Hukou and Homeownership Premiums: A Study of Chinese Price-to-Rent Ratios

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Abstract (to be written)

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I. Introduction

Interest in Chinese housing markets is widespread, not least because of the enormous growth in home prices experienced throughout the country.[1] The Chinese government's official series shows the average housing price in Beijing has gone up from 17,151 yuan/square meter in 2010 to 33,237 yuan/square meter (in 2010 price) in 2020, or about 94% real appreciation over the last decade. During the same period, Shanghai experienced a 100% real increase and Chongqing a 75% real growth.[2] Academic researchers have documented that land values also have escalated sharply over time in many different markets. For example, Beijing's land price index grew from a value of 6.01 to 16.59 from 2010 to 2017, for a 176% real, constant quality increase. Shanghai and Chongqing experienced 194% and 99% increases, respectively.[3]

In this paper, we bring new data to bear on the study of Chinese housing markets. Specifically, we use the information on listing values for both prices and rents to create price-to-rent ratios for 145 cities across the country. This allows us to cover the entire country (see Figure 1 below), not just a select set of Tier 1 (or Tier 2) cities. For all markets, there is information back to the first quarter of 2015 (2015(1)) and extending through 2020(3).

[1] This literature now is too large to cite comprehensively. Just a few of the recent articles with excellent analyses and extensive bibliographies in English and Chinese include Fang et al. (2016), Glaeser et al. (2017), and Li, Qin, and Wu (2020).
[2] The underlying data are from the National Bureau of Statistics, China.
[3] The baseline data on land values are from Wu, Gyourko, and Deng (2012, 2016). The latest data are available from Gyourko's web site at http://real-faculty.wharton.upenn.edu/gyourko/chinese-residential-land-price-indexes/.

Our data show there has been meaningful variation in price multiples even over the relatively short period covered in our analysis. In addition, there is much heterogeneity across markets. At the end of our sample period (2020(3)), price-to-rent ratios ranged from lows around 20 to highs near 60 (in Beijing and Xiamen). This wide range is not driven by a handful of outliers. The interquartile range runs from 30.6-46.3. Thus, prices trade at far higher multiples of rent in the typical Chinese market than they do in American ones. Moreover, there is an upward trend in multiples over our sample period. For nearly 90% of our markets, housing prices traded at a higher multiple of rents in late 2020 than at the beginning of 2015. There was a 31% multiple expansion for the median city in our sample, and over one-quarter of the cities saw the price-to-rent multiple rises by more than 50%.

We also compare Tier 1/Tier 2 cities to those in the rest of the country. We call that other group Tier 3/Tier 4 markets. Price-to-rent ratios are higher on average in the Tier 1/Tier 2 cities, as expected. However, both groups experienced increases in multiples over our study time frame. The median ratio of the Tier 1/Tier 2 cities increases from 36 in 2015(1) to 41 in 2020(3), while the corresponding values are 28 and 38 for the Tier 3/Tier 4 cities. It is noteworthy that price-to-rent ratios are much more volatile in the Tier 1/Tier 2 cities. For example, the 90% percentile of the ratios in the Tier 1/Tier 2 cities surges from 49 in early 2016 to 81 in mid-2017, but drops to around 55 within two years.

Traditional analytical frameworks such as Poterba (1984) show that a host of primarily financial factors (e.g., mortgage interest rates, the opportunity cost of equity,

maintenance and depreciation expenses, and expected home price appreciation) play important roles in determining the price-to-rent ratio. However, it long has been appreciated that other factors such as 'pride of ownership' could lead a household to place greater value on owning a given unit relative to renting it, independent of financial frictions.[4] Hukou, the internal registration system, is another example that may be relevant in helping account for price-to-rent ratios in China.[5] Hukou could be especially important in Chinese housing markets because its possession is much more likely if one owns, and ownership is required to access certain valuable publicly-provided services. Because of this, possession of hukou could lead to a homeownership premium relative to renting a given unit.

In this paper, we provide what we believe are the first empirical estimates of the influence of hukou on price-to-rent multiples across Chinese housing markets. Our analysis shows that households are willing to pay premiums to own compared to renting. Our results suggest that the magnitude of the effect is on the order of 1-2 units in price-to-rent multiple. This impact certainly cannot account for Chinese cities' high multiples by international standards, but it is an economically meaningful effect. Our back-of-the-envelope calculation (discussed more fully later in the paper) indicates that a one-unit increase in average PRR among our 145 city sample in 2015 would be associated with about a 6.5 trillion yuan higher total housing stock value. That amounted to 9.5% of China's GDP in 2015. Separate evidence provided on the Beijing housing market

[4] See Gurney (1999), Dietz and Haurin (2003) and McCabe (2016), among others, for discussions on 'pride of ownership' in other major economies such as U.S.
[5] See Liu (2005), Chan and Buckingham (2008) and Zhang, Wang, and Lu (2019) (among others) for more institutional background on China's hukou system.

indicates a far higher value of hukou—up to 13 units in a higher price-to-rent ratio for that market (which is about 20% of the mean for the nation's capital). That the hukou system appears to make owning a given unit preferable to renting it because ownership is virtually a necessity if migrants to a city are to obtain hukou status that brings access to valuable publicly provided services has potentially important implications for policymakers considering reform of the hukou system in China. The indirect effects of hukou reform (e.g., through wealth effects) could be considerable if they end up lowering price-to-rent multiples as much as our initial findings suggest could occur.

The plan of the paper is as follows. Section II describes our new data in detail and reports summary statistics for the full sample and for markets outside the Tier 1 and Tier 2 cities. Section III then empirically estimates how hukou is related to price-to-rent ratios across different types of Chinese cities. That is followed in Section IV by a separate analysis of the Beijing market and the impact of access to high-quality local schools. There is a brief conclusion.

II. Data: Description and Analysis

II.A. Data Collection, Cleaning, and Variable Creation

The underlying data used in this paper were collected in collaboration with a leading real estate data vendor in China, GXD. Online listing information, including asking prices for housing unit sales and rental rates, was amassed by scraping the websites of as many residential communities as possible in each market. A community is a collection of residential buildings (typically high rise in nature) that functions as a

single entity. We worked with our data vendor to clean the files so as to eliminate replicates of a given unit's listing, as well as to eliminate cases of manipulated data.[6] After all data cleaning, we suspect that the sale listings are more accurate than the rental listing information. Hence, we require more rental listings per community for it to be included in the final sample used in this paper.[7]

For each community c, we then create a price-to-rent ratio in quarter t ($prr_{c,t}$) as defined in equation (1):

$$prr_{c,t} = \frac{median\ listing\ house\ price\ resale\ per\ square\ meter_{c,t}}{median\ listing\ house\ rental\ price\ per\ year\ per\ square\ meter_{c,t}} \quad (1)$$

The price-to-rent ratio at the city i level in quarter t then is defined as the median $prr_{c,t}$ across all communities within the relevant city as shown in equation (2):

$PRR_{i,t}$ = median $prr_{c,t}$ across communities in city i during quarter t. (2)

An obvious concern is whether price-to-rent ratios based on listing information reliably reflect actual housing market conditions. We are able to gauge data quality for a subset of 25 major cities using information from Lianjia, the largest housing

[6] Careful vetting of listings data like ours is important because of the nature of the Chinese sales and rental system. Presently, there are no multiple listing services (MLS) systems in China. Thus, real estate agents, acting on behalf of the seller, will circulate listing information on various real estate listing websites. This could cause two problems for us. First, the agent might choose to post the listing information on multiple websites or multiple times on the same website in order to attract more potential buyers. Unless removed, replicates of the same information could bias our measures of the price-to-rent ratio. Second, some agents might concoct eye-catching listing information such as units with listing prices well below market levels, in order to entice potential buyers. That is what we refer to as manipulated data. In this context, the procedures used by Anenberg and Laufer (2017) in the U.S. context to clean similar data are not sufficient. To address the issue of possible replicated data, we calculate the dissimilarity between any two pieces of listing information within the same complex, and merge the identical or very similar records into one record. With respect to manipulated data, we construct a hedonic model to identify the outliers. Wang, Li, and Wu (2020) provide more detail on the data cleaning procedures.

[7] We require ten rental listings versus only two sales listings per community. As described just below, we use the medians of these data series to create price-to-rent ratios, so taking the median of a larger sample should reduce any remaining noise from measurement error still left in the cleaned data.

brokerage company in China.[8] From that firm, city-level average transaction prices for both housing resales and rentals in 2018(4) were amassed in each of the 25 markets. We then computed a price-to-rent ratio for each market using the city-level average price in the numerator and the city-level average rent in the denominator. As Figure 2 shows, the listing-information-based and transaction-information-based PRR ratios are strongly positively correlated. It is more likely than not that the listing-information-based PRR is slightly lower than the corresponding transaction-information-based PRR (i.e., more dots are above the 45^{o} line than are below it). One likely reason is that compared with the rental units, the owner-occupied dwelling units tend to be concentrated in communities with higher quality. Thus, directly calculating a city-level PRR without first compiling the community-level PRRs may overestimate the multiples.

We report city-level price-to-rent ratios for 145 cities for which there were active listings for at least 50 communities in each quarter from 2015(1)-2020(3). Our sample of cities is spread throughout China, as indicated by Figure 1's map of places across China.[9] It includes many more cities than are in the typical lists of Tier 1 and Tier 2 markets. According to the latest available data from the 2010 Population Census, there were 465.6 million people living in these 145 urban areas, accounting for 69.5% of China's total urban population.

Figure 3 plots how the distribution of $PRR_{i,t}$ evolved over our nearly six-year time period, with summary statistics for this ratio being reported in the top panel of

[8] The 25 cities include Beijing, Changsha, Chengdu, Chongqing, Dalian, Dongguan, Foshan, Guangzhou, Haikou, Hangzhou, Hefei, Jinan, Langfang, Nanjing, Qingdao, Shanghai, Shenyang, Shenzhen, Shijiazhuang, Suzhou, Wuhan, Xiamen, Xi'an, Yantai, and Zhongshan.
[9] Appendix Table 1 lists the cities in alphabetical order.

Table 1. Panel A depicts the ratio for the full sample of cities. While price-to-rent multiples did decline slightly in 2015-2016 across our 145 markets, the trend tends to be positive since then. The 95th percentile market's PRR was 19% higher in 2020(3) than it was in 2015(1), while that for the 5th percentile market increased by 39%. Not only have listed housing price resale amounts as a multiple of listed rental rates risen over time, but these multiples are also high by most international comparisons. In recently reported U.S. data for 2018, of 84 cities with populations in excess of 250,000, only two had price-to-rent ratios above 40, and a typical city has prices that are no more than 20 times rent.[10]

A second and related stylized fact is that there is substantial variation across Chinese markets. The interquartile range across Chinese cities in 2015(1) ran from 23.5 to 35. By 2020(3), it ran from 30.6 to 46.3. Xiamen's and Beijing's price-to-rent ratios average in excess of 60 over this period, while that for Harbin barely averages 20. For all quarters, the maximum city-level PRR is 94, while the minimum is 13.

Panels B and C in Figure 3 then plot the price-to-rent ratio for 29 Tier1 and Tier 2 cities versus the other 116 markets that we label as Tier 3 and Tier 4 cities.[11] Summary statistics on select variables for each group are reported in the bottom panel of Table 1. Annual real housing price appreciation is higher in Tier 1 and Tier 2 cities

[10] These figures come from the smartasset™ web site which may be accessed at https://smartasset.com/mortgage/price-to-rent-ratio-in-us-cities. The two cities with prices more than forty times rent were San Francisco and Oakland, and they are in the same metropolitan area. Comparing prices to rents is much more problematic in the U.S. data. This is typically done by computing the ratio of median home sale price to median rent as reported in the U.S. Census. [That is what this web site does.] The owner-occupied and rental housing stocks are not very similar in the United States and the units often come from different parts of the market. Even with these caveats about comparability, there is no doubt that price-to-rent ratios are much lower in the U.S.

[11] We follow the market convention in China to define the city tiers in the housing market. The 29 Tier 1/Tier 2 cities are listed in Appendix Table 1.

as expected (10% versus 6.1% in Tier 3/Tier 4 cities). Variation in that growth also is higher, as indicated by the standard deviations about those means.

The plots show that the median PRR is greater in the Tier 1/Tier 2 markets, but the ratios still are not low (absolutely or by international standards) in the Tier3/Tier4 markets). During our sample period, the median PRR of the Tier 1/Tier 2 cities increases from 36 in 2015(1) to 41 in 2020(3), while the corresponding values are 28 and 38 for the Tier 3/Tier 4 cities. Second, and perhaps more interestingly, the PRRs are much more volatile in the Tier 1/Tier 2 cities, especially for cities with high PRRs. The upper quartile of PRR in the Tier 1/Tier 2 cities jumps from 39 in 2016(1) to the peak of 61 in 2016(4), and then gradually decreases to 49 at the end of our sample period. As for the 90% percentile of PRR, it surges from 49 at the beginning of 2016 to 81 in 2017(2), but drops to around 55 within two years.

II.B. A Simple Data Check: The Role of Past Growth in Cross-City PRR's

Because our data have not been used much in previous academic research, we begin by examining the simple relationship between past price appreciation and the price-to-rent ratio. Any model of asset value will predict a higher price-to-rent ratio the greater is expected house price appreciation in the market. Presuming that recent appreciation is positively correlated with expected growth today, we begin our study of these new data on price-to-rent multiples by documenting the relationship of past growth to current price-to-rent multiples.

For this purpose, we start with the previous four quarter's constant-quality housing price index growth in the city (*HPG_1Y*), with the price index calculated as in Wu, Deng, and Liu (2014), and presume it at least partially reflects market participants' expectations about the future. Our purpose is not to take a stand on the precise nature of expectations, but it is no surprise to find a strong positive relationship between this previous housing price change variable and the current city-level price-to-rent ratios.[12] Table 2 reports regression results using different specifications, while Appendix Figure 1 plots the results.

The results in the top panel of Table 2 use the full 145 city sample. Those from the first column are from a specification that does not include any time or city fixed effects. The coefficient of *HPG_1Y* (the real, constant quality appreciation rate from the previous four quarters) is significantly positive, although the overall explanatory power of the model is only about four percent. Column (2) then introduces time effects in the form of year-quarter dummies. This raises the R^2 to 0.13, with the impact of lagged price growth becoming even larger. Introducing city fixed effects in column (3) is much more consequential. Over 70% of the variation in PRR values across cities over time can be explained when city effects are included. Moreover, the coefficient on lagged housing price growth drops by over 50% from column (1).[13] The final column of Table 2 includes both city and time fixed effects. The coefficient on last year's price appreciation (*HPG_1Y*) remains positive and highly statistically significant.

[12] Much research into house prices from around the world finds a similarly strong positive correlation. See, for example, Verbrugge (2008); Lambertini, Mendicino, and Punzi (2013); Hill and Syed (2016).
[13] The interested reader can see the cities with the 20 highest and lowest city fixed effect coefficients listed in Appendix Table 2.

Its coefficient is only modestly lower compared to that in column (1), which includes no fixed effects. Given the summary statistics reported above in Table 1, the impact based on column (4)'s specification implies that a one standard deviation increase in (lagged) housing price growth is associated with a 1.79 unit higher price-to-rent multiple, which is just under a 5% increase in that multiple about the sample mean, or about 16% of a standard deviation of the multiple.[14]

Panels B and C of Table 2 report the analogous results for subsamples of Tier 1/Tier 2 cities and Tier 3/Tier4 cities. In each specification, especially that with city and time fixed effects (column (4)), the impact of lagged price growth on the current price-to-rent ratio is stronger in the subsample of the Tier 1/Tier 2 cities. Based on the results from column (4), a one standard deviation increase in (lagged) housing price growth is associated with a 3.4 unit higher price-to-rent multiple in the Tier 1/Tier 2 cities, which is about 24% of a standard deviation of the multiple; in contrast, a one standard deviation increase in *HPG_1Y* only leads to about a 1.1 unit higher price-to-rent multiple in the Tier 3/Tier 4 cities, or about 11% of a standard deviation of the multiple.

Table 3 sheds additional light on how price-to-rent ratios vary across markets. The first column includes an interaction of *HPG_1Y* with a 0-1 dummy for each city. We do not report those results for space reasons, but the data conclusively reject the

[14] This standardized marginal effect is computed by multiplying the 0.16 standard deviation in *HPG_1Y* (from Table 1) by the 11.17 estimated coefficient from column (4) of Table 2 (0.16*11.17=1.79). That 1.79 point change is 16% of the 11.48 standard deviation in PRR taken from Table 1 (1.79/11.48=0.16). This basic conclusion is unaffected if we aggregate the data to the year level and rerun the specifications on annual data.

null hypothesis that the coefficients on the interaction terms are the same. Moreover, lagged appreciation is statistically significantly positively correlated with the current price-to-rent ratio in only 35 of the 145 cities in the sample. Hence, there are many markets in China (smaller ones especially) in which lagged appreciation does not predict price-to-rent ratios.

Column (2)'s results are from a specification that groups markets into one of four categories. More specifically, we divide the full sample of cities by the magnitude of past price appreciation so that the 25% of markets with the lowest previous annual price growth (i.e., lower than 2%) are in quartile 1 (q1) and so forth. Thus, the variable *HPG_1Y_q2* equals one if the value of *HPG_1Y* falls in the second quartile (which includes markets with previous annual growth rates between 2% and 3%) from the bottom in the sample, and so on for *HPG_1Y_q3* and *HPG_1Y_q4* (with the breakpoint of 16% annual price growth between those two groups of cities). The bottom quartile is the omitted category in column (2)'s specification. The results indicate that recent price appreciation has a bigger impact on this quarter's price-to-rent ratio the higher last year's growth was, with the difference between the first and fourth quartiles being large economically, not just statistically.[15]

The remaining columns of Table 3 explore whether there is heterogeneity by the degree of longer-run housing price growth in a city's housing market. Here, we experiment with two proxies for that condition. One, log(*SUPPLY*), is borrowed from

[15] We also follow Harrell Jr (2015) to implement a spline regression to investigate the non-linearity in the short-term expectation's effect. The results are depicted in Appendix Figure 2. The pattern depicted is consistent with the regression results reported in Table 3.

Saiz (2010) in that it measures the amount of flat (i.e., non-steeply sloped) land in a market, normalized by city population. A city with more flat land is expected to have a more elastic supply of housing, all else constant. A second variable, termed log(*DEMAND*), is the straight distance between each city and the nearest of the three top harbors in China (Hong Kong, Shanghai, and Tianjin). Because several recent studies suggest that this time-invariant variable has considerable predictive power with respect to cities' long-term economic and population growth (Lu and Xiang 2016; Chen et al. 2019; Lu, Li, and Zhong 2019), we adopt it here as a proxy of long-term housing demand.

Column (3) of Table 3 reports the coefficients on interactions of log(*SUPPLY*) and log(*DEMAND*) with lagged growth. Both interaction terms are significant and negative, indicating that the impact of short-term, past growth on price-to-rent multiples is stronger if the land supply is less elastic and/or the long-run demand is stronger in the city. Column (4) then includes these two measures without interacting them with past price appreciation (while still conditioning on the strength of past price appreciation). The results from this column suggest that a ten-percent greater amount of flat land per capita is associated with about a 0.14 unit lower price-to-rent ratio. Being ten percent further away from a major port is associated with just over one-third of a unit lower price-to-rent ratio. Overall, columns (3) and (4) indicate that past growth

has at least modestly stronger effects on the price-to-rent ratio in Chinese markets with more inelastic supply sides and stronger long-run growth trends.[16]

In sum, our new price-to-rent data for an expanded set of Chinese housing markets are correlated in (mostly) sensible ways with variables that have been studied in the past. We now use these new data to study the impact of hukou on price-to-rent ratios in Chinese cities.

III. Is There a Hukou-Related Homeownership Premium in China?

A standard user cost model of homeownership posits a host of primarily financial variables that affect the all-in cost of an owner occupying the housing unit in which it resides. These include the mortgage interest rate, the opportunity cost of equity invested in the home maintenance and depreciation, a risk premium for having so much wealth tied up in a relatively illiquid undiversified asset, and expected appreciation (which lowers user costs, of course).

Our interest here is not to redo the classic user cost calculation using Chinese data, but to investigate whether there are non-pecuniary features of the Chinese environment such as those arising from the hukou system that affect price-to-rent multiples in an economically significant manner. This is potentially important on its face because the popular culture in China treats homeownership as a coveted good. For example, there is well-known literature on its value as a status good (e.g., see Wei and Zhang (2011) and Wei, Zhang, and Liu (2017)). For our purposes, hukou, the national

[16] That combination of restricted supply and strong long-run demand characterizes what Gyourko, Mayer, and Sinai (2013) call Superstar Cities. They show that such markets should have high price-to-rent multiples in equilibrium. Our results suggest something similar for China's elite housing markets.

registration system, effectively functions so as to link ownership (not rental) of a given housing unit with the ability to consume high-quality educational services in particular.[17] In the empirical analysis below, we use the "hukou registration index" constructed by Zhang, Wang, and Lu (2019). Their index quantitatively measures the stringency of local hukou qualifications based on a close reading of official local documents. We are able to obtain data for the 2014-2016 time period for 85 of our 145 cities. Specifications are then estimated to see whether a homeownership premium exists, as well as whether its magnitude differs depending on the relative strictness of local hukou regulations.

We experiment with a number of variables that proxy for the quality of educational services. One is the amount of city government-level fiscal expenditures on education (normalized by local GDP), which we label *EduShare*. A higher expenditure share on education is interpreted to imply higher quality of education, and thus a higher homeownership premium if the city is subject to a stricter hukou restriction.

It is reasonable to question whether the magnitude of *EduShare* is endogenous in our simple regression context, perhaps because a city government can increase its education expenditure if it collects more funding from taxation or/and land sales in a

[17] Hukou also provides access to other services such as social insurance. We focus on educational services for data availability reasons and because we know it is valued by households. The U.S. literature is long and distinguished on this point (e.g., see Kain & Quigley (1970), Figlio & Lucas (2004), and Imberman & Lovenheim (2106) among others). There is rich empirical evidence in China that education quality is one of the most important factors affecting individuals' long-term development, so it is not surprising that Chinese households tend to place a high value on educational services (Li et al. 2013; Chi and Qian 2016; Jia and Li 2021). This said, the bundled nature of what hukou provides means that most of our estimates cannot be used to back out values placed on education along.

hot housing market that itself is characterized by high price-to-rent ratios. To address such concerns, we use another variable--the count of public schools or *Shu Yuan*--in each city at the end of the Qing Dynasty (i.e., at the beginning of the 20th century). This variable is put in per capita terms. Because there are many cities with zero Shu Yuan in the last Chinese dynasty, we transform this into a categorical variable when using it in our regression analysis. More specifically, we create a 0-1 dummy labelled *ShuyuanMore,* which takes on a value of one for cities with *Shu Yuan* per capita values above the subsample median.

Table 4 reports results that regress the city level price-to-rent ratio on price appreciation over the previous four quarters (*HPG_1Y*), our individual educational service proxies, and interaction of those proxies with whether the underlying city has relatively strong or loose restrictions on granting hukou. This last term is a simple 0-1 dummy that divides the sample in half (i.e., those markets above the median value of the hukou index versus those below the median). The results using *EduShare* in column 1 indicate that having stricter hukou requirements is associated with about a 2.5 unit higher price-to-rent ratio.[18] The results using *ShuyuanMore* are similar, at about a 2 unit increase.[19] These results indicate the hukou is associated with higher price-to-rent ratios in markets where access to it is more strictly regulated, but not in cities where access to it is loosely regulated. This effect certainly does not account for high price-to-rent ratios in the subset of Chinese cities in which access to hukou is most carefully guarded. However, its impact on price-to-rent ratios looks to be on a par with or slightly

[18] This marginal effect is calculated as $\partial PRR/\partial EduShare$ = -0.143 + 2.673(if strict hukou=1), or 2.530.
[19] In this case, $\partial PRR/\partial ShuyuanMore$ = -3.646 + 5.688 (if strict hukou=1), or 2.042.

higher than that associated with recent price appreciation as documented in the previous section.[20]

Moreover, the price impact looks to be large in broader economic terms. A back-of-the-envelope calculation of the potential magnitude of the change in house values is as follows. According to recent data released by the National Bureau of Statistics, China (NBSC), the total housing stock in China contains around 26.65 billion square meters of floor area in our 145 sample cities.[21] According to our data, the average rental price in the same cities is 245.03 yuan per square meter per year in 2015. Thus, a one-unit increase in the average price-to-rent multiple would lead to an increase in total housing value of over 6.53 trillion yuan (26.65*245.03/1000=6.53). That is about 9.5% of China's GDP in the same year. This is an upper bound on the share of increased house value in Chinese GDP from a one-unit higher PRR because our results show the increase in multiple occurs in cities with stricter than typical hukou regulations. Those markets also tend to have the highest absolute house values and price-to-rent ratios. Counterbalancing this is the implication of our results that the impact on the price-to-rent ratio is two, not one, units higher. Thus, the impact of hukou looks to be

[20] It is not hard to imagine other nonfinancial factors that would lead to homeownership premiums. One is the scale of economic development in the city, as it could be that there is a greater preference for owning relative to renting the more economically advanced the market is. To address this possibility and to see whether it vitiated the impact of access to educational services via hukou, we created the (log) of GDP per capita (log(*PDGP*)) in each city and reestimated the specifications in Table 4. As expected, it is the case that price-to-rent ratios are higher on average in more economically developed markets. However, this does not change our results with respect to the education and hukou variables in a meaningful way. The same holds if we add a control for the share of minority (i.e., non-Han) population. Finally, the results hold if we further introduce the hukou index itself, log(*SUPPLY*), and log (*DEMAND*). Those results are available upon request.

[21] More precisely, NBSC does not directly report the volume of housing stock. Instead, it reports the per capita living space and the urban population for each city. We calculate the volume of housing stock by per capita living space * urban population.

meaningfully large in terms of the size of the Chinese economy. Naturally, this suggests that policy makers should be cognizant of potentially negative spillovers associated with any potential hukou reform.

While these results are highly suggestive that a statistically and economically meaningful homeownership premium associated with hukou exists in China (at least in the subset of markets with relatively strict rules about obtaining hukou), we understand that reasonable people will worry about the strength of causal identification. Hence, our next set of results addresses these worries with a quasi-natural experiment based on the opportunity to enter elite universities. This is followed in the next section with an examination of the value of access to education within the Beijing market.

In China, high school graduates need to take a college entrance exam (*gao kao*) to be admitted to a university. The exam is organized by the provincial-level government. This system functions as a way to rank all high school graduates within the province based on their exam scores, while each university allocates its admission quotas to each province. In almost all cases, a high school graduate can only choose to take the exam in the city (and so province) where his or her hukou dictates.[22]

There is no doubt that Chinese households have strong incentives to help their children enter elite universities, as the belief is widespread that this will enhance their children's futures.[23] However, the distribution of elite universities is highly unequal across different provinces, and an elite university typically allocates substantially more admission quota to test takers from its own province. Hence, there is substantial spatial

[22] See Jia and Li (2021), among others, for more details on China's *gao kao* exam.
[23] This is no different from most other countries. See Jia and Li (2021) for more on the Chinese context.

variation in the probability of entering elite universities. Since the probability is based on local hukou availability, our question is whether this shows up as a homeownership premium in price-to-rent ratios.

To help test for this potential effect, we utilize a policy shock in September of 2017 to the Chinese central government's elite university plan. The Chinese government first formally named elite universities in the late 1990s (e.g., the so-called "985 project" and "211 project."). If a university is included in such a list, it could obtain greater funding from central and local governments. In addition, its graduates typically are in a more advantageous position in the labor market. In September 2017, the central government issued a new elite university plan called the "Double First-Class" project, which abolished the lists associated with the "985 project" and the "211 project". According to the new ranking system, three of the 30 provinces (Henan, Yunan, and Xinjiang) have one more university included on the elite university list than before, while the list remains unchanged for the other 27 provinces. Thus, households with local hukou in these three provinces have a higher probability of getting their children into elite universities.

To determine whether this is capitalized in the price-to-rent ratios, we estimate a standard difference-in-differences specification. The treatment group (*TREAT* =1) includes cities in the three provinces with more elite universities after the policy shock, while the control group includes cities from all other provinces (*TREAT* =0 for them). The post-period (*POST* =1) covers all the quarters from 2017(3)-on. We also include city and quarter fixed effects, as well as *HPG_1Y* and *PGDP*.

The results are reported in Table 5. In column (1), we include the whole sample period between 2016(1) and 2020(3). The results show that, controlling for lagged appreciation and the economic size of the city, the price-to-rent multiple in the treatment cities increase by about 1.3 units, which is roughly 5% of the average price-to-rent ratios of the treatment group before the policy shock. In the second column of Table 5, we report results from a reduced sample that restricts observations to the (2016(4)-2019(3)) period around the time of the policy change.[24] The findings are qualitatively and quantitatively similar.

In sum, high price-to-rent ratios in Chinese cities are underpinned not just by high (and presumably expected) housing price appreciation rates, but also by the bidding up of ownership status in a way that is consistent with certain public services, the consumption of which requires hukou status, being valuable. This suggests that any hukou system reform undertaken to address inequality in public goods consumption across cities in China will also need to consider the implications of lower price-to-rent ratios that would result if our interpretation of these simple specifications is correct.

IV. Within-Market Analysis: The Case of Beijing

As a further robustness check on there being a homeownership premium that raises the price-to-rent ratio associated with the consumption of educational services, we next turn to an analysis of within-market variation that uses the detailed 1,590 community data amassed on the Beijing market. Figure 4 plots the time series on the

[24] The results of the parallel trend test are depicted in Appendix Figure 3. The trends of both the treatment and control groups are generally parallel before the policy shock.

distribution of price-to-rent ratios using these data. It is no surprise that prices are very high multiples of rent in the nation's capital. The mean value is about 60 across the full sample, with the median being just above 50 in the most recent quarter. It is not the case that price-to-rent ratios have risen on average across all or even most communities in the nation's capital. The median in 2019(3) is almost identical to the median ratio in 2015(1). However, the figure does show they have trended up since 2015 at the 75th percentile of the distribution and above, while ratios are down for those below the median.

Trying to gauge the impact of differences in educational service quality across communities within a given housing market requires different controls and a new measure of educational service quality at the local level. Table 6 provides definitions of all variables used in this particular analysis, in addition to summary statistics on them. Past price growth (*HPG_PB*) and the price-to-rent ratio (*PRR*) are computed as described above, but at the community level here, not the city level. Other controls include measures of the floor-to-area ratio in the community (*FAR*), green space in the community (*GREEN*), the size of the floor area of the entire community complex (*FLOORAREA*), the property fee associated with living in the community (*PROPERTYFEE*), the number of housing units in the community (*HOUSENUM*), and the age of the community (*HOUSE_YEAR*).

Our educational service flow proxy reflects whether households living in a given community have the right to enter an elite primary school as determined by a national ranking (*IF_SCHOOL=1*). Here, we use the list of Top 500 Primary Schools

as complied by DC Data Center in China. According to that list, 12 of the top 100 schools are located in the Beijing market. Only 1-in-50 communities are located in areas served by these dozen elite schools.

Table 7 then reports results from a single specification that regresses community *PRR* on its previous year's price appreciation, the school quality measure, and all other controls. These results include time and building type fixed effects.[25] As expected, past price growth strongly predicts a higher price-to-rent ratio in the community. Using the summary statistics reported in Table 6, a one standard deviation higher past growth rate is associated with a 6.7 units higher price-to-rent ratio. That is just over 40% of the 16.1 units standard deviation in community-level PRRs across Beijing, so this standardized impact is much larger in the nation's capital than for the nation as a whole.

While many of the community-level controls are statistically significant, we focus our attention here on the education quality service flow proxy. Its coefficient is highly statistically significant. This variable is a 0-1 dummy, which takes a value of 1 if you live in a community that provides access to one of the twelve elite primary schools for your child. The coefficient value of 13.2 is the marginal effect of going from a community that does not provide this access to one that does. That impact is nearly 82% of a standard deviation change in Beijing's price-to-rent ratio. Thus, the impact is very large economically.

V. Summary and Conclusions

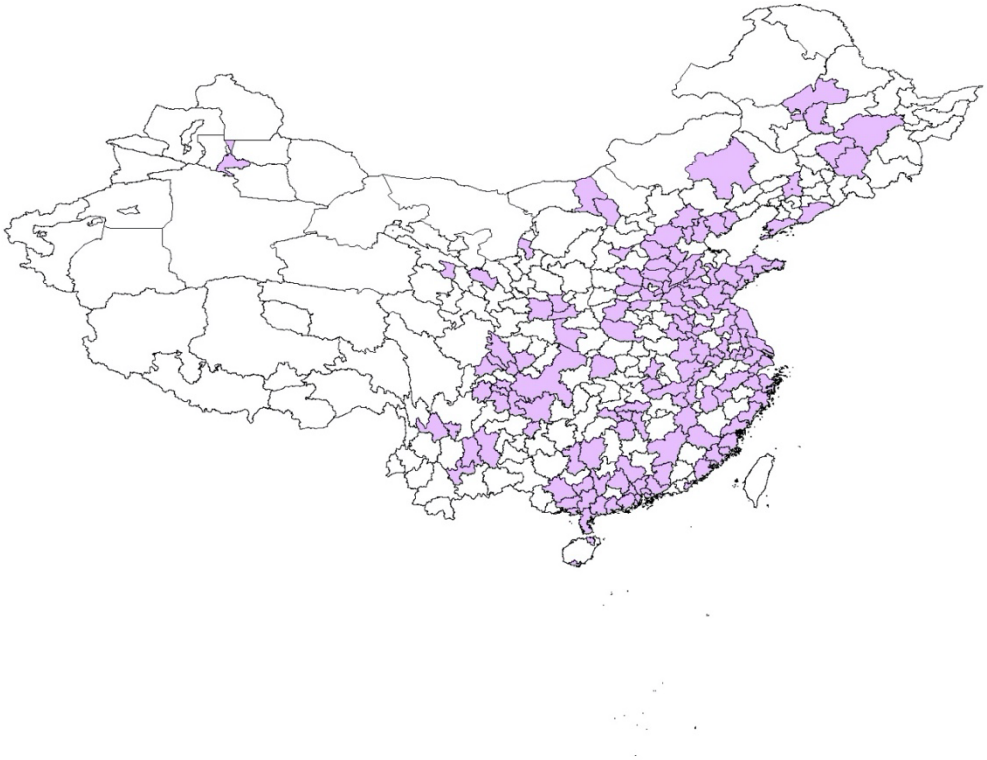
[25] The building type fixed effects distinguish buildings with different ranges of floor levels.

We amass new data on price-to-rent ratios created from web-based sales and rental listings data across many thousands of residential communities in 145 Chinese cities. Presently, these data span a six-year period from 2015-2020. More detailed information for Beijing is available through 2019(3). Listings information has been shown to be highly correlated with actual transaction data (on average) in a dozen large markets. That is encouraging as this data source can be accessed and verified independently, but caution remains in order about data quality in any smaller markets throughout China. These data show extensive heterogeneity in price-to-rent multiples across Chinese housing markets and a generally upward trend in ratios since 2015. Multiples are quite high by international standards.

As expected, some simple regression analysis indicates that price-to-rent ratios are high in a market because housing price appreciation has been high (and probably is expected to continue to be so). If these new data did not confirm an important role for growth in price-to-rent multiples, we would be much more suspicious of it. More interesting is the relation between the quality of publicly provided education services and the price-to-rent ratio. This finding is consistent with the value of owning being bid up relative to the value of renting in order to obtain hukou and gain access to those public services. The standardized marginal impacts of our educational service proxies are nearly as large as those for past price growth for the nation as a whole, and they are much larger for markets with stringent hukou regulations. The impact of being located in a complex that permits attendance at a very high-quality primary school in Beijing is very large. Controlling for recent appreciations, that location is worth nearly a full

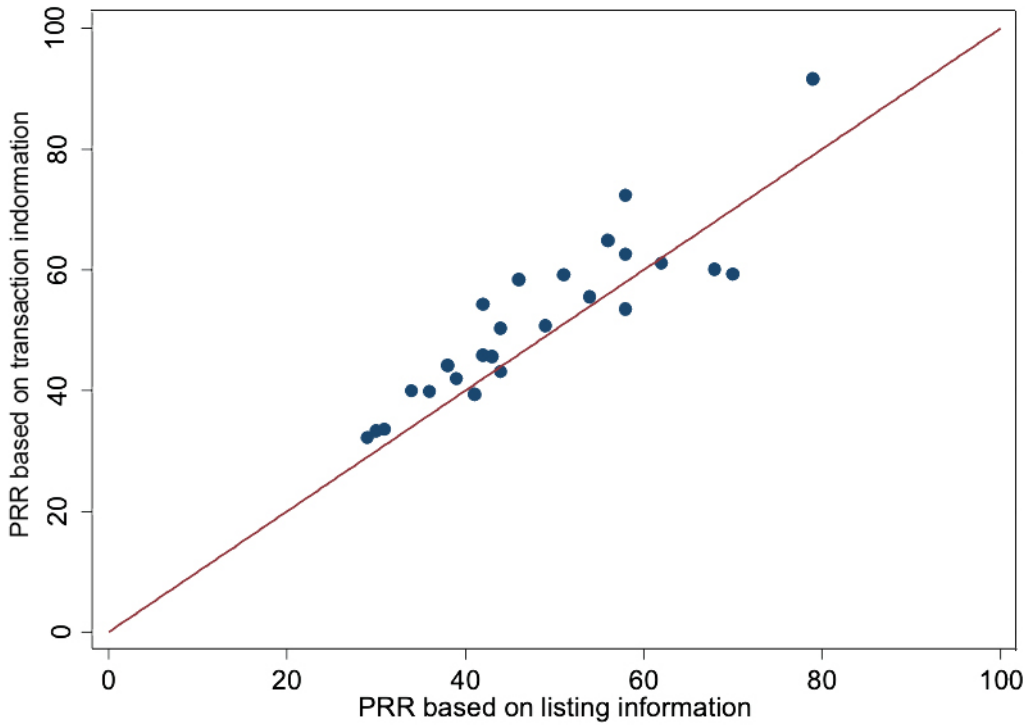
standard deviation in the higher price-to-rent ratio in the nation's capital. In addition to confirming that non-pecuniary factors can play meaningful roles in explaining price-to-rent multiples, our results also have important implications for policymakers considering the reformation of China's hukou system. The system, which is known to contribute to inequality, also contributes to house value throughout the country. The price impact of changing or eliminating hukou should be included in any reform plans.

Figure 1: Map of 145 Sample Cities Across China



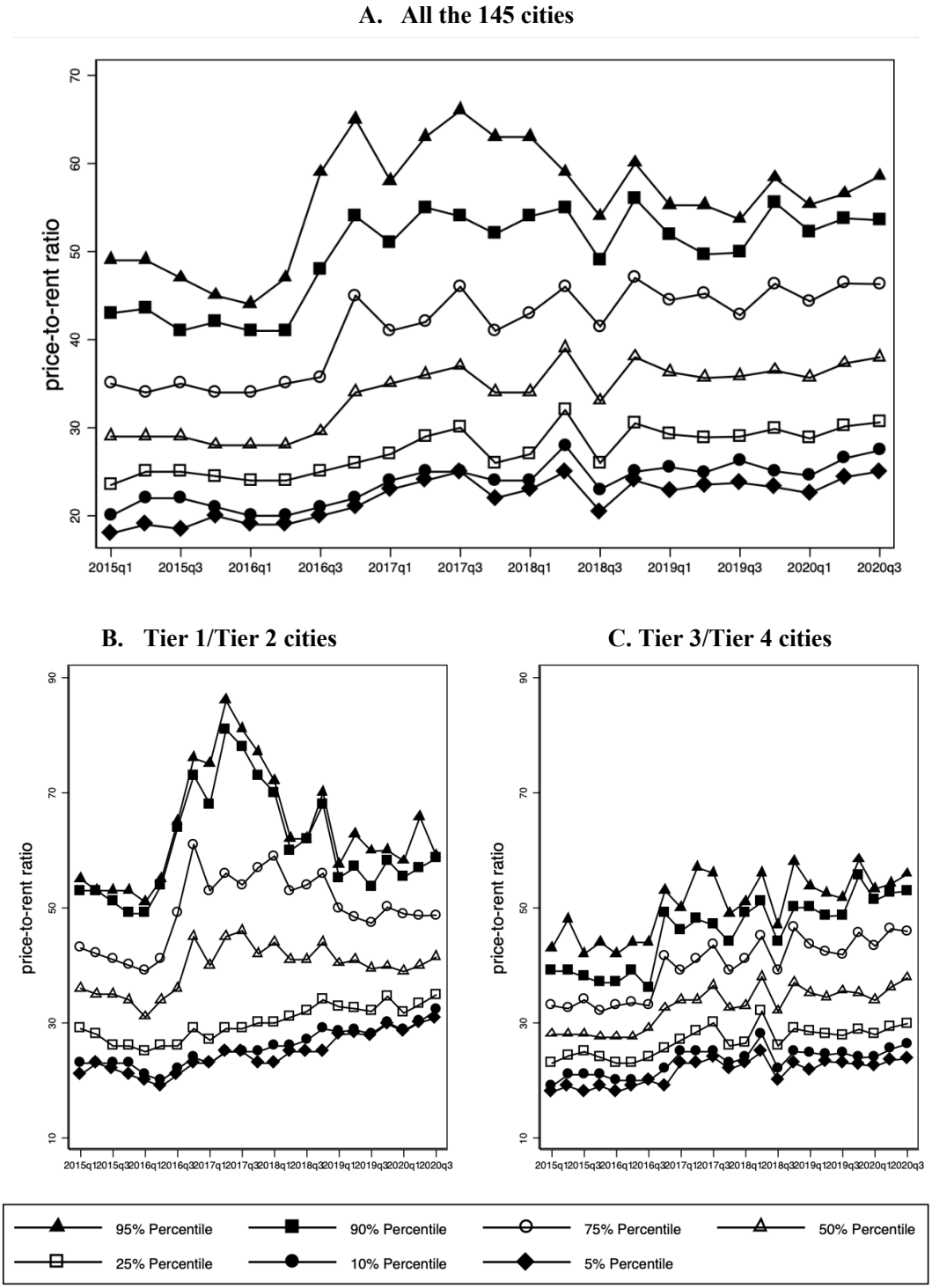
Note. This figure shows the location of the 145 sample cities.

Figure 2: Listing versus transaction price-to-rent ratios in 25 selected markets



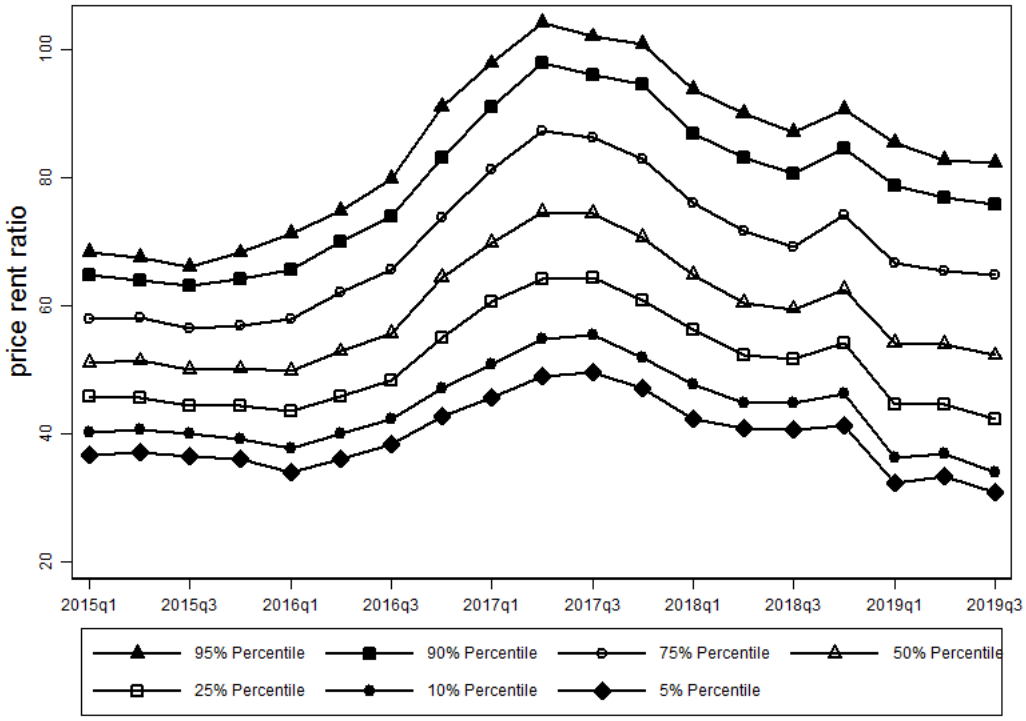
Note: See the text for more details. The 25 cities include Beijing, Changsha, Chengdu, Chongqing, Dalian, Dongguan, Foshan, Guangzhou, Haikou, Hangzhou, Hefei, Jinan, Langfang, Nanjing, Qingdao, Shanghai, Shenyang, Shenzhen, Shijiazhuang, Suzhou, Wuhan, Xiamen, Xi'an, Yantai, and Zhongshan.

Figure 3: Trend of price-to-rent ratio in 145 cities, 2015(1)-2020(3)



Note. This figure shows the percentile distribution of price-to-rent ratios in 145 cities from 2015(1) to 2020(3).

Figure 4: Trend of community-level price-to-rent ratio in Beijing (2015(1)-2019(3))



Note. This figure shows the percentile distribution of complex-level price-to-rent ratios in Beijing from 2015(1) to 2019(3).

Table 1: Summary statistics (145 cities, 2016(1)-2020(3))

Panel A: Quarterly-variant variables

Variable	Definition	Obs	Mean	Std. Dev.	Min	Max
PRR	The median value of project-level price-to-rent ratios in the city-quarter, winsorized at 1% by quarter	2,705	36.62	11.48	13	94
HPG_1Y	The cumulative growth rate of constant-quality housing price index during the previous 12 months of the city-quarter, winsorized at 1% by quarter	2,755	0.070	0.16	-0.28	0.81

Panel B: Yearly-variant variables

Variable	Definition	Obs	Mean	Std. Dev.	Min	Max
PGDP	Gross Domestic Product per capita of the city in the last year (in yuan)	709	80121.89	35964.88	19807.99	203489.09

Panel C: Time-invariant variables

Variable	Definition	Obs	Mean	Std. Dev.	Min	Max
Supply	The total area (in km^2) of flat land standardized by the population in this city	135	1385.18	1573.17	112.38	13346.89
Distance	The distance (in km) from the city center to the nearest port (i.e., Beijing, Shanghai, and Hong Kong; the distance for these port cities is defined as 1 km)	145	552.55	400.52	1	2569.34
EduShare	The proportion of education expenditure in the gross domestic product; in %.	84	2.27	0.99	0.81	5.23
ShuyuanMore	Dummy for whether the number of *Shuyuan* in Qing dynasty standardized by city-level population (in million) is high (i.e., higher than the median value of 2.64 among cities whose hukou index is available)	85	2.55	3.17	0	20.6

Panel D: Quarterly-variant variables, by tiers

Variable	Definition	Tier 1/Tier 2 cities					Tier 3/Tier 4 cities				
		Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
PRR	The median value of project-level price-to-rent ratios in the city-quarter, winsorized at 1% by quarter	551	42.26	14.08	16	94	2,154	35.18	10.244	13	94
HPG_1Y	The cumulative growth rate of constant-quality housing price index during the previous 12 months of the city-quarter, winsorized at 1% by quarter	551	0.10	0.21	-0.28	0.81	2,204	0.061	0.15	-0.28	0.81

Table 2: Effect of previous housing price growth on price-to-rent ratio

VARIABLES	(1) *PRR*	(2) *PRR*	(3) *PRR*	(4) *PRR*
Panel A: All the 145 cities				
HPG_1Y	14.36***	25.65***	6.914***	11.17***
	(1.818)	(2.638)	(0.938)	(1.350)
Observations	2,705	2,705	2,705	2,705
R-squared	0.042	0.133	0.716	0.784
Panel B: Tier 1/Tier 2 cities				
HPG_1Y	16.66***	25.58***	12.43***	16.00***
	(3.224)	(4.993)	(1.473)	(1.809)
Observations	551	551	551	551
R-squared	0.063	0.127	0.803	0.855
Panel C: Tier 3/Tier 4 cities				
HPG_1Y	10.72***	21.97***	3.930***	7.453***
	(2.029)	(3.193)	(1.175)	(1.957)
Observations	2,154	2,154	2,154	2,154
R-squared	0.024	0.136	0.651	0.740
City FE	NO	NO	YES	YES
Year by quarter FE	NO	YES	NO	YES

Note. This table reports results on the effect of previous housing price growth on the price-to-rent ratio. The sample covers 145 cities during 2016(1) and 2020(3) in Panel A, 29 Tier 1/Tier 2 cities in Panel B, and the other cities in Panel C. We control for quarter and city fixed effects separately in column (2) and column (3), and both in column (4). Robust standard errors are used in all the regressions. * indicates significance at the 0.1 level; ** indicates significance at the 0.05 level; *** indicates significance at the 0.01 level.

Table 3: Variation of the effect of expectation on price-to-rent ratio

VARIABLES	(1) *PRR*	(2) *PRR*	(3) *PRR*	(4) *PRR*
HPG_1Y	-	-20.25***	53.54***	-28.21***
	-	(4.548)	(8.266)	(5.408)
*HPG_1Y * HPG_1Y_q2*	-	4.219	13.91	95.08***
	-	(15.04)	(16.26)	(25.07)
*HPG_1Y * HPG_1Y_q3*	-	9.110*	16.63***	52.06***
	-	(4.857)	(5.083)	(8.533)
*HPG_1Y * HPG_1Y_q4*	-	15.57***	22.23***	54.93***
	-	(3.420)	(3.607)	(6.203)
HPG_1Y * log(*SUPPLY*)	-		-7.050***	
	-		(1.308)	
HPG_1Y * log(*DISTANCE*)	-		-2.699***	
	-		(0.639)	
log(*SUPPLY*)				-1.374***
				(0.311)
log(*DISTANCE*)				-3.578***
				(0.184)
Observations	2,705	2,705	2,519	2,519
R-squared	0.836	0.805	0.798	0.350
City FE	YES	YES	YES	NO
Year by quarter FE	YES	YES	YES	YES
City-specific expectation	YES	NO	NO	NO

Note. This table presents the variation of the effect of previous housing price growth on the price-to-rent ratio. In column (1), we introduce the interaction terms between housing price growth and each city dummy. In column (2), we consider the nonlinear effect by controlling for the interaction terms between previous housing price growth and the dummies indicating the higher three quartiles of previous housing price growth, with the lowest quartile as the default group. In column (3), we further consider the effect of longer-run housing market conditions by adding the interaction terms between the previous housing price growth terms and the time-invariant proxies of housing supply (*SUPPLY* in logarithm) and demand (*DISTANCE* in logarithm), respectively. In column (4), we replace the interaction terms between *HPG_1Y* and log(*SUPPLY*) or log(*DEMAND*) with log(*SUPPLY*) or log(*DEMAND*). Robust standard errors are used in all the regressions. * indicates significance at the 0.1 level; ** indicates significance at the 0.05 level; *** indicates significance at the 0.01 level.

Table 4. The effect of homeownership premium on price-to-rent ratio

VARIABLES	(1) *PRR*	(2) *PRR*
HPG_1Y	21.04***	21.97***
	(2.859)	(3.077)
EduShare	-0.143	
	(0.263)	
ShuyuanMore		-3.646***
		(0.601)
*strictHK * EduShare*	2.673***	
	(0.275)	
*strictHK * ShuyuanMore*		5.688***
		(0.682)
Observations	1,577	1,595
R-squared	0.185	0.149
City FE	NO	NO
Year by quarter FE	YES	YES

Note. This table presents the effect of ownership premium on the price-to-rent ratio. In all columns, we construct a subsample of 85 cities to study the effect of hukou, based on the hukou registration index obtained from Zhang, Wang, and Lu (2019). In both columns, we control for the previous housing price growth and the year-by-quarter fixed effects. We use the dummy for Hukou index, which equals one for cities with strict hukou restrictions. In column (1), we introduce the interaction variable between Hukou index dummy and local governments' education expenditures, normalized by local GDP (*EduShare*). In column (2), we introduce the interaction variable between Hukou index dummy and the dummy variable for Shu Yuan in Qing Dynasty, normalized by the local population (*ShuyuanMore*). Robust standard errors are used in all the regressions. * indicates significance at the 0.1 level; ** indicates significance at the 0.05 level; *** indicates significance at the 0.01 level.

Table 5. The effect of "Double First-Class" university project on price-to-rent ratio

VARIABLES	(1) 2016(1)-2020(3) *PRR*	(2) 2016(4)-2019(3) *PRR*
*TREAT * POST*	1.308**	1.762**
	(0.666)	(0.822)
HPG_1Y	11.55***	12.70***
	(1.380)	(1.385)
ln(*PGDP*)	0.789	2.524
	(1.011)	(2.226)
Observations	2,643	1,786
R-squared	0.786	0.806
City FE	YES	YES
Year by quarter FE	YES	YES

Note. This table presents the results of the difference-in-differences model. Column (1) uses the full sample from 2016(1) to 2020(3), while column (2) only includes the four quarters before the policy and eight quarters after the policy (i.e., from 2016(4) to 2019(3)). *POST* equals one after 2017(3) (i.e., the Chinese government released the "double first-class" university list), and zero otherwise. *TREAT* equals one if the number of "double first-class" universities in this province is more than the number of "211 universities," and zero otherwise. In both columns, we control for city fixed effects and year-by-quarter fixed effects. Robust standard errors are used in all the regressions. * indicates significance at the 0.1 level; ** indicates significance at the 0.05 level; *** indicates significance at the 0.01 level.

Table 6: Summary statistics of community-level variables in Beijing (2015(1)-2019(3))

Panel A: Data of price-to-rent ratio

Variable	Definition	Obs	Mean	Std. Dev.	Min	Max
PRR	The median value of project-level price-to-rent ratios in the community-quarter, winsorized at 1% by quarter	30210	60.38	16.06	24.580	115.74
HPG_PB	The cumulative growth rate of listing housing price index during the previous 12 months in the community, winsorized at 1% by quarter	23850	0.20	0.27	-0.24	1.21

Panel B: Data of community properties

Variable	Definition	Obs	Mean	Std. Dev.	Min	Max
FAR	Floor area ratio of the community (in %)	1588	2.673	1.38	0.2	13.78
GREEN	Green space ratio of the community (in %)	1578	33.11	7.16	10	80
FLOORAREA	The total floor area of the community (in sq.m.)	1588	182226.7	208334.8	3928.09	5000000
PROPERTYFEE	Property management fee of the community (in yuan/month/sq.m)	1584	1.74	1.65	0	20
HOUSENUM	Total number of dwelling units in the community	1590	1620.10	1223.35	72	13031
HOUSE_YEAR	Age of the community, equaling 2016 minus the year of the community completed	1588	18.04	10.73	0	64
IF_SCHOOL	Whether the households in the community have rights to enter one of the 100 best primary schools (source: 500 Top Primary Schools, including 12 primary schools in Beijing; 1 = yes, 0 = o/w)	1590	0.094	0.29	0	1

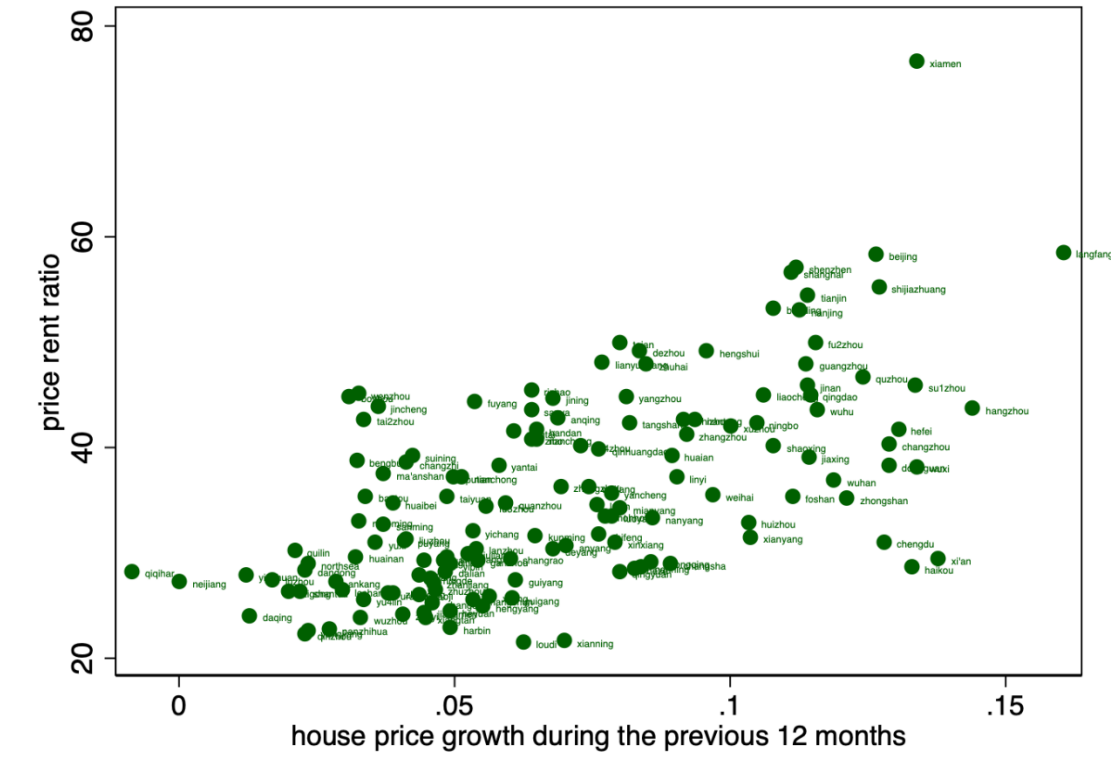
Note. This table reports the summary statistics of the community-level listing data in Beijing, used in Table 7.

Table 7. The effect of community premium on price-to-rent ratio: the case of Beijing

VARIABLES	(1) *PRR*	(2) *PRR*	(3) *PRR*	(4) *PRR*	(5) *PRR*	(6) *PRR*
HPG_PB	22.57***	25.37***	22.11***	23.17***	25.24***	26.02***
	(0.379)	(0.783)	(0.242)	(0.438)	(0.784)	(0.756)
FAR					-0.615***	-0.735***
					(0.0763)	(0.0736)
GREEN					-0.0201	-0.0228*
					(0.0134)	(0.0129)
FLOORAREA					1.73e-07	1.14e-06**
					(5.75e-07)	(5.55e-07)
PROPERTYFEE					0.0158	-0.192***
					(0.0658)	(0.0637)
HOUSE_NUM					-0.00124***	-0.00125***
					(9.85e-05)	(9.49e-05)
HOUSE_YEAR					0.105***	0.0206**
					(0.00948)	(0.00935)
IF_SCHOOL						13.17***
						(0.312)
Observations	23,850	23,850	23,850	23,850	23,520	23,520
R-squared	0.129	0.254	0.674	0.798	0.273	0.324
Community FE	NO	NO	YES	YES	NO	NO
Year-Quarter FE	NO	YES	NO	YES	YES	YES
Build type FE	NO	NO	NO	NO	YES	YES

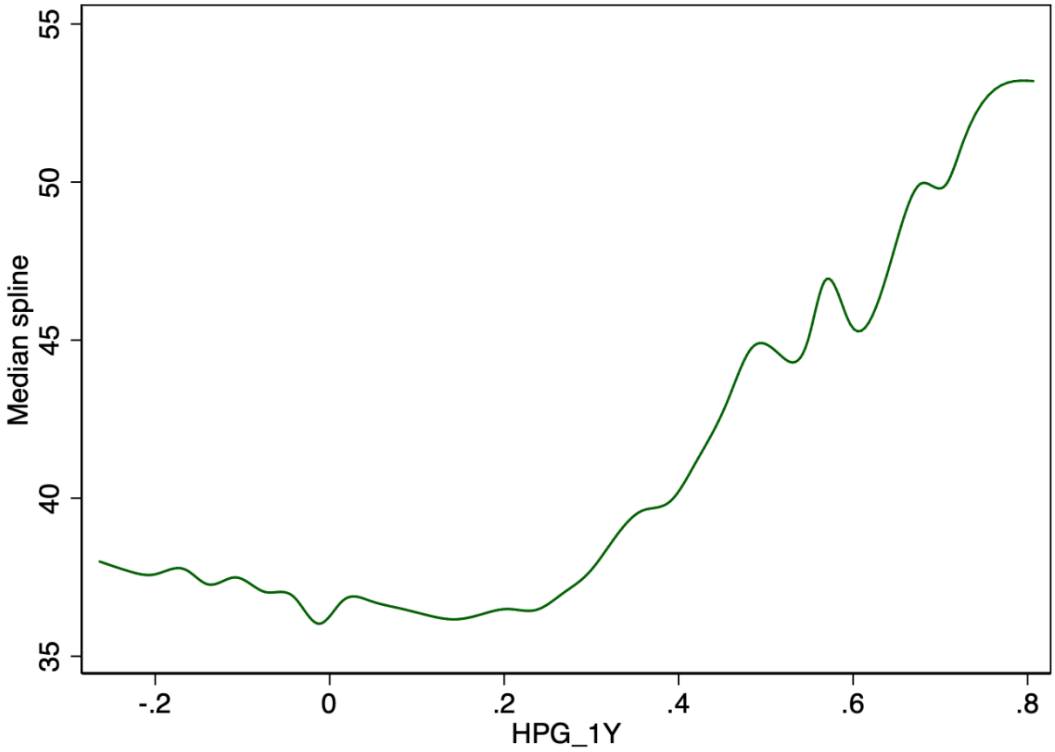
Note. This table reports results on the effect of previous housing price growth on price-to-rent ratio using the micro-level listing data in Beijing. The sample covers 1590 communities in Beijing during 2016(1) and 2019(3). We control for quarter and community fixed effects separately in column (2) and column (3), and both in column (4). In column (5), we control for community-level attributes. In column (6), we further control for the school district attribute. Robust standard errors are used in all the regressions. * indicates significance at the 0.1 level; ** indicates significance at the 0.05 level; *** indicates significance at the 0.01 level.

Appendix Figure 1: Pictorial relationship between the current price-to-rent ratio and the previous year's housing price changes



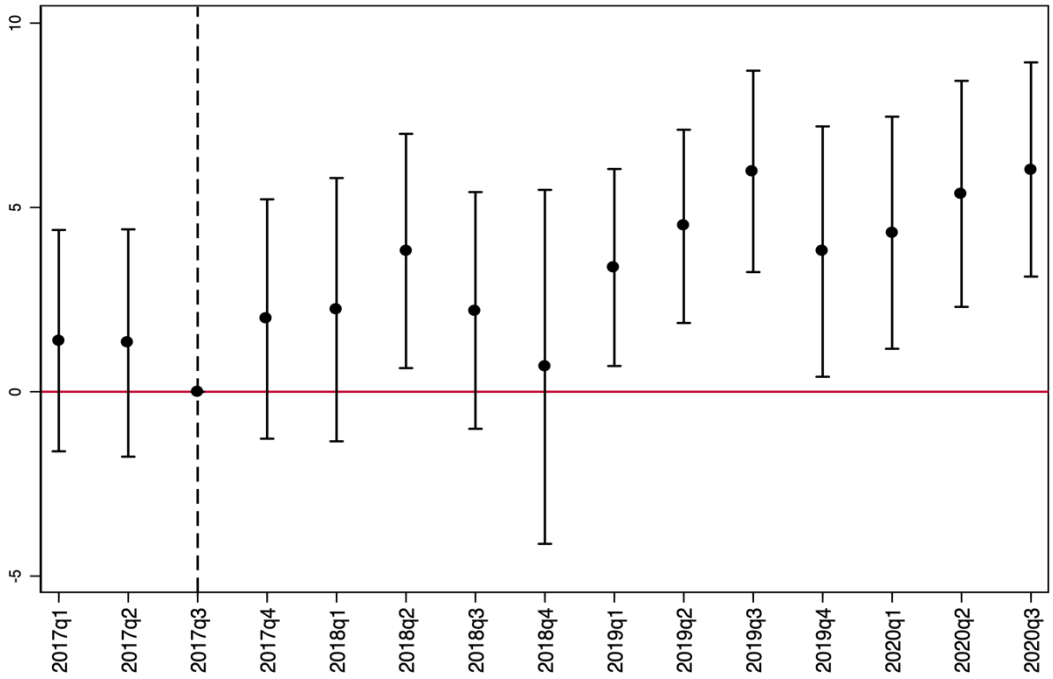
Note. This figure shows the relationship between the average price-to-rent ratio and average previous housing price changes of 145 cities.

Appendix Figure 2: Spline Regression



Note. This figure shows the predicted value of PRR given by the spline regression based on Column (4) of Table 2. We perform the regression of *PRR* against a restricted cubic spline function of *HPG_1Y* with five knots chosen according to Harrell Jr (2015)'s recommended percentiles.

Appendix Figure 3: Parallel Trend Test



Note. This figure tests the parallel trend of difference-in-differences identification in column (1) of Table 5. The default period is 2016(1) to 2016(4). The pre-policy period is two quarters before 2017(4). The dashed line denotes the implementation date of the "double first-class" policy.

Appendix Table 1: 145 Cities List

Chinese	English	Chinese	English	Chinese	English	Chinese	English
安康*	Ankang*	衡水	Hengshui	南阳	Nanyang	威海*	Weihai*
安庆	Anqing	衡阳	Hengyang	内江	Neijiang	温州*	Wenzhou*
安阳	Anyang	河源	Heyuan	宁波#*	Ningbo*	武汉#*	Wuhan*
保定	Baoding	菏泽*	Heze*	宁德	Ningde	芜湖*	Wuhu*
宝鸡*	Baoji*	呼和浩特*	Hohhot*	北海*	Northsea*	无锡*	Wuxi*
包头*	Baotou*	淮安	Huaian	攀枝花	Panzhihua	梧州	Wuzhou
北京#*	Beijing#*	淮北	Huaibei	莆田	Putian	西安#*	Xi'An*
蚌埠*	Bengbu*	淮南*	Huainan*	濮阳	Puyang	厦门#*	Xiamen*
亳州*	Bozhou*	惠州*	Huizhou*	青岛#*	Qingdao*	湘潭	Xiangtan
长春*	Changchun*	江门*	Jiangmen*	清远	Qingyuan	咸宁	Xianning
长沙#*	Changsha*	嘉兴*	Jiaxing*	秦皇岛	Qinhuangdao	咸阳*	Xianyang*
长治	Changzhi	吉林*	Jilin*	钦州*	Qinzhou*	邢台*	Xingtai*
常州*	Changzhou*	济南#*	Jinan*	齐齐哈尔	Qiqihar	西宁*	Xining*
成都#*	Chengdu*	晋城*	Jincheng*	泉州	Quanzhou	新乡	Xinxiang
赤峰*	Chifeng*	济宁	Jining	曲靖	Qujing	徐州*	Xuzhou*
池州	Chizhou	九江	Jiujiang	衢州*	Quzhou*	盐城	Yancheng
重庆#*	Chongqing*	昆明#*	Kunming*	日照*	Rizhao*	阳江	Yangjiang
大连#*	Dalian*	廊坊	Langfang	三明	Sanming	扬州	Yangzhou
丹东*	Dandong*	兰州	Lanzhou	三亚*	Sanya*	烟台*	Yantai*
大庆	Daqing	乐山*	Leshan*	上海#*	Shanghai#*	宜宾	Yibin
德阳	Deyang	连云港	Lianyungang	商丘	Shangqiu	宜昌*	Yichang*
德州*	Dezhou**	聊城*	Liaocheng*	上饶	Shangrao	银川*	Yinchuan*
东莞*	Dongguan*	丽江	Lijiang	汕头*	Shantou*	玉林*	YuLin*
佛山*	Foshan*	临沂	Linyi	绍兴	Shaoxing	玉溪	Yuxi
福州#*	Fu2Zhou*	柳州*	Liuzhou*	沈阳#*	Shenyang*	漳州	Zhangzhou
抚州	Fu3Zhou	娄底	Loudi	深圳#*	Shenzhen#*	湛江*	Zhanjiang*
阜阳*	Fuyang*	六安*	Lu'An*	石家庄#*	Shijiazhuang*	肇庆	Zhaoqing
赣州	Ganzhou	洛阳	Luoyang	苏州#*	Su1Zhou*	郑州#*	Zhengzhou*
广州#*	Guangzhou#*	泸州	Luzhou	遂宁	Suining	中山*	Zhongshan*
贵港*	Guigang*	马鞍山*	Ma'Anshan*	台州*	Tai2Zhou*	珠海*	Zhuhai*
桂林	Guilin	茂名*	Maoming*	泰州*	Tai4Zhou*	株洲*	Zhuzhou*
贵阳	Guiyang	绵阳	Mianyang	泰安	Taian	淄博*	Zibo*
海口#*	Haikou*	南昌#*	Nanchang**	太原*	Taiyuan*	自贡	Zigong
邯郸	Handan	南充	Nanchong	唐山	Tangshan	遵义	Zunyi
杭州#*	Hangzhou*	南京#*	Nanjing*	天津#*	Tianjin*		
哈尔滨#*	Harbin*	南宁#*	Nanning*	乌鲁木齐*	Urumqi*		
合肥#*	Hefei*	南通*	Nantong*	潍坊*	Weifang*		

Note. This table lists the Chinese names and corresponding English names of the 145 cities. We label the Tier 1/Tier 2 cities with #, and highlight those cities whose hukou indexes are available with *.

Appendix Table 2: Ranking of city fixed effect coefficients

20 Lowest Cities			20 Highest Cities		
City name	City name (Chinese)	Coefficient	City name	City name (Chinese)	Coefficient
xianning	咸宁市	-36.4577	sanya	三亚市	-12.3929
loudi	娄底市	-35.8363	quzhou	衢州市	-12.3844
yangjiang	阳江市	-35.7402	liaocheng	聊城市	-11.9228
qinzhou	钦州市	-35.3739	su1zhou	苏州市	-11.3633
panzhihua	攀枝花市	-34.7652	jinan	济南市	-11.1869
harbin	哈尔滨市	-34.577	guangzhou	广州市	-9.84432
zunyi	遵义市	-34.5002	taian	泰安市	-9.17752
wuzhou	梧州市	-34.3848	zhuhai	珠海市	-8.75393
xiangtan	湘潭市	-33.8289	dezhou	德州市	-8.49889
jiangmen	江门市	-33.8284	hengshui	衡水市	-6.4568
heyuan	河源市	-33.7545	fu2zhou	福州市	-6.27948
daqing	大庆市	-33.5034	nanjing	南京市	-6.0394
hengyang	衡阳市	-33.0681	tianjin	天津市	-3.43057
baoji	宝鸡市	-32.9412	baoding	保定市	-2.81552
yulin	玉林市	-32.8564	shijiazhuang	石家庄市	-0.90169
guigang	贵港市	-32.8016	shanghai	上海市	-0.42537
shantou	汕头市	-32.7614	beijing	北京市	0
changchun	长春市	-32.6609	shenzhen	深圳市	0.709249
urumqi	乌鲁木齐市	-32.6287	langfang	廊坊市	4.019131
xining	西宁市	-32.2326	xiamen	厦门市	10.88954

Note. This table lists the coefficients of city fixed effects based on column (3) of Table 2, with Beijing as the default group.

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