necessary to investigate the mechanism of how cities in the metropolitan areas influence the allocation of land resources using spatial correlations. This would assist decision makers in understanding how to influence the real estate market supply and demand to provide research evidence from the perspective of metropolitan areas for urbanization development and suitable government intervention.

5.3. Policy implications

The results of this study provide valuable references for governmental decision-making behaviors. First of all, government should recognize the impact of spatial heterogeneity on the political effects due to the segmentation of the real estate market. To prevent ‘policy failure,” it is necessary to change the past regulation mode of “one-size-fits-all.” In addition, policy formulation should follow the characteristics of the real estate market in different regions. Also, government cannot evaluate the policy effect of a single city in isolation. The connections between different cities strengthened the interactions between regional real estate markets. Under the background of Beijing-Tianjin-Hebei coordinated and integrated development, it is necessary to fully consider how the flow of humans, logistics, capital, and other mobile elements affect land market links between core cities and marginal cities. In this manner, the analysis of the supply-demand relationship in land markets is enlarged to the regional scope from the traditional urban scope. Second, each policy will involve a variety of stakeholders, including the central government, local governments, real estate developers, speculators, ordinary residents, and others. The process of public decision-making is a process of distributing interests or values, so the promulgation of policies will inevitably sacrifice the existing interests of one party. Policymakers should avoid the “short-sighted effect” caused by pandering to some stakeholders. Instead, they should aim to promote the optimal allocation of land resources and realize sustainable urban development. In the process of urban land capitalization, the full realization of increases in local government financial revenue and the surge of investment income from a few investors can cause negative effects for the greater society, such as rapid rises in housing prices and sharp rises in production costs (Zhu and Li, 2018). These effects have been proven harmful due to the excessive pursuit of land capitalization and land value-added benefits only for minority interest groups. Under this common situation, regulators are hindered in their efforts to control run-away land markets, and land policies and regimes are easily transformed into the service tools of vested interests. The vested interest thereby earn higher incomes by preventing a glut of the market (Veblen, 1919). Third, the fundamental problem in the Chinese real estate market currently is the contradiction between supply and demand. HPR policy can only be a transitional policy in the short term by squeezing out investment demand to relieve the pressure of housing price increases. The regulation of the real estate market will eventually return to a state in which the market mechanism plays a leading role. Currently, the tax structure of “light ownership and heavy transfer” in China’s real estate market leads to nearly all of the land and housing appreciation going to the holders, which stimulates speculative demand in the real estate market and is obviously unreasonable. Therefore, it is suggested to accelerate the deepening of the real estate taxation system. A pilot real estate tax reform process should be actively promoted. Increasing the cost of housing hoarding via the collection of real estate taxes can restrain speculative demand, which will play a positive role in regulating housing prices. It will also assist local governments in reducing their dependence on land finance. In addition, support of the housing rental market should be strengthened to achieve the social goal of housing security during the process of urbanization.

At the same time, in order to avoid excessive occupation of high-quality agricultural land by construction land in the process of urbanization,
the government should actively play the role of a land space planning regime to optimize the overall planning of urban, agricultural, and ecological land. By improving the relevant laws, governmental departments should establish an implementation mechanism to ensure spatial planning and finally achieve the primary goal of the planning regime in urban development.

6. Conclusion

The real estate market is a key part of the economy that affects the economic security and cost of living for people during the process of urbanization. Therefore, it is particularly important for the government to effectively regulate an irrational real estate market. Although some studies have examined the effect of government regulation on the real estate market, there are still some limitations, such as statistical data distortion, regional convergence, and unscientific research methods. Specifically, based on the monthly new housing sale price index and the second-hand housing sale price index published by the China National Bureau of Statistics website, most of the relevant studies have estimated the effect of the HPR policy in large and medium-sized cities using traditional measurement methods or the difference-in-difference method. This study analyzed the theoretical logic of the HPR policy from the perspective of the dynamic behavior of both the supply and demand sides of the real estate market. Empirically, this study collected a large number of second-hand housing data and estimated the overall effect and spatial heterogeneity of the HPR policy effect on housing prices in five counties around Beijing in Langfang using a regression discontinuity design. In addition, this study fully recognized the differential impact of core cities on marginal cities, and further explored the spatial heterogeneity of policy effects.

First, the results showed that the effect of Langfang’s HPR policy on second-hand housing prices was not statistically significant in the entire study area. The average policy effect was -1.66 %. That is to say, the effect of Langfang’s HPR policy on second-hand housing prices in study area was not obvious. The real estate market in Langfang was still dominated by rigid demand, which was the primary reason for the failure of the HPR policy.

Second, the HPR policy effect had obvious spatial heterogeneity. The housing markets in the study area was divided according to their distances from Beijing. It was found with an increase in the buffer distance, the policy effect gradually changed from pushing up housing prices to lowering it, while the significance and stability of the model gradually decreased. Within 500 m of the buffer zone, the implementation of the HPR policy significantly increased the price by 8.07 %. Within 1000 m of the buffer zone, the implementation of the policy increased the price by an average of 6.70 %. However, when the buffer zone exceeded 1000 m, the policy played a role in reducing the price, but it was not significant.

Third, according to the theoretical analysis of how the HPR policy affected the behavior of both the supply and demand sides, the spatial heterogeneity of the policy effects was primarily affected by differences in the supply and demand situations of real estate markets in different regions. The radiation effect of the big cities (such as Beijing) on the small cities affects investments in the housing markets in different locations, and then this will affect the different expectations and policy responses of suppliers and demanders. The real estate market in Langfang, which is located closer to Beijing, is more likely to be an alternative to Beijing’s housing demand, which also means that there will be more investment demand. In anticipation of a retaliatory rebound in housing prices after the end of the HPR policy, the suppliers will reduce the current supply, while the qualified demanders will have the impulse to buy houses during the current period. The behavioral changes of both supply and demand will ultimately lead to a rise in housing prices instead of a decrease.

Finally, this study provided valuable references for governmental decision-making behaviors using the heterogeneity and connection of policy objects, a balance of stakeholders, and improvements in the relevant regimes. These improvements included to increase the cost of housing hoarding via the collection of real estate taxes and to guarantee the implementation of the land space planning regime through legislation.

Acknowledgments

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.landusepol.2020.104528.

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