The Relationships Between Housing Purchase Restriction Policies and Housing Auction Markets: Evidence From Changsha, China

Ping Feng, Ziqi Zhou, Mahmut Yasar, Jeffrey P. Cohen

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Abstract

This paper identifies a mechanism by which the Chinese home purchase and foreclosure purchase restriction policies affected the sales prices of judicial auction housing. Using unique daily transaction data on over 15,000 online judicial auctioned residential homes in Changsha, China, and applying Heckman Sample Selection and Difference-in-Differences methods, we test two hypotheses. The first hypothesis is that the housing purchase restriction policy empowered households to avoid the cap on owning more homes and raised the judicial auction bidding prices via more bidders. The second hypothesis is that the foreclosure purchase restriction policy closed the loophole, lowered the number of bidders, and in turn, reduced the bidding prices for judicial auction housing. We find significant evidence in support of both of these hypotheses. The findings have significant implications for policymakers to develop and sustain effective judicial auction markets in China.

Keywords: Housing Purchase Restriction Policy; Foreclosure Purchase Restriction Policy; Housing Prices; Online Judicial Auction

JEL Codes: R31, R33, R38

Authors:
Ping Feng, School of Economics and Management, Changsha University of Science and Technology, Changsha, Hunan, P.R. China
Ziqi Zhou School of Economics and Management, Changsha University of Science and Technology, Changsha, Hunan, P.R. China
Mahmut Yasar, Department of Economics, University of Texas at Arlington, TX, USA
Jeffrey P. Cohen, Department of Finance, University of Connecticut, CT, USA

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1. Introduction

Starting in 2010, some cities in China enacted policies to restrict the number of open market homes a family can purchase. These policies are known as housing purchase restriction policies. On January 1, 2022, the policies were expanded by including the judicial auction properties (hereinafter referred to as foreclosure) in the application of local housing purchase restriction policies, and mandated that local housing purchase restriction policies bind judicial foreclosure transactions nationwide.[1] Consequently, there have been intense discussions within China's real estate industry regarding the potential implications of these two policies: the housing purchase restriction policy that only applies to open market housing (hereinafter HPRP)[2], and the foreclosure purchase restriction policy that expands the HPRP to include the foreclosed properties (hereafter FPRP).[3] In this paper, we test the hypotheses that these two policies affected the number of bidders in foreclosure auctions, and in turn, affected auctioned home prices. Specifically, we test whether the HPRP increased the number of bidders on foreclosures, and in turn raised prices. In addition, we explore whether the HPRP enabled some residents to obtain more than one home by bidding on foreclosures. Finally, we consider the effects of the FPRP on the number of bidders, and

[1] The *Provisions of the Supreme People's Court of P.R.C. (SPC) on Certain Issues Concerning the Qualifications of Bidders for Judicial Auction Properties of the People's Courts,* which came into force on January 1, 2022, expanded the local housing purchase restriction policies by clarifying that the judicial auction foreclosures are bound by the policies.

[2] In our dataset, approximately 99 percent of the auctioned properties are apartments, with the remaining including single family houses. Therefore, in this paper we refer to residential properties as housing, rather than houses or apartments.

[3] Guangzhou and Beijing enacted the FPRP in 2016 and 2017, respectively, followed by a few other major cities. Changsha began to implement FPRP in May 2021. The Supreme Court has required all the cities implementing the HPRP to expand it to include foreclosed properties since January 2022.

in turn, the foreclosure sale prices. We find strong evidence that these policies impacted the number of bidders and the foreclosure prices; and that the HPRP was a loophole for residents to invest in additional homes while the FPRP closed this loophole.

In general, foreclosure occurs when a debtor cannot settle the debt on time, and the creditor attempts to recover the amount owed on the defaulted loans by taking ownership of the properties under the debtor's name and selling them by a legal process. In China, since most foreclosed properties are forced to be auctioned due to debt issues, the court is usually not responsible for the delivery of vacant properties, and buyers may need to bear all kinds of taxes and fees that may exist on their own, including but not limited to transaction taxes, old and new tax arrears, etc., as well as transaction risks due to defects in rights such as unknown ownership, long-term leasehold, and possession by others (Bao, 2019). Despite the potential risks associated with foreclosure transactions compared to open market housing transactions, foreclosure transactions in China have been increasing each year, both in terms of the number of pending auctions and the number of transactions. In 2020, the number of property asset auctions on Taobao's judicial auction platform reached 500,225, up 119.9% compared with 2017.[4]

As an effective way to dispose of a large amount of real estate in a short period of time and reduce carrying costs, property auctions have become a typical disposition method in the judicial system to deal with foreclosed or bankruptcy-distressed assets.

[4] Property assets include residential premises, commercial premises, industrial premises, and other premises, but the data before 2017 did not make sub-category distinctions. The relevant statistics exclude discontinued or withdrawn transactions in the middle of the auction process.

Factors that affect the sale price of residential properties in general, such as the characteristics of the property itself (e.g., location, floor, property size, structure, age, presence of elevators, etc.),[5] local amenities (e.g., schools, convenience stores, stations, etc.),[6] and the environment of the property location (e.g., air quality, greenery, noise, crime rate, community quality, etc.)[7] can affect the selling price of the judicially auctioned property. Other factors in international studies, such as the reservation price (Stevenson and Young, 2015), the number of bidders (Nanda et al., 1997; Ooi et al., 2006), the occupancy status of the home (e.g., whether it comes with a long or short-term lease) and whether the auction information is promoted through the Internet (Idee, 2011; Ooka, 2021; Xu et al., 2022), also have been shown to significantly affect the foreclosure sale prices. In addition, real estate auction activity is highly cyclical (Qu and Liu, 2012; Zhou et al., 2015) and there is some evidence of "irrational exuberance" in auction markets during times of market bubbles (Shi and Kabir, 2018). The auction types have been shown to impact the sale price as well. For instance, "sealed-bid" versus "English open auction" (Chow and Ooi, 2014) – as well as comparisons of "double round auctions" versus conventional market transactions (Kallberg et al., 2021) – have led to significant sales price differences.

The limited number of studies on the Chinese foreclosure market have been conducted from a jurisprudential perspective. One strand of research focuses on the risks involved in foreclosure transactions from the buyer's perspective, such as long-

[5] See Bishop and Murphy (2019).
[6] See Black (1999).
[7] See, for instance, Chay and Greenstone (2005); Pope (2008); Currie et al. (2015); Cohen et al. (2021).

term leasehold issues, tax-related disputes, and the buyer's rights and interests (Ren et al., 2021). Another area of Chinese research focuses on jurisprudential issues related to the FPRP implemented in some specific cities. Most of this research highlights that unlike the unforced sales in negotiated transactions, judicial auctions are enforced actions based on the exercise of public power, which are only bound by law and should not be affected by local housing purchase restriction policies (He, 2018).

Ever since China's Supreme People's Court issued their ruling that foreclosed homes are subject to purchase restrictions in the form of *Provisions* nationwide,[8] there have been discussions about the implementation of HPRP and FPRP at the local level, and quantifying their impact on the foreclosure market has been of interest to various groups including policymakers, decision-makers, and researchers alike. The judicial auction of real property is an important means to dispose of non-performing real assets, enhance the ability to dematerialize and prevent financial risks, and plays a fundamental role in maintaining the development of the real estate industry. An in-depth and systematic study of the foreclosure market has important reference value for improving relevant policies and regulations, as well as formulating measures to mitigate financial risks. In China, what are the characteristics of foreclosure transactions compared with regular open market transactions? What factors affect the transaction price of foreclosed properties? How and to what extent would real estate regulation policies (residential and foreclosure purchase restrictions) affect foreclosure transaction prices? The

[8] On December 19, 2021, the Supreme People's Court announced the Provisions on Certain Issues Concerning the Qualifications of Bidders for Judicial Auction Properties of the People's Courts, which stipulates that the People's Court shall not permit bidders who are subject to the restrictive purchase policy of the location of the property to apply to participate in the judicial auction of real estate organized by the People's Court.

answers to these questions are crucial to understanding China's foreclosure market's development and soundly evaluating the role of local real estate regulation and control policies. Although there has been some research on the effects of housing price restriction policies on open market housing price changes in some major cities (e.g., Beijing) in China (Du and Zhang, 2015; Li et al.,2017; Li et al., 2020; Zou et al., 2022), to our knowledge, the impact of such policies on the bidding prices of foreclosed homes has yet to be examined. Specifically, the current research only discusses the potential effects of HPRP on housing prices on the open market and the rationale for and the importance of FPRP from the jurisprudential perspective. Only two studies in the economic literature have been conducted to examine the impacts of HPRP and FPRP on foreclosure transactions, primarily because of data sparseness. Using data on online judicial housing auctions in China, Xu et al. (2022) investigated how information disclosure facilitated real estate transactions. Using Chinese data for online residential judicial auction properties in Beijing, Yu (2022) analyzed the effect of the 2017 Beijing 3-17 HPRP on the housing price changes, but did not consider the effect of FPRP.

This study contributes to the literature by examining the effects of HPRP and FPRP on foreclosure transactions. We do so by first providing a conceptual framework for the potential effects of China's urban HPRP and FPRP on foreclosed housing prices. We then test the hypotheses by using the daily transactions data on residential foreclosed housing in Changsha city (the capital of Hunan Province, P.R. China) from January 2015 to May 2022,[9] and examine the foreclosure housing price effects of the HPRP

[9] As discussed in the data section, we obtained this data from Taobao's judicial auction platform.

and FPRP implemented in the city of Changsha. To our knowledge, this is the first paper to explore and quantify the impact of HPRP and FPRP on foreclosure transactions in China.

Applying the Heckman selection model and difference-in-differences (DID) estimation strategy, which allows us to control for heterogeneity and selection bias, we find that implementing the HPRP in Changsha led to an increase in the number of foreclosure auction bidders, which, in turn, significantly increased the foreclosure transaction prices. These findings indicate that the HPRP significantly promoted foreclosure transactions. However, the recent purchase restriction policy that extends the restrictions to foreclosures (the FPRP) decreased the number of foreclosure bidders by about 32% and the transaction prices by about 5%. The FPRP had a significant hindering effect on foreclosure transactions. Our findings have interesting implications with regard to understanding the potential price effects of such policies.

The rest of this paper is organized as follows. The next section reviews China's property judicial auction system and the evolution of Changsha's housing purchase restriction policy. Section 3 provides a theory for the impact of HPRP and FPRP on foreclosure prices and proposes research hypotheses, and it also discusses the data and the empirical approach used in the study. The results of the empirical analysis are presented in section 4. Conclusions and policy implications are discussed in the last section.

2. Development of China's property judicial auction system and the housing purchase restriction policy of Changsha city

2.1 Development of China's property judicial auction system

In 1991, *China's Civil Procedure Law* formally established the judicial auction system. The subsequent *Provisions on Several Issues Concerning the Execution of the People's Courts* confirmed judicial auctions as the primary way to dispose of litigation assets. In 2012, the Supreme Court piloted online judicial auctions via Taobao's auction platform in Zhejiang Province. Since then, five platforms - Taobao Network (www.taobao.com), JD Network (www.jd.com), the People's Court Litigation Assets Network (www.rmfysszc.gov.cn), Public Auction Network (https://www.gpai.net) and the China Association of Auctioneers Network (www.caa123.org.cn) have been identified as the judicial auction network service providers.[10] Because online auctions can effectively reduce property auction costs (Gallino and Moreno, 2014), shorten the property sale time, broaden information outreach (Srinivasan et al., 2002), strengthen the openness and transparency of property auction procedures, and increase the property sales rate and selling prices, *the Provisions on Several Issues Concerning the Online Judicial Auctions by People's Courts*, implemented in 2017, further clarifies that all the judicial auctions in China should be conducted online. Since then, the online judicial auction market has been rapidly developing in mainland China (Xu et al., 2022).

Data from Alibaba (Taobao) judicial auction platform, the largest online judicial auction service supply platform in China,[11] shows that only 6 real estate properties (including residential, commercial, industrial, and other premises) were auctioned on

[10] In 2016, the Supreme People's Court issued the Announcement on the List Bank of Online Judicial Auction Service Providers to clarify this. In 2019, ICBC (mall. icbc.com.cn) and Beijing Equity Exchange (www.cbex. com.cn) were added to the list of network service providers for judicial auction of the Supreme Court.

[11] By 2020, 99% of courts nationwide in China have settled in Taobao's online judicial auction platform, and 95% of online judicial auction transactions have been transacted through this platform.

this platform in 2012. In 2021, the number reached 308,453, with an average annual growth rate of more than 50%. Among them, residential housing accounts for more than half of all real estate transactions (see Figure 1).

Figure 1 here.

2.2 Housing purchase restriction policy development in Changsha

Changsha, a city and the capital of Hunan province in China, has jurisdiction over 6 municipal districts (Furong, Tianxin, Yuhua, Kaifu, Yuelu, Wangcheng), one county (Changsha County) and two county-level cities (Liuyang and Ningxiang). By the end of 2021, the city's nominal GDP reached 1327.07 billion yuan (about 205.7 billion US dollars), ranking 15th among cities at the prefecture level and above in China,[12] similar to the gross output value of the Denver Metropolitan Area, Colorado, USA. In 2020, the average housing price to income ratio for 50 key cities in China was 13.3. Shenzhen and Changsha ranked the highest and lowest housing price income ratio among the 50 cities, with 39.2 and 6.2, respectively.[13] Figure 2 shows the trend of housing prices and GDP per capita in Changsha (CS GDP) and the central provincial capitals Zhengzhou (ZZ) and Wuhan (WH) from 2000 to 2020. Compared with Zhengzhou and Wuhan, Changsha has a higher GDP per capita but a lower housing price.

Figure 2 here.

After China's housing market reform in 1998, housing prices in major cities in China rose rapidly. In order to control the rapid rise of residential prices nationwide and

[12] In 2021, Changsha had a total permanent population of 10.2393 million, with a GDP of 1327.07 billion yuan. The data comes from the National Bureau of Statistics and Changsha Municipal Bureau of Statistics.
[13] Data source: the Report on the Housing Price Income Ratio of 50 Cities in China in 2020 released by E-House Research Institute.

to combat speculative demand for housing, in April 2010 the Chinese State Council issued *the Notice on Resolutely Curbing the Rapid Rise of Housing Prices in Some Cities*, which put forward the concept of residential housing purchase restrictions for the first time. The *Notice* highlighted the need to take practical measures to curb unreasonable speculative housing demand and required local governments to take steps to limit the number of homes purchased by residents to accomplish it.[14] In the same year, Beijing issued the first housing purchase restriction rules in China to restrict the number of homes a family can purchase.[15] Following Beijing, in March 2011, Changsha imposed purchase restrictions on new residential housing with no more than 90 square meters.[16] With the rising trend of housing prices stabilizing, in August 2014, Changsha canceled the residential housing purchase restriction.[17] In March 2017, to echo the request of China's central government's Central Economic Work Conference that "*houses are for living in, not for speculation"*, Changsha restarted the purchase restriction and restricted the purchase of new residential properties within the purchase restriction area (6 districts of Changsha City and Changsha County Economic Development Zone and Xingsha area) by non-local households.[18] In May of the same

[14] See the Notice of the State Council on resolutely curbing the excessive rise of housing prices in some cities (GuoFa [2010] No. 10). See Du and Zhang (2015), Sun et al.(2017), Somerville et al.(2020), and Zou et al.(2022) for discussions about the housing purchase restriction policies.

[15] The Notice of the Beijing Municipal People's Government on the Implementation of the Document of the State Council on Firmly curbing the Excessive Rise of Housing Prices in Some Cities (JZF [2010] No. 13) stipulates that since then, a family can only buy one new residential housing in this city.

[16] Changsha stipulated the Notice on Issues Related to Further Strengthening the Management of the Real Estate Market (CZBF [2011] No. 10). It clarified that in the five districts under the jurisdiction of Changsha city (Wangcheng was changed from a county to a district in May 2011), a family may have one home and the non-local families who have no home in the urban area and can provide their own residence permits are restricted to purchase one more new residential housing less than 90 square meters (including) in Changsha urban area. For families with more than 2 (including) houses in the Changsha urban area and families from other places with more than 1 (including) house, and families from other places who cannot provide their own residence permits, the purchase of new residential housing less than 90 square meters (including) in the urban area was suspended.

[17] Changsha's HPRP only covers commercial housing under 90 square meters, and no official document has been issued to lift the policy. However, the CCTV Finance Channel reported the incident.

[18] The Notice on Further Promoting the Steady and Healthy Development of the Real Estate Market (CZBH

year, Changsha extended the scope of purchase restriction to families who already owned two or more homes and banned them from buying both newly built and second-hand residential homes.[19] In September 2017, Changsha further tightened the purchase restriction policy, expanding the scope of purchase restriction in urban areas and narrowing the scope of family purchase qualification.[20] In April 2021, Changsha started the specific foreclosure purchase restriction policy (FPRP) for foreclosed residential homes.[21] In May of 2021, the Changsha Intermediate People's Court clarified that it would impose a distinct purchase restrictions policy for popular foreclosure properties according to the dynamically adjusted purchase restriction list provided by the relevant government department of Changsha.[22] If it was indicated in the judicial auction announcement that the home to be auctioned must comply with the housing purchase restriction policy, the bidders must be qualified to participate in the auction. On December 19, 2021, the Supreme People's Court announced the *Provisions on Several Issues Concerning the Qualifications of Bidders for People's Court Judicial*

[2017] No. 38) restricts the purchase eligibility of non-local households who have no residence in the restricted purchase area.

[19] The Notice on Further Improving the Regulation and Control of the Residential Real Estate Market (CZJF [2017] No. 71) suspends the sale of commercial houses (including new commercial houses and second-hand houses) to the registered residence families in the city who have two or more houses in the restricted purchase area; Suspend the sale of commercial housing to non-registered residence families who have one or more houses in the restricted area; Non registered residence households without housing in Changsha City are restricted to purchase one commercial housing by the certificate of continuous payment of individual income tax or social security in Changsha City for more than 12 months.

[20] The Commission of housing and urban-rural development of Changsha City issued the notice on further stabilizing the real estate market and promoting healthy growth, which made it clear that families with registered residences in this city who already have one housing in this city can buy second housing only after the first housing has obtained the real estate ownership certificate for three years; The tax payment or social security certificate period for non-registered residence families in this city is extended to 24 months; The purchase restriction area is adjusted to the administrative area of the city (excluding Liuyang City and Ningxiang City).

[21] Relevant information was obtained from Hunan local media Xiaoxiang Morning Post on April 22, 2021.

[22] The standards to define 'popular' neighborhoods of specific FPRP in Changsha are based on the following : (1) neighborhoods with high turnover and high bidding prices in recent judicial auctions; (2) Best school district housing with high attention; (3) The houses with high price difference between the existing houses and the houses under construction, such as the houses around the subway entrance and the landscape houses (including the houses around Xiangjiang River, Liuyang River, Meixi Lake, and Yanghu Lake, etc.); (4) Hot opening houses that need to be lottery at the time of opening. For relevant information, please refer to the report of Hunan Daily on May 15, 2021.

Auction Properties, which stipulated foreclosed properties were subject to local purchase restriction policies from January 1, 2022. Chinese media interpreted this Regulation as a comprehensive restriction on purchasing foreclosed properties in restricted areas. However, after reviewing the judicial auction announcement of foreclosed housing in Changsha published after this date, it is found that Changsha still implemented the specific foreclosure purchase restriction policy (specific FPRP) for foreclosed residential housing, and more than 80% of foreclosed properties were free from the foreclosure purchase restriction policy. Figure 3 shows the evolution of the housing purchase restriction policy (HPRP) in Changsha.

Figure 3 here.

2.3 Development of Changsha's online foreclosure housing market

Changsha foreclosure housing market started late. According to Taobao's judicial auction platform, in 2015, there were 14 residential properties listed on the platform, with 3 sold and 11 unsold. In 2016, there were a total of 39 residential properties listed on the platform (7 sold), which was less than the number of listed properties in one month in 2022. Since 2017, the number of foreclosure properties listed and sold has increased gradually. In 2021, a total of 3961 residential properties were listed for the first time on the Taobao judicial auction platform, and 2049 of them were sold, and 1912 were not (see Figure 4).[23] By region, the number of foreclosed homes in the city's six districts subject to housing purchase restrictions accounted for the absolute majority

[23] The data only includes the first-time auctions. The unsold houses will be auctioned for the second and the third time until they are sold. Our dataset does not include the second or the third auction transactions for the houses not old at the first auction, either discontinued or withdrawn transactions in the middle of the auction process.

of the total number of foreclosed homes in the city, with the largest number of foreclosed homes in Yuelu District, Yuhua District, and Tianxin District. The number of foreclosed homes in Ningxiang City and Liuyang City, which was not subject to the housing purchase restriction in Changsha, was comparable to that in Furong District.

Figure 4 here.

Figure 5 shows the average sales rate of residential foreclosed housing in the urban area (6 districts and 1 county) affected by the purchase restriction policy (HPRP) and that of the two county-level cities (Ningxiang and Liuyang) not affected by the purchase restriction policy (HPRP), from June 2020 to April 2022. The sales rate in purchase-restricted areas was generally higher than in non-restricted areas. The foreclosed properties in the restricted area had a record-high sales rate during April and May 2021, then the sales rate began to decline. After a slight rebound in December 2021, the sales rate was parallel to that of the unrestricted area.

Figure 5 here.

In April and May 2021, news of the specific foreclosure purchase restriction policy (specific FPRP) for foreclosed properties in Changsha came out from the media. Nevertheless, the actual transaction time of the foreclosed properties generally lags behind the announcement time. The actual foreclosure transactions in April and May usually were announced in March and April and were not subject to purchase restrictions. Although the sales rate of foreclosures in restriction areas peaked in April and May, the sales rate of foreclosed housing in non-restricted areas was generally stable. It indicates that the specific FPRP is correlated with the foreclosure sales rate.

But a careful analysis of causality would yield valuable information about the relationships between these policies and foreclosure sales prices.

3. Theoretical analysis and model construction

3.1 Theoretical analysis and research hypothesis

As described in the above literature review on foreclosure sales in other countries, the bidding price of a foreclosed home is affected by the property characteristics, the auction method, etc. Most of the first auction transactions in the Chinese foreclosure market follow the English auction. The court will first set a starting price based on the property's appraisal value (price), and the bidders compete by bidding higher prices within a designated period to win. The bidder with the highest bidding price wins the auction and must buy the property at the final bidding price.[24]

Compared with the negotiated sales of open-market second-hand housing, an auction transaction, especially a judicial auction transaction, requires a quick sale, so a foreclosed property is typically sold at a discount (Adams et al., 1992; Mayer, 1995, 1998; Quan, 2002; Campbell et al., 2011; Donner, 2017). In the U.S., most foreclosed properties offered at auction are bought by the lender and subsequently sold as REO properties. But in China, most foreclosed homes need to be judicially auctioned to a third-party buyer. Chinloy et al. (2017) finds that foreclosure auctions at which the property was sold to a third-party buyer result in a larger discount compared with REO

[24] According to Xu et al. (2022): "If no bidder accepts the starting price, the first auction fails, and the court will implement a second auction for the same property within 30 days. The second auction follows the same procedure as the first auction, the only difference being that the starting price is typically 20% lower than in the first. If the second auction also fails, a last sell-off attempt is made. The court will re-list the property on the online platform for 60 days, using the starting price of the second auction again. The first buyer accepting this price will get the property. If the sell-off attempt also fails, no further attempts are made." See Xu et al. (2022) for more information about the online judicial auction process.

properties, which are, in turn, sold at lower prices than with unforced sales.

In addition, although China has made significant progress in technological and social development, Chinese people's ancient and traditional geomantic (Fengshui) ideology still influences their daily decisions (Bourassa and Peng, 1999; Madeddu and Zhang, 2021). The former homeowner's property was judicially auctioned due to the loan default, debt dispute, and/or other reasons. The potential Chinese buyers may be more cautious in bidding because of career geomantic (Fengshui) considerations.[25]

Therefore, in areas not subject to purchase restrictive policies, foreclosed homes are usually sold at a discount in the foreclosure housing market. In Beijing, for example, in 2020, a total of 5,620 properties were listed for auction in the foreclosure market, and 2,384 of them were sold at an average price of 77.8% of the market price.[26] Being cheaper than the negotiated sale prices of second-hand homes is one of the driving forces for bidders to participate in foreclosure bidding.

Implementing the HPRP has removed the eligibility of both non-local households and local households with two or more homes that do not meet the requirements. Moreover, it has directly suppressed the intention of families with purchasing ability but without purchasing qualifications.[27] In cities where residential housing purchase restrictions are implemented but foreclosed properties are not included in the policy

[25] Madeddu and Zhang (2021) note: "Feng Shui, or Chinese geomancy, is an ancient system of thoughts underpinning the selection of favorable sites for cities, and providing a guide for positioning buildings and other man-made objects in a harmonious relationship with their environment. It aims to ensure alignment between humans' needs, spiritual or otherwise, and the configuration of their physical spaces. It originated in China centuries ago and influenced every aspect of the daily life of emperors and ordinary people: from the arrangement of the 'dwellings for the living', to the identification of a favorable day on which to get married and even the choice of a name for a child." For more details, see Madeddu and Zhang (2021).

[26] Source: Legal Daily News, January 4, 2021.

[27] The specific details of purchase restriction measures in different cities are different, and the purchase restriction measures in the same city are also different at different time periods.

scope, the foreclosure market provides a compliant way for these buyers to resolve their housing purchase eligibility. Even if a bidder does not qualify to purchase a home, after a successful judicial bidding, the bidder can register the property rights to the foreclosure property with a *Notice of Assistance in Execution* issued by the court. This means that the implementation of the housing purchase restriction policy (HPRP) has endowed the foreclosures with the functional attribute of circumventing the purchase restriction policy and prompted more potential buyers to participate in foreclosure bidding to realize their purchase intentions actively. Therefore, it has increased the demand for foreclosures, intensified the auction competition, and increased the foreclosure transaction prices. Accordingly, we propose research hypothesis 1 as follows:

Hypothesis 1 (H1): The HPRP led to a higher number of bidders, which, in turn, results in higher bidding prices for foreclosure housing.

However, when the HPRP was extended to include foreclosed housing, the attribute of foreclosed properties to circumvent purchase restrictions will no longer exist. The number of foreclosure bidders would be expected to decrease, and the transaction price would fall accordingly. Therefore, research hypothesis 2 of this paper is proposed:

Hypothesis 2 (H2): The FPRP resulted in fewer bidders for foreclosed housing, which, in turn, leads to lower foreclosure bidding prices.

3.2 Empirical Model

The main determinants of a foreclosure property transaction price are the

characteristics of the housing itself. This paper adopts the hedonic price model to analyze the impact of the purchase restriction policy on the foreclosure bidding price. Based on the theory of consumer preference proposed by Lancaster (1966) and the theory of market equilibrium advocated by Rosen (1974), the hedonic price model emphasizes product heterogeneity and contends that consumer demand for a product is based on the characteristics of the product rather than the product itself, and the product characteristics determine the product market price. This method is widely used in the analysis of factors affecting real estate prices (Witte et al., 1979; Mok et al., 1995; Chau and Chin, 2003; Nepal et al., 2020). Following the previous studies, we specify the following equation to test hypothesis H1：

$$PD_i = \alpha_1 + \beta_1 HPRP_i + \sum_{j=1}^{n} \delta_j X_{ij} + \varepsilon_i \quad (1)$$

where the PD_i is the transaction price of foreclosure *i*. $HPRP_i$ is a dummy variable for whether foreclosure *i* should be subject to the HPRP, which takes the value of 1 if yes, and 0 otherwise. X_{ij}（j=1，...，n） is a series of control variables that affect the bidding price of foreclosure *i*, such as the property's interior and exterior area, location, the quality of available schools, and proximity to subway stations, among other attributes.

Only foreclosed housing with successful auctions is observed and thus have bidding prices (PD_i). Therefore, our sample is censored, and the OLS estimates with such data will be biased and inconsistent. We, thus, use Heckman's two-stage regression model (Heckman, 1979) to control the sample selection bias when estimating the impact of the HPRP on foreclosure transaction prices. The Heckman selection modeling approach has been used in other foreclosure auction studies, such as Chow et al. (2015),

who focus on Singapore land markets. To do so, we first estimate equation (2) below using the Probit model and then estimate equation (1) by adding the Inverse Mills Ratio obtained from the Probit Model.

$$D_i^* = \alpha_2 + \beta_2 HPRP_i + \sum_{j=1}^{n} \delta_j Z_{ij} + u_i \quad (2)$$

where D_i^* is an unobservable latent variable determined by *HPRP* and a set of explanatory variables Z. If the bidders expect that the utility of bidding is greater than that of no bidding, the auction deal will close. Hereby, the indicator function is defined as follows:

$$D_i=1, \text{ if } D_i^*>0$$

$$D_i=0, \text{ if } D_i^* \leq 0$$

D_i=1 and D_i=0 indicate that the foreclosure property is sold and unsold, respectively. The bidding price PD_i is observed only when D_i=1. The inverse mills ratio (*IMR*) estimated from the first-stage model (equation 2) will be included as an explanatory variable in the second-stage regression model (equation 1) to control for potential selection bias.[28]

Following Jiang (2022) and Dell (2010),[29] we next estimate equation (3) to identify a mechanism through which the HPRP affects the foreclosure bidding process. We expect such a mechanism to be the number of bidders. Specifically, HPRP leads to a higher number of bidders, which, in turn, increases the bidding prices.

$$Bidder_i = \alpha_3 + \beta_3 HPRP_i + \sum_{j=1}^{n} \delta_j X_{ij} + v_i, \quad (3)$$

[28] Chow et al. (2015), who study foreclosure auctions in Singapore, are able to distinguish between foreclosure sales and negotiated sales, which is how they set up their first stage of the Heckman selection process.
[29] Note that Jiang (2022) and Dell (2010) used such an estimation strategy to explore different relationships than ours.

where $Bidder_i$ is the number of bidders for foreclosure i in Changsha, and the coefficient β_3 represents the effect of the HPRP on the number of bidders. A statistically and economically significant coefficient on $HPRP$ provides evidence that the number of bidders mediates the impact of policy on prices.

To test hypothesis H2, we need to analyze the impact of the foreclosure housing purchase restriction policy on the foreclosure bidding prices. Unlike the other Chinese cities' '*One size fit all*' FPRP for local foreclosed houses, Changsha imposes specific purchase restrictions on foreclosure housing in certain "popular" neighborhoods. The sample used in this paper represents the residential homes that were auctioned on the Taobao judicial auction platform for the first time. It is impossible to observe the changes in the bidding price of the same restricted home with and without the foreclosure purchase restriction. Considering that the bidding prices of different homes cannot be combined, we construct the transaction premium rate index of foreclosure i based on the bidding price of property i and the appraisal price of the home, as in equation (4):

$$DEratio_i = PD_i/PE_i, \tag{4}$$

where $DEratio_i$ is the transaction premium rate of foreclosure i, PD_i is the auction bidding price of foreclosure i, and PE_i is the appraisal price of the property. The foreclosure appraisal price is an objective evaluation of the property value made by the real estate appraisal company based on the property's characteristics. The higher the foreclosure transaction premium rate, the higher the final bidding price of the foreclosed home compared with its actual value. Because the property characteristics that

influence property appraisal price will also impact the sales, the transaction premium rate ($\mathrm{DEratio_i}$) controls for unobserved property characteristics.

Based on the transaction premium rate of a single home, we take the arithmetic average of all foreclosure transaction premium rates of the properties belonging to the neighborhood *r* in month *t* by month to construct the monthly index of foreclosure transaction premium rate of residential neighborhood *r*.

$$mDEratio_{rt} = \sum_{i=1}^{n} DEratio_{rit}/n, \quad (5)$$

where n is the total number of foreclosed homes in residential neighborhood *r* sold in month *t*. If $mDEratio_{rt}$ is less than 1, the bidding price of foreclosed properties in neighborhood *r* in month *t* is lower than the appraised price, i.e., the foreclosure is sold at a discount. If this indicator is greater than 1, it means that on average, the foreclosed properties in the neighborhood achieve premium transactions.

Similarly, based on the number of bidders registered for a single foreclosure, this paper takes the arithmetic mean of the number of bidders for all foreclosed properties sold in month *t* in the neighborhood *r* on a monthly basis, and constructs the monthly index of the number of bidders for foreclosed homes in residential neighborhoods as follows.

$$mBidder_{rt} = \sum_{\mathrm{i=1}}^{\mathrm{n}} Bidder_{\mathrm{rit}}/n, \quad (6)$$

where *n* is the total number of foreclosed homes sold in residential neighborhood *r* in month *t*.

Based on equations (7) and (8), we use the DID method to estimate the effect of the FPRP on the number of bidders and the bidding price of foreclosed homes.

$$mBidder_{\mathrm{rt}} = \alpha_4 + \varphi FPRP_{rt} + \sum_{\mathrm{j}=1}^{\mathrm{n}} \delta_{\mathrm{j}} \ln \mathrm{X}_{\mathrm{rt}} + \lambda_r + \nu_t + \varepsilon_{rt} \quad (7)$$

$$mDEratio_{rt} = \alpha_5 + \gamma FPRP_{rt} + \sum_{\mathrm{j}=1}^{\mathrm{n}} \delta_j \ln X_{rt} + \lambda_r + \nu_t + \varepsilon_{rt} \quad (8)$$

where $FPRP_{rt}$ is a dummy variable of whether or not the neighborhood *r,* where the foreclosure is located, is included in the specific purchase restriction range in period *t*, and the value takes 1 if it is true; otherwise, it takes 0. The coefficients φ and γ reflect the impact of the FPRP on the number of bidders and the bidding price, respectively. If the FPRP significantly reduces the number of foreclosure bidders in the neighborhood, the coefficient φ should be negative. If the FPRP substantially reduces the bidding price of foreclosed homes in the neighborhood, the policy will also reduce the transaction premium rate of foreclosed properties in the neighborhood, and the coefficient γ should also be negative.

Parallel Trends Assumption:

The DID identification strategy relies on the parallel trends assumption. That is, the difference in our dependent variables between the treated neighborhoods and the control group should stay the same in the absence of the treatment (e.g., FPRP implementation). To test this assumption, we follow Beck et al. (2010) and estimate the following models:

$$mbidder_{rt} = \alpha_6 + \sum_{\tau=-10}^{10} \varphi_m FPRP_{r,t+m} + \sum_{j=1}^{n} \delta_j lnX_{rt} + \lambda_r + \nu_t + \varepsilon_{rt} \quad (9)$$

$$DEratio_{rt} = \alpha_7 + \sum_{\mathrm{m}=-10}^{10} \gamma_m FPRP_{r,t+m} + \sum_{j=1}^{n} \delta_j lnX_{rjt} + \lambda_r + \nu_t + \varepsilon_{rt} \quad (10)$$

where $FPRP_{r,t+m}$ is a dummy variable representing the FPRP implementation, taking the value of 1 if the FPRP is implemented in period $t+m$ by neighborhood *r* and 0 otherwise. As before, t represents the month, and m denotes the periods before (lags)

and after (leads) the policy implementation month. We include 10 lags and 10 leads of *FPRP* variable in our models. For instance, m=2 represents two months after the FPRP implementation (lead 2) and m-2 represents two months prior to FPRP came into effect (lag 2). The coefficients γ_{-10} to γ_{-1} are the estimates for the difference in $mbidder$ between the treated and control groups for each of the ten months before the month of FPRP implementation in region *r*. Similarly, γ_{+1} to γ_{+10} are the estimates for the difference between the treated and control groups for each ten months after the FPRP was implemented. γ_0 is a measure of the differential in $mbidder$ between the treated and control group during the month in which the policy was enacted. If γ_{-10} to γ_{-1} are insignificant, we can conclude that there is no significant difference between the treatment and control groups in periods before the policy implementation, indicating that the parallel trends assumption holds.

3.3 Data and Variables

To understand the impact of the HPRP on the bidding price of foreclosure, this paper collects 16,720 residential foreclosure transaction observations from January 2015 to May 2022 in Changsha on the Taobao judicial auction platform, including 9,035 successfully completed transaction records and 7,685 unsold records.[30] After dropping the transaction data of land use rights, real estate enterprise bankruptcy liquidation residential, storefront or commercial premises, pure garage or parking space without residential, office building for office use, storage (miscellaneous) room, part (such as 50% share of a residential house), multiple properties in one auction, and the

[30] Again, our dataset only includes information on first-time.

observations with missing property appraisal price, we end up with the sample of 15,538 transaction records, including 8430 successfully sold transactions and 7108 unsold transactions. This dataset contains the full property identifier of the foreclosure housing (including the street address, and when the home is an apartment it also includes the building name and unit number), the final bidding price (PD_i), the appraisal price (PE_i), the time of the sale, and the number of bidders ($Bidder_{it}$). Because the property characteristic variables that affect the price of foreclosed housing, like property area and location, also affect their appraisal prices, this paper uses each foreclosed house's appraisal price (PD_i) as a proxy variable of the property characteristic information. Using the transaction status of each transaction, we construct the transaction dummy variable D_i, which takes the value of 1 if the i-th foreclosed home is successfully traded and 0 if the i-th foreclosed home is unsold.

According to the evolution time of the HPRP in Changsha (Figure 3), the purchase restriction dummy variable (*HPRP*) is constructed. *HPRP* takes the value of 0 for all districts and counties before May 2017; in May 2017 and after May, the variable takes the value of 1 for transactions in 6 districts and one county in Changsha (Kaifu District, Furong District, Tianxin District, Yuhua District, Yuelu District, Wangcheng District, and Changsha County), and the value of 0 for observations in Ningxiang and Liuyang county-level city. Table 1 shows the descriptive statistics of the transaction premium ratio (*DEratio*) of single foreclosure transactions under different values of the *HPRP* variable.

Table 1 here.

It can be seen that, on average, the *DEratio* of foreclosed homes is less than 1 in areas or periods without purchase restrictions, i.e., homes are usually sold at a discount below the appraisal price. After the purchase restriction is in effect, the transaction premium ratio is greater than 1, and the foreclosed homes are sold at a premium over the appraisal price.

After checking the judicial auction announcement of foreclosed housing in Changsha one by one, if the auction announcement explicitly states that this foreclosure property is subject to the specific foreclosure restriction policy (specific FPRP), the *FPRP* variable for that month will be 1 for the property and its corresponding neighborhood. If all the listings that month in that neighborhood do not explicitly require a qualification to bid, *FPRP* will take 0.[31] According to the statistics, as of May 2022, the sample covers 45 restricted neighborhoods involving 192 foreclosure houses. Table 2 shows the definitions of relevant variables and the results of descriptive statistics.

Table 2 here.

4. Analysis of estimation results

[31] According to the Changsha residential auction announcement, as of May 2022, the neighborhoods subject to the specific FPR mainly include 2 houses in Furong District, 2 in Tianxin District, 5 in Kaifu District, 5 in Yuhua District, and 31 in Yuelu District. However, due to the different publishing times of each property on the Taobao judicial auction platform, it reflects that the purchase restriction time of each property is different. Changsha's Court has yet to publicly release the list of precision purchase restriction houses to the public. The variable that represents the purchase restriction for judicial auction houses used in this paper is thus determined according to the auction time of foreclosure houses in the Taobao judicial auction platform sample data, not the actual purchase restriction time. By checking the auction announcement, the actual purchase restriction of a neighborhood in the sample is not exactly the same as the list of purchase restrictions of neighborhoods circulating on the network.

4.1 The impact of HPRP on foreclosure bidding prices

Table 3 reports the estimation results of the impact of HPRP on foreclosure bidding prices. Among them, Model 1 does not consider the sample selection bias. Model 2 and Model 3 use the Heckman selection model to estimate parameters, the former based on the maximum likelihood method without exclusion restrictions and the latter based on the two-step method with exclusion restrictions.

The regression results show that the coefficients of the HPRP are all positive and significant at the 1% significance level. After adding the inverse Mills ratio to control the sample selection bias, the coefficient of HPRP in Model 3 is smaller than that of Model 1. The inverse Mills ratio is significant at the 1% significance level, indicating that sample selection bias may be present in the results, which will yield biased and inconsistent parameter estimates. The first stage estimation results from Model 3 show that the housing purchase restriction policy had a significant positive effect on foreclosure transactions, increasing the foreclosure probability. The second stage estimation results show that after controlling for selection bias and other determinants of price, on average, the price of foreclosed housing subject to HPRP was about 5% higher than the price of foreclosed housing that was not subject to the restrictions imposed by HPRP. These results verify part of hypothesis H1.

Table 3 here.

In addition, the results in Table 3 show that the appraisal price of a foreclosed property had a significant adverse effect on the transaction probability. The higher the appraisal price, the lower the likelihood of closing the deal. The appraisal price

represented the comprehensive characteristics of the property itself, and the higher the appraisal price, the higher the foreclosure bidding price.

4.2 Mediating effect model estimation results

Table 4 shows the results of the mediating effect of the number of bidders. 6,541 observations of the total sample (42.1% of the total sample) had no bidders. Model 4 uses the OLS method to estimate the effect of the HPRP on the number of bidders, while Models 5 and 6 apply the Tobit truncation model and negative binomial regression model, respectively. The estimation results show that the coefficient of HPRP was significantly positive, which means the implementation of the HPRP led to an increase in the number of bidders for foreclosure transactions. The mediating effect of the number of bidders was significant. The implementation of the HPRP increased the bidding prices of foreclosed houses by encouraging more people to participate in foreclosure transactions. Our research hypothesis H1 is verified.

Table 4 here.

4.3 The impact of FPRP on the number of bidders and bidding prices of foreclosures

Changsha's specific foreclosure purchase restriction policy only covered a few neighborhoods in the five urban districts of Changsha: Yuelu District, Yuhua District, Furong District, Kaifu District, and Tianxin District. To accurately estimate the impact of FPRP on the bidding prices of foreclosed houses, excluding the influence of HPRP, we keep the transaction records of the 5 districts from June 2020 to May 2022 and calculate the monthly transaction premium ratio and the average number of bidders in each neighborhood in the sample based on equation (5) and (6). Finally, we have the

monthly unbalanced panel data of 2,261 observations from 895 neighborhoods with the foreclosure sales property records.

Table 5 shows the estimation results of the panel data with fixed effects based on equation (7). The regression results show that, at the 5% significance level, the FPRP significantly negatively affected the number of foreclosure bidders. The average number of foreclosure bidders in a neighborhood decreased by nearly 2 people after the foreclosure restriction is implemented, which was about 32% of the sample mean (5.290).

Table 5 here.

Table 6 shows the estimation results of the panel data with fixed effects based on equation (8). The regression results show that the specific FPRP significantly negatively impacted the foreclosure transaction premium ratio at the 5% significance level. Compared with the neighborhoods not affected by the FPRP, the foreclosure transaction premium ratio in the neighborhoods subject to FPRP decreased by 0.056 points, which was about 5.08% of the average value of the foreclosure transaction premium ratio in the sample neighborhoods (1.102) during the sample period. Research hypothesis H2 is supported: the foreclosure purchase restriction policy decreased the number of foreclosure bidders and foreclosure bidding prices.

4.4 Robustness checks

4.4.1 Parallel trend test

Figures 6a and 6b show the parallel trend test results for the effect of the FPRP on foreclosed properties.

Figure 6a here

Figure 6b here

Specifically, these figures display the coefficient estimates and their 95% confidence intervals from equations (9) and (10). The solid line represents the estimated differentials in the number of bidders (Figure 6a) and the transaction premium ratio of neighborhoods (Figure 6b) between the treated and control groups for the periods before and after the policy implementation. The dotted lines represent the 95% confidence intervals for these differentials. In both figures, 0 ($m = 0$ in equations (9) and (10)) represents the time of policy implementation. As shown in equations (9) and (10), m can take on values from -10 to +10, where -1 to -10 represent five months before the policy implementation month ($m = 0$) and 1 to 10 represent five months after the policy implementation. Thus, the predicted coefficients γ_{-10} to γ_{-1} in equation (9) and $\varphi_{-10}\ to\ \varphi_{-1}$in equation (10) are the estimates for the difference in the outcome (the number of bidders or the transaction premium ratio) between the treated and control groups for each of the ten months before the policy was implemented. Similarly, coefficients γ_{+1} to γ_{+10} in equation (9) and $\varphi_{+1}\ to\ \varphi_{+10}$ in equation (10) represent the differential in the outcome variable (the number of bidders or the transaction premium ratio) between the treated and control groups for each of the ten months after the policy was implemented. In Figure 6a, for instance, γ_{-5} represents

the difference in the number of bidders between the treated and control groups five months before the policy was implemented ($m = 0$). For the parallel trend assumption to hold, the estimated differentials in the outcome variable between the treatment and control group for the pre-policy period (the coefficients γ_{-10} to γ_{-1} in equation (9)) and φ_{-10} *to* φ_{-1} in equation (10)) should not be statistically significant.

A coefficient whose confidence interval (either upper or lower) does not cross or touch the horizontal red zero line is significant. These figures show that the pre-policy differentials in the number of bidders between the two groups were statistically insignificant for all lags, and thus the parallel trend assumption holds, validating the use of DID.

As for equation (10), only the coefficient on one lag out of 10 was significant and positive. Specifically, as shown in Figure 6b, the difference in the transaction premium ratio between the treatment and control groups was significantly different from zero three months before the policy execution. Before FPRP came into effect, the treatment group's transaction premium ratio was generally higher than the control group. Because the HPRP endowed the foreclosures with the attribute of circumventing the HPRP, it prompted more potential buyers to participate in foreclosure bidding actively. This was especially true for houses in the foreclosure market in some "popular" neighborhoods.[32] The positive difference was consistent with expectations. However, after implementing FPRP, the purchase restriction policy's role of benefiting popular foreclosure properties disappeared. The FPRP had a significant negative impact, and the transaction premium

[32] See footnote 21 for a definition of "popular."

ratio dropped significantly.

To provide further evidence that the parallel trend assumption holds, we have also conducted an F-test to see if the coefficients γ_{-10} to γ_{-1} in equation (9) and $\varphi_{-10}\ to\ \varphi_{-1}$ in equation (10) are statistically significant. The F-test's P-values were 0.1862 and 0.1698 for the number of bidders and the transaction premium ratio, respectively. Thus, these test results also showed that these pre-treatment coefficients are not jointly significant, indicating that the parallel trend assumption was valid.

4.4.2 Placebo test

To further test the robustness of the findings, we also selected 2-5 original control group neighborhoods around each neighborhood subject to FPRP through the map of the online real estate platform Anjuke (https://www.anjuke.com) and used them as the treatment group to conduct a placebo test on the model. The estimation results are shown in Table 7. The second and third columns present the full-sample regression results without excluding the real foreclosure properties subject to the FPRP. The last two columns show the sub-sample regression results excluding the aforementioned properties. The placebo test under both samples indicated that there was no significant effect of the placebo on the number of bidders and transaction premium ratio of foreclosed properties. The conclusion that foreclosure purchase restriction policy had a significant inhibitory effect on foreclosure transaction prices was robust.

Table 7 here.

5. Conclusions and policy recommendations

Using more than 15,000 daily transaction observations of residential foreclosed properties in Changsha from January 2015 to May 2022, and utilizing the Heckman selection model and the DID estimation strategy, this study examined the impact of the HPRP and FPRP on the bidding prices of foreclosure housing in China. We found that implementing the HPRP in Changsha led to an increase in the number of bidders participating in the auction, which, in turn, raised the average bidding prices by about 5%. This finding indicated that with the implementation of the HPRP, the foreclosed properties were utilized to circumvent the purchase restrictions, increasing the number of bidders and, in turn, raising the bidding prices of foreclosed houses. Furthermore, the implementation of the foreclosure purchase restriction policy in Changsha led to a 32% fall in the number of bidders for foreclosed properties and a 5% decline in the transaction premium ratio. These later results indicated that when the city implementing HPRP included foreclosed properties in the scope of purchase restriction and required foreclosure bidders to have the housing purchase eligibility to participate in the auction, foreclosed properties were no longer effective in circumventing the HPRP. The number of bidders participating in foreclosure auctions declined, and the bidding prices fell.

Compared with other provincial capital cities or new first-tier cities, the housing prices in Changsha were the lowest. The likelihood of a price bubble in Changsha, if it had one, was relatively small. The impacts of HPRP and FPRP policies on foreclosure bidding prices in other cities outside the sample were likely more substantial than those in Changsha, which we explored in this study. It would be fruitful to examine the impact of these policies using data from other cities.

The findings of this paper provided some insight for further understanding the HPRP and FPRP policies in China from an economic perspective. HPRP affected the development of the foreclosure market. When the scope of application of HPRP was expanded to include foreclosed housing, the policy (i.e., FPRP) led to lower bidding prices on foreclosed properties. Therefore, the foreclosure purchase restriction policy was likely an effective tool for local governments in tackling the housing speculation problem. However, most foreclosed properties were mortgage assets of banks and other financial institutions. Effectively implementing the real estate regulation policy and fully protecting the legitimate rights and interests of the vast majority of debtors and creditors requires more effort and clarity from policymakers. Unlike other cities' one-size-fits-all foreclosure purchase restriction policy, Changsha's specific FPRP only precisely regulates overheated real estate, which not only cuts off the loopholes for speculators to circumvent the HPRP through judicial auctions but also protects the legitimate rights and interests of the vast majority of creditors. This is worthy of reference for policymakers in other Chinese cities. It is a feasible direction to scientifically monitor overheated neighborhoods through data analysis for Changsha to optimize the current specific FPRP.

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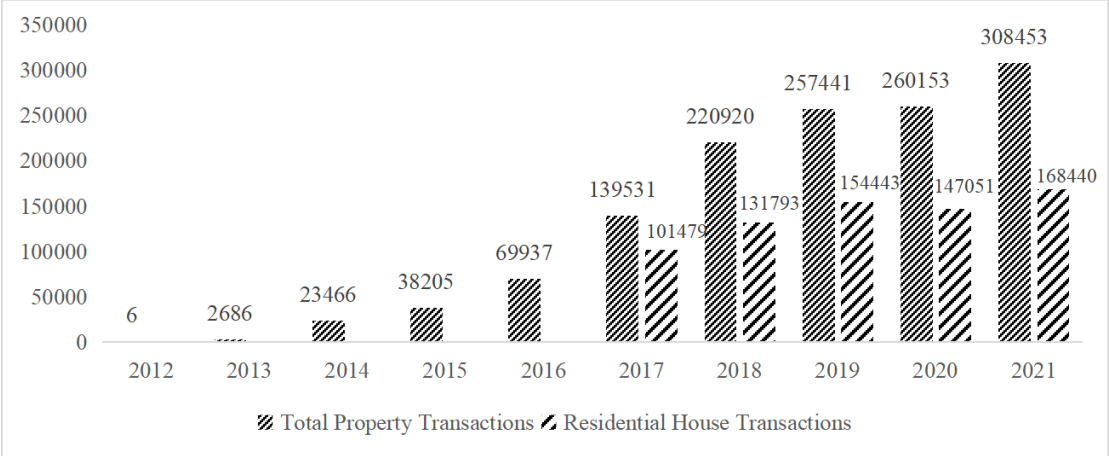

Figure 1 Taobao.com judicial auction platform (residential) property transaction[33]

[33] Taobao.com real estate auction transactions include the first auction, reauction, and foreclosure sale. The number of properties in the first auction refers to the number of properties listed on Taobao's judicial auction platform for the first time. The houses that failed to be auctioned in the first auction will be auctioned again in the process of reauction, and the properties that failed in reauction twice will be sold-off at a very large discount.

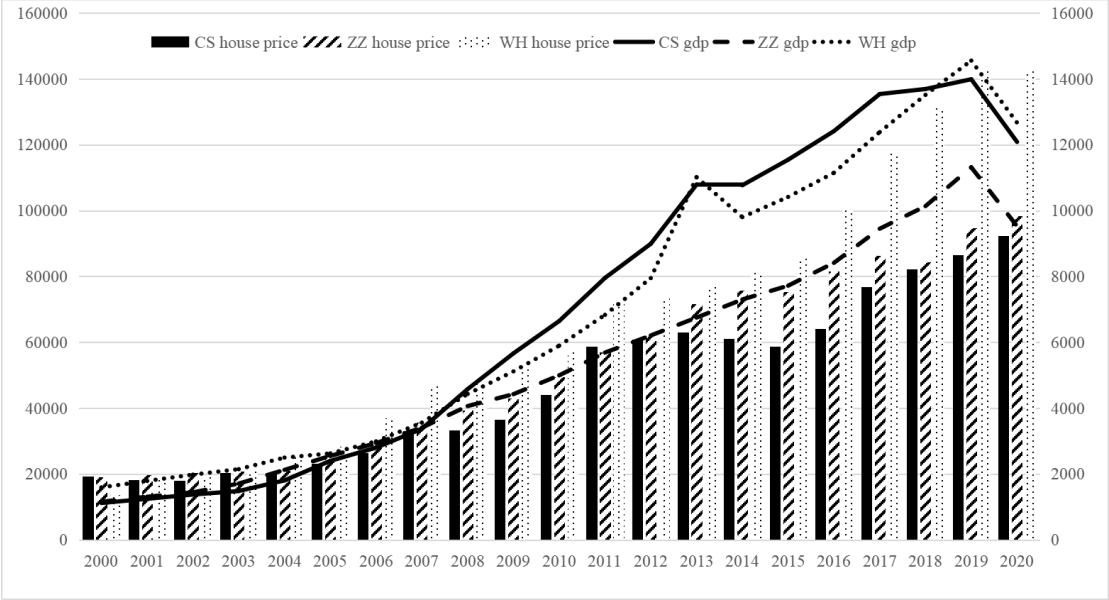

Figure 2 Per capita GDP and housing prices in Changsha, Zhengzhou, and Wuhan

Notes: CS represents Changsha city (the capital of Hunan Province), ZZ represents Zhengzhou city (capital of Henan Province), and WH represents Wuhan city (the capital of Hubei Province). These three provinces are similar inland provinces in central China.

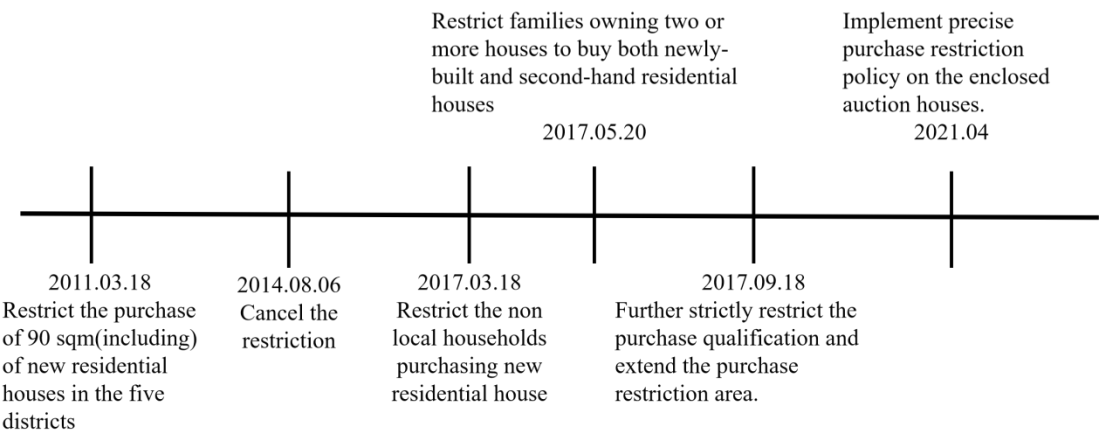

Figure 3 Evolution of residential housing purchase restriction policy (HPRP) in Changsha

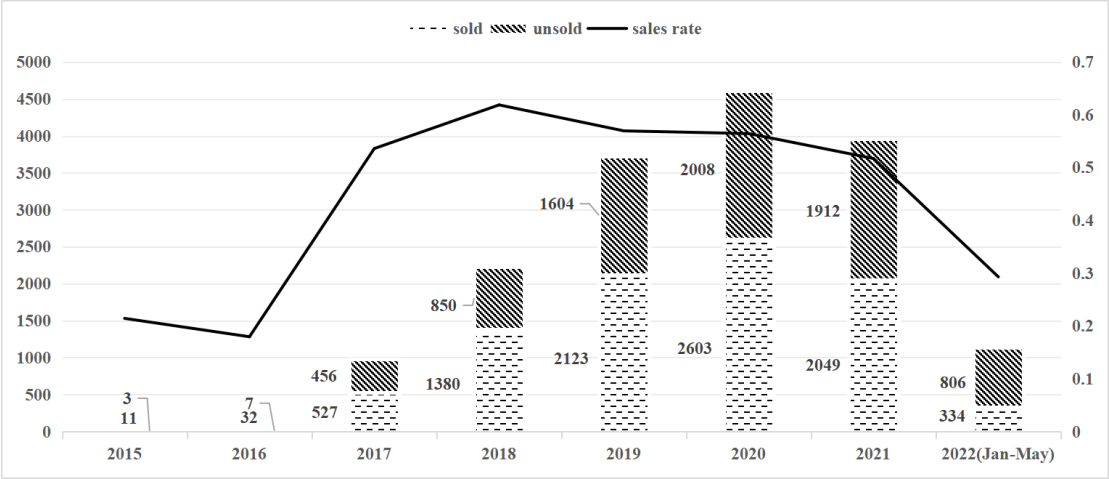

Figure 4 Statistics of residential foreclosure housing in Changsha on Taobao.com, 2015-2022

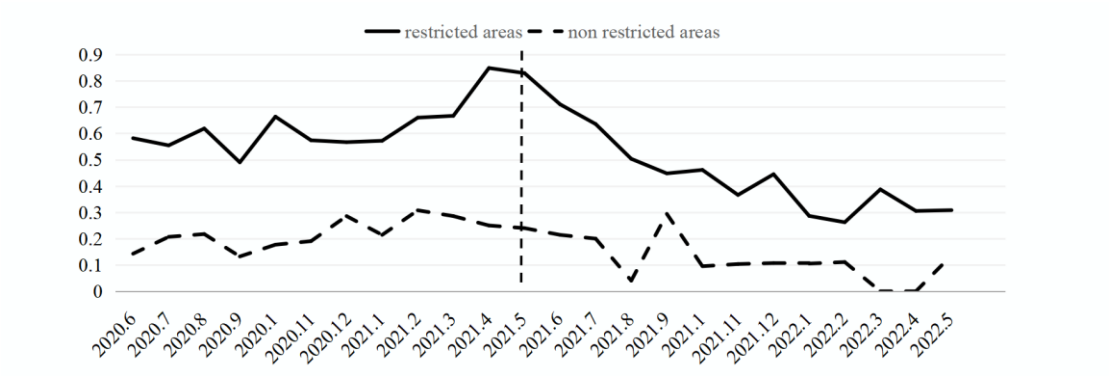

Figure 5 Trend of sales rates in restricted and non-restricted areas in Changsha, 2020-2022

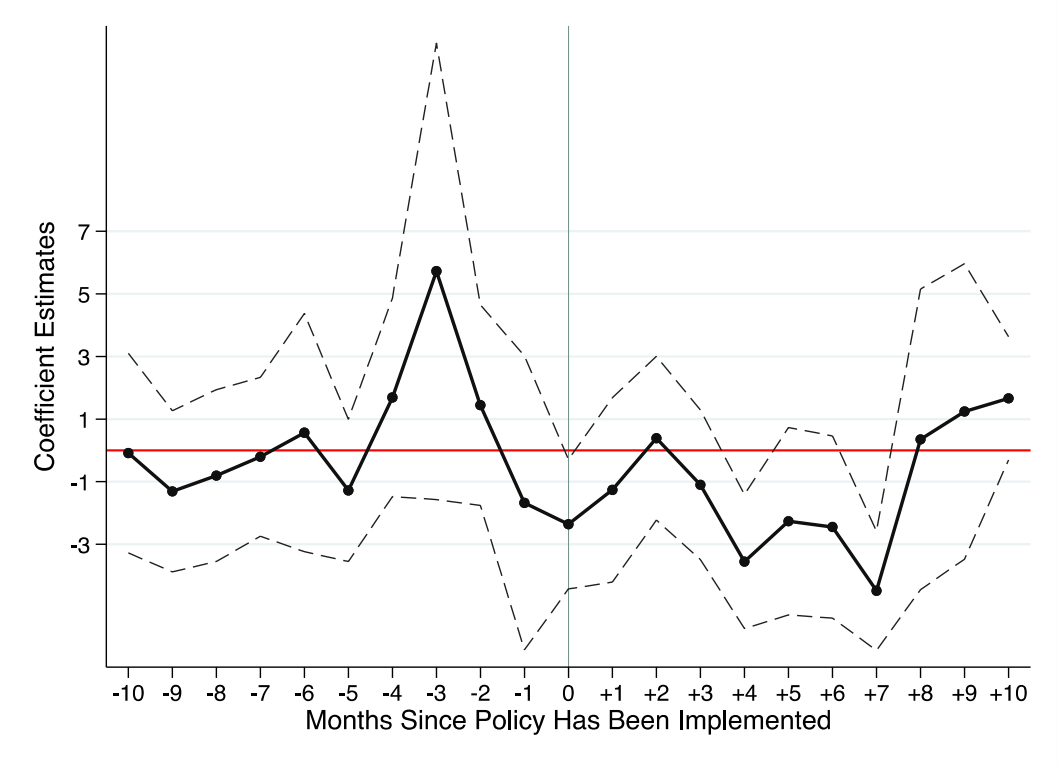

Figure 6a Parallel trend test of the effect of the FPRP on the number of bidders

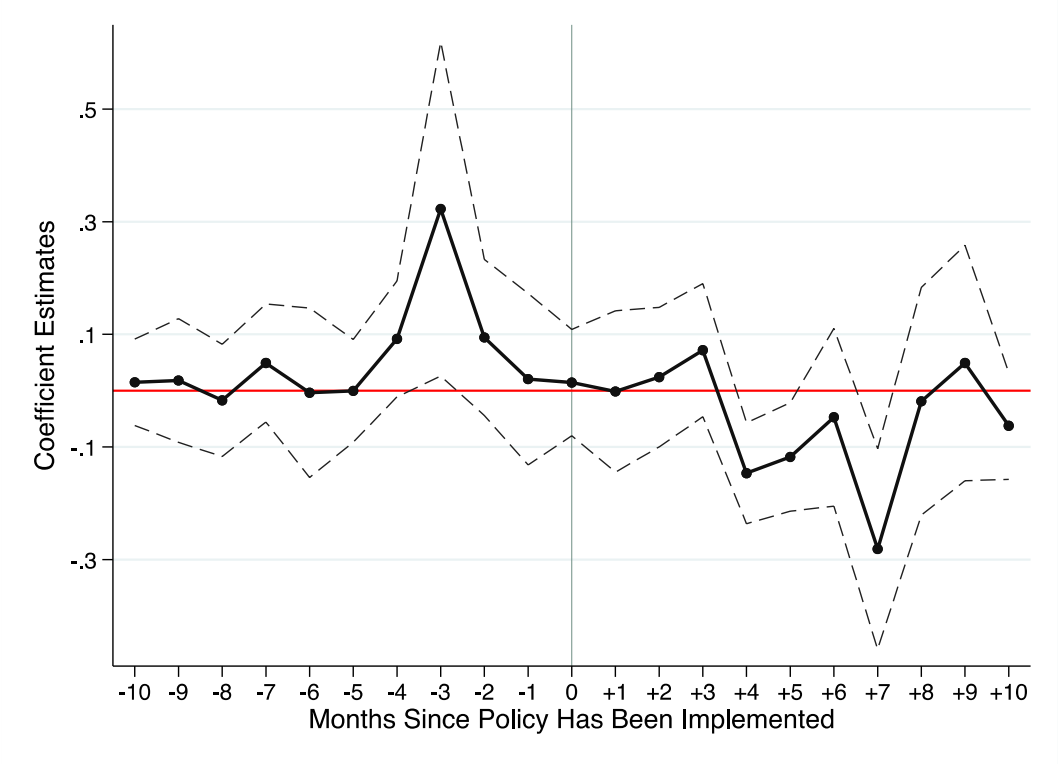

Figure 6b Parallel trend test of the effect of the FPRP on the transaction premium ratio

Table 1 The differences in transaction premium ratio between the properties that are subject to HPRP and those that are not

Subject to HPRP or not	Observations	Mean	Std. Dev	Minimum	Maximum
HPRP = 0 (No)	377	0.946	0.172	0.700	1.614
HPRP =1 (Yes)	8053	1.086	0.195	0.361	3.665

Table 2 Variable definitions and descriptive statistics

Variable name	Variable Description	Mean	Std. Dev	Minimum	Maximum
PD	Bidding price of single foreclosure property (10,000Yuan)	132.352	114.933	14.3	2718.863
PE	Appraisal price of single foreclosure property (10,000Yuan)	126.318	116.269	11	2541.3
DEratio	Transaction premium ratio	1.080	0.196	0.361	3.665
Bidder	the number of bidders (person)	2.626	4.202	0	57
D	Dummy for sold (yes=1, no=0)	0.543	0.498	0	1
HPRP	Dummy for subject to HPRP	0.910	0.286	0	1
FPRP	Dummy for subject to FPRP	0.012	0.110	0	1

Note: The number of observations for all variables is 15,538, except for *PD* and *DEratio,* for which there are 8,430 observations (there is no bidding price for an unsold foreclosure property).

Table 3 Estimation results of the impact of HPRP on foreclosure bidding prices

Variable	OLS	Heckman Maximum Likelihood	Heckman Two-step Stepwise
	Model 1	Model 2	Model 3
The first stage: the dependent variable is whether or not the foreclosure is sold (*D)*			
HPRP		0.938*** （0.040）	0.929*** （0.039）
PE		-0.086*** （0.017）	-0.086*** （0.017）
t		-0.042*** （0.003）	-0.041*** （0.004）
Year Dummies		Yes	Yes
IMR			-0.159*** （0.020）
The second stage: the dependent variable is bidding price (*PD)*			
HPRP	0.144*** （0.009）	0.110*** （0.010）	0.050*** （0.015）
PE	0.989*** （0.004）	0.992*** （0.004）	0.997*** （0.004）
t	-0.0001 （0.0001）	0.0004** （0.0001）	0.001*** （0.0002）
Observations	8430	15538	15538

Note: (1) Robust standard errors are in parentheses; (2) ***, **, and * indicate significance at 1%, 5%, and 10% significance levels, respectively.

Table 4 Estimated results of mediating effects of the number of bidders[34]

Variables	*Bidders*		
	Model 4 OLS	Model 5 Tobit	Model 6 Negative Binomial
HPRP	1.972*** （0.083）	4.961*** （0.217）	1.101***（0.062）
Bidder	——	——	——
Control variables	Yes	Yes	Yes
Observations	15538	15538	15538

Note: (1) Robust standard errors are in parentheses; (2) ***, **, and * indicate significance at 1%, 5%, and 10% significance levels, respectively.

[34] The number of bidders and purchase restriction policy variables were simultaneously included in the equation, and Heckman two-step regression was used. The coefficients of the two variables were significant at the 1% significance level.

Table 5 Estimated results of the impact of the FPRP on the number of foreclosure bidders

	Model 7	Model 8	Model 9
FPRP	-2.364***（0.695）	-1.783**（0.744）	-1.696**（0.729）
t (monthly)	——	-0.055***（0.018）	-0.205***（0.048）
Year fixed effects	No	No	Yes
Neighborhood fixed effects	Yes	Yes	Yes

Note: (1) Robust standard errors are in parentheses; (2) ***, **, and * indicate significance at 1%, 5%, and 10% significance levels, respectively; (3) All sample sizes are 2261.

Table 6 Estimated results of the impact of the FPRP on the transaction premium ratio

	Model 10	Model 11	Model 12
FPRP	-0.077*** （0.024）	-0.059** （0.026）	-0.056** （0.024）
t (monthly)	——	-0.002** （0.001）	-0.005*** （0.002）
Year fixed effects	No	No	Yes
Neighborhood Fixed Effects	Yes	Yes	Yes

Note: (1) Robust standard errors are in parentheses; (2) ***, **, and * indicate significance at 1%, 5%, and 10% significance levels, respectively; (3) All sample sizes are 2261.

Table 7 Placebo test results of the effect of FPRP on the premium ratio of foreclosure transactions[35]

	Full-sample (no exclusion)		Sub-sample	
	Bidders Number	Premium Ratio	Bidders Number	Premium Ratio
FPRP-placebo	-0.884 （0.845）	-0.0008 （0.028）	-1.000 （0.849）	-0.0076 （0.029）
t (monthly)	-0.066*** （0.017）	-0.005*** （0.002）	-0.056*** （0.018）	-0.003 （0.002）
year fixed effect	Yes	Yes	Yes	Yes
neighborhood fixed effect	Yes	Yes	Yes	Yes
Observations	2261	2261	1997	1997

Note: (1) Robust standard errors are in parentheses; (2) ***, **, and * indicate significance at 1%, 5%, and 10% significance levels, respectively.

[35] As of May 2022, the sample covers 45 neighborhoods subject to the specific FPRP, involving 192 restricted auction transaction records and 72 unrestricted auction transaction records.