The impacts of population mobility controls on housing market: Evidence from the 2014 household registration reform in China

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Abstract

Household registration system (Hukou system) as a mobility control instrument in China largely restricts individuals' access to social welfare system out of their hometown, making it costly and inconvenient for migrants to live in the hosting cities in the long term. Majority of the migrants do not consider purchase houses where they work without a Hukou. In this paper, I study the effects of 2014 Hukou reform on housing prices. Using apartment complex level housing data, I find that the implementation of the reform lead to an increase in prices of lower-quality residential properties while those of higher quality experience negative shocks. This is consistent with the findings in previous literature that more migrant workers move to places where controls are relaxed, which spurs demands for basic housing.

Keywords: Hukou reform, housing, migration

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1 Introduction

The New Urbanization Plan, a major reform of household registration system in China, affect the migration pattern and urban development tremendously. It was first announced in 2014, aiming to relax the population mobility control long instated for more than a half century. The goal has two-fold. It aims to diminish the local rural urban divide and attract more labor to cities with high growth potentials by relaxing the restriction in the household registration. The government worries the disruptions it might cause so they conduct pilots before the national roll out. The recent work by Qin and Wu [2022] finds there is a migration response to this policy shock with more of the migrants moving to cities with a more relaxed regulation.

A relatable phenomenon in the U.S. is the black migration and white flights. Accompanied by the influx of black migrants from the rural South into the northern cities during World War II and the following decades, white population fled from the central cities and moved to suburban areas in response. With every black migrant arriving in the city, 2.7 white residents left, according to the Boustan [2007]. Although Chinese population is more homogeneous in the racial composition, the discrimination against migrants may still exist in other similar capacities. It could be due to the increasingly crowded living environment, heterogeneity in the education attainment and income among the two population groups [Dorn and Zweimüller, 2021]. The consequences can be profound. Similar concerns on regional disparities in the context of black white segregation also apply. Many social welfare benefits and public services in China are locally financed. For example, since 2001, the county governments take on most of the responsibilities of compulsory education, including financing, allocating resources and school development [Zhao, 2009]. Hospital revenues are less dependent on the local government subsidies after financial decentralization but it still accounts for about 10 %. The current social medical insurance has three networks with funds pooled at county or prefecture levels [Meng et al., 2015]. Most of the primary care are provided within counties. The departures of residents with certain characteristics in response to the adjustment of mobility restriction can lead to inequalities across regions.

The sales and rental markets should be both affected by the arrival of new migrants. The fluctuation in prices could lead to the redistribution of wealth and affect individuals decisions like school designation and employment status. Hence, I focus on the housing market responses to the reform particularly.

With all these concerns, the benefit of the relaxation is also hard to ignore. Before the relaxation, Migrants in the city without local Hukou are discriminated against in the housing market. They might be not eligible to purchase housing units or apply for low-rent public housing. Financially, they might face a higher housing mortgage rate.

Exploring the variation of pilot status within cities and using monthly data at the apartment complex level, I find that the reform has a positive effect on housing sales price within a city for about 6% and on rental prices about 8%, which is consistent with the prediction that more demand for basic housing is generated by the new migrants. However, the effect on the higher-end housing could be much less positive. It could be driven by the departure of potential higher-quality housing buyers.

This paper contributes to the large literature that studies the impacts of Hukou system, a mean of population mobility control, on various social economic aspects and individuals' life decisions. It creates inequality between rural and urban population, and between local residents and migrants. These inequalities are reflected in marriage [Qian et al., 2020], social identity [Afridi et al., 2015], rural urban labor market segregation [Meng, 2012, Ngai et al., 2018], wages [Liu and Kawata, 2022, Qin and Wu, 2022], unequal access to educational opportunities [Sieg et al., 2020, 2023] and other dimensions like rentals and purchases of residential properties [Li et al., 2017, Sun et al., 2017]. It also adds to the literature on internal migration in general. Specifically, it offers an additional example on local responses to the influx of migrants, which is related to but different from the black migration and white flight in the U.S. after World War II [Boustan, 2007, 2010, Boustan and Margo, 2013] and migrations across countries in Europe [Dorn and Zweimüller, 2021].

2 Institutional background

2.1 Household registration system

Household registration system, also known as hukou system, has a long history in mainland China. It was first instated in 1958, as a policy instrument to control internal migration. Under the system, every citizen will be assigned a Hukou at birth. It has two categories, agricultural hukou, and non-agricultural hukou, sometimes referred to as urban hukou. Another piece of information on the certificate is where your Hukou is registered. It determines whether you have access to social welfare benefits and public services provided locally. For example, you are registered in Middlesex county in Massachusetts, it is hard for your children to enjoy the benefits of public education in Norfolk county. Given the restrictions, most people choose to buy houses in the county where their hukou is. An individual can be considered as local or non-local, depending on whether the hukou is in the area where a specific social benefit is provided. A person's hukou typically follows their parents' type, and the conversion is strictly regulated.

At the height of the hukou regulation, internal migration was rare because migrants were denied employment out of their hukou locality. Nowadays, even after decades of evolution, it still exists and determines individuals' access to local public services, like education, medical insurance, housing and many other aspects of social economic life. Particularly, migrants are discriminated against in the housing market. They might not be eligible to purchase housing properties, not qualified for low-rent public housing; financially, they might face a higher housing mortgage rate or lack the support of housing provident fund. In addition, the non-coverage in other social welfare system, like medical insurance, further impairs their ability to purchase a residential property of their own in the urban area (Liao, 2020).

2.2 Administrative division in China

Figure 1a is a map where the lines delineate the boundaries of provinces. Each province could be further partitioned into prefectural cities. Take one coastal province, Zhejiang, as an example. If we enlarge Zhejing Province, the one on the middle of east coastal line, it contains 12 prefectural cities and each of them is shaded in a different color (See Figure 1b). If we further look at the prefectural city, Huzhou, on the top, it can be separated into 5 county-level subdivisions (See Figure 1c).[1] Geographically, prefectural cities are comparable to states in the U.S. They constitute a general partition of the country. [2] Geographically, a county in China is comparable to the counties in the U.S.

2.3 New urbanization plan and three rounds of pilots

This paper focuses on the most recent large scale Hukou reform in China, Following the initial announcement in 2014, three rounds of pilots were conducted in the following two years in cities and counties across the nation, which offers an opportunity to examine its short-term impact on the housing market. The reason to use pilots as treatment units is that they receive favorable fiscal support from both central and provincial government to implement the reform. Hence, I expect to see an effect of the reform more quickly in the pilot area.

In February 2015, the first round pilots were initiated. Later in November 2015, the second round of pilots started to roll out. The last round of pilots were announced in December 2016. It is about one year apart between the launch of two pilots. According to the plan, the reform would start to roll out nationwide between 2018 and 2020. While the exact progress of rollout need to be checked by examining Hukou registration documents posted by local government, for simplicity, it is reasonable to assume that the areas not

[1]While there exist some other administrative divisions like autonomous regions, municipalities, autonomous prefectures, districts, and so on, I categorize them into the most comparable group in this three-level division in terms of hukou regulations and city size.

[2]They are comparable to some states in terms of area and population. For example, Huzhou city covers land of 2,247 square mile and has a population of 3,367,579. The area is similar to that of Delaware. Its population is close to that of Connecticut.

listed by any of the three rounds are not directly affected by the policy change before 2018.

The maps (Figure 2) show geographic distributions of pilots across three rounds. Some pilots are not included in the housing data set, though. The index drawn on the maps is calculated at city level. For example, city A consists of five counties, one of which is listed among the first round of pilot. The index, fraction of counties treated within city A, would be 0.2. City A falls into the category "$\leq$ 20% of counties treated". The categories in the legend do not cover the full range between 0 and 1 because there is no data point in the omitted range. [3]

3 Data

For the analysis in this paper, I first use two data sets from Xitai, a company which collects and compiles data from major online real estate transaction platforms. The first data set contains four outcome variables, the sales prices, rental prices and the two types of housing availability on the market. They are monthly data collected at apartment complex level. For each apartment complex, it also provides detailed information on features, such as the geographic location including latitudes and longitudes, green space, construction years, the total number of units, the number of parking lots, floor area ratio (FAR), the type of the buildings such as villas and townhouses, the area ranges of each floor plan and the area compositions of different floor plans on sale and for rental, respectively. The data set covers residential units in 20 major prefectural cities from 2009 to 2018, which grants a relatively long window to study the effects of the 2014 reform on the housing market. The second data set also contains the four outcome variables but they are aggregate variables measured at county level. The advantage is that it has a larger geographic coverage of 70 cities.

[3] These maps show all the pilots on the lists, not limited to areas included in my data set on housing market.

4 Empirical Strategy

A key question when evaluating the effects of the reform is how to define the treatment group versus control group. Qin and Wu [2022] defines the cities with an urban population above 5 million as the control group and those with an urban population below 5 million as the treatment group. The reason for this division is that the central government stated in their 2014 initial announcement that the overall stringency for mega cities with an urban population above 5 million should remain at the same level while restrictions in cities with an urban population below 5 million should be relaxed to different degrees(More details in Figure 3). In my housing data most of cities are large and fall into the same population category. They generally see a higher exclusion degree in Hukou regulation but non-plot area increases more in the stringency compared to pilot area..

In this paper, I explore a setup for treatment and control groups different from that in Qin and Wu [2022]. Granting Hukou more generously means integrating more people into local social welfare and public services system, which would require an upgrade of the system capacity. For instance, with more migrants getting local Hukou and residing in the city for a long run, more schools and housing supplies are needed. It takes time to build or expand those infrastructures. According to the 2014 announcement, the reform was expected to be completed by 2020. With the fiscal support of both provincial and central government, I expect to see that pilot areas are able to implement the reform in a relatively shorter time. However, defining the treatment group using whether being selected as pilots could also raise concerns. Wang and Yang [2021] find that policy experiments in China are often positively selected for persuasive purposes. Also, they point out that local implementation and site selection could be affected by the career incentives of the local leaders, even though the central government wants to achieve sample representativeness. Therefore, I will examine whether the selection of pilots or the treatment group defined by the urban population is correlated with the pre-reform housing prices.

4.1 Pilots as treatment groups

The three rounds of pilots include areas of various administrative levels. The effects on the housing prices could be different, depending on whether the whole city is conducting the pilot experiment or only part of the city is selected as a pilot. If the whole city is treated, it might offer a stronger incentive for migrants from other cities to settle down while location preferences and restrictions over purchasing a house within the city for local residents should be largely preserved. However, if only a small part of the city is being listed as a pilot, its pulling forces on migrants from other cities may not be as strong. Meanwhile, it is reasonable to expect the gap between housing prices of pilot versus non-pilot areas within a city to change in response to this policy shock. To avoid missing heterogeneous effects though multiple channels, I estimate the effects for cities that are fully treated and cities that are partially treated separately.

In China, if an individual has a household registration in a city, typically the person would be allowed to purchase a residential unit anywhere in the city. In this sense, reforms on household registration in one county or a few counties within a city will supposedly have a spillover effect on the housing markets in the rest of the counties. However, due to some social welfare benefits tied to the household registration and offered at county level, living in another county might not be so convenient. For example, public medical insurances usually do not cover medical services outside the county; low-cost mandatory education is also offered in schools within the county of your household registration. Besides, a county is relatively large. Currently, there are 2851 county level divisions in the whole nation. Take Cixi, a coastal county in Ningbo City, Zhejiang Province, as an example, it covers an area of 525 square mile and hosts 1.83 million residents in 2020. In comparison, Boston covers a land area of 48.4 square miles and has a population of 675,647. The commuting cost is high if you reside in one county and work or go to school in another. Considering all these factors, it is not so common to purchase a residential property for self-use not in the county where most of your daily activities take place. Meanwhile, most of the migrants obtain household registration through employment. Hence, it is still reasonable to expect the county where the household registration is relaxed will see a larger increase in the demand for housing compared to other counties not treated.

Equation 1 estimates the average effect of a county being listed as a pilot on the sales prices of its residential units. With city-year fixed effects, I exploit the variation of treatment status across counties within a city. The sample for this regression includes cities that do not include any pilots and cities that are partially treated, which means at least one county but not all are listed as a pilot at some point.

$$\begin{aligned} ln(price)_{icpt} = \beta_0 + \beta_1 pilot_c \times post_y + \boldsymbol{\beta_2'} \boldsymbol{F_i} \times pilot_c \times post_y + \boldsymbol{\beta_3'} \boldsymbol{F_i} \times post_y \\ + \boldsymbol{\beta_4'} \boldsymbol{FM_i} \times pilot_c \times post_y + \boldsymbol{\beta_5'} \boldsymbol{FM_i} \times post_y + \alpha_i + \gamma_{py} + \epsilon_{icpt} \end{aligned} \tag{1}$$

$ln(price)_{icpt}$ is the log of average sales prices for apartment complex i in county c, prefectural city, p in month t. α_i is the apartment complex fixed effect. γ_{py} is the city-year fixed effect. $post_y$ is a dummy variable. It equals 1 if it is year 2014, when the initial announcement of New Urbanization Plan is released, or later. $pilot_c$ is a group indicator. In this regression for partially treated cities, it varies at county level. For all apartments located in counties that are listed in some round of pilot, it equals 1; otherwise, it is 0. F_i is a vector of standardized apartment features, including green space, floor area ratio (FAR), the number of parking lots per unit (PUR), the latest construction year, whether the compartment complex has villas or townhouses, the fraction of one bedroom units among all the units on sale, and the fraction of one bedroom units for rental among all rental units. If a complex has missing information for some features, 0s are assigned for the standardized feature variables, which means I assign sample averages to them. In the meantime, I include a vector of missing value indicators FM_i for each feature. Some interactions are omitted in the regression model due the presence of fixed effects. For example, the main terms of apartment complex features are not included because they are constant across time and the apartment complex fixed effect is controlled for. Similarly, the main term of $pilot_c$ is skipped because an apartment complex can either belong to a pilot area or non-pilot area. Once the apartment complex is fixed, there will be no variation across pilot versus non pilot groups in the data. I cluster the standard errors at the county level. The results are shown in Table 8. I also estimate a variant of the model by replacing all the continuous feature variables by dummy indicators, which equal 1 if the features have a value above sample mean and 0, otherwise. For missing features, I assign 0 to them and the corresponding missing value indicator would be 1 for these observations. The results can be found in Table 9.

Other than sales prices, I also explore the effects on rental prices, the number of residential units on sale and the number of posted rental units at apartment complex level under the framework of Equation 1. Renting and owning an apartment can be substitutes to each other. Under a more welcoming household registration policy, it is possible that more migrants switch from tenancy to ownership, driving up sales prices and dampening rental prices. However, even the substitution between ownership and renting exists, the rental prices could still go up if there is enough new demand for housing from an influx of new migrants. The comparison across the changes in these outcome variables could help reveal the underlying dynamics to some extent. Results are also included in Table 8 and Table 9.

With Equation 2, I estimate the effect of cities being fully listed as pilots on their housing prices. I first use the sample with information from apartment-complex level but this time select cities that are listed as pilots as a whole and cities that are not listed at all. Partially treated cities included in Equation 1 are excluded. Specifications are modified accordingly as well. I replace the city-year fixed effect in 1 by year fixed effect, η_t, since I am no longer exploring the variation of treatment status within prefectural cities. Then I estimate the equation using the data set with county level information and containing 70 cities. The effects on sales price, rental price and is nonsignificant no matter I cluster at city level. The results are shown in Table 10.

$$ln(price)_{ipt} = \beta_0 + \beta_1 pilot_p * post + \alpha_i + \eta_t + \epsilon_{ipt} \tag{2}$$

When I use the data set with information from county level, all the specifications remain the same except that I replace the apartment fixed effects by city fixed effects, given that there is no apartment complex level information in this data set. The results are shown in Table 11.

5 Results

5.1 Heterogeneous effects on the sales prices, rental prices, sales and rental volumes

Before I show the results from estimating Equation 1, I first show the overall effects without controlling for the apartment features (Table 4). The overall effects on the housing market are not significant. Being listed as a pilot county does not have a clear overall impact on the sales prices, rental prices, sales and rental volumes. However, after I control for a few apartment features, the results suggest that the pilot program has heterogeneous effects on high-quality housing versus basic housing (Table 8 and Table 9. In table 8, the coefficient of the main interaction term of treatment dummy, pilot, and time dummy, post, suggests a 6% increase in the sales prices on average due to the pilot conduction, setting all the features to 0s, the averages of the sample. The estimate remains roughly the same when I switch from continuous controls for apartment feature to binary controls.

To look at the effects on high-quality and basic housing separately, I assume a higher portion of green space in the complex, more parking lots per unit (higher PUR), having a high floor area ratio, being constructed more recently, and having villas or townhouses offered in the complex are indicators for high-quality complexes. While most of them should be unambiguous, having a high floor area ratio needs a bit more justification. In China, many high-rise residential buildings in urban areas were constructed in recent years due to the rapid expansion of population. These modern skyscrapers make the most of the limited land resources in the cities and are often equipped with high-standard amenities and maintenance. In contrast, old residential buildings built when land resources were in abundance tend to be low-rise and less maintained and have fewer amenities. The difference between the policy effects on apartment complexes of higher quality in all these features and housing that are considered as more basic would be as large as about 17%, significant at 0.05 significance level. Given that the supply for the housing is relatively inelastic in the short term, these results hint at the possibility that basic housing is facing a surge in demand in response to the reform while the demand for high-end housing embraces a negative shock.

The rents also increase by about 8 %, setting all the apartment features to average level, although it is only marginally significant (Table 8). This is consistent with the findings by Qin and Wu [2022] that more migrants are attracted to cities where the Hukou regulations are relaxed. More migrants move to the pilot counties, creating new demand in the rental market and possibly in the sales market as well. The numbers of new listings for sales or rentals do not change significantly, which also suggests the change in the prices might be mainly attributed to the change in demand.

5.2 Treatment intensity: Does the fraction of treated counties within a city matter?

For those cities that are partially listed as pilots, the treatment effects might vary based on how much the regulation has been changed. Geographically, it could be represented by the fraction of counties conducting pilot experiments within a prefectural city. I estimate the main regression again except that I use a continuous measure of treatment intensity, $intensity^f$, defined as the fraction of pilot counties within each city if a county is listed as pilot and 0 if not. If a larger fraction of counties within a city propose more welcoming policies, migrants might view this city as presenting more opportunities to settle down. If the synergy effect on attracting migrants is stronger as more counties go under reform, we should observe a larger effect if the fraction of pilot counties is higher, thus a positive β_1 in Equation 3. In the mean time, if the potential buyers for better quality housing has a strong distaste of living or owning properties alongside these new residents, the better-quality housing prices should be more negatively affected as more migrants are attracted to the area by the friendlier policies. I also estimate the regression using other three outcome variables, $ln(rent)$, the number of sales units, the number of rental units.

Results can be found in Table 13 and Table 12.

$$ln(price)_{icpt} = \beta_0 + \beta_1 intensity_c^f \times post_y + \boldsymbol{\beta_2' F_i} \times intensity_c^f \times post_y + \boldsymbol{\beta_3' F_i} \times post_y + \boldsymbol{\beta_4' FM_i} \times intensity_c^f \times post_y + \boldsymbol{\beta_5' FM_i} \times post_y + \alpha_i + \gamma_{py} + \epsilon_{icpt} \quad (3)$$

For apartment complexes with all features at the sample average level and without offering townhouses or villas, the pilot treatment has a positive effect on promoting the sales prices. It ranges from 1.6% to 8.7 % for the lowest intensity of around 0.1 and for highest intensity of around 0.5. The estimated range is between 2.0 % and 10% using binary controls for apartment features. They are roughly comparable. Similar to the results from the main regression, the residential units of higher quality experienced a more negative price shock. For comparison, I define a type of "high quality" housing by having desirable apartment features, including green space, floor area ratio (FAR), the number of parking lots per unit (PUR), the latest construction year equal to the 75th percentile of the sample, the dummy for townhouses or villas to be 1, and indicators for basic housing, including the fraction of one bedroom units among all the units on sale and the fraction of one bedroom units for rental among all rental units, equal to the 25th percentile of the sample. The definition for "basic housing" is that all the continuous features are set to 0, which corresponds to the means before standardization, and the dummy for townhouses or villas is also set to 0. Table 16 reports the difference in the policy effects. If the intensity is set to be 1 (Table 16 A.2.), the price growth rate of the selected high quality housing could be 32.5 percentage points lower compared to that of basic housing. This estimate could be exaggerated due to the projection in treatment intensity. In Panel A.3 and Panel A.4, I set the fraction to be its maximum and minimum in the sample. The growth rate is estimated to be 16 percentage points and 3 percentage points lower, respectively. The estimates using binary controls are quite similar.

5.3 Treatment intensity: measuring the policy changes

Migrants can obtain household registration (Hukou) in the hosting city mainly through four channels–investment, house purchase, high-end employment, ordinary employment. Other channels through direct relatives, special contributions exist, but their regulations either lack variations across cities or target a small number of migrants. Qin and Wu [2022] finds that the difficulty of obtaining a Hukou in cities with an urban population below 5 million through the ordinary employment significantly decreases compared to that of mega cities with an urban population above 5 million in the period between 2014 and 2016. However, they do not observe a significant drop of the stringency in other channels.

I use the index data constructed by Zhang et al. [2019]. They construct indices to measure the stringency of Hukou regulation in two periods: from 2000 to 2013 and from 2014 to 2016. Each index is based on the regulations about obtaining local urban Hukou through a specific channel. The information on regulations is extracted from Hukou policy documents at prefectural, provincial and national levels. A higher value of a specific index means a higher level of stringency in granting a local urban Hukou through that channel. For example, academic qualification, years of employment, year of residence in the hosting city, years of contribution to local social security (insurance) network are often considered in the evaluation of Hukou grant via ordinary employment. Zhang et al. [2019] assigns higher score to more stringent requirement and synthesize all the dimensions into one single index. For instance, if a city relaxes its requirement on academic qualification and years of employment after the reform while keeping requirements on other dimensions the same, we would expect a higher index value for the city, although the magnitude of the change is less interpretable. Another limitation of the index data is that it only calculates the averages in the two periods for each city so I reply on the strong assumption that the change between the two values is driven by the reform in the pilot counties.

Figure 3 summarizes the change in the stringency of getting a local Hukou through each channel. Each bar stands for the difference between the average stringency level for the period from 2014 to 2016 and the average stringency level for the period from 2000 to 2013 for each city contained in the housing price data set. From this figure, we can see that big cities with an urban population above 5 million in the sample like Beijing, Guangzhou, Shanghai and Shenzhen, have witnessed an increase in the stringency level for the ordinary employment channel. In contrast, cities like Changsha, Zhengzhou, Nanjing, Suzhou and Xiamen reduce the bar in this channel.

Similarly, I estimate Equation 4 like I do when using the fraction of treated counties as the intensity measure. The variable $intensity_c^e$ is the interaction between the change in employment-related Hukou granting policy after and before 2014 in prefectural city p and the pilot status of a county c. The results are shown in Table 14. Given that most of the cities experience a slight increase in the index in the post period, the result is in line with the previous observations that the policy has a positive effect on the prices for the basic housings. The high quality housing is estimated to have a less positive shock, although the result is not significant in this setting, which could be caused by the imprecise measure of policy changes (Table 17).

$$
\begin{aligned}
ln(price)_{icpt} = \beta_0 + \beta_1 intensity_c^e \times post_y + \boldsymbol{\beta_2'F_i} \times intensity_c^e \times post_y + \boldsymbol{\beta_3'F_i} \times post_y \\
+ \boldsymbol{\beta_4'FM_i} \times intensity_c^e \times post_y + \boldsymbol{\beta_5'FM_i} \times post_y + \alpha_i + \gamma_{py} + \epsilon_{icpt}
\end{aligned}
\tag{4}
$$

5.4 Treatment intensity: measuring spillover effects

Given that my sample of apartment complexes only contains a subset of the major cities, one might be worried that the adjacency to the nearest pilot areas that are smaller than themselves in urban population size, thus relaxing Hukou by a larger degree, might affect the policy effect observed for the cities in my sample. To alleviate this concern, I calculate the distance of each apartment complex in my sample to the nearest small city with urban population below 1 million either partially listed as pilots or fully listed as pilots. The motivation is that being closer to such an area would impair the positive effect of the policy in attracting migrants.

$$ln(price)_{icpt} = \beta_0 + \beta_1 distance_i \times pilot_c \times post_y + \boldsymbol{\beta_2'} \boldsymbol{F_i} \times distance_i \times pilot_c \times post_y + \boldsymbol{\beta_3'} \boldsymbol{F_i} \times post_y$$
$$+ \boldsymbol{\beta_4'} \boldsymbol{FM_i} \times distance_i \times pilot_c \times post_y + \boldsymbol{\beta_5'} \boldsymbol{FM_i} \times post_y + \alpha_i + \gamma_{py} + \epsilon_{icpt} \quad (5)$$

I estimate the model below in Equation 5. $distance_i$ varies across apartment complexes. The estimated effect for basic housing in Table 15 is 0.0003. Given that the sample mean of distance is about 227 km, the average effect would be 0.0681 (6.81 %). It also predicts that being closer to a city with larger degree of relaxation would mitigate the positive effect in the city with relatively more moderate policy change. The difference between the effects on basic housing and better quality housing is also stark. The sales price of the latter increases less than that of the basic housing by about 10.4 percentage points given the average distance.

6 Conclusion

The evidences found in this paper suggest that the pilot program on Hukou relaxation has heterogeneous effects on high-quality housing versus basic housing. For average housing units, the pilot conduction could potentially contribute to a 6% increase in the sales prices. The supply of new housing units are relatively inelastic. In addition to the null effects on the volume of rental and sales units discussed earlier, the land sales for residential constructions after 2014 in large cities do not change significantly (Table 21. The change in prices could mostly be attributed to the change in the demand. These housing units are usually the choices for new settlers in the urban areas. In line with previous literature (e.g. [Qin and Wu, 2022]) which documents that there were more migrants attracted to cities after the reform where Hukou were adjusted, the increased prices for basic housing units could be reflecting the arrival of this group of population and their demand for housing. The rents are also estimated to increase by about 8 %. It further suggests that the increase in sales price is not purely driven by incumbent migrants in the city substituting from renting to purchasing housing units.

However, the policy has almost opposite effects on apartment complexes of higher quality. They could have had a much less positive price shock. The difference can be as large as 17 %. It could be driven by the locals leaving the area, or less investments in general in the higher-quality housing units. Local residents or potential investors might be concerned that the influx of new migrants would overcrowd the area and lead to a decline in the quality of public services and social welfare benefits.

Tables

Table 1: Pilot prefectural cities in the housing price data set

	Round 1	Round 2	Round 3
Full city	Nanjing(P5)[1], Dalian(P4), Guangzhou(P5), Wuhan(P5), Suzhou(P4), Changsha(P4), Qingdao(P4)		
Part of city	Beijing (0.056)(P5), Zhengzhou(0.1)(P4), Wenzhou (0.1) (P4), Chongqing(0.237)(P5)	Beijing (0.167)(P5), Zhengzhou(0.1)(P4), Wenzhou (0.1) (P4), Chongqing(0.289)(P5), Shanghai(0.056)(P5)	Beijing (0.333)(P5), Zhengzhou(0.1)(P4), Wenzhou (0.1) (P4), Chongqing(0.368)(P5), Shanghai(0.222)(P5), Tianjing(0.111)(P5), Fuzhou(0.091)(P3)
Not listed	Shanghai (P5), Tianjing(P5), Chengdu(P5), Hangzhou(P5), Shenyang(P5), Shenzhen(P5), Xi'an(P5), Xiamen (P4), Fuzhou(P3)	Tianjing(P5), Chengdu(P5), Hangzhou(P5), Shenyang(P5), Shenzhen(P5), Xi'an(P5), Xiamen (P4), Fuzhou(P3)	Chengdu(P5), Hangzhou(P5), Shenyang(P5), Shenzhen(P5), Xi'an(P5), Xiamen (P4)

[1] P5 stands for urban population above 5 million, P4 for urban population between 3 million and 5 million, P3 for urban population between 1 million and 3 million, P2 for urban population between 0.5 million and 1 million, P1 for urban population below 0.5 million.

Table 2: Summary statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Panel A. Policy-related					
$fraction_p$	4,958	0.479	0.442	0	1
$exclusion\_index_{pt}$	4,957	0.792	0.267	0.494	1.508
$\Delta exclusion\_index_{pt}$	4,957	0.142	0.254	-0.243	0.628
$apartment\_dist\_min_i$ (km)	4,957	191.5	103.4	28.19	515.9
Panel B. Apartment features					
unit sales price (k ¥/sqft)	4,364	1.821	1.653	0.208	17.86
unit rental price (k ¥/sqft)	3,206	0.003	0.002	0.001	0.025
units for sales	4957	20.113	30.931	0	390
units for rental	4957	11.402	20.056	0	222
green space (%)	4,896	34.83	8.276	10	80
FAR(floor_area_ratio)	4,894	2.650	1.468	0.130	13.85
construction year	4,875	2,010	6.743	1,980	2,018
parking lots	3,836	1,218	1,398	10	25,265
PUR (parking unit ratio)	3,823	1.037	1.229	0.008	23.95
villa available	4,958	0.129	0.335	0	1
townhouse available	4,958	0.048	0.215	0	1

[1] Numbers are rounded to the third decimal place.

Table 3: Summary statistics: continued

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Panel C. units for sales (area %)					
1B	4,889	0.091	0.168	0.000	1
2B	4,889	0.328	0.236	0.000	1
3B	4,889	0.405	0.235	0.000	1
4B	4,889	0.132	0.181	0.000	1
5B	4,889	0.037	0.117	0.000	1
6B	4,889	0.006	0.041	0.000	0.813
7B	4,889	0.000	0.007	0.000	0.367
8B	4,889	0.000	0.009	0.000	0.610
Panel D. units for sales (imputed fractions)					
1B	4,889	0.125	0.203	0	1
2B	4,889	0.358	0.239	0	1
3B	4,889	0.376	0.239	0	1
4B	4,889	0.108	0.167	0	1
5B	4,889	0.029	0.102	0	1
6B	4,889	0.005	0.033	0	0.767
7B	4,889	0.000	0.005	0	0.270
8B	4,889	0.000	0.006	0	0.388
Panel E. units for rental (area %)					
1B	4,715	0.169	0.241	0	1
2B	4,715	0.374	0.255	0	1
3B	4,715	0.354	0.259	0	1
4B	4,715	0.081	0.156	0	1
5B	4,715	0.019	0.090	0	1
6B	4,715	0.003	0.028	0	0.828
7B	4,715	0.000	0.010	0	0.468
8B	4,715	0.000	0.008	0	0.507
Panel F. units for rental (imputed fractions)					
1B	4,715	0.219	0.287	0	1
2B	4,715	0.386	0.264	0	1
3B	4,715	0.314	0.264	0	1
4B	4,715	0.064	0.146	0	1
5B	4,715	0.015	0.082	0	1
6B	4,715	0.002	0.023	0	0.847
7B	4,715	0.000	0.006	0	0.352
8B	4,715	0.000	0.005	0	0.309

[1] Numbers are rounded to the third decimal place.

Table 4: Overall effects (No apartment feature controls)

VARIABLES	(1) Ln(price)	(2) Ln(rent)	(3) # sales unit	(4) # rental unit
pilot * post	-0.012	0.046	3.800	-0.862
	(0.026)	(0.030)	(3.492)	(3.196)
Constant	0.457***	-5.825***	23.737***	16.203***
	(0.003)	(0.003)	(0.449)	(0.411)
Observations	149,339	122,122	164,463	164,463
R^2	0.972	0.907	0.475	0.589
apartment complex FE	YES	YES	YES	YES
city-year FE	YES	YES	YES	YES
cluster	141	137	141	141
mean of dep var	0.455	-5.820	24.23	16.09

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: main effects by rounds of pilots. *round1* Never treated as comparison group

VARIABLES	(1) Ln(price)	(2) Ln(rent)	(3) # sales unit	(4) # rental unit
pilot (round1) * post	0.095***	0.080***	14.841**	7.756***
	(0.024)	(0.022)	(6.405)	(2.251)
Constant	0.429***	-5.822***	23.238***	15.748***
	(0.002)	(0.001)	(0.454)	(0.160)
Observations	139,143	114,441	153,556	153,556
R^2	0.973	0.909	0.481	0.592
apartment complex FE	YES	YES	YES	YES
city-year FE	YES	YES	YES	YES
cluster	126	122	126	126
mean of dep var	0.436	-5.817	24.29	16.30

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: main effects by rounds of pilots. *round2* Never treated as comparison group

VARIABLES	(1) Ln(price)	(2) Ln(rent)	(3) # sales unit	(4) # rental unit
pilot(round2) * post	0.007	0.050*	6.104**	5.879**
	(0.017)	(0.025)	(2.525)	(2.879)
Constant	0.503***	-5.796***	23.425***	16.654***
	(0.000)	(0.001)	(0.065)	(0.074)
Observations	131,476	110,045	145,253	145,253
R^2	0.973	0.911	0.480	0.591
apartment complex FE	YES	YES	YES	YES
city-year FE	YES	YES	YES	YES
cluster	119	115	119	119
mean of dep var	0.503	-5.794	23.58	16.81

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: main effects by rounds of pilots. *round3* Never treated as comparison group

VARIABLES	(1) Ln(price)	(2) Ln(rent)	(3) # sales unit	(4) # rental unit
pilot (round3)*post	0.043**	0.050*	2.979	2.044
	(0.019)	(0.027)	(2.212)	(1.520)
Constant	0.501***	-5.793***	23.338***	16.716***
	(0.000)	(0.000)	(0.040)	(0.028)
Observations	131,079	109,710	144,896	144,896
R^2	0.973	0.911	0.481	0.594
apartment complex FE	YES	YES	YES	YES
city-year FE	YES	YES	YES	YES
cluster	125	121	125	125
mean of dep var	0.502	-5.792	23.39	16.75

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: binary treatment with continuous controls

VARIABLES	(1) Ln(price)	(2) Ln(rent)	(3) # sales unit	(4) # rental unit
pilot * post	0.058**	0.081*	-1.071	-1.060
	(0.027)	(0.049)	(3.857)	(3.017)
green space * pilot * post	0.021*	-0.002	-0.048	0.616
	(0.011)	(0.012)	(2.352)	(2.489)
FAR * pilot * post	0.014	0.028**	2.949	2.481
	(0.016)	(0.012)	(2.734)	(2.300)
PUR * pilot * post	0.022	0.026	1.701	2.123
	(0.015)	(0.021)	(2.203)	(2.001)
latest construction year * pilot * post	0.005	0.013	-0.986	-2.148
	(0.019)	(0.016)	(2.657)	(1.988)
has villa/townhouse * pilot * post	-0.123***	-0.069	4.742	-3.515
	(0.043)	(0.068)	(6.034)	(5.610)
1B(sale) * pilot * post	0.004	-0.049*	-1.378	2.597
	(0.024)	(0.027)	(2.295)	(2.308)
1B(rent) * pilot * post	0.002	0.058**	-1.451	-1.855
	(0.023)	(0.028)	(2.719)	(2.245)
FAR miss * pilot * post	-0.067		-0.053	3.280
	(0.084)		(6.027)	(3.530)
green space miss* pilot * post	0.250***	0.121*	15.876**	18.475***
	(0.056)	(0.068)	(6.348)	(5.403)
PUR miss * pilot * post	-0.015	-0.017	-4.149	-6.453
	(0.054)	(0.040)	(6.541)	(5.640)
latest construction year miss * pilot * post	-0.002	-0.042	10.329**	4.167
	(0.034)	(0.046)	(5.012)	(3.372)
1B(sale) miss * pilot * post	0.181		-12.798	5.917
	(0.280)		(14.420)	(12.266)
1B(rent) miss * pilot * post	-0.090		8.519	2.931
	(0.089)		(7.708)	(6.907)
green space * post	-0.015***	-0.010	0.955	1.581
	(0.005)	(0.007)	(0.814)	(0.957)
FAR * post	-0.010*	-0.012**	1.063*	1.497**
	(0.005)	(0.006)	(0.622)	(0.719)
PUR * post	-0.027*	-0.016	0.941	-1.004
	(0.014)	(0.011)	(1.824)	(1.226)
latest construction year * post	-0.021**	-0.001	4.293***	3.398**
	(0.009)	(0.008)	(1.197)	(1.341)
has villa/townhouse * post	-0.037	0.010	-0.400	-0.403
	(0.036)	(0.056)	(3.875)	(2.942)
1B(sale) * post	0.011*	0.012	0.286	0.575
	(0.007)	(0.013)	(1.193)	(1.107)
1B(rent) * post	-0.006	-0.025*	-1.104	0.049
	(0.006)	(0.015)	(1.131)	(0.793)
FAR miss * post	-0.043***	-0.114***	0.187	0.314
	(0.011)	(0.015)	(0.788)	(0.930)
green space miss * post	0.015	-0.068***	-6.905***	-1.605*
	(0.017)	(0.017)	(1.185)	(0.903)
PUR miss * post	-0.021	-0.087***	-12.046***	-6.138
	(0.025)	(0.032)	(3.772)	(3.807)
latest construction year miss * post	-0.025	-0.049*	-4.236	-1.828
	(0.018)	(0.025)	(2.838)	(2.142)
1B(sale) miss * post	0.057	-	-1.870	0.750
	(0.128)		(8.688)	(7.366)
1B(rent) miss * post	0.072	-	3.216	-6.782
	(0.088)		(3.602)	(6.281)
Constant	0.464***	-5.800***	26.999***	18.002***
	(0.008)	(0.012)	(1.158)	(1.030)
Observations	149,339	122,122	164,463	164,463
R^2	0.972	0.907	0.482	0.595
apartment complex FE	YES	YES	YES	YES
city-year FE	YES	YES	YES	YES
cluster	141	137	141	141
mean of dep var	0.455	-5.820	24.23	16.09

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: binary treatment with binary controls

VARIABLES	(1) Ln(price)	(2) Ln(rent)	(3) # sales unit	(4) # rental unit
pilot * post	0.055*	0.083	-17.846***	-2.785
	(0.030)	(0.062)	(6.297)	(7.565)
green space above mean * pilot * post	0.011	-0.066**	2.571	-1.692
	(0.016)	(0.028)	(4.767)	(4.984)
FAR above mean * pilot * post	0.026	0.008	0.413	4.510
	(0.023)	(0.030)	(5.748)	(4.815)
PUR above mean * pilot * post	0.027	0.068	14.802*	13.364
	(0.039)	(0.053)	(8.068)	(8.418)
latest construction year above mean * pilot * post	-0.034	-0.048	11.391*	-4.138
	(0.036)	(0.038)	(6.039)	(4.139)
has villa/townhouse * pilot * post	-0.127***	-0.078	1.379	-6.386
	(0.044)	(0.066)	(5.526)	(4.283)
1B(sale) above mean * pilot * post	-0.040	-0.065	15.908***	11.177**
	(0.036)	(0.042)	(4.824)	(4.945)
1B(rent) above mean * pilot * post	0.072**	0.105***	-19.758***	-11.577***
	(0.035)	(0.034)	(6.316)	(4.081)
FAR miss * pilot * post	-0.020		-18.877***	-5.285
	(0.085)		(7.124)	(4.541)
green space miss * pilot * post	0.218***	0.193***	31.965***	27.607***
	(0.052)	(0.061)	(7.286)	(6.437)
PUR miss * pilot * post	-0.095	-0.145*	-0.213	-15.606
	(0.071)	(0.077)	(14.675)	(9.881)
latest construction year miss * pilot * post	-0.008	-0.060	11.728***	6.652**
	(0.027)	(0.042)	(4.119)	(3.015)
1B(sale) miss * pilot * post	0.227		-21.612	2.879
	(0.283)		(14.073)	(13.004)
1B(rent) miss * pilot * post	-0.103		14.390	1.972
	(0.100)		(10.298)	(9.051)
green space * post	-0.012	0.013	1.857	3.537**
	(0.009)	(0.013)	(1.684)	(1.733)
FAR * post	-0.018**	-0.016	2.872*	3.003***
	(0.009)	(0.010)	(1.487)	(1.096)
PUR * post	-0.087***	-0.075***	-0.553	-2.387
	(0.019)	(0.028)	(2.305)	(2.357)
latest construction year above mean * post	-0.005	0.053***	7.749***	8.689***
	(0.018)	(0.018)	(2.766)	(3.105)
has villa/townhouse * post	-0.031	0.028	1.260	0.928
	(0.037)	(0.059)	(3.867)	(2.873)
1B(sale) above mean * post	0.027**	0.015	1.182	1.546
	(0.013)	(0.017)	(2.270)	(1.699)
1B(rent) above mean * post	-0.012	-0.038**	-1.530	2.734**
	(0.013)	(0.017)	(2.026)	(1.195)
FAR miss * post	-0.034***	-0.106***	-1.349	-0.995
	(0.013)	(0.015)	(1.101)	(1.029)
green space miss * post	0.017	-0.085***	-7.596***	-3.706**
	(0.018)	(0.018)	(1.610)	(1.776)
PUR miss * post	0.082***	0.027	-13.224***	-4.566
	(0.029)	(0.043)	(3.525)	(3.388)
latest construction year miss * post	-0.003	-0.050**	-8.805***	-5.470***
	(0.018)	(0.025)	(2.395)	(1.761)
1B(sale) miss * post	0.014		-3.070	-0.079
	(0.128)		(8.992)	(8.260)
1B(rent) miss * post	0.068		6.482	-5.900
	(0.091)		(5.163)	(7.755)
Constant	0.482***	-5.813***	22.779***	11.235***
	(0.016)	(0.017)	(2.321)	(2.864)
Observations	149,339	122,122	164,463	164,463
R^2	0.972	0.907	0.483	0.596
apartment complex FE	YES	YES	YES	YES
city-year FE	YES	YES	YES	YES
cluster	141	137	141	141
mean of dep var	0.455	-5.820	24.23	16.09

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 10: Effects of conducting pilot in the whole city

VARIABLES	(1) Ln(price)	(2) Ln(rent)	(3) # rental unit	(4) # sales unit
pilot * post	-0.093	-0.001	0.292	5.581
	(0.164)	(0.039)	(2.102)	(4.034)
Constant	0.269***	-5.958***	16.388***	21.593***
	(0.076)	(0.018)	(0.977)	(1.875)
Observations	163,021	138,283	180,367	180,367
R^2	0.606	0.347	0.030	0.045
City FE	YES	YES	YES	YES
year FE	YES	YES	YES	YES
cluster(city)	13	13	13	13
mean of dep var	0.225	-5.959	16.52	24.19

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11: Effects of conducting pilot in the whole city

VARIABLES	(1) Ln(price)	(2) Ln(rent)	(3) # rental unit	(4) # sales unit
pilot * post	0.007	-0.017	57.436	165.170
	(0.043)	(0.030)	(160.378)	(149.679)
Constant	-0.600***	-6.559***	1,277.178***	1,530.862***
	(0.014)	(0.010)	(50.290)	(46.936)
Observations	63,603	61,597	65,321	65,321
R^2	0.669	0.525	0.293	0.308
City FE	YES	YES	YES	YES
year FE	YES	YES	YES	YES
cluster(city)	61	61	61	61
mean of dep var	-0.598	-6.565	1295	1583

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 12: treatment intensity with binary controls

VARIABLES	(1) Ln(price)	(2) Ln(rent)	(3) # sales unit	(4) # rental unit
pilot * fraction * post	0.198**	0.178	-52.671**	-13.776
	(0.096)	(0.185)	(21.932)	(19.949)
green space above mean * fraction * pilot * post	0.053	-0.119*	8.408	-1.797
	(0.039)	(0.067)	(13.817)	(13.054)
FAR above mean * fraction * pilot * post	0.031	0.012	3.579	12.777
	(0.049)	(0.069)	(12.516)	(9.575)
PUR above mean * fraction * pilot * post	0.146	0.264**	42.452*	45.390*
	(0.090)	(0.127)	(25.147)	(24.217)
latest construction year above mean * fraction * pilot * post	-0.146	-0.123	41.227*	-12.226
	(0.105)	(0.114)	(21.856)	(11.414)
has villa/townhouse * fraction * pilot * post	-0.333***	-0.262	-3.845	-18.848*
	(0.118)	(0.212)	(17.479)	(11.106)
1B(sale) above mean * fraction * pilot * post	-0.125	-0.138	35.589**	25.021*
	(0.092)	(0.103)	(16.354)	(13.492)
1B(rent) above mean * fraction * pilot * post	0.208**	0.202*	-53.253***	-28.977**
	(0.098)	(0.103)	(19.496)	(11.637)
FAR miss * fraction * pilot * post	-0.140		-102.441***	-21.775
	(0.373)		(32.935)	(20.102)
green space miss * fraction * pilot * post	1.804***	1.714***	192.622***	111.843***
	(0.318)	(0.501)	(35.458)	(29.231)
PUR miss * fraction * pilot * post	-0.396**	-0.417**	4.784	-51.123*
	(0.184)	(0.209)	(46.049)	(27.117)
latest construction year miss * fraction * pilot * post	-0.035	-0.246	28.491**	21.279**
	(0.073)	(0.203)	(12.380)	(8.542)
1B(sale) miss * fraction * pilot * post	-1.121**		-55.607*	-41.190
	(0.515)		(31.916)	(33.965)
1B(rent) miss * fraction * pilot * post	-0.257		33.660	2.949
	(0.208)		(27.608)	(20.193)
green space * post	-0.013	0.011	1.948	3.529**
	(0.009)	(0.013)	(1.668)	(1.720)
FAR * post	-0.017**	-0.017*	2.823*	2.852***
	(0.009)	(0.010)	(1.478)	(1.092)
PUR * post	-0.090***	-0.080***	-0.722	-3.079
	(0.018)	(0.028)	(2.307)	(2.289)
latest construction year above mean * post	-0.005	0.054***	7.286***	8.421***
	(0.017)	(0.018)	(2.713)	(3.084)
has villa/townhouse * post	-0.036	0.028	1.925	0.811
	(0.036)	(0.056)	(3.737)	(2.733)
1B(sale) above mean * post	0.027**	0.012	1.626	1.898
	(0.013)	(0.017)	(2.253)	(1.700)
1B(rent) above mean * post	-0.012	-0.035**	-1.735	2.381**
	(0.013)	(0.017)	(1.989)	(1.191)
FAR miss * post	-0.036**	-0.107***	-1.164	-0.737
	(0.014)	(0.015)	(1.081)	(0.924)
green space miss * post	0.017	-0.085***	-7.451***	-3.426**
	(0.018)	(0.018)	(1.572)	(1.688)
PUR miss * post	0.089***	0.030	-13.356***	-4.316
	(0.028)	(0.043)	(3.550)	(3.429)
latest construction year miss * post	-0.002	-0.050**	-8.419***	-5.562***
	(0.018)	(0.024)	(2.339)	(1.745)
1B(sale) miss * post	0.319		-4.180	4.483
	(0.216)		(7.275)	(8.934)
1B(rent) miss * post	0.066		6.787	-5.749
	(0.092)		(5.122)	(7.771)
Constant	0.481***	-5.811***	22.965***	11.923***
	(0.017)	(0.018)	(2.340)	(2.895)
Observations	149,339	122,122	164,463	164,463
R^2	0.972	0.907	0.483	0.597
apartment complex FE	YES	YES	YES	YES
city-year FE	YES	YES	YES	YES
cluster	141	137	141	141
mean of dep var	0.455	-5.820	24.23	16.09

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13: treatment intensity with continuous controls

VARIABLES	(1) Ln(price)	(2) Ln(rent)	(3) # sales unit	(4) # rental unit
pilot * fraction * post	0.174*	0.207	1.140	-7.544
	(0.090)	(0.164)	(11.891)	(9.459)
green space * fraction * pilot * post	0.064***	0.004	0.122	2.494
	(0.019)	(0.023)	(6.317)	(6.673)
FAR * fraction * pilot * post	0.019	0.055**	8.200	6.324
	(0.031)	(0.024)	(5.561)	(5.436)
PUR * fraction * pilot * post	0.067	0.088*	7.952	10.222
	(0.043)	(0.050)	(7.387)	(7.812)
latest construction year * fraction * pilot * post	-0.048	0.035	5.964	-7.854
	(0.064)	(0.077)	(13.335)	(8.526)
has villa/townhouse * fraction * pilot * post	-0.307***	-0.220	2.661	-11.919
	(0.104)	(0.217)	(17.387)	(14.507)
1B(sale) * fraction * pilot * post	-0.013	-0.116**	-8.073	3.715
	(0.036)	(0.056)	(5.157)	(4.917)
1B(rent) * fraction * pilot * post	0.033	0.126**	-1.940	-2.891
	(0.033)	(0.062)	(7.062)	(5.772)
FAR miss * fraction * pilot * post	-0.233	-	-38.145	17.917
	(0.348)		(32.030)	(16.173)
green space miss * fraction * pilot * post	1.980***	1.335***	124.370***	83.661***
	(0.316)	(0.499)	(38.871)	(29.999)
PUR miss * fraction * pilot * post	-0.174	-0.032	-1.350	-21.858
	(0.147)	(0.133)	(24.191)	(17.435)
latest construction year miss * fraction * pilot * post	-0.078	-0.203	33.329*	12.841
	(0.100)	(0.223)	(18.996)	(12.217)
1B(sale) miss * fraction * pilot * post	-1.247***	-	-56.306*	-36.608
	(0.475)		(29.969)	(29.603)
1B(rent) miss * fraction * pilot * post	-0.164	-	15.397	7.209
	(0.179)		(18.077)	(14.775)
green space * post	-0.016***	-0.010	0.958	1.519
	(0.005)	(0.007)	(0.802)	(0.947)
FAR * post	-0.009*	-0.012**	1.000	1.431**
	(0.005)	(0.006)	(0.616)	(0.713)
PUR * post	-0.027**	-0.018	0.509	-1.498
	(0.014)	(0.011)	(1.939)	(1.387)
latest construction year * post	-0.019**	0.001	4.015***	3.388**
	(0.009)	(0.008)	(1.203)	(1.349)
has villa/townhouse * post	-0.043	0.009	0.340	-0.362
	(0.035)	(0.054)	(3.763)	(2.822)
1B(sale) * post	0.012*	0.011	0.425	0.679
	(0.007)	(0.013)	(1.181)	(1.104)
1B(rent) * post	-0.007	-0.025*	-1.131	-0.046
	(0.006)	(0.015)	(1.115)	(0.790)
FAR miss * post	-0.045***	-0.116***	0.271	0.407
	(0.013)	(0.015)	(0.763)	(0.855)
green space miss * post	0.016	-0.070***	-6.763***	-1.418*
	(0.017)	(0.017)	(1.169)	(0.828)
PUR miss * post	-0.014	-0.086***	-12.091***	-6.027
	(0.025)	(0.032)	(3.857)	(3.883)
latest construction year miss * post	-0.022	-0.048*	-4.159	-1.950
	(0.018)	(0.025)	(2.798)	(2.150)
1B(sale) miss * post	0.347*	-	-0.502	7.321
	(0.205)		(6.691)	(8.182)
1B(rent) miss * post	0.070	-	3.359	-6.853
	(0.088)		(3.619)	(6.307)
Constant	0.463***	-5.801***	26.641***	18.287***
	(0.009)	(0.014)	(1.278)	(1.084)
Observations	149,339	122,122	164,463	164,463
R^2	0.972	0.907	0.482	0.595
apartment complex FE	YES	YES	YES	YES
city-year FE	YES	YES	YES	YES
cluster	141	137	141	141
mean of dep var	0.455	-5.820	24.23	16.09

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 14: Treatment intensity: the policy changes

VARIABLES	(1) Ln(price)	(2) Ln(rent)	(3) # sales unit	(4) # rental unit
pilot * change in exclusion * post	0.112*	0.182	-9.816	-4.881
	(0.060)	(0.113)	(8.189)	(7.815)
green space * change in exclusion * pilot * post	0.038	-0.017	-0.322	-0.000
	(0.025)	(0.042)	(4.084)	(4.179)
FAR * change in exclusion * pilot * post	0.087	0.043	2.670	3.840
	(0.058)	(0.068)	(9.575)	(7.695)
PUR * change in exclusion * pilot * post	0.035	0.021	0.087	0.434
	(0.023)	(0.029)	(2.795)	(1.904)
latest construction year * change in exclusion * pilot * post	0.037	0.045	-5.060	-5.737
	(0.038)	(0.028)	(4.149)	(3.999)
has villa/townhouse * change in exclusion * pilot * post	-0.148*	-0.102	10.640	-8.735
	(0.087)	(0.123)	(9.209)	(9.073)
1B(rent) * change in exclusion * pilot * post	0.108**	-0.161*	0.554	7.865*
	(0.044)	(0.095)	(4.211)	(4.371)
1B(rent) * change in exclusion * pilot * post	-0.078***	0.243***	-3.740	-6.077*
	(0.028)	(0.081)	(5.769)	(3.594)
FAR miss * change in exclusion * pilot * post	-0.210		-10.626	7.554
	(0.442)		(19.413)	(13.793)
green space miss * change in exclusion * pilot * post	1.658***	1.028**	118.157***	68.648***
	(0.254)	(0.452)	(31.828)	(26.071)
PUR miss * change in exclusion * pilot * post	0.074	0.018	-3.866	-12.818
	(0.109)	(0.097)	(15.224)	(14.176)
latest construction year miss * change in exclusion * pilot * post	0.078	-0.011	19.286*	4.028
	(0.057)	(0.061)	(10.131)	(6.818)
1B(sale) miss * change in exclusion * pilot * post	0.164		-142.055	20.074
	(2.513)		(86.363)	(75.379)
1B(rent) miss * change in exclusion * pilot * post	-0.906		61.662	-11.199
	(0.619)		(41.464)	(45.995)
green space * post	-0.013***	-0.009	0.907	1.648*
	(0.005)	(0.006)	(0.802)	(0.930)
FAR * post	-0.010*	-0.010*	1.217*	1.667**
	(0.005)	(0.005)	(0.636)	(0.724)
PUR * post	-0.026**	-0.013	1.706	-0.076
	(0.013)	(0.010)	(1.576)	(1.139)
latest construction year * post	-0.022**	-0.001	4.562***	3.588***
	(0.009)	(0.008)	(1.217)	(1.335)
has villa/townhouse * post	-0.052	0.001	-0.051	-0.358
	(0.035)	(0.054)	(3.713)	(2.816)
1B(sale) * post	0.009	0.010	0.205	0.664
	(0.007)	(0.013)	(1.165)	(1.081)
1B(rent) * post	-0.003	-0.025*	-1.178	0.013
	(0.006)	(0.015)	(1.112)	(0.790)
FAR miss * post	-0.043***	-0.115***	0.259	0.502
	(0.012)	(0.015)	(0.770)	(0.845)
green space miss * post	0.014	-0.070***	-6.856***	-1.460*
	(0.017)	(0.017)	(1.174)	(0.824)
PUR miss * post	-0.029	-0.092***	-12.120***	-6.127*
	(0.025)	(0.029)	(3.620)	(3.655)
latest construction year miss * post	-0.030*	-0.056**	-3.117	-0.972
	(0.017)	(0.025)	(2.739)	(2.060)
1B(sale) miss * post	0.178		0.153	2.514
	(0.178)		(8.344)	(7.273)
1B(rent) miss * post	0.072		3.198	-6.540
	(0.088)		(3.546)	(6.224)
Constant	0.468***	-5.796***	27.143***	17.906***
	(0.008)	(0.010)	(1.010)	(0.962)
Observations	149,339	122,122	164,463	164,463
R^2	0.972	0.907	0.482	0.595
apartment complex FE	YES	YES	YES	YES
city-year FE	YES	YES	YES	YES
cluster	141	137	141	141
mean of dep var	0.455	-5.820	24.23	16.09

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 15: treatment intensity: distance to the nearest treated city

VARIABLES	(1) Ln(price)	(2) # sales unit	(3) # rental unit	(4) # rental unit
pilot * distance min * post	0.0003**	-0.003	-0.006	-0.006
	(0.000)	(0.017)	(0.012)	(0.012)
green space * distance min * pilot * post	0.000**	0.001	0.003	0.003
	(0.000)	(0.010)	(0.010)	(0.010)
FAR * distance min * pilot * post	0.000	0.013	0.011	0.011
	(0.000)	(0.011)	(0.009)	(0.009)
PUR * distance min * pilot * post	0.000	0.008	0.010	0.010
	(0.000)	(0.009)	(0.009)	(0.009)
latest construction year * distance min * pilot * post	0.000	-0.003	-0.011	-0.011
	(0.000)	(0.012)	(0.009)	(0.009)
has villa/townhouse * distance min * pilot * post	-0.001***	0.015	-0.016	-0.016
	(0.000)	(0.027)	(0.023)	(0.023)
1B(sale) * distance min * pilot * post	-0.000	-0.007	0.009	0.009
	(0.000)	(0.009)	(0.009)	(0.009)
1B(rent) * distance min * pilot * post	0.000	-0.006	-0.007	-0.007
	(0.000)	(0.012)	(0.011)	(0.011)
FAR miss * distance min * pilot * post	-0.000	-0.005	0.016	0.016
	(0.000)	(0.027)	(0.015)	(0.015)
green space miss * distance min * pilot * post	0.001***	0.065**	0.078***	0.078***
	(0.000)	(0.026)	(0.024)	(0.024)
PUR miss * distance min * pilot * post	-0.000	-0.014	-0.027	-0.027
	(0.000)	(0.027)	(0.024)	(0.024)
latest construction year miss * distance min * pilot * post	-0.000	0.045*	0.018	0.018
	(0.000)	(0.024)	(0.016)	(0.016)
1B(sale) miss * distance min * pilot * post	0.001	-0.058	0.020	0.020
	(0.001)	(0.059)	(0.054)	(0.054)
1B(rent) miss * distance min * pilot * post	-0.000	0.036	0.013	0.013
	(0.000)	(0.031)	(0.027)	(0.027)
green space * post	-0.016***	0.939	1.547	1.547
	(0.005)	(0.811)	(0.956)	(0.956)
FAR * post	-0.009*	1.038*	1.474**	1.474**
	(0.005)	(0.620)	(0.718)	(0.718)
PUR * post	-0.027*	0.818	-1.075	-1.075
	(0.014)	(1.842)	(1.227)	(1.227)
latest construction year * post	-0.021**	4.261***	3.402**	3.402**
	(0.009)	(1.193)	(1.337)	(1.337)
has villa/townhouse * post	-0.041	-0.147	-0.491	-0.491
	(0.036)	(3.810)	(2.861)	(2.861)
1B(sale) * post	0.012*	0.307	0.627	0.627
	(0.007)	(1.188)	(1.104)	(1.104)
1B(rent) * post	-0.007	-1.087	-0.004	-0.004
	(0.006)	(1.125)	(0.791)	(0.791)
FAR miss * post	-0.043***	0.210	0.304	0.304
	(0.011)	(0.783)	(0.944)	(0.944)
green space miss * post	0.016	-6.874***	-1.572*	-1.572*
	(0.017)	(1.184)	(0.900)	(0.900)
PUR miss * post	-0.021	-12.078***	-6.327*	-6.327*
	(0.025)	(3.804)	(3.815)	(3.815)
latest construction year miss * post	-0.025	-4.170	-1.839	-1.839
	(0.018)	(2.823)	(2.142)	(2.142)
1B(sale) miss * post	0.079	-1.477	1.229	1.229
	(0.133)	(8.701)	(7.365)	(7.365)
1B(rent) miss * post	0.072	3.226	-6.790	-6.790
	(0.088)	(3.608)	(6.285)	(6.285)
Constant	0.463***	26.949***	18.134***	18.134***
	(0.009)	(1.203)	(1.049)	(1.049)
Observations	149,339	164,463	164,463	164,463
R^2	0.972	0.482	0.595	0.595
apartment complex FE	YES	YES	YES	YES
city-year FE	YES	YES	YES	YES
cluster	141	141	141	141
mean of dep var	0.455	24.23	16.09	16.09
mean of distance (km)	226.6	229.5	229.5	229.5

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 16: Heterogeneous effects on housing units

VARIABLES	(1) ln(price)	(2) ln(rent)	(3) # sales unit	(4) # rental unit
Panel A. continuous features				
A.1. Table 8; high quality - basic				
Difference	-0.106**	-0.062	7.215	-4.264
	(0.047)	(0.066)	(5.969)	(6.034)
A.2. Table 13; fraction = 1; high quality - basic				
Difference	-0.325**	-0.191	18.321	-14.842
	(0.126)	(0.217)	(17.755)	(16.206)
A.3. Table 13; fraction = 0.5(max); high quality - basic				
Difference	-0.162**	-0.095	9.161	-7.421
	(0.063)	(0.109)	(8.877)	(8.103)
A.4. Table 13; fraction = 0.09 (min); high quality - basic				
Difference	-0.030**	-0.017	1.666	-1.349
	(0.011)	(0.020)	(1.614)	(1.473)
Panel B. binary features				
B.1. Table 9; above mean - below mean				
Difference	-0.130**	-0.157*	34.407**	6.058
	(0.065)	(0.084)	(15.310)	(15.846)
B.2. Table 12; fraction = 1; above mean - below mean				
Difference	-0.332**	-0.292	109.485**	29.251
	(0.156)	(0.288)	(48.615)	(39.570)
B.3. Table 12; fraction = 0.5(max); above mean - below mean				
Constant	-0.166**	-0.146	54.742**	14.626
	(0.078)	(0.144)	(24.307)	(19.785)
B.4. Table 12; fraction = 0.09(min); above mean - below mean				
Difference	-0.030**	-0.027	9.953**	2.659
	(0.014)	(0.026)	(4.420)	(3.597)
Observations	149,339	122,122	164,463	164,463

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 The definition used for "High quality" in the testing is having desirable apartment features, including green space, floor area ratio (FAR), the number of parking lots per unit (PUR), the latest construction year, at the 75th percentile in the sample, the dummy for townhouses or villas being 1, and indicators for basic housing, including the fraction of one bedroom units among all the units on sale and the fraction of one bedroom units for rental among all rental units, at 25th percentile. The definition for "basic" is that all the continuous features set to 0, which correspond to the means before standardization and the dummy for townhouses or villas also set to 0.

Table 17: Heterogeneous effects on housing units: policy change

VARIABLES	(1) ln(price)	(2) ln(rent)	(3) # sales unit	(4) # rental unit
Difference (high quality - basic)	-0.017	-0.035	2.231	-2.894
	(0.023)	(0.028)	(2.446)	(2.594)
Observations	149,339	122,122	164,463	164,463

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 The definition used for "High quality" in the testing is having desirable apartment features, including green space, floor area ratio (FAR), the number of parking lots per unit (PUR), the latest construction year, at the 75th percentile in the sample, the dummy for townhouses or villas being 1, and indicators for basic housing, including the fraction of one bedroom units among all the units on sale and the fraction of one bedroom units for rental among all rental units, at 25th percentile. The definition for "basic" is that all the continuous features set to 0, which correspond to the means before standardization and the dummy for townhouses or villas also set to 0. The change in restriction index is set to be around 0.23.

Table 18: Heterogeneous effects on housing units: distance

VARIABLES	(1) ln(price)	(2) ln(rent)	(3) # sales unit	(4) # rental unit
Difference (high quality - basic)	-0.104**	6.132	-4.638	-4.638
	(0.047)	(6.061)	(5.757)	(5.757)
Observations	149,339	164,463	164,463	164,463

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 The definition used for "High quality" in the testing is having desirable apartment features, including green space, floor area ratio (FAR), the number of parking lots per unit (PUR), the latest construction year, at the 75th percentile in the sample, the dummy for townhouses or villas being 1, and indicators for basic housing, including the fraction of one bedroom units among all the units on sale and the fraction of one bedroom units for rental among all rental units, at 25th percentile. The definition for "basic" is that all the continuous features set to 0, which correspond to the means before standardization and the dummy for townhouses or villas also set to 0. The distance is set to be the sample mean for the regression, varying from 226.6 km to 229.5 km depending on the outcome variable.

Table 19: two steps: predicting ln(price) with full features

VARIABLES	(1) Ln(price)	(2) Ln(price)
pilot * fraction * post	-0.023	
	(0.102)	
quality * fraction * pilot * post	-0.278**	
	(0.108)	
pilot * post		-0.006
		(0.028)
quality * pilot * post		-0.109**
		(0.055)
Constant	0.454***	0.454***
	(0.005)	(0.004)
Observations	149,339	149,339
R^2	0.972	0.972
apartment complex FE	YES	YES
city-year FE	YES	YES
cluster	141	141
mean of dep var	0.455	0.455

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 20: two steps: predicting price with full features

VARIABLES	(1) Ln(price)	(2) Ln(price)
pilot * fraction * post	0.173	
	(0.136)	
qualitylevel * fraction * pilot * post	-0.168***	
	(0.064)	
pilot * post		0.080
		(0.049)
qualitylevel * pilot * post		-0.072**
		(0.032)
Constant	0.455***	0.455***
	(0.005)	(0.004)
Observations	149,339	149,339
R^2	0.972	0.972
apartment complex FE	YES	YES
city-year FE	YES	YES
cluster	141	141
mean of dep var	0.455	0.455

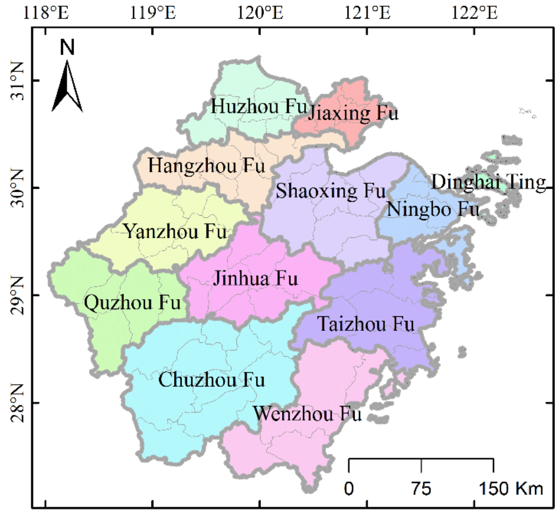
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 21: Land transactions for residential purposes involve larger volumes after 2015

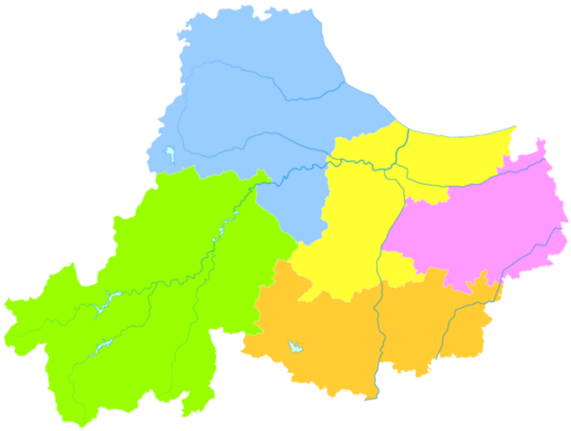
VARIABLES	(1) construction area	(2) building area
post	-1,173	-28,296
	(9,877)	(23,184)
pop0.5-1 $*$ post	21,399*	74,225***
	(11,819)	(28,042)
pop1-3 $*$ post	10,884	37,752
	(11,044)	(25,927)
pop3-5 $*$ post	4,638	23,157
	(11,963)	(28,080)
pop5above$*$ post	-3,930	-29,626
	(12,494)	(29,327)
Constant	29,365***	69,866***
	(1,827)	(4,341)
City fixed effects	Yes	Yes
Observations	1,456	1,445
R-squared	0.294	0.315

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. pop0.5-1, pop1-3, pop3-5, pop5above stands for urban population between 0.5 million and 1 million, between 1 million and 3 million, between 3 million and 5 million and above 5 million, respectively. The base category are cities with urban population below 0.5 million.

(a) Province



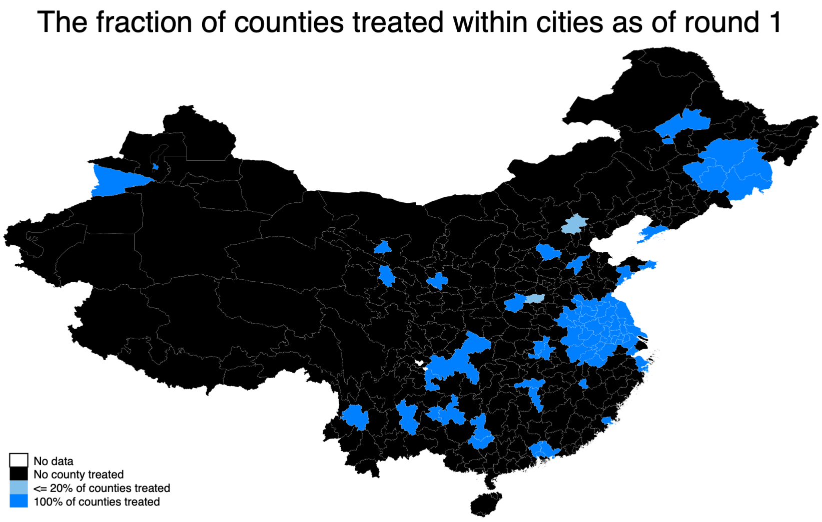
(b) Prefectural city in Zhejiang Province



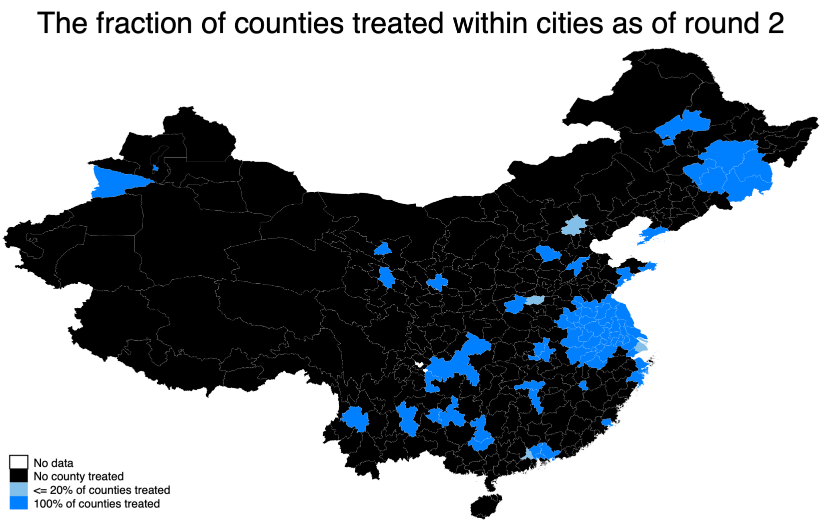
(c) Counties in Huzhou prefectural city

Figure 1: Three-level administrative division in China

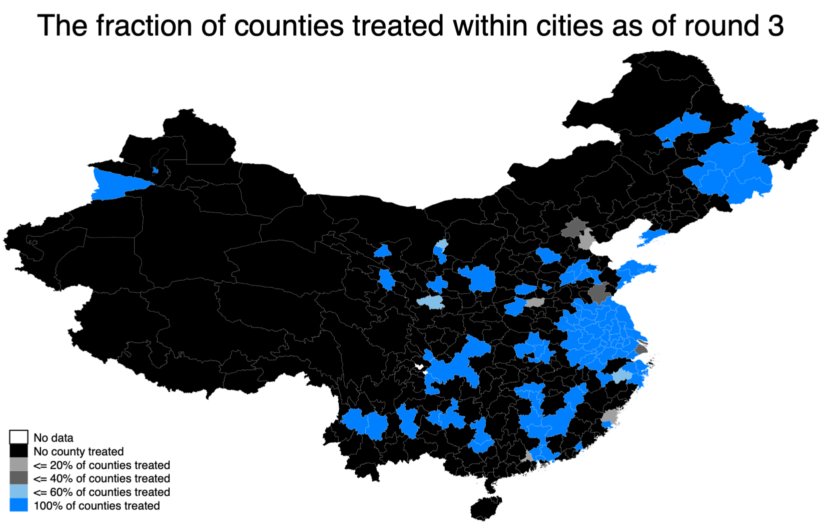
Figures



(a) The first round of pilots

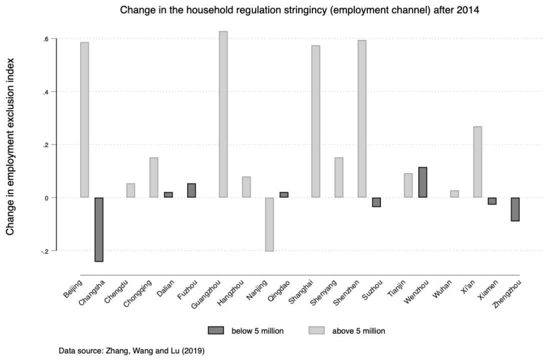


(b) The second round of pilots

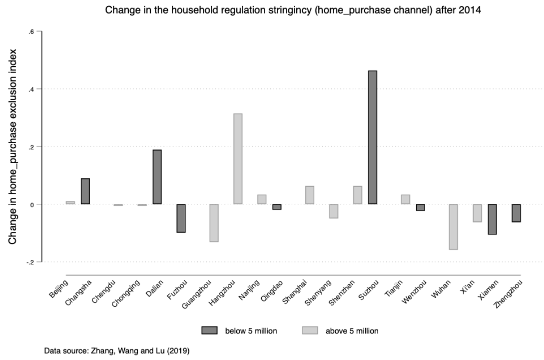


(c) The third round of pilots

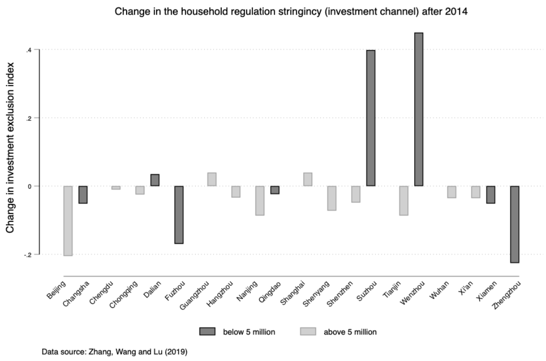
Figure 2: The geographical distribution of pilots



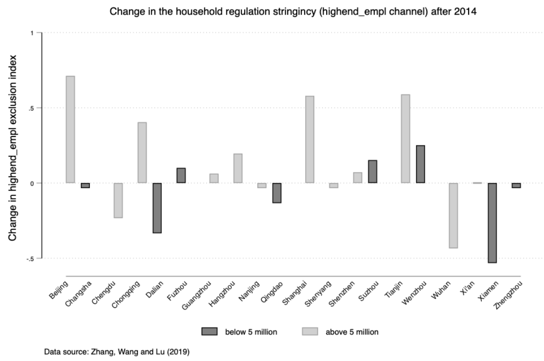
(a) Ordinary employment channel



(b) Home purchase channel



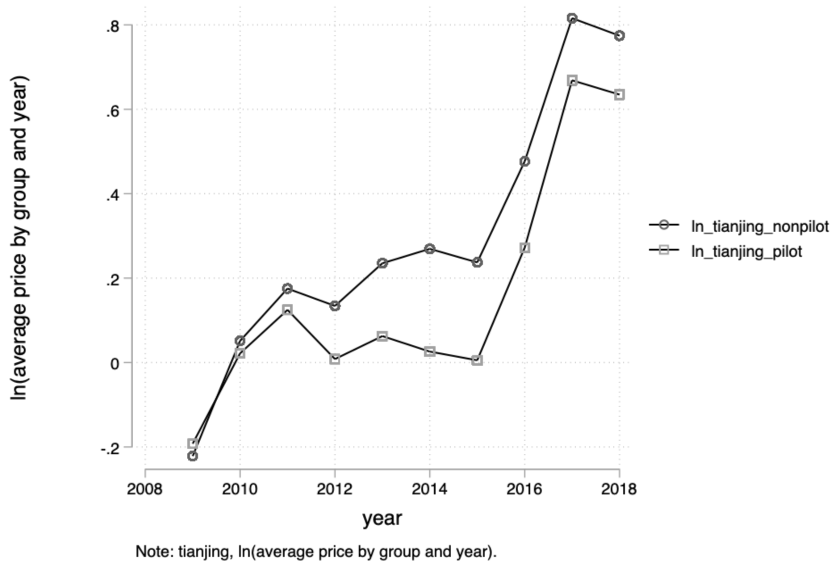
(c) Investment channel

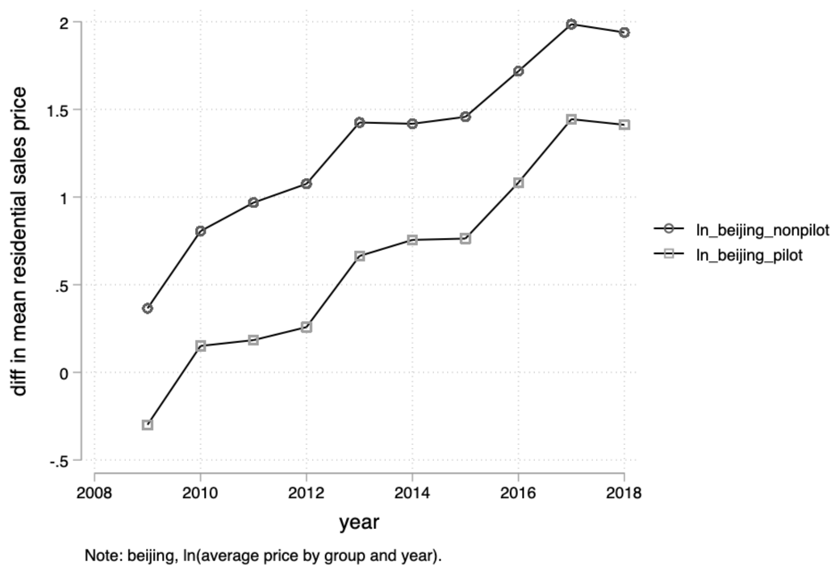


(d) High-end employment channel

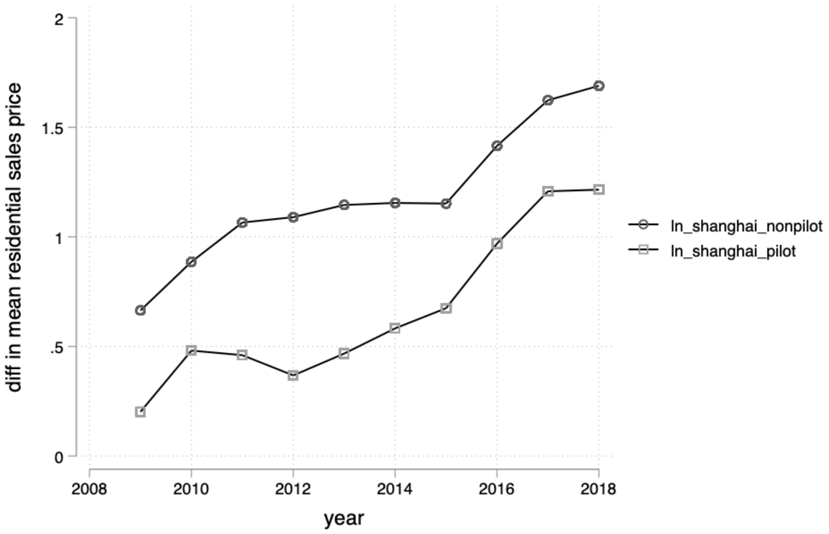
Figure 3: The change in the household registration stringency after 2014 through four main channels. The change for each channel is calculated as the difference between the index in period 2 and the index in period 1. The index data is constructed by Zhang et al. [2019]. Each index is based on the regulations about obtaining local urban Hukou through that specific channel. The information on regulations is extracted from Hukou policy documents at prefectural, provincial and national levels. A higher value of a specific index means a higher level of stringency in granting a local urban Hukou through that channel.

Partial pilot cities: pilot vs non pilot areas.
log of averages.

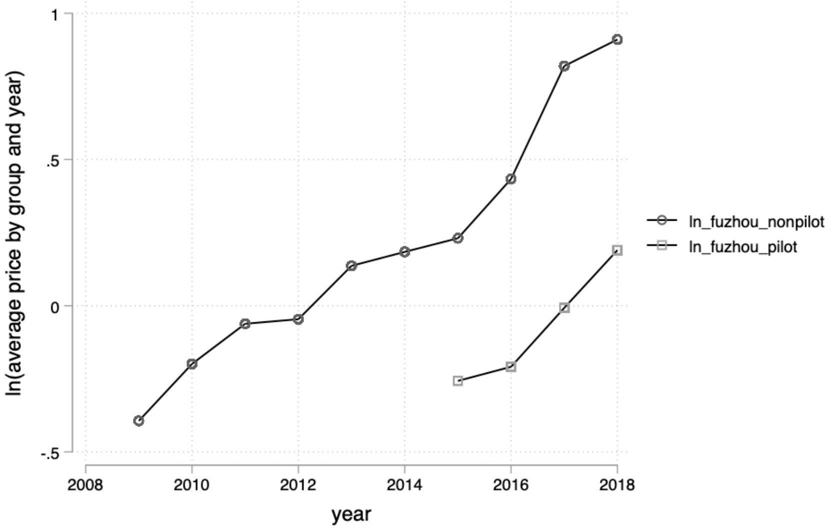




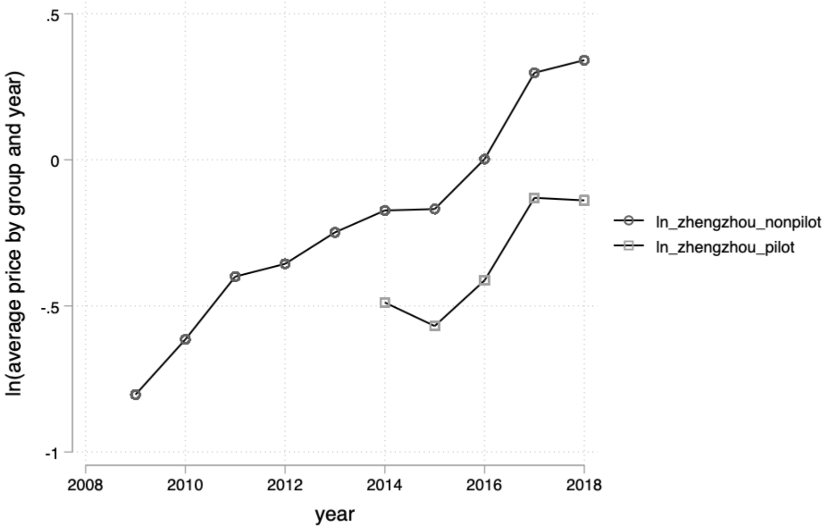
Partial pilot cities: pilot vs non pilot areas.
difference in log of averages.



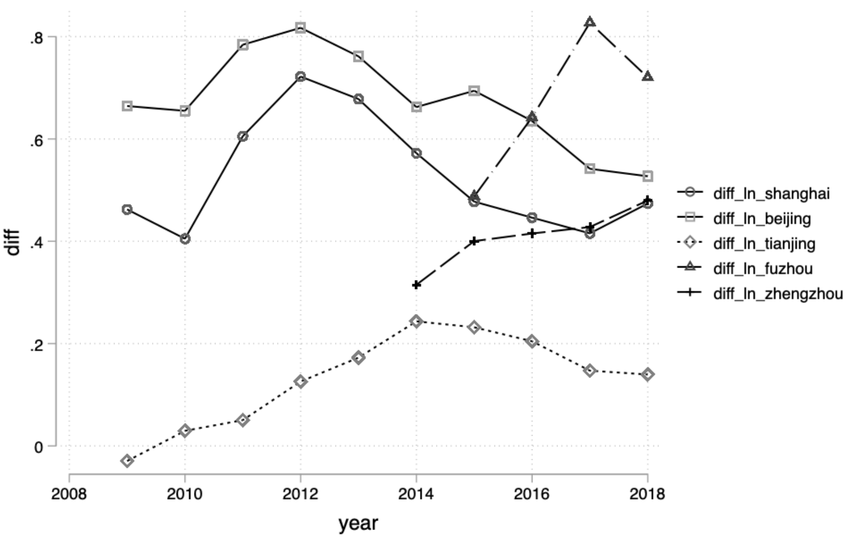
Note: shanghai, ln(average price by group and year).



Note: fuzhou, ln(average price by group and year).

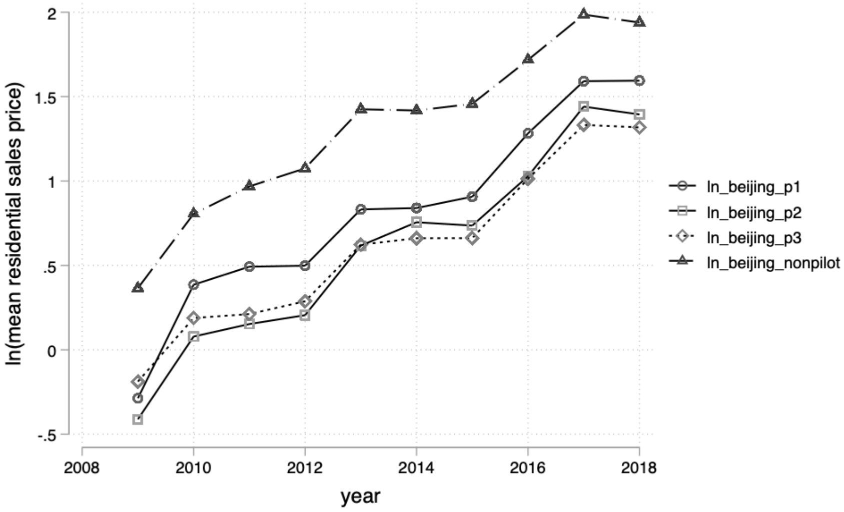


Note: zhengzhou, ln(average price by group and year).

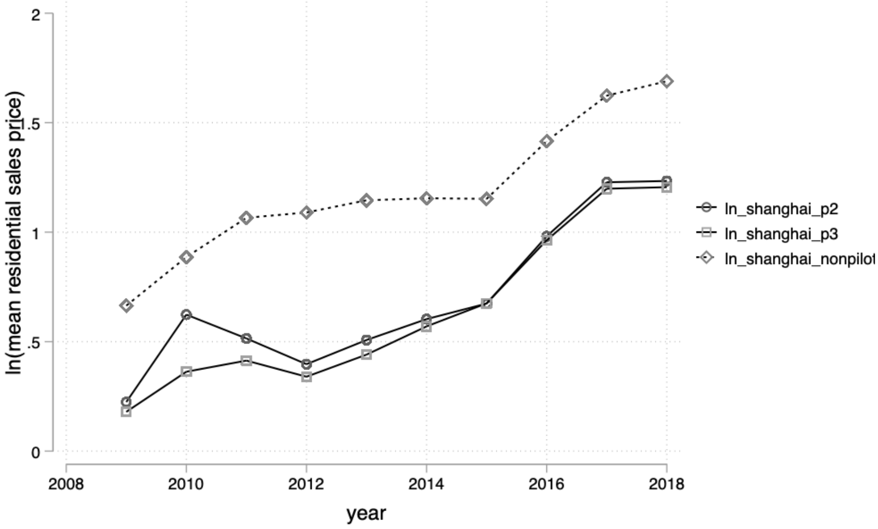


Note: ln(average price of nonpilot area by year) - ln(average price of pilot area by year) .

Partial pilot cities: pilot by round vs non pilot areas.
log of averages. Tianjing, Zhengzhou, Fuzhou only have one round. So I do not include extra plots for them here again.

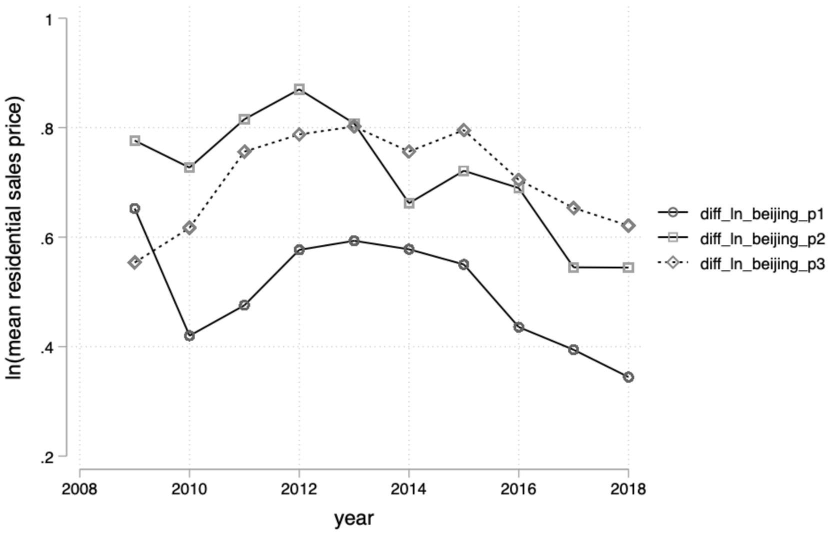


Note: log average prices. Beijing. ln(pilot 1 average price) ln(pilot 2 average price) ln(pilot 3 average price) ln(non-pilot average price)

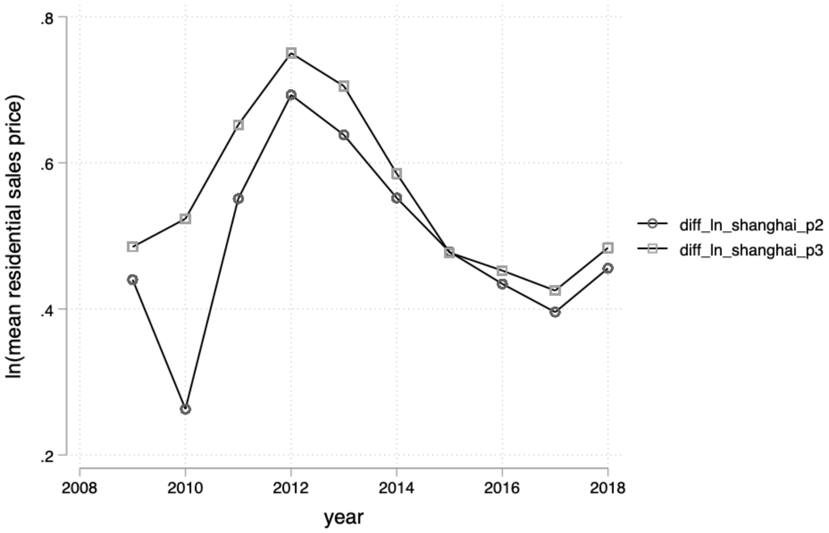


Note: log average prices. Shanghai. ln(pilot 2 average price) ln(pilot 3 average price) ln(non-pilot average price)

Partial pilot cities: pilot by round vs non pilot areas.
difference in log of averages. Tianjing, Zhengzhou, Fuzhou only have one round. So I do not include extra plots for them here again.
ln(non-pilot average price) - ln(pilot i average price).



Note: Beijing. ln(non-pilot average price) - ln(pilot i average price)



Note: Shanghai. ln(non-pilot average price) - ln(pilot i average price)

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