Property Right Uncertainty, Prices, and Speculation: Evidence from China's Housing Market*

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Abstract

We study the causal impact of property right uncertainty on prices and speculative activities in the housing market. We exploit a unique feature of residential housing markets in the Chinese city of Shenzhen, where otherwise comparable housing units with different property right protections are located adjacent to each other. Some have full property rights (FPR) protection with a 70-year leasehold while others only have limited property right (LPR) protections. Using detailed data of listings for sales, we show that sales market values property right protections, but the rental market does not. Our estimates suggest that the market perceives that the chance that property right of the FPR might be in doubt at the end of their 70-year leasehold ranges from 7% to 21%, and that there is more than 50% chance that the LPR may not receive any legal protection in any future year. We also provide evidence that housing units with LPR protections are more prone to speculative activities measured by turnover rates and price volatility. Finally, we find that a public release of the new urban planning codes increases the listing prices and reduces the turnover rates and price volatility of the LPR properties relative to their matched FPR counterparts.

Keywords: Property Rights, Housing Prices, Speculative Activities, Urban Planning Codes.
JEL Classification: G11; G12; R30

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1 Introduction

The role of well-defined property rights in efficient resource allocation is well understood by economists since Coase (1960). There is also ample empirical evidence of the first-order effect of property rights institutions on long-term economic growth, investment, and financial development (e.g., Acemoglu et al., 2001; Johnson et al., 2002; Acemoglu and Johnson, 2005; Galiani and Schargrodsky, 2010, among others). A lack of formal property rights on land is found to impede the use of land as collateral to access the financial markets (Besley, 1995) and the transformation of wealth owned by the poor into capital (De Soto, 2000). These insights lead to a global consensus on the importance of formalizing property rights, particularly in the adoption of land titling programs in developing countries.

In this paper, we study the causal impact of imperfect property rights on housing on the prices and speculative activities in the Chinese housing market. While the Chinese economy is now ranked second in the world in overall size, it is generally recognized that it still lacks strong formal private property rights protection, and thus offers a fertile testing ground to study the impact of property rights protections on important economic issues. Second, and very unique to China, is that the dual property rights coexist in its housing markets. While full property rights (FPR) takes the predominant form, with its urban owners entitled to use, possess, collateralize, and dispose of property during a 70-year lease, a significant proportion of housing stock in the country lacks land titling by the central and municipal governments; that is, land with limited property rights (LPR) can only be transacted within its local cooperative society or village committee. We exploit a unique feature of residential housing markets in the Chinese city of Shenzhen, where otherwise comparable housing units with different property right protections can be *adjacent* to each other. By examining the effect of different property rights on individual listing price as well as market volatility, we aim to shed some light on the role of imperfect property right arrangement in a housing market that has experienced rapid appreciations over a long period of time.

In a simple asset price model with dual property rights, the price differential between otherwise identical properties but with different property rights protection captures the present value of cash flow differentials due to a number of uncertainty factors: market liquidity, lack of collateralization opportunities in borrowing, contractual frictions, and uncertainty associated with the lack of mandatory compensation in the case of involuntary demolition. We also study the effect of the public release – for the first time in the city history – of the urban planning codes of individual communities as a policy intervention that reduces property right uncertainties, particularly for LPR communities.

Our empirical analysis is made possible by the availability of a unique building census that surveys the characteristics of every community in Shenzhen, one of country's four top-tier cities. The data indicate whether the community and all its units are developed with LPR or FPR, as well as other useful information about community amenities. We match the data to all listings in the city from 2015 to 2017, compiled from multiple listing platforms. Since properties with LPR cannot be transacted in the open market and are thus not recorded by any municipal or central

government, no transaction data are available for LPR properties, nor are they included in any home price calculations. Therefore, the price we observe is the seller's listing price, not the final sale price, and the market we study is overlooked by government statistics and academic literature. Just like data from multiple listing services (MLS) in the United States, our listing data contain detailed property characteristics such as location and structural attributes that determine property value.

First, we estimate the relative prices or long-term discount rates of property rights by comparing the prices of otherwise similar LPR and FPR units. To make sure these properties are identical in all observable characteristics, we first match each LPR community in the sample with its nearest FPR community based on geographic proximity, the most important factor in the price equation. We use hedonic regression techniques to control for matched pairs of communities as fixed effects to compare only properties listed at the same month within matched pairs. We also control for a full menu of unit- and community-level attributes that could affect housing consumption values. We find that prices of the FPR properties are approximately three times that of otherwise identical LPR units. Based on our pricing formula, our estimates suggest that the market perceives that the chance that property right of the FPR might be in doubt at the end of their 70-year leasehold ranges from 7% to 21%, and that there is more than 50% chance that the LPR may not receive any legal protection in any future year. Interestingly, we do not find any statistically significant differences in the placebo outcome of monthly rents, suggesting that the relative price of property rights does not capture any heterogeneity that would affect the consumption value of the home.

We then use the government's public release of the urban planning codes in November 2016 as a natural experiment on how public information release may reduce the property right uncertainty. We find that following the public release of the new codes, the relative price of LPR units increases significantly, by approximately nine percent relative to the estimated price discount. We do not find any effect on rent levels, our placebo outcome. We also conduct a falsification test based on hypothetical event dates other than the release of new codes, confirming the effect is not caused by other confounding factors.

We further evaluate the effect of property right uncertainty on speculative activities as measured by turnover rate and price volatility at community level, as well as how the policy interventions – the public release of the urban planning codes – affects such activities. We estimate that the turnover rate in FPR neighborhoods is 27 lower than in matched LPR neighborhoods, but following the public release of the new urban planning codes, the relative turnover rate of LPR properties decreased by about a half. Similarly, price volatility is about 24% lower in FPR neighborhoods than in matched LPR counterparts, but following the public release of the urban planning codes, the volatility difference is reduced by about 15-20%. The results suggest that an important contributor to the speculative activities in the Chinese housing market may be the property right uncertainty that is associated with the LPR properties, as well as the FPR properties after the end of their 70-year leaseholds.

Overall, our findings suggest that a significant portion of the value of residential properties in China's housing market comes from different rights entitling the homeowner to use, collateralize

and dispose of the property. Uncertainty associated with imperfect property rights protection leads to significantly more speculative activities in the market. Given that even FPR provides far less from full protection in China, the aggregate effect of property rights protection on the market could be much greater than our estimates. More importantly, our results suggest the issue can be, at least partially, addressed by the government acting as a clearing house. By eliminating the uncertainty as well as possible frictions in the LPR market, the entire market could benefit from less speculative activities.

Our analysis of the relative price of property rights is closely related to the analysis of Giglio, Maggiori, and Stroebel (2015) and He et al. (2020). Giglio, Maggiori, and Stroebel (2015) estimate the price discount of leaseholds with maturities ranging from 99 to 999 years relative to perpetual ownership contracts in freeholds in residential housing markets in the United Kingdom and Singapore, and they use these price discounts to infer about the long-run discount rates. We study a different but unique feature that only exists in China's residential housing markets: dual property rights and uncertainty about the property rights protections. Unlike Singapore and UK, in China all properties take the form of leaseholds, and land is owned by either the state or collective societies. The differences in dual property rights lie not simply in the residual cash flows after the expiration of the leasehold, but in different entitlements to transact, collateralize, possible frictions, and receive compensation from the government. He et al. (2020) empirically analyze the pricing of political uncertainty in long-term property rights in Hong Kong's housing market. They identify exposure to political uncertainty by exploiting a unique variation around land lease extension protection beyond 2047 when the current government is set to expire due to the historical arrangements under the "One Country, Two Systems" design. The property right uncertainty associated with FPR and LPR units in mainland China are distinct from the political uncertainty associate with the leaseholds in Hong Kong.

Our study joins a growing microeconomics literature that explores the pathways through which particular institutions influence investment or productivity (e.g., Besley, 1995; Goldstein and Udry, 2008; Galiani and Schargrodsky, 2010). By identifying the role of government regulations on the relative price of property rights as well as market activities, our findings also contribute to the literature that studies the factors that cultivate asset price bubbles. For example, Dow and Han (2014) predict that incomplete contracts and managerial agency problems can make intermediaries take excessive risks to exploit limited liability, bidding up risky asset prices.

The remainder of the paper is structured as follows. In Section 2, we provide the institutional background on property rights for housing in China; in Section 3, we describe our data sources and present the summary statistics; in Section 4, we provide a simple asset-pricing model of how property rights may affect housing prices and speculative activities, and use these theoretical predictions as a guide for our empirical design; in Section 5, we present our empirical results on property rights and housing prices; in Section 6, we describe our results on property rights and speculative activities; and finally, in Section 7, we conclude.

2 Institutional Background

2.1 Property Rights for Land and Housing in China

Brief History. From the founding of the People's Republic of China in 1949 up until early 1990s, all urban land and residential housing units in China were owned by the government. Residential housing units were allocated to individuals through the state or state-owned enterprises (SOE), and there was no market for housing transactions. The sector started to change in the 1990s, as China introduced a series of reforms to establish a housing market. First, in early 1990s existing residents were offered the opportunity to purchase housing units from their state or SOE employers at below-market prices; and then from mid-1990s private developers were allowed to purchase land parcels from the government to build commercial residential properties.[1]

According to the Urban Real Estate Administration Law passed in 1994, the housing property rights in China include the right for the structure and land use rights (LUR). The units built on the legally obtained land shall be entitled to use, possess, and dispose of the property, as well as the right to use the house as collateral to borrow from banks (i.e., FPR) for 70 years from the date of the land purchase. Those built on non-legally obtained land are only entitled to the right to use and possess but not that to dispose of or collateralize it (i.e., LPR). Unlike FPR homes, LPR ones are not guaranteed to be protected in case of government-ordered demolitions or legal disputes.

Supply and Demand for LPR Housing Units. The simultaneous presence of the FPR and LPR housing units appears to be a unique Chinese phenomenon. There are both the supply- and demand-side reasons for the dual systems. First, the Constitution has long instituted a dual-track system of land ownership: all urban land belongs to the state and rural land belongs to farmers' cooperative societies and village committees. Laws enacted in early 1990s allowed urban land to be legally obtained for private development. However, rural land can only be used for cultivation or for building villagers' own homes, but not be legally obtained for commercial development or resale on the market. Thus, LPR housing units arise when the rural land is developed without legally-obtained proofs, thus only recognized by the cooperative society, but not by the government or court.

Second, China has experienced massive urbanization in recent decades, with its urbanization rate jumping from 26% to 50% from 1990 to 2010, and a total of 372 million people shifting from rural to urban residents (National Bureau of Statistics of China, 2015). This was primarily achieved through the outward expansion of urban boundaries (Wang, Zhang, and Zhou, 2016). While the expansion typically required the previously collectively owned rural land being transferred to the city government for resale and for future development, it also allowed cooperative societies and individual villagers to develop on their own, thus creating the supply of LPR housing units.

[1] The Chinese housing market took off from 1998 when the People's Bank of China introduced residential mortgages in the housing purchases (Fang et al., 2015). The housing reform greatly increased the home ownership rates in China, which is now among one of the highest in the world (Wang, 2012).

Although the contracts signed in the LPR transactions will not stand in any court as a legal ownership proof, LPR houses have met enormous demand for urban dwellings unleashed by the rapid urbanization. First, the LPR units present a relatively affordable solution to new migrants to cities as the FPR ones have become increasingly unaffordable in many parts of the country after years of rapid appreciation.[2] As we will show in Section 3.3, LPR housing units are on average priced at about one-third of otherwise comparable FPR properties in nearby neighborhoods. Second, many cities have implemented various housing purchase restrictions (HPR) on both the new supply and existing purchase of FPR housing units to curb potential overheating[3], making LPR units a viable dwelling and investment alternative for non-local residents.

Legal Implications. It is estimated that LPR housing units account for about 20% of China's total housing stock (National Bureau of Statistics of China, 2013). The fraction is even higher in newer cities such as Shenzhen. Of the two legal documents (i.e., structure and land permits) that authenticate the property ownership, the buyer of an LPR property obtains only the structure permit issued by the municipal government, but not the land permit. Thus, the transaction of LPR units to members outside of the village cooperative is legally prohibited. There is no legal recognition of ownership, and thus no legal protection when the housing unit is transferred to a buyer who is not a village member.

The legal differences have several other implications. First, because LPR purchases/sales are not legally sanctioned, buyers and sellers of LPR properties can avoid paying transaction-related taxes levied on FPR transactions, which can amount to 10% of the sale price. Second, as we mentioned previously, the transactions of LPR properties are not subject to any HPR policies. Third, buyers of LPR properties are not allowed to use the properties as collateral to take out mortgages or tap the housing provident fund, a government insurance fund available to home buyers. Fourth, the owners of LPR properties who do not belong to the village committee are not necessarily guaranteed access to amenities such as public schools. Fifth and most importantly, while FPR property owners are entitled to compensation by the government in the case of government-mandated demolition and acquisition, this is not the case for LPR property owners.[4]

2.2 What is Unique About Shenzhen?

Although LPR housing units are present in almost all cities in China, the city of Shenzhen is uniquely suited for our empirical analysis for several reasons.

[2]Fang et al. (2015) find that FPR housing prices had an average annual real growth rate of 13.1% in the four first-tier cities during the period of 2003 to 2013.

[3]For example, the HPR implemented in Shenzhen allows a local household to purchase at most two FPR units and a non-local households to purchase FPR units after at least paying one year of local taxes.

[4]Since the legal ownership of the land for the LPR properties still belong to the village committee, any government compensation for the demolition and acquisition will be provided to the village committee, but there is no guarantee that LPR property owner who is not a village member will receive the full amount of compensation from the village committee.

First, Shenzhen is unique in that FPR and LPR housing units are co-located. This is in striking contrast with other cities in China where the LPR properties are only found outside the fringe of the city boundary. This unique nature of co-mingled FPR and LPR housing units in Shenzhen is a result of the city's history. It was only incorporated in 1979 when it was designated by the People's Congress in 1980 as a special zone for experimenting with then-Chinese leader Deng Xiaoping's Reform and Open policies. The area that was today's Shenzhen was all rural before 1979, and essentially the entire housing market in Shenzhen has been transformed from rural to urban land, except that the transformation was not complete for historical reasons. As the municipal government takes time to complete the land acquisition – a process ongoing in the past three decades – many adjacent lands are still owned by villagers. Figure 1 shows the distribution of FPR and LPR properties in Shenzhen, illustrating that LPR and FPR housing properties are co-located. In Section 3.2 we will describe our empirical procedure to create matched pairs of LPR and FPR properties based on the nearest neighbor procedure.

[Figure 1 About Here]

Second, Shenzhen is the ideal laboratory to explore the effect of property rights on the housing market because it conducted a *building census* in 2015, the first of its kind in China. The availability of the data allows us to know precisely whether apartment complexes are FPR or LPR and other characteristics of the housing units. Third, in Shenzhen LPR housing units account for a significant share (as high as 60%) of the city's total housing stock, one of the highest among all cities.[5]

3 Data and Descriptive Statistics

In this section, we describe the data sources used in the empirical analysis, and present some descriptive statistics.

3.1 Data Sets

Listing Data. Our main data source is the listing records from January 2015 through December 2017 that cover LPR and FPR flats in Shenzhen. This contrasts with other studies on China's housing markets, which primarily use housing transaction or deed data (see, e.g., Fang et al., 2015). The reason for us to use listing data as the primary data source is that because of their illegal nature, LPR housing unis are not legally permitted in open housing transactions, and as a result the transactions are not recorded in any official government data sets. However, the LPR housing units are still listed on listing platforms. We exclude any record that contains invalid data

[5]The 20% of the housing stock at the national level and the 60% in Shenzhen include more than just LPR homes. Other homes also lack complete property rights, with, for example, (1) villagers building more units or extra floors on the lot allocated for their personal use and potentially selling or renting extra space on the private market and (2) SOE or military or other non-state organizations develop properties on land allocated to them in the past.

values for prices, location, and property characteristics. Duplicate listings of the same property on multiple platforms also exist; we remove simultaneous duplicate listings. Finally, all listings with a price above RMB 100 million or below RMB 10,000 are excluded from our analysis sample.

Similar to MLS in U.S., Chinese listing platforms generally act as clearinghouses through which the realtors in each market advertise properties for sale. Some platforms specialize in listing LPR housing units, while others specialize in listing FPR housing units. The information contained in the Chinese listing platforms is very similar to that collected by MLS. We scraped listings of both LPR and FPR housing units from the largest listing platforms to form our sample. Thus our sample provides nearly complete coverage of listings during the period, regardless of whether the house is eventually sold. These data contain detailed information about properties on the market, such as their exact location (including the community name), detailed housing characteristics, the initial listing price, and the listing date.[6] Each listing also includes an average rent in the listing month in the community where the unit is located, which we use below in our analysis on how property rights affect rents.

Transaction Data. Our second data source is a relatively small random sample of transaction records of FPR housing units from January 2015 through December 2017 in Shenzhen. Compared to listing data, this data contains the final price transacted between a willing buyer and seller. The transaction data is recorded by the local government as part of the settlement process.[7] The sample contains 13,316 FPR transactions.

Building Census Data. Our analysis requires that we identify the exact type of property rights for individual properties. This is made possible by an anonymous real estate data vendor who, sponsored by the municipal government, conducted a housing census in 2015. The census covers all 4,615 gated communities, or complexes, within the jurisdiction of Shenzhen and surveys a broad range of questions about complexes, including their exact property rights. In what follows, we use the terms *community* and *complex* interchangeably throughout the text.

We first clean up the building census data by dropping communities that were built before 1980 and those with missing property rights information, leaving 3,822 communities in our sample. Of these, 3,173 (or 86.2 percent) communities have FPR, 430 (or 11.7 percent) have LPR, and another 219 have other types of partial property rights protection (other).[8] Using the community name

[6]Compared to MLS data, our listing data lack information on the number of days the unit is the market, and whether and when the listing is under contract. Thus we are unable to explore the sale outcomes. We also do not have information on realtors.

[7]However, during our sample period, the government has taken aggressive measures to curb the overheating of the real estate market, one of which being to place mandatory ceilings on developers' pre-sale price. This measure results in so-called "dual contracts" in practice to circumvent the price control, in which nominal contract price submitted to government deeds is significantly lower than actual contract price, thus making the transaction data from government records highly inaccurate. We are able to obtain a sample of transaction records with actual contract prices from one of the leading brokerage firms in Shenzhen.

[8]The "other" category includes 26 that are owned by governments, 37 by the military, 15 by SOE, and 141 by other unspecified entities.

in the listing data, we identify the exact property rights type for the vast majority of the listings. Our final listing sample contains 570,458 listings that are located in the matched pairs of FPR and LPR communities in Shenzhen spanning the period of January 2015 to December 2017.

Besides property rights, the building census data also contain information on other community characteristics, including the total land area, the green area ratio, the community property management fee, the total floor area, the floor area ratio (FAR), the number of buildings, the number of units (or flats), the number of floors, the year the community was built, the community name, and its exact location which allows geocoding.[9] The green area ratio is one of the most important housing amenities in Shenzhen, given the city's low housing supply price elasticity (Wang, Chan, and Xu, 2012). Community property management fees are a good indicator of quality, since communities with higher fees tend to offer more services. The number of buildings and the number of units can capture a size effect, with larger communities carrying greater liquidity. Using the exact location, we can calculate the distance to the city's central business district (CBD) as an additional amenity measure and identify the number of LPR flats nearby as a measure of clustering.

Urban Planning Codes. The fourth data source used in our analysis is Shenzhen's 2016–2020 urban planning codes, which contain different demolition codes assigned at community level. Similar information is unavailable for Shenzhen prior to 2016 or for other cities in China.

Despite the marketization reform, China has largely maintained its tradition of a five-year planning process at both national and local levels for public resource prioritization and budget planning. Shenzhen started its five-year urban planning as early as 2006. However, its first two five-year urban planning codes (e.g., 2006–2010 and 2011–2015) focused primarily on increasing city's housing supply to accommodate the population growth. In the 2011–2015 planning cycle, the municipal government also identified a list of communities for planned demolition. However, neither the specific community names nor the map had ever been made available to the public during that period, making it impossible for researchers to obtain exact information.

On November 21, 2016, Shenzhen's Planning and Land Resources Commission released an official version of its 2016–2020 urban planning codes, including both the text and maps. The text contains the exact demolition code at the community level, the first time in the city's history that such details had been made available to the general public. As anticipated, the new zoning codes had immediately attracted widespread attention and became the subject of discussion among city residents and the local media. Since FPR unit owners, but not LPR unit owners, are entitled to full compensation by the government in case of demolition, this creates a unique setting to study the effect of the new regulation, which may reduce the property rights uncertainty, on the housing market outcomes.

[9] Brueckner et al. (2017) measure the FAR as a major form of land use regulation and building height restriction in China. They find great variation in the stringency of FAR regulation across Chinese cities and their single-city estimation for Beijing shows that stringency varies with site characteristics.

3.2 Nearest Neighbor Matching among Communities

Our first empirical challenge is that the LPR and FPR properties can be fundamentally different in terms of location and other unit- and community-level amenities (e.g., access to schools and points of major interests). We use a number of measures to ensure that the properties in the two market segments are comparable based on observable characteristics. Our first step is to create matched pairs using the nearest neighbor matching algorithm. Instead of propensity score matching, which would consider a set of characteristics, we focus exclusively on location, the most important factor in determining home prices, more so in China.

We match each LPR community with its nearest FPR community as follows: (1) Each LPR community is matched with its nearest FPR community, and if there is no FPR community within a one-kilometer radius, then this LPR community is not included in this step; (2) if one FPR community is matched with two or more LPR communities, only the pair with the shortest geographic distance is retained and the other LPR communities are rematched with their next nearest FPR communities; and (3) if an LPR community could not be matched with any FPR community in the preceding steps, it can be added to the matched pair that contains its nearest FPR community, even if the distance exceeds one kilometer. The matching process produces a total of 338 pairs of communities, including 335 FPR and 392 LPR communities. This is the main restriction that is used to define our base sample.

In addition to the base sample, we also use a supplemental sample that is restricted to FPR communities to estimate the price discount of different remaining leaseholds in FPR units, which is a necessary input in estimating the relative price of LPR. Although all housing units in China have 70 years of leasehold from the date of land acquisition, each unit has different remaining leaseholds at the time of sale. To make sure that communities with longer remaining leaseholds are similar to those with shorter remaining leaseholds, we separate all 1,176 FPR communities that were completed after 2000 into two groups: 345 communities that are in the bottom quartile of remaining leasehold (i.e., $\leq$ 54 years in January 2015) and the rest that contains 831 FPR communities. For each of the communities in the low-leasehold group, we match the nearest neighbor from the second group following three criteria: (1) distance between the two $\leq$ 1 kilometer; (2) difference in building ages $\leq$ 5 years; and (3) if there are multiple communities matched, we choose the one with the closest building age. The supplemental sample contains 297 matched pairs of FPR communities.

3.3 Summary Statistics

Table 1 reports statistics based on the overall listing sample as well as the subsamples split by property rights. Among 570,458 listings, about half, or 295,234, are LPR listings. We have no information on the buyers or the ultimate sale outcome of the LPR listings. Nevertheless, the listing data provide useful information on the striking differences between properties under different property rights. First, the average listing price of LPR flats is RMB 8,958 per square meter, about 30% of the RMB 30,623 for FPR listings. For a typical unit of 100 square meters (equivalent to 1,076 square feet), the price difference is RMB 1.7 million, or $255,000 (assuming an exchange rate

of $1 = RMB 6.8), about the median home price listed in the United States in 2018. Given the median income of Chinese households is only a fraction of that of US households,[10] the numbers reflect the relative lack of affordability of the housing market in China. We can also calculate the price-to-rent ratio, a naive measure commonly used to gauge home affordability. Overall, the average rent-to-price ratio is 2.6% in our sample, suggesting renting is much more economically appealing than buying. However, monthly rents per square meter are RMB 36 for LPR flats, which is about 77% of the RMB 47 asked for their FPR counterparts, and much more comparable relative to price deifferntials.

[Table 1 About Here]

The differences in property characteristics, including unit and community characteristics, are rather limited, suggesting that our matching logic results in very similar properties. The mean unit floor area is 100 square feet for LPR units and 157 square feet for FPR units. However, their medians are both 88 square feet, suggesting that the two units are very similar overall, with some extreme values in FPR units. Consistently, the numbers of bedrooms, living rooms, and bathrooms are similar between LPR and FPR flats, with means of 2.8, 1.9, and 1.4, respectively. Two other important unit characteristics in the Chinese housing market are the direction the unit faces and the construction quality. The former directly relates to exposure to sunlight, as well as the views of the individual unit. The latter is costly, since premium renovation can easily add another 10% to 50% of the purchase price. Unlike the United States and other Western countries, the original condition of new construction in China is very raw, all requiring some degree of renovation before becoming move-in ready. In our sample, facing south seems to be the most common feature and most units therefore receive some direct sunlight. The vast majority of properties have gone through a simple average renovation at the time of listing, since most are existing home sales. In our sample, only about 1% of the properties were listed new by developers and about 10% of the homes were constructed within three years at the time of listing. The distribution of these characteristics is very similar between homes with different property rights.

Regarding community characteristics, the average lot size is 41,000 square meters, with LPR lots 14% smaller than FPR lots. The total floor areas in developments are 112,000 square meters, on average, implying an average FAR of 2.9. On average, the FAR is 2.8 for LPR lots and 2.0 for FPR lots, suggesting local governments do not discriminate between LPR and FPR developments. LPR communities have less green space than FPR communities, with an average green ratio of 28%, relative to 37% for their FPR counterparts. That difference reflects the greater number of units developed from smaller lots in LPR communities. The average number of units is 969 in LPR communities, 133 more than for their FPR counterparts. The average age of the communities is around 10 years for both LPR and FPR communities.

The summary statistics do not condition on geographic location or listing time. Since the composition of the listings could distort the comparison between property rights, Figure 2 plots the

[10]The median household income in the U.S. is $60,309, whereas a close measure in China, the per capita income of urban households, was only $4,944 in 2016.

residuals of a regression of each hedonic characteristic on the interaction of matched community pairs and listing months. Within each pair of matched communities and properties listed at the same month, we find little systematic difference in these observable characteristics across property rights. Regarding the number of units, LPR communities tend to have slightly fewer units built compared to their immediate FPR neighbors.

[Figure 2 About Here]

In Table A1 of online appendix, we report summary statistics of main variables contained in the supplemental sample that contains listings and properties of matched FPR units. It shows that while characteristics of units and communities appear similar between the high- vs low-leasehold properties, the average price of high-leasehold units is lower than the low-leasehold units before controlling for any of property characteristics in the multivariate setting.

4 A Simple Model and Empirical Design

In this section, we first present a simple pricing model for houses with full and limited property rights, which we use as the basis of our empirical designs.

4.1 A Model

Matched Pairs of FPR Units. We first consider a matched pair of FPR units that are otherwise identical, except for the age of the units. Let us denote the current age of the FPR unit as A_F, where the subscript "F" stands for FPR. Since FPR units have a 70-year leasehold, thus an FPR unit of age A_F has $70 - A_F$ remaining years of full property right protection; we assume, however, that after $70 - A_F$ years, i.e., after the end of the 70-year leasehold, the FPR units also face uncertainty in the property right protection.[11]

Assume that the flow (rent) value received from the matched FPR units are identical and normalized to 1, provided that there is no property right uncertainty. We capture the uncertainty of property rights by assuming that, after the end of the 70-year leasehold, there is a $\gamma_F \in [0, 1]$ probability that the flow value will continue, and with probability $1 - \gamma_F$, the flow value will drop to zero; or equivalently, the property right uncertainty leads to a discount of the flow value received from the property. One can interpret γ_F as reflecting the uncertainty about how the government will handle the renewal of leaseholds after the initial 70-year leasehold ends.

We assume that the fundamental value of an FPR unit is equal to the present value of the expected discounted flow value a buyer can receive from the property. Let r denote the household's

[11] The 70-year leasehold starts from the time when developer acquired from the local government the land on which the FPR units are build, not when the home buyer purchases the unit.

discount rate. We can write the price of FPR unit with age A_F, denoted by p_F, as follows:

$$P_F(A_F) = \int_0^{70-A_F} e^{-rt}dt + \int_{70-A_F}^{\infty} \gamma_F e^{-rt}dt \quad (1)$$

$$= \frac{1-(1-\gamma_F)\,e^{-r(70-A_F)}}{r} \quad (2)$$

where the first term in Eq. (1) is the discounted flow value from today till the end of the 70-year leasehold, during which the unit yields a flow value of 1; the second term is the discounted flow value from the end of the 70-year leasehold, during which the flow value is $\gamma_F \in [0,1]$.

Taking logs on both sides of Eq. (2), we can further simplify the pricing equation for FPR units as:

$$\begin{aligned}
\ln P_F(A_F) &= \ln\left[1-(1-\gamma_F)\,e^{-r(70-A_F)}\right] - \ln r \\
&\approx \ln\left[1-(1-\gamma_F)\left[1-r\,(70-A_F)\right]\right] - \ln r \\
&= (\ln\gamma_F - \ln r) + \ln\left[1+\frac{(1-\gamma_F)\,r\,(70-A_F)}{\gamma_F}\right] \\
&\approx (\ln\gamma_F - \ln r) + \frac{(1-\gamma_F)\,r}{\gamma_F} * (70-A_F)\,. \quad (3)
\end{aligned}$$

Matched Pairs of FPR and LPR Units. Now we consider a matched pair of LPR and FPR units that are otherwise identical. Let the age of the FPR unit be A_F, thus it still has $70-A_F$ years of remaining leasehold. Since the LPR unit does not have full property right protection, the flow value an owner receives from LPR units is denoted by $\gamma_L \in [0,1]$, which one can interpret as reflecting the uncertainty that LPR properties may be confiscated by the government without proper compensation.

Similar to that of the FPR unit, the price of an LPR unit, denoted by P_L, can be written as its expected discounted flow value:

$$P_L = \int_0^{\infty} \gamma_L e^{-rt}dt = \frac{\gamma_L}{r}, \quad (4)$$

and in log form, we have

$$\ln P_L = \ln\gamma_L - \ln r. \quad (5)$$

Combining Eqs. (3) and (5), we have the following relationship in the prices between the matched FPR and LPR units:

$$\ln P_F(A_F) - \ln P_L = \ln\gamma_F - \ln\gamma_L + \frac{(1-\gamma_F)\,r}{\gamma_F} * (70-A_F)\,. \quad (6)$$

4.2 Empirical Strategies

Estimating γ_F and γ_L. Eqs. (3) and (6) provide the basis of our empirical strategy to quantify γ_F, which denotes the uncertainties associated with FPR units at the end of 70-year leasehold, and

γ_L, which denotes the uncertainties associated with LPR units.

First, guided by Eq. (3), we can estimate the relationship between the log price (transaction or listing) of FPR units with different remaining leaseholds in otherwise comparable (matched) development projects. We can then recover γ_F from the coefficient estimate on *remaining leasehold* $70 - A_F$ in the log price regression, for a *given* discount factor r.

Specifically, we use the sample of matched pairs of FPR units, to run the following price regressions:

$$\ln(P_{i,j,t}) = \beta_1 \cdot Remain\_Leasehold_{i,t} + \gamma \cdot \mathbf{X}_{i,t} + \delta \cdot \mathbf{Y}_{c,t} + \theta_j + \theta_t + \varepsilon_{i,t}, \tag{7}$$

where:

- $P_{i,j,t}$ is the listing price of the FPR property i in matched pair j at year-month t, which represents the present value of its expected cash flow;
- $Remain\_leasehold_{i,t} \equiv 70 - A_F$ is unit i's remaining leasehold at the time of listing or transaction;
- $\mathbf{X}_{i,t}$ is a full set of unit characteristics, including the numbers of bedrooms, living rooms, and bathrooms, the total floor area, an elevator indicator, the orientation of the unit, and dummies that indicate the quality of construction;[12]
- $\mathbf{Y}_{c,t}$ includes controls of community characteristics such as age, the community green area ratio and community property management fees.[13]
- θ_j indicates the matched pair fixed effects;
- θ_t indicates the year-month fixed effects of the listing (or sales);
- The standard errors for $\varepsilon_{i,t}$ are double clustered at the group and quarter levels.

The β_1 coefficient in estimating Eq. (7) captures the price discount associated with shorter remaining leaseholds among similar FPR units at the time of their sales. According to Eq. (3), we have:

$$\hat{\beta}_1 \approx \frac{(1-\gamma_F)\, r}{\gamma_F}$$

Thus, with a postulated value of the discount rate r, we can recover the value of γ_F as follows:

$$\hat{\gamma}_F = \frac{r}{\hat{\beta}_1 + r} \tag{8}$$

[12] Chinese home buyers often put a premium on units facing the south, which tends to receive better sunlight.

[13] The remaining leasehold is calculated from the date the developer acquires the land, which can differ substantially from the community age. Community age is measured from when the community construction was completed and units sold on the market. Controlling for age helps to isolate price discount associated with remaining leasehold from natural depreciation.

After we recover the value of γ_F in the previous step, the value of γ_L can be recovered from a regression on the log price difference between the matched FPR and LPR units as predicted by Eq. (6). Specifically, we estimate the following regression equation:

$$\begin{aligned} \ln(P_{i,k,t}) &= \alpha_0 \cdot FPR_i + \alpha_1 \cdot FPR_i \cdot Remain\_Leasehold_{i,t} \\ &+ \gamma \cdot \mathbf{X}_{i,t} + \delta \cdot \mathbf{Y}_{c,t} + \theta_k + \theta_t + \varepsilon_{i,t}, \end{aligned} \tag{9}$$

where FPR_i is the indicators for whether property i is FPR; θ_k is the fixed effect for the LPR/FPR matched pair; and the other variables are defined the same way as those for regression equation (7).[14] It is clear from comparing Eq. (6) with the regression equation (9) that:

$$\hat{\alpha}_0 \approx \ln \gamma_F - \ln \gamma_L, \tag{10}$$

which yields an estimate for γ_L as:

$$\hat{\gamma}_L = \frac{\hat{\gamma}_F}{\exp(\hat{\alpha}_0)} \tag{11}$$

Remark 1 In principle, γ_F can be recovered from the regression coefficient $\hat{\alpha}_1$ in regression Eq. (9) as well. The variations in *Remain_Leasehold* for regressions Eqs. (9) and (7) differ: Regression (7) uses the variations among matched FPR properties, while regression (9) uses the variations among matched FPR/LPR properties, in the remaining leaseholds.

Property Rights and Rental Rates: Placebo Outcome. We also conduct a regression, at the community level, to examine the effect of property rights on *monthly rents*. We consider the effect of property rights on monthly rents as our placebo outcome because for rentals, unlike sales prices, the difference in the property rights protections between the LPR and FPR should *not* matter. We only observe the community-level average rents $R_{c,k,t}$ per square meter each month for community c at year-month t in a matched community pair k, thus our placebo test using the rental data is based on the community-level regression as follows:

$$\ln(R_{c,k,t}) = \psi_0 \cdot FPR_c + \psi_1 \cdot FPR_c \cdot Remain\_Leasehold_{c,t} + \delta \times \mathbf{Y}_{c,t} + \theta_{k,t} + \varepsilon_{c,t}, \tag{12}$$

where $\mathbf{Y}_{c,t}$ is a vector of community-level observable characteristics, including the green area ratio, community property management fees, the FAR, the total land area, the total floor area, the number of units, the number of floors, age, and age squared; and $\theta_{k,t}$ is the interaction of the matched-pair and year-month fixed effects, $\theta_{k,t}$. We expect the coefficients of ψ_0 and ψ_1 to be both close to zero for the placebo outcome of rental prices.

[14] For both regressions Eqs. (7) and (9), the standard errors are double clustered at the matched pair and quarter levels.

Effects of the Release of Urban Planning Codes on Prices and Rents. To examine the effect of change in government regulations, we regress Eq. (13) using a difference-in-difference (DID) design. The first difference captures the price discount of LPR units relative to otherwise similar matched FPR units as in Eq. (9), and the second difference captures the causal effect of a change in the government's zoning regulations, as an event study, that is supposed to affect only LPR units. The event is the release of new zoning codes that classified complexes in the city into one of the five demolition categories. Since the time from the drafting of the codes to the official release of the final codes was very short, the event was largely a surprise to residents. In addition, because it was the first time in Shenzhen's history that such detailed information was made available to the general public, the codes had received widespread attention from residents and the media. The essence of the changes in the zoning codes is to determine whether the entire complex is subject to involuntary demolition and thus compensation is an important matter. The law has prescribed that FPR owners be compensated when they become subject to such outcomes. However, it is unambiguous whether or how LPR owners should be treated in such cases, given the complexity of their transactions. We exploit the disparate effects of the codes on dual property rights due to their differences in entitlement to mandatory compensation and estimate the following equation:

$$\begin{aligned}\ln(P_{i,k,t}) = {} & \zeta_0 \cdot FPR_i + \zeta_1 \cdot FPR_i \cdot Remain\_Leasehold_{i,t} + \zeta_2 \cdot FPR_i \cdot Post_t \\ & + \zeta_3 \cdot FPR_i \cdot Remain\_Leasehold_{i,t} \cdot Post_t + \gamma \cdot \mathbf{X}_{i,t} + \delta \cdot \mathbf{Y}_{c,t} + \theta_{j,t} + \varepsilon_{i,t}, \end{aligned} \tag{13}$$

where $Post_t = 1$ if the property is listed on or after the new zoning code announcement date of November 9, 2016, and zero if before. We restrict the sample to listings within 12 months before and after the event date. All the other variables are the same as those defined as in Eq. (7). The ζ_2 coefficient captures the effect of change in zoning codes on the relative prices of LPR flats following the release of the new codes: if the zoning code releases reduce the property right uncertainty of the LPR relative to those of the FPR, we would expect ζ_3 to be negative.

Similarly, we examine the effect of the new zoning codes on the placebo outcome (rents) and other community-level outcomes in Eq. (13):

$$\begin{aligned}\ln(R_{c,k,t}) = {} & \eta_0 \cdot FPR_c + \eta_1 \cdot FPR_c \cdot Remain\_Leasehold_{c,t} + \eta_2 \cdot FPR_c \cdot Post_t \\ & + \eta_3 \cdot FPR_c \cdot Remain\_Leasehold_{i,t} \cdot Post_t + \delta \times \mathbf{Y}_{c,t} + \theta_{k,t} + \varepsilon_{c,t}, \end{aligned} \tag{14}$$

Similar to our previous argument that the placebo outcome of rents should not be affected by the property right uncertainty, we do not expect that the zoning code releases should have a significant effect of the rent differences between LPR and FPR properties, i.e., we expect η_3 to be zero.

5 Housing Prices, Rents and Property Rights

In this section, we describe our empirical results on the relationship between property rights and housing prices and rents.

5.1 Price Discount of Remaining Leaseholds for FPR Properties

We first examine the relationship between the remaining leasehold and housing prices for the matched FPR properties. Table 2 reports the results from regressions as specified by Eq. (7). For FPR properties, we have both the listing and transaction prices. Columns (1) and (2) respectively report the coefficient $\hat{\beta}_1$ on remaining leaseholds (in years) using the listing and transaction prices. Column (1) shows that, based on listing prices, each additional year remaining in the leasehold of the property is associated with 0.44 percent of price premium; Column (2) shows that, based on transaction data, shows that each additional year remaining in the leasehold of the property is associated with 0.35 percent of price premium in transaction prices. Both coefficients are statistically significant at 5% level. The magnitude is quantitatively similar to the estimated long-run discount rate (0-2.6 percent) that Giglio, Maggiori and Stroebel (2015) find for residential property ownership using the United Kingdom and Singapore housing transaction data.

[Table 2 About Here]

According to Eq. (8), the $\hat{\beta}_1$ estimates of 0.00442 or 0.00349 imply that, the housing market for FPR properties in Shenzhen builds in a consideration for the uncertainty in FPR property rights at the end of the 70-year leasehold, with $\hat{\gamma}_F \approx 0.92$, when we assume a discount rate of $r = 0.05$.

5.2 Price Differences Between FPR and LPR Properties

We now examine the price discount of LPR relative to matched FPR properties. Since we only have access to the listing prices for LPR properties, we will also use the listing prices for FPR properties in order to maintain consistency. Table 3 reports the results as specified by Eq. (9). We present the regression results of the three different specifications with more granular locations and time controls in Columns (1) to (3). In all three columns, we control for a full menu of unit-level attributes, including the number of bedrooms, the number of living rooms, the number of bathrooms, the floor area, an elevator indicator, unit-facing direction dummies, and construction quality dummies, along with a number of community-level attributes, including the green area ratio and community property management fees. In Column (1), we control for only year and month fixed effects; in Columns (2) and (3), we control for the interaction of match pair and listing year-month, so that we compare units in an LPR complex to similar units in a matched FPR complex that are listed at the same time; and, in Column (3), we control for the average rent at the complex level along with match pair by year-month fixed effects.[15] Regression in Column (4) is similar to

[15]Controlling for the average rent at the complex level ensures that the matched FPR and LPR properties are not only in close proximity, but also have similar investment values for perspective buyers.

(3), but based on only listings within 12-month window before and after November 2016 to have the same sample as that will be used in DID regressions below. In all four specifications, standard errors are double clustered at the group and quarter levels.

[Table 3 About Here]

We find that $\hat{\alpha}_0$, the estimated coefficient on FPR indicator, is about 0.65 to 0.68, according to our preferred specifications in Columns (3) and (4); and $\hat{\alpha}_1$, the estimated coefficient on the $FRP \times Remain\_Leasehold$, is about 0.793 to 0.822. Note that the estimates of both $\hat{\alpha}_0$ and $\hat{\alpha}_1$ are statistically significant at the 1% level.

According to Table 1, the average remaining leaseholds of the FPR properties in our sample is about 56 years. Thus our estimates in Table 3 suggests that the FPR properties are listed at a significant premium, $\frac{P_F}{P_L} \approx \exp(0.65 + 0.008 \times 56) = \exp(1.1) = 3$; that is, the unit prices of FPR properties are approximately three times that of otherwise identical LPR units, which is consistent with the raw summary statistics presented in Table 1.

We can use Eq. (11) to estimate the implied uncertainty associated with LPR, γ_L. Again, assuming a discount rate of $r = 0.05$, we have:

$$\hat{\gamma}_L \approx \frac{\hat{\gamma}_F}{\exp(\hat{\alpha}_0)} = \frac{0.92}{\exp(0.654)} = 0.48$$

5.3 Rental Prices and Property Rights: Placebo Outcome

Property rights are largely a concern of homeowners, while renters should be indifferent to property rights protection with similar amenities. We exploit the different implications of LPR by using rents, the value to renters, as a placebo outcome. To the extent that any observable characteristic should affect the consumption value of the home, this helps alleviate concerns over unobserved structural heterogeneity between different property rights.

To test this, we regress the average logarithm of monthly rents at the community level on the indicator LPR following Eq. (12). The results are reported in Table 4. While the ψ_0 and ψ_1 coefficients are not statistically significant in all four specifications. These results provide support for the assumption that our controls are correctly capturing the main heterogeneity across properties with different property rights, and we are comparing properties with similar amenities that affect the consumption value of the home. Thus, the significant price discount reported in Table 3 reflects the value of property rights to sellers and not any differences due to location, market conditions, or other unobservable characteristics.

[Table 4 About Here]

Taking Stock. Taking stock of these results, we find no significant difference in cash and service flows based on rents between LPR and FPR units. However, there is a significant difference in the expected future service flows associated with the LPR. We now summarize the implications of the estimates reported in Tables 3 and 4 on the parameters of interest γ_F and γ_L.

[Table 5 About Here]

In Table 5, we show the implied values of γ_F and γ_L based on the regression coefficients ($\hat{\beta}_1 \approx 0.004$ from Eq. (7) and $\hat{\alpha}_0 \approx 0.65$ from Eq. (9). Using (8) and (11), we show that for $r = 0.03$ and $r = 0.05$, we respectively calculate ($\hat{\gamma}_F = 0.882, \hat{\gamma}_L = 0.461$) and ($\hat{\gamma}_F = 0.925, \hat{\gamma}_L = 0.483$).

As we discussed in Remark 1, we can also infer about γ_F using the coefficient estimate $\hat{\alpha}_1 = 0.008$ in regression Eq. (9) instead of $\hat{\beta}_1 \approx 0.004$. Table 5 shows that the implied values of γ_F and γ_L, for $r = 0.03$ and $r = 0.05$, are respectively ($\hat{\gamma}_F = 0.789, \hat{\gamma}_L = 0.412$) and ($\hat{\gamma}_F = 0.862, \hat{\gamma}_L = 0.450$).

Based on the estimates of the perceived property right uncertainty listed in Table 5, we can reach the following conclusions. First, there is non-negligible property right uncertainty associated with FPR properties at the end of the 70-year leasehold; the perceived probability that the property right of the FPR might be in doubt ranges from 7% to 21%. Second, the perceived uncertainty about the property rights for LPR is much higher; the market perceives that there is more than 50% chance that the LPR may not receive any legal protection in any future year.

5.4 Effect of the Urban Planning Codes Release

In this subsection, we evaluate the hypothesis that the public release of the new urban planning codes by the Shenzhen government on November 16, 2016 reduces the property right uncertainty, particularly for LPR properties.

We report the results from regressions (13) for listing prices in Table 6. In these regressions, we use listings 12 months before and after November 2016, when the new codes were released. In Columns (1)-(3), we focus on FPR and FPR×Post; and in Columns (4)-(6), we also include their interactions with *Remain_Leasehold*. The preferred specification in Column (3) of Table 6 shows that the FPR price premium decreased by about 8.3% ($\approx 1 - exp(-0.08633)$) following the public release of the new urban planning code, suggesting that it reduces the property right uncertainty associated with the LPR properties. Column (6) further confirms that the price premium of FPR properties with longer remaining leasehold relative to matched LPR properties is reduced in the post-release period, with the coefficient estimate of the triple interaction of FPR, Post and *Remain_Leasehold* statistically significant at 5% level.

[Table 6 About Here]

What exactly does the estimated DID effect measure? The new urban planning codes, especially the priority demolition zone, provide clarity in terms of the government plan to acquire and demolish selected communities for compliance purposes. This should not a concern for the FPR owners since they are always entitled to compensation at the market value per the 1994 URA Law. It also should not concern the owners of LPR units in neighborhoods that had no change in zoning or no zoning at all. Instead, it should only affect the owners of LPR units in the demolition zones, whose ownership, prior to the new zoning codes, was not considered legal by the municipal government,

and thus could have been subject to confiscation without proper compensation. The new codes, all of sudden, provided hope that government would acquire and compensate all the units, regardless of their property rights, since the new zoning codes are based on characteristics unrelated to property rights and apply to all neighborhoods in the city. They would be much better off even if the village committee, as the legal owner of the land, would be directly compensated by the municipal government in the legal proceedings. In addition, the expected government demolition would be better than existing private placement often subject to many frictions. Therefore, the estimated effect of 9 percent reflects the value of removing some frictions and uncertainty associated with government compensation, not liquidity or collateralization associated with LPR.

In Table 7, we report the regression results for our placebo outcomes, the rent level, at the community level on the FPR indicator and on FPR×Post following the regression Eq. (14). We find that for the preferred specifications reported in Columns (3) and (6), the coefficient estimate of FPR×Post and FPR×*Remain_Leasehold*×Post are not statistically significant, and their magnitudes are close to zero. These results confirm that the significant effects in Table 6 reflect the effect of property rights due to changes in government regulation and are not driven by any differences in observable characteristics.

[Table 7 About Here]

Falsification Tests. To ensure there are no other confounding factors that could drive the estimated effect of the public release of the urban planning codes around similar times, we conduct a falsification test based on hypothetical event dates. The true event date is November 9, 2016, when the new planning codes were released. The hypothetical event dates then include December 2015, January 2016, ..., May 2016, May 2017, June 2017, ..., September 2017. We restrict the sample for each event to six months before and six months after the event date so that we can test for as many hypothetical events.[16] We define *Post* to be one if the listings are after the event date and zero for those before the date. We run regressions similar to Eq. (13) for each fictitious event date, except that we only include FPR, Post and their interactions, where the dependent variable is the logarithm of the listing price.[17]

Because we defined the event date in these falsification tests were arbitrary and fictitious except for when November 2016 is defined to be the event date, we should expect that the interaction term (FPR×Post) to be statistically insignificant except for November 2016, unless there are some spurious events that occurred in that fictitious event month to affect only LPR houses and not FPR ones. Figure 4 plots the estimated coefficients and the 95 percent confidence intervals for the interaction term. As expected, the ζ_2 coefficients on the interaction terms are insignificant in the periods for all the other dates, confirming the validity of the observed negative effect surrounding the rollout date of the new urban planning codes. Thus, the falsification test using arbitrary and

[16]For the tests in August and September 2017, we only have data for five months and four months after the event, since our sample ends in December 2017.

[17]Not including the interactions with *Remain_Leasehold* allows us to cleanly focus on the total treatment effect of the "event."

fictitious event dates provides additional support for our contention that the results reported in earlier testing of the impact of the government regulations are not spurious.

[Figure 4 About Here]

5.5 Parallel Trends

To better understand the dynamics of home prices across communities with different property rights, Figure 3 plots different home price measures based on our sample. In Panel (a), the two series are calculated as the median listing price at the community level, normalize by their respective November 2016 (the month of the public release of urban planning codes) at level 100.[18] We see that, prior to November 2016, home prices in FPR communities experienced much more rapid appreciation, with an accumulative appreciation of 63 percent from January 2015 to October 2016, compared to only 5.7 percent for LPR flats. The trends immediately reversed after November 2016. Except for a temporary appreciation in January 2017, the median listing price in FPR communities declined by 14 percent from December 2016 to April 2017. In contrast, the median price in LPR communities increased from December 2016 to February 2017 before it took off to a dramatic appreciation beginning in March. Note that January and February 2017 cover the most important holiday season of the year, with Chinese New Year on January 28, 2016. In these two months, the number of listings is barely half the average volume in other months, suggesting a very slow market.

[Figure 3 About Here]

Home price trends, however, do not control for property characteristics such as the floor area, the age of the communities, and other amenities that determine home prices. To estimate a home price index that controls for hedonic characteristics, we estimate the following regression, for $S \in \{FPR, LPR\}$,

$$\ln(P^S_{i,k,t}) \quad = \quad \sum_{\tau \in T} p^S_\tau \cdot \mathbf{1}\{t = \tau\} + \gamma \cdot \mathbf{X}_{i,t} + \varepsilon_{i,t}, \tag{15}$$

where p^S_t is a set of coefficients on time dummies and captures the home price trend in a given market after controlling for hedonic factors $\mathbf{X}_{i,t}$. Since location is an essential component of home prices, p^S_t absorbs not only the year-month fixed effect ζ_t, but also the matched pair fixed effect θ_k and the year-month fixed effect θ_t in Eq. (9).

We estimate Eq.uation (15) separately for different property rights in our sample and plot the estimated home price indexes in Panel (b) of Figure 3, where both are indexed to November 2016. Compared to Panel (a), the differences in the parallel trends are smaller. From January 2015 to

[18] It is notable that all existing home price indexes in China are only based on FPR properties, since LPR transactions are not recorded by the municipal governments. Thus the home price series of FPR properties based on our sample should be comparable to the published home price indexes as plotted in Figure **??**.

October 2016, FPR communities experienced an accumulative growth of 7 percent, compared to only 2 percent in LPR communities. Even after controlling for hedonic characteristics, we find LPR housing segments significantly underperformed the FPR market and appeared like a separate market. However, as in Panel (a), the two estimated home price series in Panel (b) become more synchronized after the event date, that is, both series decline in parallel during the next three months before rapidly appreciating from March 2017 through the end of our sample period. Combining the results in Table 3, the dynamics in parallel trends suggest that the new urban planning codes resulted in significant changes to both the LPR and FPR markets, as well as to the differences between the two. The changes for LPR houses appear to be much greater than for FPR houses, leading to a more level playing field and synchronization between the markets for the two types of housing units.

6 Property Rights and Speculative Activities

So far, we have shown that the housing prices in the Chinese market reflect significant uncertainty regarding property rights, both for the FPR units after the expiration of the 70-year leasehold and for the LPR properties. In this section, we aim to make a link between the property right uncertainty and the rampant speculative activities in Chinese housing market. We first review the theoretical considerations that uncertainty, and more importantly, lack of common knowledge on the property right protection, can lead to more speculative activities; we then provide empirical evidence that speculative activities measured by turnover rates and price volatility are both higher among LPR complexes than those of matched FPR complexes, and that the public release of the new urban planning codes lowered the speculative activities.

6.1 Uncertainty, Heterogeneous Beliefs and Speculative Activities: Theory

The economics literature has emphasized the role of heterogeneous beliefs in generating *bubbles*, which is defined as the episode where the asset price exceeds the average valuations of the asset by investors. The marginal investors who buy the asset tend to be more optimistic than the average investors, and they are willing to pay a higher price for the asset than her own valuation of the future payoffs of the asset for the value of the resale option. This theoretical literature originated at least with Harrison and Kreps (1978), further developed by Allen, Morris and Postlewaite (1993), Morris (1996), among others.

Scheinkman and Xiong (2003) build on the literature and present a continuous-time equilibrium model in which overconfidence generates disagreements among agents regarding asset fundamentals.[19] With short-sale constraints, an asset buyer acquires an option to sell the asset to other agents when those agents have more optimistic beliefs. As in Harrison and Kreps (1978), agents

[19]See also Scheinkman (2014), for a survey.

in the model pay prices that exceed their own valuation of future dividends because they believe that in the future they will find a buyer willing to pay even more. This causes a significant bubble component in asset prices even when small differences of beliefs are sufficient to generate a trade. Importantly for our empirical analysis below, they show that in equilibrium, bubbles are accompanied by *large trading volume* and *high price volatility.*

The two basic assumptions of the Scheinkman and Xiong (2003) model are, first, differences in beliefs, and second, higher costs of going short, are particularly relevant in the Chinese housing market. As we discussed in the previous sections of the paper, Chinese government has so far not made any public statement regarding how to address the land use rights of the FPR properties after the end of their 70-year leaseholds; and for LPR properties, local governments are provided with much discretion in how they could be compensated in the event of land appropriations, and whether the owners can access local schools, etc. The ambiguities lead to ripe speculations and divergence in opinions. For the second condition, the short-sales of housing are also impossible, and at least much short selling houses is much harder than short selling stocks.

Scheinkman and Xiong (2003) also predict that, an increase in the volatility of beliefs increases the value of the resale option, thus increasing the divergence between asset prices and fundamental valuation, and also increases the volume of trade. In their model, bubble episodes are associated with increases in trading volume, and price volatility. Of course, the converse of their prediction is that, any public release of information that reduces the divergence of traders' beliefs will result in reduced speculation as measured by turnover rates and price volatility. In fact, Scheinkman (2014) argues that this relationship between bubbles and trading distinguishes models of bubbles based on heterogeneous beliefs and cost asymmetries from rational bubble theories (see, Tirole 1982; Stiglitz, 1990, among others). A rational bubble is characterized by a continuous rise in an asset's price, and can not exist in finite models with rational traders (Tirole 1982). Investors in infinite horizon models may generate bubbles where the investors are content to hold the asset at the current price, because they believe that they are compensated for any risk of the bubble bursting by a suitable expected rate of the price increase. In contrast to models based on heterogeneous beliefs and costly short-selling, rational bubble theories fail to explain the association between bubbles and high trading volume.

6.2 Property Rights Uncertainty and Speculations: Evidence

We now provide empirical evidence regarding the property rights uncertainty and measures of speculative activities. We use two common measures of speculation, turnover rates and price volatility, where speculation is associated with higher turnover rates and higher price volatility. We estimate a Difference-in-Difference specification to examine how the public release of urban planning codes on November 2016 deferentially impacted the turnover rate and the price volatility of FPR and LPR units:

$$Z_{c,k,t} = \mu_0 \cdot FPR_c + \mu_1 \cdot FPR_c \cdot Post_t + \delta \times \mathbf{Y}_{c,t} + \theta_k + \theta_t + \varepsilon_{c,t}, \tag{16}$$

where the dependent variable $Z_{c,k,t}$ is either the turnover rate or the price volatility (see below for their measurement) at community c in matched pair k in year-month t, $\mathbf{Y}_{c,t}$ is a vector of community attributes, and θ_k and θ_t are respectively the matched pair and the year-month fixed effects. If, as we hypothesized, FPR units have lower uncertainty than LPR units and that the public release of the urban planning codes reduces the uncertainty for LPR units more so than for FPR units, then we expect the coefficient estimates of μ_0 to be negative and μ_1 to be positive.

Turnover Rates. We examine the effect of zoning changes on market activities based on the listing data. Our first measure of speculative activity is the *turnover rate*, defined as the number of listings each month divided by the number of units at the community level. Faster turnover implies more speculative selling activities by existing homeowners.

We regress the turnover rate on FPR and $FPR \times Post$ along with community and time controls, following Equation (13). The results are reported in Columns (1) – (3) of Table 8 reports the results from regressions along the specifications suggested by Eq. (16). Columns (1) and (2) compare the turnover rates of FPR communities relative to their matched LPR communities, with or without controlling for community attributes. Column (1) shows that the turnover rate is 3.511 percentage points lower in FPR communities than in matched LPR communities, without controlling for community attributes, and the estimate is statistically significant at 1% level. The estimate is also significant in magnitude: Table 1 shows that the average turnover rate is 12.8 percent, thus the 3.511 percentage difference estimated in Column 1 represents more than 27% difference. Even after controlling for the community attributes, the FPR communities have a 0.889 percentage lower monthly turnover rate than the matched LPR communities, and the estimate is statistically significant at 5% level.

Columns (3) and (4) report the DID estimates specified in Eq. (16). Without controlling for community attributes, Column (3) shows that FPR communities have 3.871 percentage points lower than matched LPR communities and it is statistically significant at 1%; in addition, the coefficient of the interaction term FPR×Post is estimated to be 0.704 percentage point, suggesting that after the public release of the urban planning codes, the difference in the turnover rates between FPR and LPR properties narrowed. The estimate is statistically significant at 5% level. After controlling for community attributes, Column (4) shows that the coefficient estimate for the FPR dummy is -1.317 percentage points, and the coefficient estimate for the interaction term FPR×Post is 0.656 percentage points, and both are statistically significant at 1% level.

[Table 8 About Here]

Price Volatility. Our second measure of speculative activity is *price volatility.* We construct the community-level monthly price volatility measures as follows: we first take the average listing price at the community by month level, then run GARCH(1,1) models on the log price series for each community; the predicted variance of the residuals from the GARCH(1,1) models is taken as the measure of price volatility for the community in each month (see Bollerslev, 1986; Miles, 2008).

[Table 9 About Here]

To quantify the difference in the price volatility between the FPR and LPR communities, and how the public release of the urban planning codes affects the differences, we run regressions as specified by Eq. (16) based on community-level panel data but with the estimated price volatility as the dependent variables. The results are reported in Table 9. Columns (1) and (2) only include the FRP dummy, respectively with and without controls for community attributes. The coefficient estimate of FPR on the price volatility is -257.076 and statistically significant at 1%, confirming the hypothesis that FPR communities usually have lower price volatility than the matched LPR counterparts. The magnitude is also significant: as shown in Table 1, the mean price volatility is 1087 and its standard deviation is 806; thus the -257.076 difference in price volatility accounts for 24% of the mean and 0.32 standard deviation of the price volatility among all matched communities in our estimation sample.

Column (2) shows that, once controlling for community attributes, the price volatility of FPR communities is now 329.437 lower than those of similar and matched LPR properties. The estimate is again statistically significant at 1% level.

Columns (3) and (4) shows that, as hypothesized, post the public release of the urban planning codes, the difference in the price volatility between FPR and LPR was reduced by 58.13 and 47.3 depending on whether one controls for community attributes. Both estimates are statistically significant at 5% level. This represents about 15-20% reduction in price volatility differences.

Taking Stock. The results suggest that limited property rights protection can induce a significant amount of speculative activities in housing market. Our results also indicate the public release of urban planning codes in November2016 by the city government proves useful in reducing the uncertainty gap between FPR and LPR properties.

In addition, it should be noted that even the FPR properties in China have much higher property right uncertainty, as we estimated in Table 5, than the fee simple ownership rights in the U.S., thus, *ceteris paribus*, the property rights uncertainties may have contributed to the more prevalent speculative activities in the Chinese housing market than those in other countries.

Remark 2 We should point out that the asset pricing formula in Section 4 assumes that the houses are listed at the fundamental values of discounted expected service flows, yet the evidence presented in this section suggests that there may be significant speculative components in the housing prices in China, fueled at least partly by the property rights uncertainty associated with both the LPR and FPR properties. To the extent that the listing prices we used in our analysis include the resale option value – the so-called bubble component in Scheinkman and Xiong (2003) – the estimated values of $\hat{\gamma}_F$ and $\hat{\gamma}_L$, as reported in Table 5, should be construed as an upper bound.

7 Conclusion

In this paper, we examine the causal impact of property right uncertainty on prices and speculative activities in the housing market, by exploiting a unique feature of residential housing markets in the Chinese city of Shenzhen, where otherwise comparable housing units with different property right protections can be adjacent to each other. Some have full property right (FPR) protection with up to seventy-year leasehold on the land use right (LUR), and others only have limited property right (LPR) protections. Using detailed data of listing prices for home sales and rentals, we show that the sales market values property right protections but the rental market does not. We estimate that LPR properties are listed at a significant discount with an annualized price of 61-72 percent compared to otherwise identical FPR units. Our estimates suggest that the market perceives that the chance that property right of the FPR might be in doubt at the end of their 70-year leasehold ranges from 7% to 21%, and that there is more than 50% chance that the LPR may not receive any legal protection in any future year. We do not find any statistically significant differences in the placebo outcome, monthly rents, suggesting that the relative prices of property rights do not capture any heterogeneity that would affect the consumption value of the home.

We also provide evidence that housing units with limited property right protections are more prone to speculative activities measured by turnover rates and price volatility. We also show that a public release of the urban planning codes increases the listing price of LPR and reduces the turnover rates and price volatility of the LPR properties relative to their matched FPR counterparts.

Our results have important and clear policy implications. We show that limited property rights protection can induce a significant amount of speculative activities in housing market, and that the public release of information that reduces the uncertainty can be effective in reducing speculation. In addition, to the extent that even the FPR properties in China have much higher property right uncertainty than the fee-simple ownership rights, clarifying the land use right extension policy after the end of the current 70-year leasehold can play an important role in reducing the rampant speculation in the Chinese housing market.

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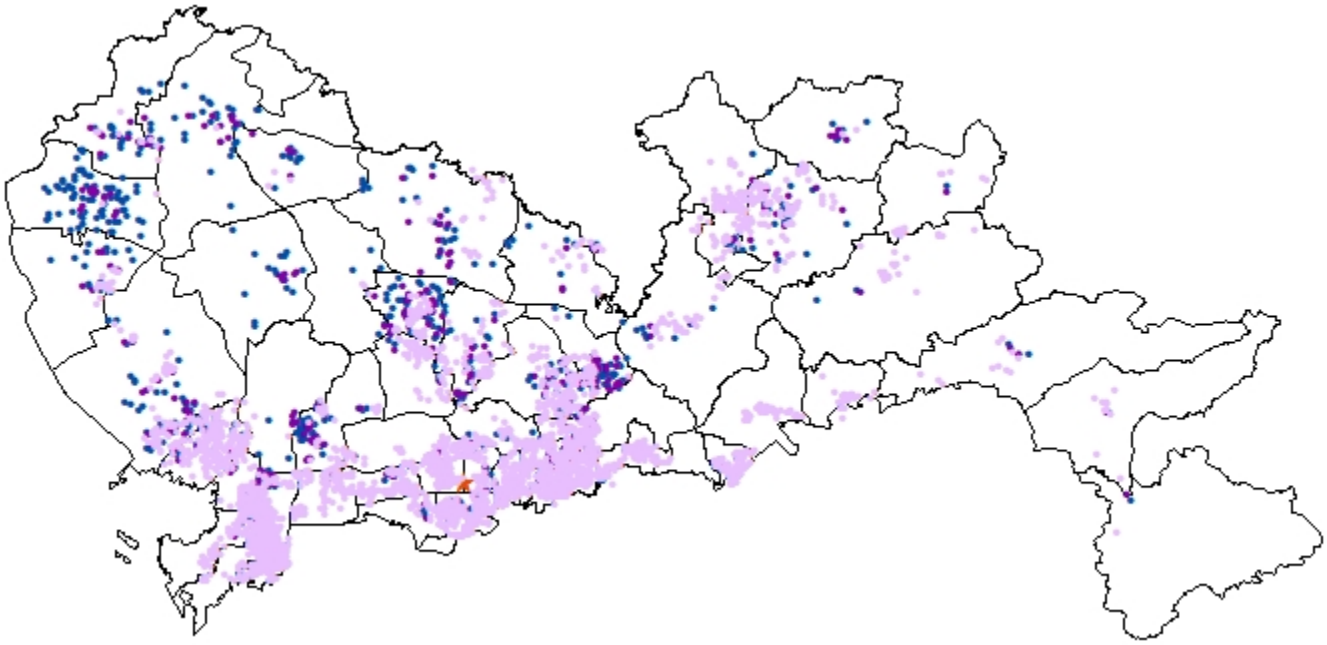
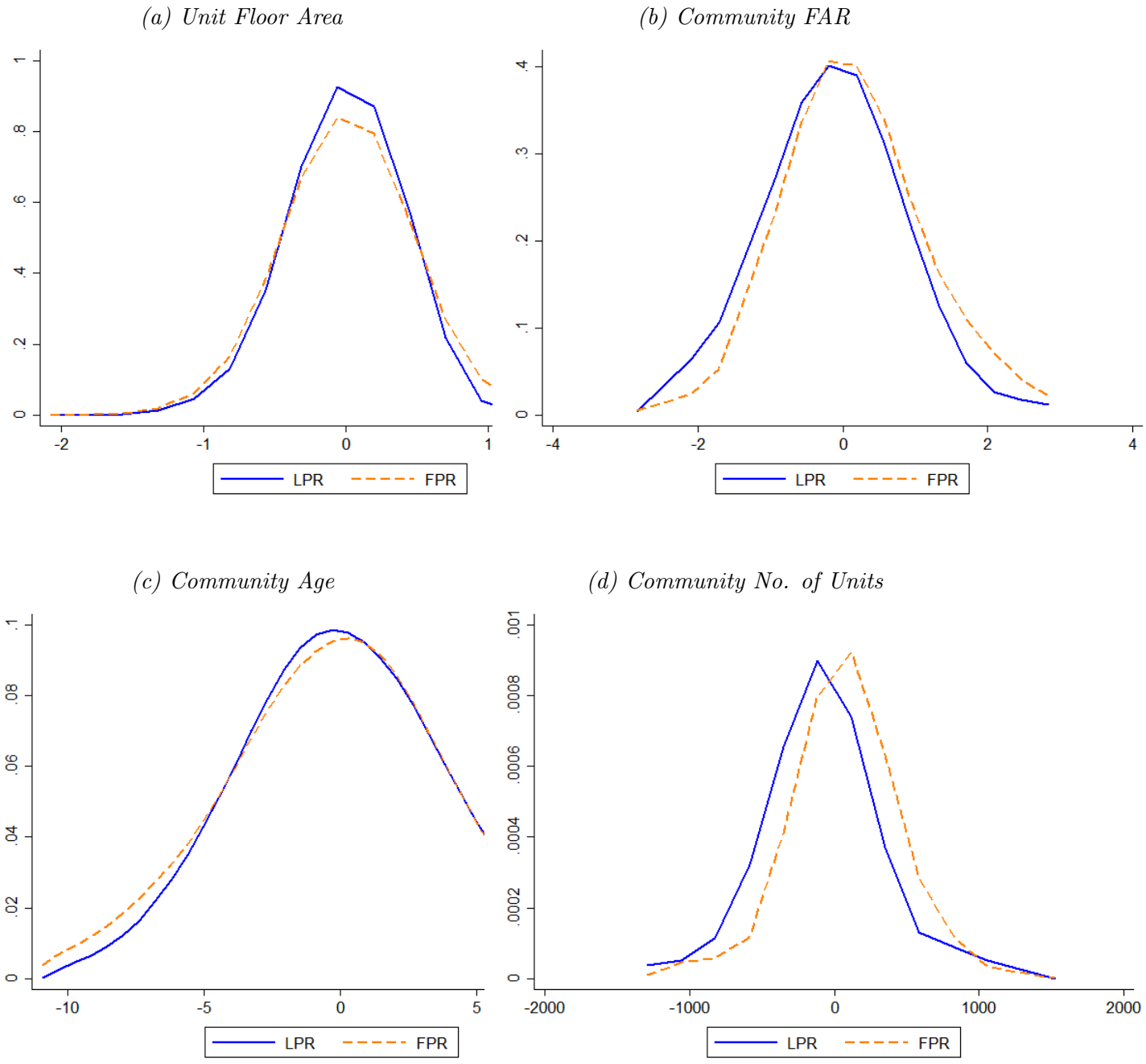
Figure 1: Geographic Distribution of Full and Limited Property Right Apartment Complexes in Shenzhen



Notes: Dark purple dots represent matched FPR apartment complexes, dark blue dots represent LPR apartment complexes, and light purple dots represent unmatched FPR apartment complexes.

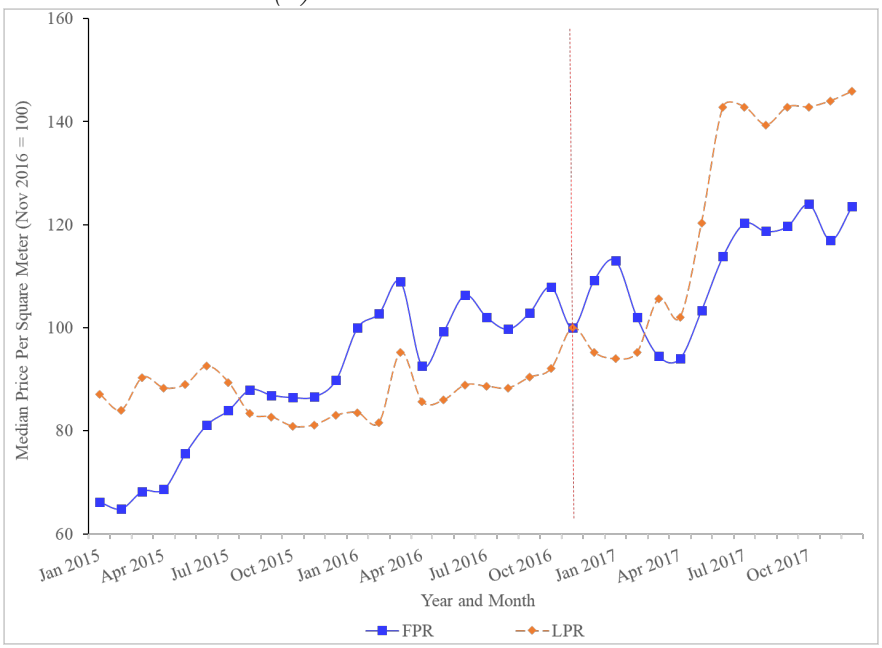
Figure 2: Distribution of Residuals



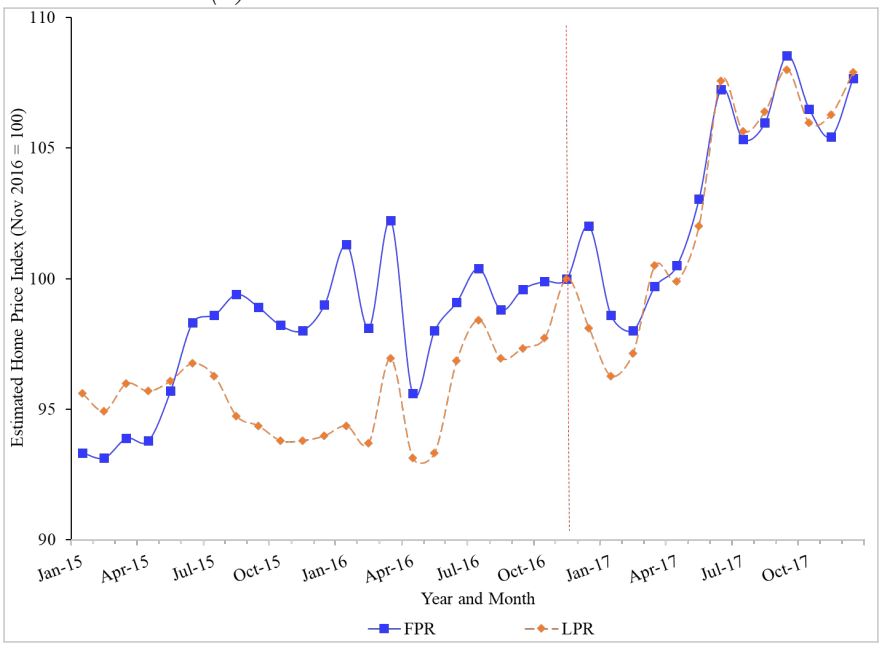
Notes: Panels (a) to (d) show the distribution of residuals from a regression of property characteristics on FPR–LPR pairs of complexes that have at least one unit listed on the market in the same month. The sample consist of all flats listed on the market from January 2015 to December 2017 in Shenzhen. The characteristics plotted are the unit floor area (in square meters), the community FAR, the community age since the year built (in years), and the community number of bedrooms. To construct each pair, an LPR complex is matched with its nearest FPR complex. When two or more FPR complexes are matched, only the one with the shortest distance is kept in the sample.

Figure 3: Parallel Home Price Trends

(a) Median Home Prices

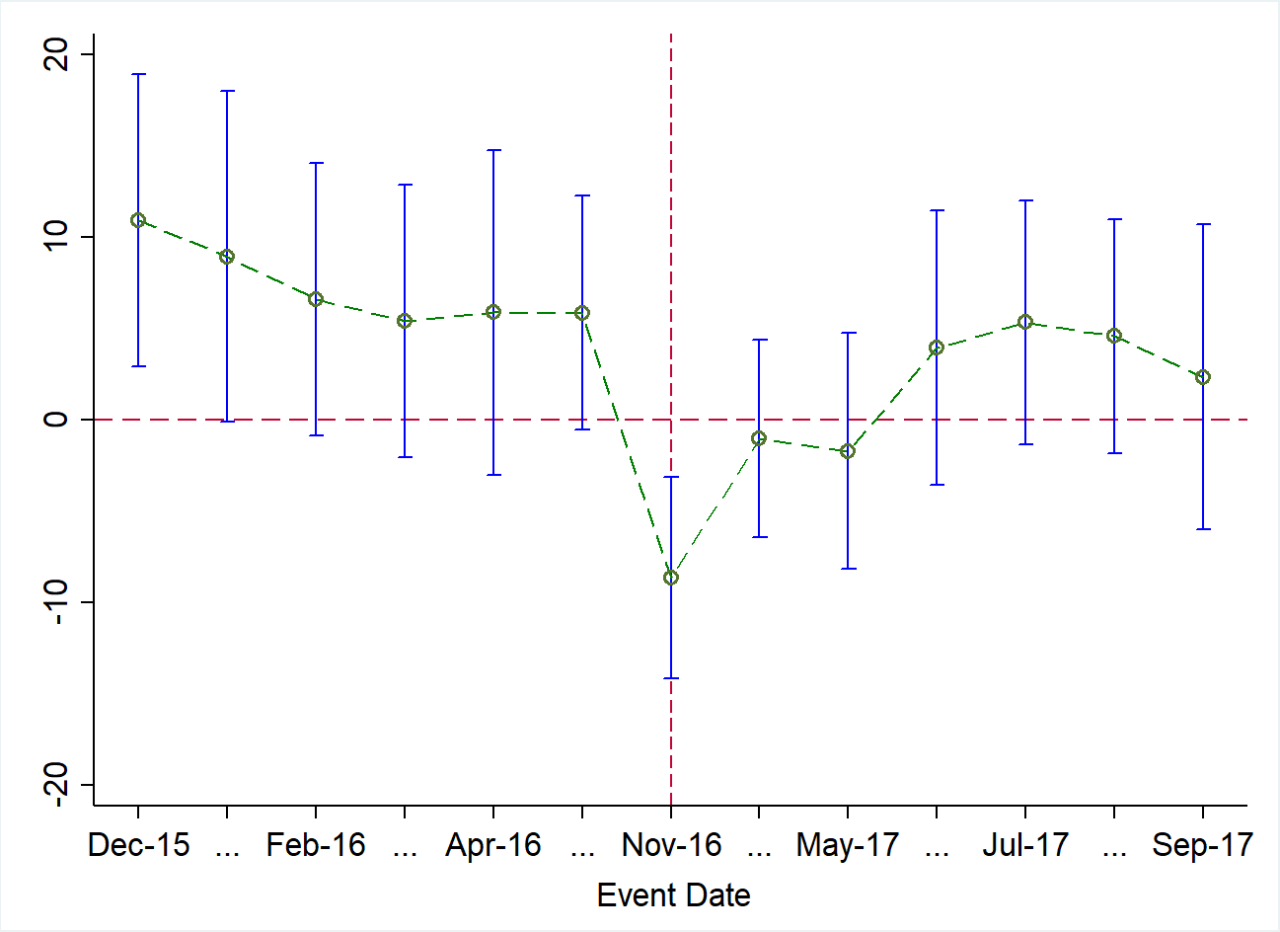


(b) Estimated Home Price Indices



Notes: This figure plots the price trends by different property rights. All the series plotted are calculated based on the listing sample. The series in Panel (a) are the median listing price per square meter for FPR and LPR units, respectively normalized to their respectively value at November 2016 (i.e., value = 100). The series in Panel (b) are the estimated home price indexes using the hedonic regression of Eq. (15) with the value in November 2016 indexed to 100. The solid line indicates LPR and the dashed line FPR. The red vertical dashed line represents November 2016, the date when the new regulation was released.

Figure 4: Falsification Test on Alternative Event Dates



Notes: This figure plots the coefficients on LPR × Post along with the 95 percent confidence intervals based on hypothetical event dates. The sample used in each of the regressions includes listings from 6 months before to 6 months after the event date except for the true event in November 2016, we use the listings in the 12 months before to 12 months after November 2016. The dependent variable is the logarithm of the listing price multiplied by 100. The right hand-side variables include LPR, LPR × Post, and those for the number of bedrooms, the number of living rooms, the number of bathrooms, the floor area, an indicator for an elevator, direction facing dummies, construction quality dummies, the community green area ratio, and community property management fees. We also control for the interaction of pairs of complexes and listing months so that we compare units in an LPR complex to similar units in a similar FPR complex that are listed at the same time. All the regressions are ordinary least squares (OLS) regressions. The variable *Post* is defined as an indicator for listings after the event date.

Table 1: Summary Statistics

	All		FPR		LPR		
	Mean	SD	Mean	SD	Mean	SD	Difference
Unit Characteristics							
Unit Price (per sq. meter)	19,411	17,169	30,623	17,610	8,958	7,350	-21,665
Remain_Leasehold	55.78	5.82	55.29	5.51	...	...	...
Bedrooms	2.76	0.98	2.89	1.16	2.64	0.753	-0.25
Living rooms	1.89	0.427	1.88	.49	1.9	0.358	0.02
Bathrooms	1.4	0.622	1.42	.7	1.39	0.538	-0.03
Floor Area	128	3166	157	4,210	100	1685	-57.00
Elevator	0.887	0.316	0.813	.39	0.956	0.204	0.14
Unit Facing Direction							
Missing	0.03	0.16	0.03	.172	0.03	0.16	-0.01
East	0.06	0.24	0.08	.273	0.05	0.21	-0.04
Northeast	0.01	0.07	0.01	.085	0.00	0.06	0.00
Southeast	0.08	0.27	0.10	.295	0.07	0.25	-0.03
East–west	0.00	0.04	0.00	.0391	0.00	0.03	0.00
North	0.14	0.35	0.13	.341	0.15	0.35	0.01
Southeast	0.35	0.48	0.36	.481	0.33	0.47	-0.03
South–north	0.31	0.46	0.26	.437	0.37	0.48	0.11
West	0.00	0.06	0.00	.0659	0.00	0.06	0.00
Northwest	0.00	0.06	0.01	.0728	0.00	0.05	0.00
Southwest	0.01	0.12	0.02	.133	0.01	0.10	-0.01
Quality of Construction							
Missing	0.08	0.27	0.10	.306	0.05	0.22	-0.05
Original	0.04	0.19	0.05	.219	0.03	0.16	-0.02
Simple Renovation	0.16	0.37	0.15	.36	0.17	0.38	0.02
Average Renovation	0.67	0.47	0.62	.486	0.71	0.45	0.09
Premium Renovation	0.06	0.23	0.07	.26	0.04	0.19	-0.03
Community Characteristics							
FAR	2.90	1.36	3.04	1.44	2.77	1.25	-0.27
GreenRatio	32.40	11.30	36.80	10.8	28.20	10.20	-8.60
HOAFee	1.86	1.17	2.41	1.13	1.34	0.95	-1.07
LotSize	41,501	54,307	43,944	46,079	37,598	65,149	-6,346
TotalArea	112,445	184,373	126,510	221,192	94,406	119432	-32,104
NoUnits	902.00	898.00	835.00	779	968.00	998.00	133.00
NoBuilding	12.70	23.90	14.30	28.8	11.00	17.30	-3.30
PropertyAge	10.10	5.44	10.60	5.57	9.56	5.27	-1.04
UnitRent	41.50	18.60	47.30	19.7	36.10	15.70	-11.20
Turnover	12.8	50.1	9.1	25	23.8	89.8	14.7
Price Volatility	1087	806	952	793	1245	1101	98
No. of Communities	611		318		293		
No. of Community×YM Pairs	16,235		8,728		7,507		
No. of Listings	570,458		275,224		295,234		

Notes: This table presents summary statistics for all the variables used in the analysis. It is based on a large sample that contains all the listings in Shenzhen from January 2015 to December 2017.

Table 2: Housing Prices and Remaining Leasehold: Matched FPR Properties

	(1)	(2)
Dep Var	Log(Price) × 100	
Sample	Listing	Transaction
Remain_Leasehold	0.442**	0.349**
	(2.08)	(2.13)
Unit Attributes	Yes	Yes
Community Attributes	Yes	Yes
Year-Month FE	Yes	Yes
Matched Pair FE	Yes	Yes
N	970,401	13,316
Adj. R^2	0.801	0.901

Notes: This table presents the coefficients on *Remain_Leasehold* based on the regressions following Eq. (7). *Remain_Leasehold* is calculated as 70 - property age. The dependent variable is the logarithm of the listing (Column (1)) and transaction price (Column (2)). Data for Columns (1) and (2) contains listings and transactions, respectively, in Shenzhen from January 2015 to December 2017 for the matched pairs of FPR communities. The right hand-side variables include *Remain_Leasehold*, the number of bedrooms, the number of living rooms, the number of bathrooms, the floor area, an elevator indicator, dummies for unit direction and construction quality, the community green area ratio, and community property management fees. We also control for pairs (groups) of complexes and year-month fixed effects so that we can compare units in similar FPR complexes but with different leaseholds. Standard errors are double clustered around Group and YM. All regressions are OLS regressions. The t-statistics are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: Listing Price Differences between Matched FPR and LPR Properties

	(1)	(2)	(3)	(4)	(5)	(6)
Dep Var	Log(Unit Price) × 100					
FPR	118.261***	113.392***	118.036***	66.072***	65.418***	68.484***
	(76.54)	(48.86)	(47.82)	(4.93)	(4.52)	(4.28)
FPR×*Remain_Leasehold*				0.858***	0.793***	0.822***
				(3.87)	(3.27)	(3.08)
Unit Attributes	Yes	Yes	Yes	Yes	Yes	Yes
Community Attributes	Yes	Yes	Yes	Yes	Yes	Yes
Unit Rent	No	No	Yes	No	No	Yes
Fixed Effects	Group+YM	Group×YM	Group×YM	Group+YM	Group×YM	Group×YM
N	537,502	537,502	384,650	537,502	537,502	384,650
Adj. R^2	0.628	0.660	0.654	0.628	0.660	0.654

Notes: This table presents the coefficients on FPR indicator and FPR × *Remain_Leasehold* based on the regressions Eq. (9). *Remain_Leasehold* is calculated as 70 - property age. The dependent variable is the logarithm of the list price and the data are at the individual listing level. The unit attributes included: number of bedrooms, number of living rooms, number of bathrooms, floor area, an elevator indicator, dummies for unit direction and construction quality; the community attributes include: community green area ratio, and community property management fees. We also control for the interactions of pairs of complexes and listing year-months so that we can compare units in an LPR complex to similar units in a similar FPR complex that are listed at the same time. Standard errors are clustered around Group×YM. All regressions are OLS regressions using all the listings in Shenzhen from January 2015 to December 2017. The t-statistics are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Listed Rental Rate Differences Between Matched LPR and FPR Properties: A Placebo Test

	(1)	(2)	(3)	(4)	(5)	(6)
Dep Var	Log(Unit Rent)					
FPR	0.028	0.049	0.104	-0.803	-0.771	-0.341
	(0.44)	(0.84)	(1.40)	(-1.35)	(-1.44)	(-0.52)
FPR×*Remain_Leasehold*				0.015	0.014	0.008
				(1.46)	(1.59)	(0.72)
Unit Attributes	Yes	Yes	Yes	Yes	Yes	Yes
Community Attributes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	YM	Group+YM	Group×YM	YM	Group+YM	Group×YM
N	10850	7393	7393	10850	7393	7393
Adj. R^2	0.533	0.321	0.336	0.534	0.323	0.337

Notes: This table reports the regression results based on the regressions Eq. (12). The dependent variable is listed rent rate and the data are at the community and month levels. *Remain_Leasehold* is calculated as 70 - property age. The community attributes include: green area ratio, community property management fees, Floor Area Ratio (FAR), total land area, total floor area, the number of units, the number of floors, age, and age squared. We also control for pairs of complexes and listing months so that we compare an LPR complex to its FPR counterpart in the matched pair. Standard errors are clustered at the matched pair level. All regressions are OLS regressions using all the listings in Shenzhen from January 2015 to December 2017. The t-statistics are in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Implied Property Right Uncertainty for FPR and LPR

	$r = 0.03, \quad \hat{\alpha}_0 = 0.65$		$r = 0.05, \quad \hat{\alpha}_0 = 0.65$	
	$\hat{\beta}_1 = 0.004$	$\hat{\alpha}_1 = 0.008$	$\hat{\beta}_1 = 0.004$	$\hat{\alpha}_1 = 0.008$
$\hat{\gamma}_F$	0.882	0.789	0.925	0.862
$\hat{\gamma}_L$	0.461	0.412	0.483	0.450

Notes: Authors' calculations based on the estimates in Tables 2 and 3.

Table 6: Effect of the Public Release of Urban Planning Zoning Codes on Listing Prices

	(1)	(2)	(3)	(4)	(5)	(6)
	Log(Unit Price) × 100					
FPR	123.878***	125.769***	122.594***	73.233***	22.353	27.134
	(59.66)	(51.42)	(40.31)	(3.88)	(0.94)	(1.13)
FPR×Post	-5.771***	-8.759***	-8.633***	-11.920	54.702*	63.726**
	(-3.04)	(-3.12)	(-3.07)	(-0.83)	(1.88)	(2.16)
FPR×*Remain_Leasehold*				0.833***	1.721***	1.595***
				(2.63)	(4.31)	(3.93)
FPR×*Remain_Leasehold*×Post				0.096	-1.070**	-1.213**
				(0.40)	(-2.22)	(-2.48)
Unit Attributes	Yes	Yes	Yes	Yes	Yes	Yes
Community Attributes	Yes	Yes	Yes	Yes	Yes	Yes
Unit Rent	No	No	Yes	No	No	Yes
Fixed Effects	Group+YM	Group×YM	Group×YM	Group+YM	Group×YM	Group×YM
N	384650	384650	384650	384668	384650	384650
Adj. R^2	0.627	0.653	0.654	0.627	0.654	0.654

Notes: This table reports the regression results from Eq. (13). The dependent variable is the logarithm of the listing price multiplied by 100. The variable *Post* is defined as one for listings within 12 months after the release of the new zoning codes and zero for those within the previous 12 months. Unit attributes include the number of bedrooms, the number of living rooms, the number of bathrooms, the floor area, an elevator indicator, dummies for unit direction and construction quality; community attributes include green area ratio, and community property management fees. Standard errors are clustered around matched pair×YM. All the regressions are OLS using all the listings in Shenzhen from November 2015 to November 2017. The t-statistics are in parentheses.

Table 7: Effect of the Public Release of Urban Planning Zoning Codes on Rents: Placebo Test

	(1)	(2)	(3)	(4)	(5)	(6)
Dep Var	Log(Unit Rent)					
FPR	0.225***	0.092*	0.058	-0.352	-0.279	-0.518
	(5.36)	(1.76)	(0.79)	(-0.77)	(-0.41)	(-0.74)
FPR×Post	-0.009	-0.006	-0.002	0.007	0.093	0.135
	(-0.38)	(-0.25)	(-0.07)	(0.05)	(0.48)	(0.67)
FPR×*Remain_Leasehold*				0.010	0.006	0.010
				(1.29)	(0.56)	(0.86)
FPR×*Remain_Leasehold*×Post				-0.000	-0.002	-0.002
				(-0.11)	(-0.49)	(-0.65)
Unit Attributes	Yes	Yes	Yes	Yes	Yes	Yes
Community Attributes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed Effects	YM	Group+YM	Group×YM	YM	Group+YM	Group×YM
N	7393	7393	7393	7393	7393	7393
Adj. R^2	0.546	0.559	0.562	0.547	0.559	0.562

Notes: This table reports the regression results from Eq. (13). The dependent variable is the logarithm of rent and the data are at the community and month levels. The variable *Post* is defined as one for listings within 12 months after the release of the new zoning codes and zero for those within the previous 12 months. Community attributes include green area ratio, community property management fees, the FAR, the total land area, the total floor area, the number of units, the number of floors, age, and age squares. Standard errors are clustered at the matched pair level. All the regressions are OLS using all the listings in Shenzhen from November 2015 to November 2017. The t-statistics are in parentheses.

Table 8: Property Rights Uncertainty, and Speculation: Turnover Rates

	(1)	(2)	(3)	(4)
Dep Var	Turnover Rate × 100			
FPR	-3.511***	-0.889**	-3.871***	-1.317***
	(-15.26)	(-2.32)	(-13.56)	(-3.16)
FPR×Post			0.704**	0.656***
			(2.13)	(2.62)
Community Attributes	No	Yes	No	Yes
Fixed Effects	Group+YM	Group+YM	Group+YM	Group+YM
N	6515	6515	6515	6515
Adj. R^2	0.666	0.814	0.666	0.814

Notes: This table reports the regression results from Eq. (16). The dependent variable is the turnover rate at the community and month levels, defined as the number of listings divided by number of units in the community multiplied by 100. The variable *Post* is defined as one for listings within 12 months after the release of the new zoning codes and zero for those within the previous 12 months. Community attributes include green area ratio, community property management fees, the FAR, the total land area, the total floor area, the number of units, the number of floors, age, age squared, average number of bedroom, average living rooms, and average floor areas. We also control for pairs of complexes and listing months so that we compare an LPR complex to its FPR counterpart in the matched pair. All the regressions are OLS using the data at community by month level from November 2015 to November 2017. The t-statistics are in parentheses. * $p < 0.1$, ** $p < 0.05$

Table 9: Property Rights Uncertainty, and Speculation: Price Volatility

	(1)	(2)	(3)	(4)
Dep Var	Price Volatility			
FPR	-257.076***	-329.437***	-287.042***	-354.007***
	(-11.71)	(-9.08)	(-11.18)	(-9.24)
FPR×Post			58.128**	47.299**
			(2.24)	(1.99)
Community Attributes	No	Yes	No	Yes
Fixed Effects	Group+YM	Group+YM	Group+YM	Group+YM
N	5520	5520	5520	5520
Adj. R^2	0.758	0.797	0.758	0.798

Notes: This table presents the regression results following Eq. (16). The dependent variable is *price volatility*, which is the predicted variance of the residuals obtained from GARCH(1, 1) model of log(Unit Price) × 100 over all listings in the community by month. The variable *Post* is defined as one for listings within 12 months after the release of the new zoning codes and zero for those within the previous 12 months. Community attributes include green area ratio, community property management fees, the FAR, the total land area, the total floor area, the number of units, the number of floors, age, age squared, average number of bedroom, average living rooms, and average floor areas. We also control for matched pair fixed effect and listing year-month fixed effects. Standard errors are clustered at the group level. All the regressions are OLS using the data at community by month level from November 2015 to November 2017. The t-statistics are in parentheses. * $p < 0.1$, ** $p < 0.05$

Table A1: Summary Statistics of Supplemental Samples

Sample	Remaining Leaseholds				Differences
	Low		High		
	Mean	SD	Mean	SD	
	A. Listing Data				
Listing price (per sq. meter)	53,872	21,481	49,448	15,855	(4,424)
Floor Area	99.09	41.17	97.23	45.07	-1.86
Bedrooms	2.746	0.871	2.755	0.964	0.009
Living rooms	1.851	0.412	1.821	0.455	-0.03
Bathrooms	1.45	0.573	1.434	0.624	-0.016
Remain_Leasehold (years)	49.39	2.727	57.28	2.807	7.89
PropertyAge	12.8	3.977	10.78	3.608	-2.02
FAR	3.482	1.629	3.453	2.261	-0.029
GreenRatio	40.9	11.83	37.44	9.471	-3.46
NoUnits	1300	1107	1555	1175	255
HOAFee	2.772	0.884	2.58	0.542	-0.192
N	388,400		660,571		
	B. Transaction Data				
Sale price (per sq. meter)	48,209	19,582	44,137	15,976	(4,072)
Floor Area	88.58	39.04	89.27	44.71	0.69
Remaining_LS (years)	48.82	3.191	57.35	2.958	8.53
PropertyAge	12.26	4.306	11.21	3.227	-1.05
FAR	3.545	1.582	3.184	2.005	-0.361
GreenRatio	41.77	12.3	38.92	9.417	-2.85
NoUnits	1154	731.6	1477	1057	323
HOAFee	2.718	1.011	2.482	0.579	-0.236
N	5,330		8,960		

Notes: This table presents summary statistics of variables in the two supplemental samples that contain listings (Panel A) and transactions (Panel B) of the matched FPR communities from January 2015 to December 2017 in Shenzhen. The samples are used in estimating price discount of *Remain_Leasehold* for FPR units following Eq. (7), reported in Table 2.