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1 Introduction

Extrapolative expectations play an important role in shaping agents' investment choices and explaining asset returns and macroeconomic fluctuations (e.g., Fuster et al., 2010; Greenwood and Shleifer, 2014; Barberis et al., 2015; Malmendier and Nagel, 2016; Botsch and Malmendier, 2020; Kuchler and Zafar, 2019; Bordalo et al., 2018, 2019, 2020). Particularly, extrapolative housing market expectations affect individuals' home purchase, sale, and mortgage financing decisions (e.g., Glaeser and Nathanson, 2017; Adelino et al., 2018; Kuchler et al., 2023). The effect may spill over to the rental market where individual landlords supply their spare properties as rental units since these landlords have an alternative investment option to sell their houses. Landlords who extrapolate on past growth may find home sales more attractive in the near future and become less willing to lock in a long-term rental contract.

The duration of rental supply speaks to a more general question of buying versus renting to the extent that long-term rental housing provides housing stability and peace of mind similar to homeownership. Therefore, to understand the spillover impact of housing market prospects on rental housing supply, it is crucial to understand its impact on rental supply duration. However, this impact is understudied in existing literature due to data limitations. The supply side of the rental housing market is rarely observed separately from the demand side in previous research using landlord-tenant rental contract data, and even less is known about the duration of rental supply, as rental contracts typically have a duration of one year and roll over only when both sides agree to renew.

In this paper, we investigate how local housing price growth affects the duration of rental housing supply using proprietary rental contract data from a leading Chinese PropTech rental platform in Beijing between 2015 to 2019. This unique dataset is particularly suitable for our analysis of rental supply duration because the platform deals with landlords and tenants separately. Hence, we are able to separately observe the supply and demand sides in the rental housing market. Specifically, the platform serves as an intermediary by sourcing relatively long-term rental properties from individual landlords, renovating rental units based on standardized furnishing templates, and leasing them out to tenants through its online websites and mobile applications. For each rental lease between landlords and the PropTech platform, we obtain detailed information regarding the rental housing unit, contract terms (including the duration and rent), whether it is renewed at expiration, and landlord characteristics. We then merge each rental contract with local housing price growth constructed using home sale transactions within a two-kilometer-radius neighborhood around the rental unit. Our conjecture is that landlords' expectations of future home price growth, extrapolated from recently experienced growth, reduce their willingness to supply long-term rental units.

We begin our analysis by showing that local housing price growth predicts the duration of newly signed landlord-platform contracts in a statistically significant and negative way. Consistent with our hypothesis, we find that a one-standard-deviation increase in recent local housing price growth is associated with an approximately one-month reduction in the duration of rental supply. The results on local rental price growth are also highly significant but slightly weaker, and cannot absorb the impact of housing price growth. In addition to adjusting the duration downward, landlords may be less likely to renew leases with the PropTech platform, corroborating our hypothesis that the supply of longer-duration rental housing decreases with higher housing price growth. These results indicate that landlords' perception of housing market prospects exerts significant influences on the duration of rental supply.

To establish the causal relationship whereby higher market prospects reduce the duration of rental supply, we exploit a house purchase restriction (HPR) policy in Beijing that unexpectedly reduced the growth prospects of some housing units substantially more than it did others. Specifically, on September 30, 2016, the Beijing municipal government introduced an HPR policy that raised the down payment percentage from 50% to 70% for nonordinary housing units, i.e., units with sizes over 140 square meters,[1] with the intention of cooling down the high-end segment of the housing market, which thus has a negative impact on the price growth of nonordinary units. Using nonordinary housing units as the treatment group and ordinary housing units as the control group, our difference-in-differences (DID) analysis shows that nonordinary units experience a significantly larger increase in contract duration than ordinary units less affected by the policy change, consistent

[1] Housing units with sizes below 140 square meters may also be classified as nonordinary units if the price per square meter exceeds 39.6 thousand RMB or the total value exceeds 4.68 million RMB. Further details can be found on the following webpage: https://finance.qianlong.com/2016/1021/1031975.shtml.

with our baseline results. We further adopt the regression discontinuity (RD) approach to focus on a subset of units whose area sizes are near the policy threshold of 140 square meters. Within this close sample range, we obtain consistent results that higher market prospects lead to shorter rental contract duration. Our evidence thus collectively reveals an important spillover impact of housing price growth on rental supply duration.

We provide further evidence supporting the extrapolative expectations of landlords by examining periods of lagged and exceptionally high local housing price growth. We find a more pronounced effect of more recent price growth on the reduction in rental supply duration, consistent with the extrapolation decay pattern proposed by Glaeser and Nathanson (2017), Malmendier and Nagel (2016) and Bordalo et al. (2018). Additionally, individual landlords disproportionately extrapolate on more extreme past growth, echoing the findings in Gulen and Woeppel (2022) on price-path convexity and extrapolation in stock returns.

To support our arguments that extrapolative landlords reduce their contract duration to enjoy greater flexibility in home sale timing, we conduct various heterogeneity analyses utilizing landlord and property features. We show that the effect of local housing market prospects on rental supply duration is more pronounced for landlords with multiple rental units than for those with only one rental unit with the PropTech platform, consistent with the rationale that multi-home landlords place greater value on home sale options. We also find that given local housing price growth, older landlords are less likely to reduce rental supply than younger landlords, implying that older generations are more conservative in investment and that they rely more on rental housing to generate income as evidenced by Gargano and Giacoletti (2022). In terms of property features, we show that the negative impact is more pronounced for rental units that are easier to sell, such as those with two or fewer bedrooms and entire-rental units, consistent with the fact that housing market prospects are more relevant for units with higher marketability. Additionally, the effect is less pronounced for units that are to incur greater renovation expenses on the PropTech platform, i.e., units with poor initial conditions.

In the last part of the paper, we examine the impact of local housing price growth on the term structure of rent and landlord-tenant matching. We document an upward-sloping, convex term structure of rent by showing a positive relationship between lease duration and rent. We find that the rent with a duration above the median increases further with better market prospects, suggesting that local housing price growth further bends up the term structure of rent. In terms of the real impact on rental market matching, we find that the available duration of leases supplied by landlords positively predicts tenants' duration demand. This maturity-matching pattern can be explained by two reasons: First, tenants prefer units with sufficient lease length that matches well with their planned occupancy in the rental unit to achieve housing stability and reduce rollover risk. Second, the PropTech platform plays an intermediary role by matching the maturity demanded by tenants with that supplied by landlords. Space sourced from landlords with longer available duration would be offered to tenants with longer planned occupancy in the units. Our findings suggest that rental supply duration has a real impact on the stability of rental housing.

Our paper contributes to several strands of literature on housing, expectations, and the role of intermediaries. First, our paper identifies the impact of experienced housing market growth on individual landlords' rental supply duration, highlighting the connection between the housing and rental markets. Amid the extensive research on housing markets and real estate economics (e.g., Case and Shiller, 1989; DiPasquale and Wheaton, 1994; Sinai and Souleles, 2005; Campbell et al., 2011; Fuster and Zafar, 2016; Gete and Reher, 2018; Diamond et al., 2019; Malmendier and Wellsjo, 2020; He et al., 2020; Howard and Liebersohn, 2021; Gupta et al., 2022a,c,b), most studies examine the two markets in isolation. Li et al. (2022) studies the impact of holiday rentals (i.e., Airbnb) on the traditional rental market, without considering housing market prospects. The few exceptions include Favilukis and Van Nieuwerburgh (2021), which finds that housing prices and rents rise substantially due to out-of-town homebuyers and thus identifies the connections between home-buying behavior and rents. Our paper further examines the relationship between housing market conditions and individual landlord behavior. Molloy et al. (2022) find that housing supply constraints have larger effects on home prices than on rents. Adelino et al. (2018) shows that house price risk perceptions strongly correlate with individuals' current housing decisions and future intentions to buy versus rent, while our paper examines the impact of house price growth on homeowners' decisions regarding whether to sell or rent out their vacant properties. To the best of our knowledge, our paper is among the first to study the impact of local house price growth on rental housing supply and the spillover effect of housing market policies.

Second, we provide novel empirical evidence supporting extrapolative expectations using contract-level data from the rental housing market. Recent research on subjective belief formation finds that agents appear to extrapolate on past growth to form expectations about future growth, which holds across asset classes in different markets and in macroeconomic forecasting (e.g., Fuster et al., 2010; Greenwood and Shleifer, 2014; Barberis et al., 2015; Hirshleifer et al., 2015; Malmendier and Nagel, 2016; Glaeser and Nathanson, 2017; Adelino et al., 2018; Cassella and Gulen, 2018; Bordalo et al., 2018, 2019, 2020; Choi and Mertens, 2019; Da et al., 2021). In the housing market, specifically, Case and Shiller (1989) and DiPasquale and Wheaton (1994) show that housing prices exhibit significant momentum. Armona et al. (2019) show that individuals revise their year-ahead home price expectations in a way consistent with short-term momentum in home price growth. Gao et al. (2020) show that past housing price growth stimulated housing speculation through home buyers' extrapolative expectations, which affected local economic performance. Gargano et al. (2020) find that local experiences of housing price growth affect home buyers' online search activities and have real impacts on the housing market. Bottan and Perez-Truglia (2020) conduct field experiments and find that higher home price expectations caused a reduction in homeowners' likelihood of selling their houses. We contribute to research on extrapolative expectations in the housing market by providing empirical evidence using rental housing contract data. Our findings show that recently experienced home price changes negatively impact the lease term of rental housing supply and that more recent and extreme local housing price growth has a larger impact.

Third, our study offers new insights into the parallel literature on the value-enhancing role of financial intermediaries (e.g., Bernstein et al., 2016; Samila and Sorenson, 2011) by analyzing the role of a PropTech intermediary in the rental housing market. Our findings show that renovation by PropTech firms has a positive impact on rental supply duration, highlighting the role of rental agencies in boosting rental supply and enhancing rental market stability. Our study is related to Reher (2021), which shows that financial intermediaries improve rental housing quality and affordability by financing quality improvement projects. Our result differs from Reher (2021) in that in our study, the units that receive more quality improvement in terms of higher renovation expense have higher relative rent. The PropTech intermediary in our study is also distinct from other technology-enabled intermediary innovations in the housing market, such as Zillow's Zestimate algorithm designed for residential property sales (see Fu et al., 2022) and the algorithm-based iBuyers studied in Buchak et al. (2020), who purchase and sell residential real estate through online platforms and supply liquidity to households by shortening the home sale process. Our paper thus contributes to the understanding of an emerging PropTech business model in the rental housing market.

The remainder of our paper proceeds as follows. Section 2 provides details on the institutional background of housing and rental markets in China. Section 3 describes our data and sample. Section 4 summarizes our empirical methodology exploiting the HPR policy. We report our regression results on local housing price growth and rental supply duration in Section 5. Section 6 presents further analyses on landlords' renewal decisions, the term structure of rents, and the real impact of longer rental supply duration. We conclude the paper in Section 7.

2 Institutional Background

2.1 The Rental Housing Market

A stable supply of long-term rental housing has important implications for social welfare because a large fraction of households live in rented homes, especially in large cities with severe housing affordability issues. Recent statistics show that over one-third of U.S. residents are renters, and this number is even higher in urban metro areas such as Los Angeles and New York City (Reher, 2021). In Europe, the homeownership rate ranges from less than 50% to approximately 80% (Malmendier and Wellsjo, 2020), implying that the remaining 20% to 50% of households live in rented homes or are homeless.

The rental housing market also plays a pivotal role in China, where housing prices have grown rapidly in the past two decades. According to the Blue Book of Urban Rental Life 2021, the population living in rented houses will reach 260 million by 2030, a number equivalent to approximately 80% of the entire U.S. population. Nearly 70% of the migrant population relies on rental housing, and some of them have lived in these homes for a long time (Report of the Ministry of Housing and Urban-Rural Development, 2021). Among tenants in first-tier cities (namely Beijing, Shanghai, Shenzhen, and Guangzhou) in China, 75% have lived in rented homes for more than three years; 12% have lived in rented homes for over ten years; and 51% plan to rent for five more years, including 18% who plan to rent for ten more years.[2]

However, the duration of rental contracts is short in China, which, while comparable at face value to the case in developed countries, generates significant rollover risks for tenants due to insufficient tenant rights protections. According to a 2015 survey, approximately 80% of rental contracts have a duration of one year or less.[3] Furthermore, since institutional landlords are still in the development stage in China, renters have traditionally relied on the individual leasing market, thus suffering from unstable rental periods, a lack of service, and a low level of transparency.[4] Additionally, the quality of rental housing is concerning: According to the Chinese Census Yearbook 2020, while one-quarter of urban households in China lease their homes, 65.3% of the houses are over 20 years old, with 27.3% of rental housing being over 30 years old and 40% of rental homes suffering from a lack of maintenance and renovation.

2.2 PropTech Rental Intermediary

A PropTech business model has emerged as a market-based solution to the aforementioned frictions in the rental housing market. These PropTech rental intermediaries function not only as a traditional rental agency but also as a "second-hand landlord" that sublets to tenants to earn rent differences and a property manager that provides services such as home improvement, housekeeping, and maintenance. Specifically, these PropTech platforms source housing units from property owners, renovate these units following standardized template styles and then rent them out at a premium while providing the abovementioned add-on services.

The PropTech rental platform in our study is one of the largest subleasing PropTech platforms in China, acquiring individual landlords and tenants through its own websites, mobile applications, and offline advertisements. Based in Beijing, it targets the niche rental market of young, educated newcomers in large cities, where the housing price is too high to afford at least in the short run, and provides them with a furnished accommodation at premium. It also allows tenants to switch to different rental housing units within the platform, thus offering flexibility for city newcomers

[2] See https://www.chinanews.com.cn/cj/2021/11-16/9609800.shtml.
[3] See https://xw.qq.com/amphtml/20211012A08RJM00.
[4] See https://www.chinanews.com.cn/shipin/spfts/20210830/3582.shtml.

to "move up the rental ladder" before they buy a property. According to estimates by the Wall Street Journal, this PropTech rental platform manages over 500,000 rooms and approximately 1.2 million tenants in nine major Chinese cities. As of the end of 2021, it held approximately 20% of the market share in the long-term rental market, cumulatively serving approximately 500 thousand homeowners and 5 million tenants in all four top-tier cities (Beijing, Shanghai, Guangzhou, and Shenzhen) and six other major cities in China. Thus, this comprehensive dataset provides an excellent empirical setting to examine individuals' rental housing market behavior with sufficient cross-sectional and time variation.

The fact that the PropTech rental platform deals with landlords and tenants separately enables us to disentangle the supply and demand sides in the rental housing market. There are two types of rental contracts: rental leases between landlords and the PropTech platform (*landlord-platform contracts*) and those between the platform and tenants (*platform-platform contracts*). The PropTech rental platform earns profits from the rent differences between landlords and tenants, net of renovation and management expenses. The room remodeling and subleasing features of the PropTech platform distinguish it from traditional rental agencies that serve as middle persons and earn only commission fees. This business model also differs from institutional landlords that typically own their properties, which do not face rent spread risks.

In terms of rental supply duration, the duration of landlord-platform contracts typically ranges from 1 to 5 years, while landlords in the regular rental market typically offer leases with durations within one year to tenants. From the landlords' perspective, leasing to the PropTech platform is similar to leasing to a long-term institutional tenant. Considering the fixed cost of renovation and furnishing, the PropTech platform is always incentivized to secure long-term contracts with property owners to spread the costs. Therefore, the negotiated duration of the landlord-platform contracts largely reflects the highest duration that landlords are willing to supply.

2.3 Housing Market Regulations

The Chinese government led by President Xi Jinping has adopted a series of policies to contain the soaring housing prices in top-tier cities.[5] Deng et al. (2022) use spillovers from HPR policies on local housing to nearby unregulated cities to identify the impact of out-of-town housing demand on house prices and consumer spending.

We focus on the HPR policy in Beijing, which consists of a series of rule changes implemented in a short period of time between October 2016 and March 2017. On September 30, 2016, the HPR policy raised the down payment rate for a nonordinary second home from 50% to 70% and left the down payment rate of an ordinary second home unchanged at 50%.[6] In March 2017, the down payment rates were further raised to 80% for nonordinary second homes and 60% for ordinary second homes.[7] As a result, the price growth of nonordinary housing units decreased significantly relative to that of their ordinary counterparts.

According to the HPR policy, nonordinary units are those that (1) have a structural area of more than 140 square meters or (2) have a price per area above 39.6 thousand RMB or a total value above 4.68 million RMB. However, the cutoff of the housing value for labeling ordinary versus nonordinary units may lead to manipulation. That is, some owners, when selling their housing units, may sell them at a price that is just below the cutoff price on paper while collecting the remainder under the table. Thus, in our empirical analysis, we define nonordinary units using the size cutoff, which is immune to potential manipulation.

3 Data and Summary Statistics

3.1 Data Sources

Rental contract data. We obtain contract-level data from a large PropTech rental platform in China, which leases dwelling units from individual property owners and subleases them to individual

[5] See http://www.xinhuanet.com/english/2021-01/06/c_139646693.htm for an article on "housing is for living in, not for speculation."

[6] See http://finance.qianlong.com/2016/1021/1031975.shtml

[7] See https://www.scmp.com/business/china-business/article/2079960/beijing-rolls-out-harshest-ever-home-buyer-down-payment

tenants. Our data contain both landlord-platform and tenant-platform contracts. We focus on the rental housing market in Beijing since the PropTech rental platform has the largest market share and the longest operating period in Beijing, the capital of China, where it started its business. Our sample period starts in January 2015 and ends in December 2019, which covers sufficient observation periods around the HPR policy shock while excluding the potential impacts of the COVID-19 pandemic in China.

We extract the following three sets of variables from the database: (1) housing unit characteristics, such as home address, area size, number of bedrooms, building age, whether the heating is provided, landscape ratio of the residential block, and whether there is at least one elevator; (2) landlord-platform contract information, such as the signing date, contract duration, renovation expenses, rents received from tenants, rents paid to landlords, and renewal status (indicator); and (3) tenants-platform contract information, including the signing date, contract duration, renewal status (indicator), and tenants' gender, age, and educational background.

Housing market data. We manually collect housing transaction data in Beijing from a major real estate broker's website.[8] The dataset contains 463,590 relevant second-hand housing transactions from January 2013 to December 2019 in the six main urban districts in Beijing. The website records over 64% of all second-hand housing transactions in our sample period and therefore should be largely representative of the Beijing housing market. This data allow us to construct two key variables: (1) price (and price growth) and (2) number of transactions in the neighboring area for each observation in our rental unit sample.

3.2 Descriptive Analysis

Spatial distribution of sample data. Figure 2 visualizes the spatial distribution of our sample contracts (Panel A) and second-hand home transactions (Panel B) in 130 subdistricts (*jiedao*) in Beijing. Panel A covers 92,948 landlord-platform rental contracts signed between 2015 and 2019, while Panel B covers 463,590 second-hand home sale transactions obtained from a major real estate broker's website (Lianjia.com). As shown in Figure 2, these rental contracts and housing transactions not only are concentrated in subdistricts with vigorous economic activities, such as

[8] The data are collected through an automated web search on Lianjia.com

the central business district (CBD), but also have a diverse geographic distribution.

Furthermore, we find that the spatial pattern of rental housing units highly resembles that of second-hand home transactions; that is, subdistricts with active housing market activities are also important sources for the PropTech platform to lease rental housing units from individual landlords. The similarity in the spatial patterns of rental contracts and second-hand home transactions validates our assumption that individual landlords simultaneously consider the options of renting out and selling their houses and that the properties for sale are comparable to those for rent. Hence, local housing market conditions are likely to affect landlords' decision-making regarding rental contracts with the PropTech agency.

Distribution of rental contract duration. Figure 3 presents the distribution of our main variables for rental contract duration. Panel A shows that the duration of first-time landlord-platform contracts is concentrated in the range of three to five years; only a small number of landlord-platform contracts have a duration of one, two, or six years. Panel B shows that most first-time tenant-platform rental contracts have a duration of one year, due to a rule of the PropTech agency that tenants' initial contract cannot exceed one year. Panel C shows the distribution of tenants' total number of years with the PropTech agency (including renewals). We find that while the majority of tenants stay with the PropTech platform for no more than one year, there are many tenants who have renewed their contracts at least once, implying that the one-year duration constraint is binding for some tenants that demand longer-term rental housing.

Housing price and rent growth. Figure 4 shows the quarterly trends of housing and rental price growth between 2015 and 2019. As shown in Panel A, the average housing price in Beijing grew from 40,000 RMB per square meter at the beginning of 2015 to nearly 80,000 RMB per square meter by the end of 2016, almost doubling during a short span of two years. The year-on-year price growth is also increasing and reaches over 60% at its peak, as indicated by the dotted line. This soaring trend slowed slightly with the rollout of the HPR policy in early 2017, with the year-on-year growth rate decreasing from its peak of 60% to negative in less than a year. The average home price in Beijing then remained at a level of approximately 70,000 RMB per square meter throughout 2018 and 2019, with nearly zero year-on-year growth.

Panel B plots the average monthly rent per square meter that the PropTech platform paid to landlords over time. The monthly rent increased from 60 RMB per square meter at the beginning of 2015 to approximately 100 RMB per square meter in 2019. Notably, the year-on-year rent growth rate fluctuates within a narrow range between 0% and 20%, implying that the rental price is more stable than the housing price during our sample period.

Impact of the HPR policy. Figure 5 illustrates the price discount of nonordinary houses relative to ordinary houses using second-hand home transaction data from Lianjia.com. Specifically, for each nonordinary housing transaction in month t, we calculate the average transaction price of all ordinary houses that share the same housing characteristics in the same residential block as the nonordinary unit transacted between months $t-2$ and t. The price discount is calculated as the ratio of the transaction price of nonordinary units to that of the matched ordinary units. Our price discount measure accounts for the property's location, housing characteristics, and transaction month fixed effects. We present the price discount for a [-2 years, +2 years] period around the HPR policy, along with the 95% confidence interval, as shown in Figure 5. Our results show that the relative price discount increases from 3% to 5% after the HPR policy, indicating that the HPR policy reduces the value of nonordinary units more than it does that of ordinary units.

3.3 Summary Statistics

Our final sample consists of 92,948 landlord-platform contracts and 177,581 tenant-platform contracts signed in Beijing between January 2015 and December 2019. Table 1 presents the definitions of our main variables and Table 2 reports the summary statistics. Our main dependent variable is the duration of landlord-platform contracts (Dur_L). As shown in Panel A of Table 2, most contracts have a duration greater than or equal to three years.[9] The average contract duration is 3.88 years, and the standard deviation is 1.01 years. Panel B shows that the renewal rate of landlords with the PropTech rental platform is approximately 86%, with a standard deviation of 35%.

The PropTech platform converts housing units sourced from individual landlords into standardized furnished units, which incurs significant renovation expenses. Panel A of Table 2 shows that, the renovation expenses ($RenoCost$), on average, amount to 37% of the annual rent. That is, if the

[9]The early termination rate of the landlords is approximately 1.5% in our sample.

renovation increases the rent paid by tenants by 10%, then the payback period is approximately 3.7 years. If a landlord leases the unit to the agency for five years, then she may receive higher rent, even after the agency charges a spread that covers all renovation costs, than if leasing the unit "as is" without the PropTech platform.

Since the agency provides relatively standardized products, the renovation expense depends mostly on the initial condition of the properties. In our sample, the housing units on average have a size of 72.32 square meters, with a standard deviation of approximately 28 square meters, and were built almost 17 years ago, with a standard deviation of 7.5 years. The average green ratio is 31%, which is just above the minimum ratio required by the government. Of the housing units, 29% have one bedroom, and 22% have three or more bedrooms; 52% of the housing units are rented out as an entire unit, while the remaining 48% are shared apartments; 64% have elevators and 89% provide heating. Given the substantial heterogeneity in initial housing conditions, the variation in renovation expenses is large, with a standard deviation of 24%. The average ex-post rental spread earned by the agency (*RentSpread*) is approximately 22%. There is also substantial variation in the spread, with a standard deviation of 22%, reflecting that the agency has taken on significant risks associated with rental market fluctuations and sometimes reports losses.

Panel C of Table 2 displays the summary statistics for our main housing market variables. The average (median) local housing price growth *PriceGrowth* is 13% (6%) per year, meaning that home prices in Beijing grow rapidly in our sample period. The price growth is right-skewed, with the top quartile ranging from 27% to 53% and the bottom quartile ranging from -8% to -1%. The average local rent grows by approximately 12% per year.[10]

Panel D reports tenant characteristics. The tenants' average age $TenantAge$ is approximately 33 years old, with a standard deviation of approximately 5 years. The average rounded commuting distance *CommuteDistance* is 8.22 kilometers, with a large standard deviation of 7.86 kilometers; 48% of the tenants are female, 6% are local Beijingers, 50% have a bachelor's or higher degree, 29% work in the IT industry, and 13% work in the financial industry. Overall, these tenants are likely

[10]Note that the average (median) rent-to-price ratio is approximately 1.78% (1.72%), which appears to be quite low compared to the prevailing interest rate of approximately 3 to 3.5% in this time period but is in line with that of existing studies. For example, Chen et al. (2022) finds that the rent-to-price ratio is approximately 1.4% in Shanghai in 2017 and attributes this low rent-to-price ratio to the "Hukou" system in China, which prevents non-homeowners from receiving local public services.

to be educated working professionals in their early-career stage who have migrated to Beijing for education and work.

4 Empirical Methodology

4.1 Baseline Regression

We start with a simple ordinary least squares (OLS) regression to examine the impact of local housing price growth on the contract duration between landlords and the rental agency. For a rental contract i, we have

$$Dur\_L_i = \alpha + \beta_1 PriceGrowth_i + \beta_2 RentGrowth_i + \beta_3 RenoCost_i + \gamma_m + \gamma_d + \eta \mathbf{X}_i + \epsilon_i \tag{1}$$

where i denotes a rental contract signed between the landlord and the PropTech platform in year-month m in administrative district d. Dur_L denotes the landlord-platform contract duration. $PriceGrowth_i$ is the annual housing price growth. $RentGrowth_i$ is the annual rent growth. $RenoCost_i$ is the renovation expense paid by the rental agency scaled by the annual rent received by the landlord.

We expect coefficients β_1 and β_2 to be negative and β_3 to be positive based on our model predictions. To control for housing conditions, we include a vector of housing characteristics as control variables, such as house age, house size (structure area size, in logs), the number of bedrooms, and whether the building has an elevator, heating, or landscaping. We include year-month dummies γ_m to control for those time-specific fixed effects that are common to all rental contracts signed in the same month. We also include district dummies γ_d on the housing location to control for time-invariant administrative district characteristics. We adjust the standard errors for time and block clusters. In our additional robustness tests, we include housing block fixed effects. As the number of properties in a housing block is much fewer than that of a district, we expect housing block fixed effects to offer a much stricter control for location-specific fixed effects. Our main findings still remain qualitatively similar using the block fixed effects.

4.2 HPR Policy as an Exogenous Shock

4.2.1 Matched Difference-in-Differences (DID) analysis

Our identification strategy exploits the HPR policy launched by the Beijing municipal government in 2017, which targets nonordinary units with an area size of over 140 square meters. We first conduct a DID analysis with the following specification:

$$Dur\_L_i = \alpha + \beta_1 NonOrdinary_i \times PostHPR_i + \beta_2 NonOrdinary_i + \gamma_m + \gamma_d + \eta \mathbf{X}_i + \epsilon_i \tag{2}$$

where i denotes a landlord-platform contract signed in year-month m in administrative district d. Dur_L represents the duration of the landlord-platform contract. We label rental housing units with sizes over 140 square meters as our treatment group (i.e., $NonOrdinary = 1$) and those with sizes under 140 square meters as the control group (i.e., $NonOrdinary = 0$). $PostHPR_i$ equals one for rental contracts signed after March 2017, when all HPR policies took effect.

Our control variables $\mathbf{X}$ include recent local housing price growth *PriceGrowth* and rent growth *RentGrowth*, green plot ratio *GreenRatio*, renovation-expense-to-rent ratio *RenoCost*, rental spread *RentSpread*, building age *PropertyAge*, housing unit size (in logs) *Size*, and a series of housing characteristic indicators I(1 bedroom), I(3+ bedrooms), I(Entire unit), I(Elevator), and I(Heating). We include year-month fixed effects γ_m and district fixed effects γ_d. Standard errors are clustered by year-month and residential block.

We adopt a matching approach to address the potential selection problem in our empirical analysis. Rather than using the entire sample population to estimate the DID effect, units in the control group are selected based on their "closeness" to units in the treated group. Specifically, for each rental contract concerning a nonordinary housing unit, we match it with all applicable ordinary units that satisfy the following conditions: (1) the rental contracts of the ordinary housing units are signed in the same period (either pre- or post-HPR) as the nonordinary housing unit, (2) the ordinary housing units are located in the same block as that of the nonordinary unit, and (3) the ordinary housing units have the same number of bedrooms as do the nonordinary unit. We retain the rental contracts of all ordinary housing units that can be matched to a nonordinary unit and drop nonordinary housing units for which we cannot find a match. To the extent that our treatment and control groups are comparable along matched, observable dimensions, such as location, neighborhood, amenities, and number of bedrooms, we are able to rule out confounding factors associated with these housing characteristics.

4.2.2 Regression Discontinuity (RD) Analysis

To fully utilize the HPR policy cutoff in housing unit size and alleviate concerns that units of vastly different sizes may not be comparable, we use an RD design around the 140-square-meter cutoff to identify the impact of housing price growth on rental supply duration. We narrow our sample to those contracts whose underlying units have a structural area size between 125 and 155 square meters. We select the number of bins using the mimicking variance evenly-spaced method and use the spacing estimators developed by Calonico et al. (2015). We use second-order global polynomials to approximate the population conditional mean functions for nonordinary and ordinary houses. We follow Calonico et al. (2015) to determine the optimal bandwidth, using both mean square error (MSE)- and coverage error rate (CER)-optimal bandwidth selectors for the sum of the regression estimates. Our MSE- and CER-optimal bandwidths are 4.13 and 2.17 square meters, respectively. We run regressions using the specific samples within the corresponding bandwidths for our empirical inference.

5 Housing Market Growth and Rental Housing Supply

In this section, we empirically investigate the effect of housing market conditions on rental housing supply. We first test our main hypothesis that housing market conditions affect the contract duration of rental housing supply. In particular, if landlords form extrapolative expectations based on past housing price growth, either rationally or irrationally, then after a run-up in home prices, they expect a high payoff from selling the property in the near future when the housing price maintains its momentum. Previous research (e.g., Bottan and Perez-Truglia, 2020) has shown that higher home price expectations, formed on past local housing price growth, caused a reduction in potential sellers' probability of selling their houses within the following months since they become more optimistic about future price growth. Our paper, on the other hand, considers a longer horizon, i.e., the following three to five years. Therefore, we expect that landlords are less likely to enter into a long-term rental contract, so as to retain the alternative option to sell the property and realize capital gains before the housing price momentum attenuates.

5.1 Baseline Results

Table 3 reports the regression results of the impact of recent local housing price growth on rental contract duration. Consistent with our model predictions, the coefficients of housing price growth are all significantly negative. In Column (1), the coefficient on price growth is -0.46, implying that a one-standard-deviation increase in price growth (18%) is associated with a one-month decrease ($0.18 \times 0.46 = 0.083$ years, or 30 days) in contract duration. Another way to interpret this duration decrease is that one out of every twelve contracts would have its duration decreased by one year following an excess home price growth of approximately 18% in the past twelve months. We control for a rich set of home characteristics, including the property age, number of bedrooms, structural area, elevator indicator, heating indicator, and green landscape ratio. We also include district fixed effects in our regressions to control for time-invariant neighborhood characteristics, such as location and major amenities.

In Column (2), we regress landlords' contract duration on local rent growth. The expectation hypothesis of the term structure posits that prices at each maturity level reflect the market's expectation of future spot prices. Combining this with extrapolative beliefs, we hypothesize that landlords would be less willing to sign long-duration contracts following a large rent increase if the expected future rent is higher. We find that the coefficient is negative and statistically significant after controlling for home characteristics, showing that previous rent growth is associated with significantly shorter contract duration of rental housing supply. The magnitude of -0.54 means that a one-standard-deviation increase in rent growth (8%) is associated with a decrease in contract duration of 0.043 years, or 15.8 days, which is smaller than that of price growth.

Column (3) includes both *PriceGrowth* and *RentGrowth* in the regression to examine the combined impact of housing price growth on rental housing supply. We find that the coefficient of *PriceGrowth* decreases slightly from -0.46 to -0.43 but remains economically large and statistically significant. Similarly, the coefficient of *RentGrowth* decreases by a small magnitude and maintains its economic and statistical significance. Overall, our results show that local housing price growth exerts significant impacts on landlords' contract duration with the rental agency. These results are consistent with our model predictions based on term structure theories of asset prices and extrapolative beliefs.

One caveat is that our sample only includes those landlords who chose to lease their property through the rental agency but not those who do not, leading to potential selection bias. For example, as selling a house becomes more attractive after large growth in home prices, there may be a larger fraction of landlords who chose to lease their homes directly to tenants in the individual rental market, which typically offers a short-term lease of one-year duration. Some landlords may even quit the rental market. This selection bias, however, works in favor of our argument that rapid housing price growth shortens the duration of the rental housing supply. In other words, our effects are identified from a biased sample that likely understates the variation in long-term rental supply in response to any covariates. Thus, our coefficient estimates for local housing and rental price growth in Table 3 are likely biased toward zero and hence should be viewed as a lower bound of the true effects.

5.2 Causal Impact Identification

To causally identify the impact of housing price growth on the contract duration of rental housing supply, we exploit the HPR policy as an exogenous shock to local housing price growth and housing market expectations. Panel A of Table 4 presents our DID results using three event windows with different lengths: four, eight, and twelve quarters. We find that the coefficients on the interaction term $NonOrdinary \times PostHPR$ are significantly positive across all regression specifications, regardless of the width of the event window and whether we include housing-unit-level controls. In terms of economic magnitude, Column (1) shows that the coefficient of $NonOrdinary \times PostHPR$ is 0.15, which suggests that after the HPR policy, newly signed nonordinary units, on average, have a 0.15-year (or 1.8-month) larger increase in contract duration than their ordinary counterparts. Column (2) shows that our findings are robust when we add year-month dummies to control for time fixed effects. In Column (3), we further include control variables and district fixed effects. The coefficient on the interaction term $NonOrdinary \times PostHPR$ remains statistically significant, although the magnitude decreases slightly.

To mitigate potential confounding effects, we conduct a balance test to ensure that the nonordinary units in our treatment group are comparable along other observable dimensions with the ordinary units in the matched control sample. Panel B of Table 4 reports our balance test results, which show that the nonordinary housing units are not systematically different from the ordinary units in our matched sample, except that they are significantly larger in size (by definition) and less likely to be rented out as an entire unit (possibly due to their larger size). Although nonordinary units also have significantly lower rent spreads and are less likely to provide heating, the differences are relatively small and economically close. Overall, the balance test confirms that our DID analysis, by comparing the differences between nonordinary and matched ordinary samples before and after the HPR policy, captures the causal impact of the variation in housing market prospects on landlords' choice of rental supply duration.

Next, we test for the parallel trends assumption for our DID analysis. One may be concerned that the rental contract duration of nonordinary housing units responds to housing price growth differently than that of ordinary units even before the implementation of the HPR policy. As a result, our regression results may not reflect the impact of exogenous housing price changes due to the HPR policy. To test whether parallel trends exist prior to the HPR policy, we regress rental duration on a vector of interaction terms between $NonOrdinary$ and semiannual period dummies. Our benchmark period is defined as the semiannual period between October 2016 and March 2017, which is omitted from the regression.

Figure 6 depicts the estimated coefficients of the interaction terms against the corresponding semiannual periods. We find that the differences between the rental contract durations of nonordinary and ordinary housing units are not significantly different from zero in the pre-HPR period, supporting the parallel trends assumption prior to the HPR policy shock. After the implementation of the HPR policy in March 2017, however, the coefficients become significantly positive, indicating that landlords of nonordinary housing units agree to a longer leasing period in their first rental contract with the PropTech platform than those of ordinary housing units. Our interpretation is that since the HPR policy effectively contains the housing price growth of nonordinary housing units, the landlords of nonordinary housing units expect less favorable housing market conditions in the future and are thus more willing to lease their houses to the PropTech platform for longer terms.

To further alleviate the concern that housing units of vastly different sizes are not comparable along other dimensions, we apply an RD approach exploiting the HPR policy cutoff in housing unit size. Specifically, as the HPR policy applies to nonordinary units with an area size over 140 square meters, we focus on a narrow neighborhood around 140 square meters to causally identify the impact of market prospect variations brought about by the HPR policy on rental supply duration for housing units near the cutoff size.

Figure 7 plots the binned-average contract duration around the 140-square-meter cutoff before and after the HPR policy. Before the HPR policy, we see no apparent difference in contract duration between units that are just above and just below the threshold of 140 square meters in size. After 2017Q1, an apparent discontinuity emerges at the cutoff of 140 square meters, with a significant duration gap of 0.2 years (or 2.4 months). We also present regression results in Table 5, where the interaction term $NonOrdinary \times PostHPR$ is significantly positive. These results lend further support to our main hypothesis that lower market prospects cause landlords to provide a longer leasing period to the PropTech rental agency.

5.3 Extrapolative Beliefs and Extreme Price Growth

We provide further evidence on the impact of market expectations by testing a set of hypotheses regarding landlords' extrapolative beliefs regarding local housing price growth. In particular, a common feature of extrapolative belief processes is that the intensity of extrapolation decays when the horizon moves into a more distant past, as proposed by Glaeser and Nathanson (2017), Malmendier and Nagel (2016) and Bordalo et al. (2018).

We test this hypothesis of extrapolation decay by regressing landlords' contract duration on recent local housing price growth, price growth lagged by 12 months, and price growth lagged by 24 months, as shown in Panel A of Table 6. Column (1) shows that price growth with 12- and 24-month lags significantly reduces the contract duration of rental supply. The magnitude of the coefficient on lagged 12-month price growth (-0.55) is 24% smaller than that on recent price growth (-0.72), while the coefficient on lagged 24-month price growth has the smallest magnitude of -0.51. We run similar regressions on rent growth with similar lags in Column (2) and include all lagged values of price and rent growth in Column (3). These results reveal a clear decay in the economic magnitude as the lag window increases, a pattern that is consistent with our extrapolative expectation hypothesis and distinguishes the findings from alternative theories.

Another empirical regularity for extrapolative beliefs is that the effect seems to be convex with respect to past growth (Gulen and Woeppel, 2022). That is, individuals appear to disproportionately extrapolate on extreme past growth. We test this conjecture of convex extrapolation by including interaction terms between past price growth and an indicator denoting if the price growth is in the top cross-sectional quartile. Panel B of Table 6 reports our regression results, which support the convex extrapolation prediction. Column (1) of Panel B shows that the top-quartile housing price growth has a more negative impact on rental contract duration, with the estimated coefficient being both statistically and economically significant. We repeat the regression for extreme rent growth in Column (2) and find similar results. In Column (3), we include both top-quartile housing and rental price growth variables in our regression. Our estimates remain almost unchanged, meaning that the impact of extreme housing price growth cannot be fully absorbed by that of rent growth.

5.4 Heterogeneous Effects of Price Growth

To support our argument that the home sale option becomes more attractive under local housing price growth and extrapolative market expectations, we further examine the heterogeneous impact of housing price growth on rental supply duration by exploiting landlord characteristics and housing features. Table 7 reports our heterogeneity analysis results with respect to landlord age and whether a landlord owns multiple rental housing units with the PropTech platform. Column (1) shows that local housing price growth has a more pronounced impact on rental supply duration for landlords owning multiple rental units (i.e., $I(\text{Multi}) = 1$) than those owning one rental housing unit (i.e., $I(\text{Multi}) = 0$). Our results become even stronger when we include both housing and rent growth variables in Column (3). These results suggest that, in addition to leasing with the platform, the alternative option of selling the house in good market times is more valuable for landlords holding multiple rental housing units. However, for those landlords with only one rental unit, this option to sell is less valuable and they may be more reluctant to sell their only rental units, especially when homeownership is bundled with the *hukou* system in China, which determines households' access to a series of public resources (e.g., education, medical services, and pension). Hence, landlords with multiple rental units behave more similarly to our model predictions than those holding only one unit.

In terms of landlords' age, Columns (4) and (5) show that the negative impact of local housing price growth is less pronounced among older landlords, with statistically significant coefficients of 0.46 and 1.05, respectively. These coefficients increase to 0.57 and 1.38, respectively, if we include both housing and rent growth variables in our regression, as shown in Column (6). These results indicate that older landlords are less responsive to local housing price growth when leasing with the PropTech agency, consistent with the rationale that older households are generally more risk-averse and more reliant on stable incomes than younger households, and hence the alternative option of selling the rental units becomes less attractive to them relative to stable long-term income from their rental units.

Table 8 reports our heterogeneity analysis results with respect to housing features, such as whether there are more than three bedrooms (i.e., $I(3+\text{ bedrooms}) = 1$), whether it is rented out as an entire unit (i.e., $I(\text{Entire unit}) = 1$) rather than a shared unit, as well as the ratio of agency-paid renovation costs to the annual rent ($RenoCost$), which largely depends on the initial conditions of the rental unit. Columns (1) and (3) show that the contract duration of rental housing units with three or more bedrooms and those with high renovation costs are less responsive to local housing price growth, whereas Column (2) shows that housing units rented out as an entire unit are more responsive to local housing market conditions. Since entire-unit rental homes and smaller houses are more popular and have better marketability in the housing market, our results further support the spillover channel from the housing market to landlords' rental contract decisions.

6 Further Analysis

6.1 Landlords' Contract Renewal

Our previous analysis focuses on the impact of housing market conditions on rental contract duration when landlords enter into a rental contract with the PropTech agency for the first time. To further examine the impact at the extensive margin, we now investigate how housing price growth at contract expiration affects landlords' renewal decision with the rental agency.

We find that higher local housing price growth reduces landlords' renewal likelihood, implying that landlords value alternative options of selling the rental units in times of good market prospects. As shown in Table 9, we find a significantly negative impact of local housing price growth at the time of contract expiration on landlords' renewal likelihood. Column (1) shows that a 1% increase in local housing price growth results in a 0.26% decrease in landlords' renewal likelihood. Given that the standard deviation of local housing price growth is 18%, this coefficient is also economically important. In contrast, Column (2) shows that landlords' contract renewal decision is not responsive to local rent growth at the contract expiration date, suggesting that the alternative option of self-letting is a secondary consideration relative to selling. We include both housing price and rent growth in Column (3) and find that our results still hold.

We include expiration year-month fixed effects, district fixed effects, and housing unit characteristics in all columns. It is possible that the characteristics of the initial landlord-platform contract may also affect landlords' renewal decisions. Hence, we include in our regressions the duration of the initial rental contract, which would expire if the landlord chooses not to renew it.

Table 9 shows that the coefficient on the initial contract duration Dur_L is significantly positive across all columns, implying that landlords who choose the longer duration in their initial contracts are more likely to continue leasing with the PropTech platform. We also find a positive coefficient of the rent spread received by the PropTech platform $RentSpread$, which means that landlords that are more underpaid by the agency (relative to the rent paid by the tenants) in the initial contract are more likely to renew. One interpretation is that the spread charged by the PropTech platform reflects the intermediation value to individual landlords; therefore, landlords with higher reliance on the PropTech platform are more willing to accept a higher intermediation spread and are also more likely to stay with the PropTech platform. Another interpretation is that these landlords are less savvy in bargaining with agencies or are less price-sensitive, hence having a higher renewal probability. Additionally, the coefficients of the renovation expense ratio $RenoCost$ are negative, consistent with our arguments that landlords value the renovation service provided by the PropTech platform, which diminishes in the renewal contracts.

6.2 The Term Structure of Rent

A rental agency could boost rental housing supply by rewarding those landlords that offer longer-term supply with a higher rental price. In this rent schedule, the rental price paid by the rental agency to the landlords would have an upward-sloping curve against the rental duration. To directly test for the positive relationship between rent and duration (i.e., an upward-sloping term structure of rent), we adopt the following empirical specification:

$$Y_i = \alpha + \beta_1 Tenure4_i + \beta_2 Tenure5_i + \gamma_m + \gamma_d + \eta \mathbf{X}_i + \epsilon_i \tag{3}$$

where the dependent variable is the rent paid by the PropTech agency to the landlord of a rental contract i. For less than 1% of contracts with noninteger duration, we take the rounded value of their duration. $Tenure4_i$ is a dummy indicating whether contract i has a rounded duration of 4 years, after rounding the raw duration to the nearest integer. Similarly, $Tenure5_i$ indicates that contract i has a rounded duration of 5 years. We include a series of control variables such as housing price (in logs), local housing price growth, local rent growth, the renovation expense ratio, and a vector of housing characteristics as in Eq(1). We include both year-month and district fixed effects, γ_m and γ_d, respectively, and adjust the standard errors for time and block clusters.

Panel A of Table 10 shows a significantly positive relation between contract duration and the rental price received by the landlords, confirming an upward-sloping term structure of rent. This result is consistent with our expectation that the PropTech platform rewards longer duration by offering landlords a higher rental price. Columns (2) and (4) show that compared with signing a contract with a duration of three or fewer years, a landlord can receive 2.38 RMB higher rent per square meter per month, and 158.41 RMB higher total monthly rent, by entering into a four-year rental contract. The monetary rewards increase to 3.43 RMB and 223.97 RMB for a five-year contract and 5.91 RMB and 608.19 RMB for a six-year contract, respectively. These results are consistent with our model predictions that renovation by the rental agency increases the payoff of the long-term contract and hence an upward-sloping term structure of rent.

In Panel B of Table 10, we examine how local housing price growth affects the term structure of rent. The coefficient of interest is that of the interaction term between the dummy for above-median duration and the local housing price growth rate, $PriceGrowth \times I(Dur\_L > median)$, which is statistically and economically significant throughout Columns (1)-(4). These results indicate that higher housing price growth is associated with higher rents paid by the agency to landlords and that this impact is more pronounced in landlord-platform contracts with above-median duration. Our findings imply that the PropTech agency responds to local housing price growth by increasing rent rewards to landlords, especially to those supplying longer-term rental housing units.

6.3 Real Impact: Maturity Matching in Rental Supply and Demand

We further demonstrate that the landlord-platform contract duration has a real impact by showing the maturity matching between the duration of landlord-platform and tenant-platform contracts. That is, there is some level of maturity matching by the tenants or by the PropTech platform; thus, tenants who prefer longer-term rentals end up living in units with longer availability.

An important institutional detail here is that even if tenants plan to live in the same unit for five years, they cannot do so in their initial contracts since the PropTech platform only permits a duration of no more than one year for new tenants. Therefore, we ask whether tenants' probability of renewing their lease is higher for those who live in rental units with longer availability to test for maturity matching. To avoid confounding tenants' renewal due to landlords' contract expiration, we restrict the sample to rental units with a remaining landlord-platform contract duration greater than 12 months when a tenant's lease expires.

Table 11 presents our regression results using a linear probability model to test whether tenants rent units that match their rental horizon. The estimated coefficient of 0.62 in Column (1) indicates that a one-year increase in the unit's contract duration is associated with a 0.62% increase in the duration of the initial tenant-platform contract. The effect becomes slightly smaller in Column (2) when we add control variables such as tenant characteristics and rent, but the coefficient remains statistically significant. We replace the dependent variable with tenants' actual length of stay ($Total\_Dur\_T$) in Columns (3) and (4). The matching effect remains robust and becomes even stronger, with point estimates of 1.32 (without controls) and 1.21 (with controls). The results show that housing units with longer available rental duration are matched with tenants who sign longer-term contracts with the PropTech platform and who stay with the rental platform for a greater number of years. Thus, the contract duration of the rental housing supply has important welfare consequences.

7 Conclusion

In this paper, we examine the impact of local housing price growth on individual landlords' rental supply by exploiting unique landlord-platform contract data from a large PropTech rental platform in China. To establish a causal relationship between local growth prospects and rental supply duration, we exploit the HPR policy in Beijing as a quasi-natural experiment on the market prospects of nonordinary housing units above a cutoff size and obtain consistent results. We also examine landlord renewal decisions with the PropTech intermediary at the expiration of their existing contracts. Our results reveal that the rental supply duration, as well as renewal likelihood, decreases with higher past local housing growth, consistent with our hypothesis that landlords form extrapolative expectations and prefer the alternative investment option of selling their houses in a booming housing market. Taken together, our results show how extrapolative price expectations explain the contract duration of rental supply to a PropTech rental intermediary, which in turn has a real impact on rental market stability.

A stable rental supply has profound implications for housing affordability and social welfare. Our findings may apply to other economies that face similar issues such as a shortage of stable rental supply and a lack of affordable housing. In the U.S., the recent surge in housing and rental prices has brought about a renewed policy discussion about a stable and affordable housing market (e.g., Favilukis et al., 2021). In China, the government is exploring and experimenting with various ways to avoid a housing crisis (Glaeser et al., 2017; Fang et al., 2016). The role of rental market intermediaries that we document hints at a potential market-based solution for many social problems related to housing stability. Furthermore, to the extent that long-term rental housing provides housing stability, or peace-of-mind, similar to homeownership, it is possible that the variations in long-term rental markets can help explain the cross-sectional dispersion in homeownership rates and its macroeconomic implications (e.g., Sodini et al., 2016). The interplay between the housing and rental markets also suggests a new potential mechanism for housing market momentum and the boom-bust cycle.

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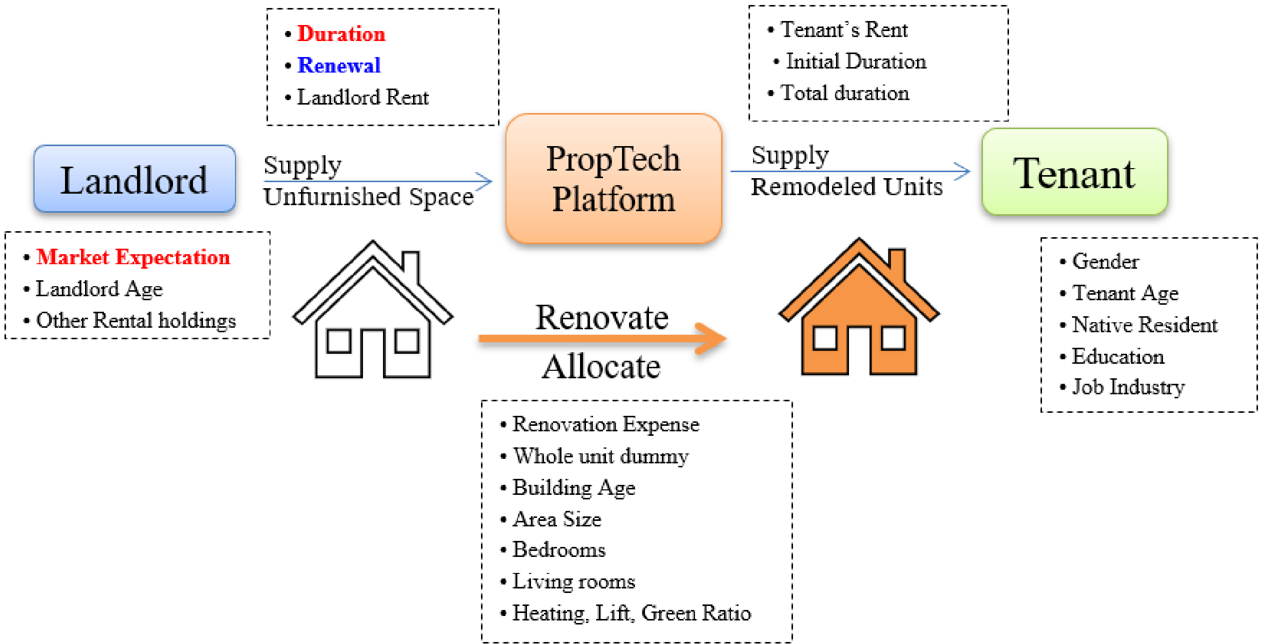
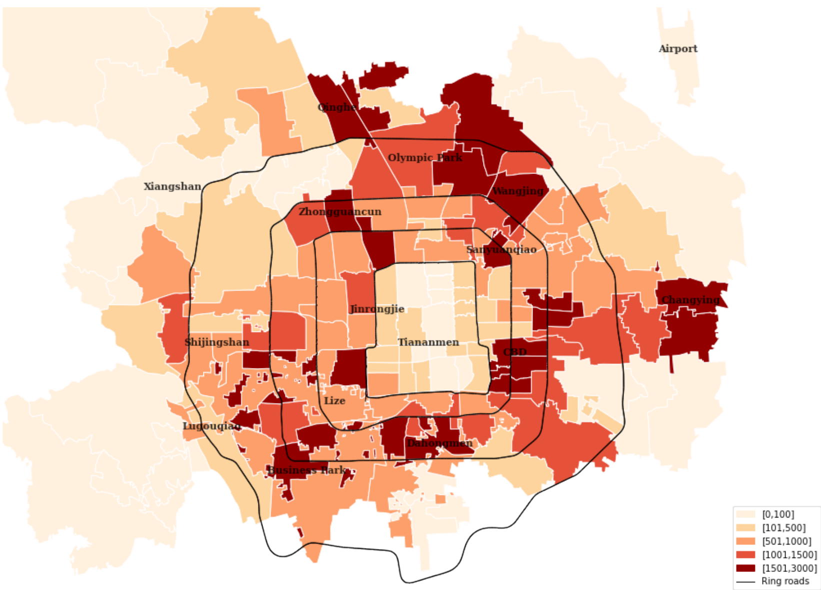
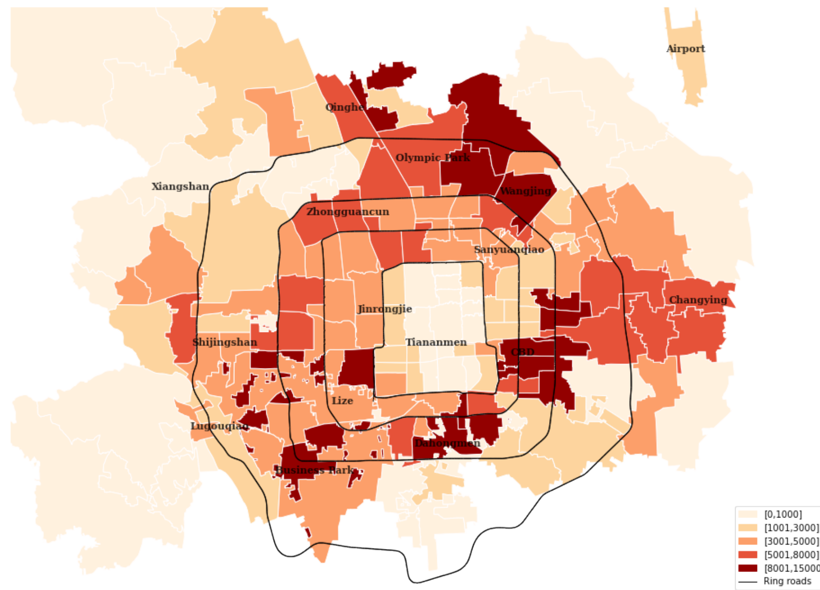


Figure 1: **Roles of the PropTech rental platform.** This figure illustrates the business model of the PropTech platform, which sources rental units from individual landlords, furnishes the units based on standardized templates, and supplies them to tenants through its website and mobile application.

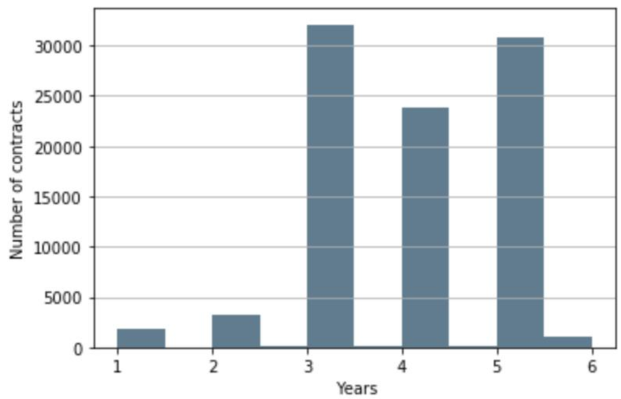


Panel A: Rental transactions

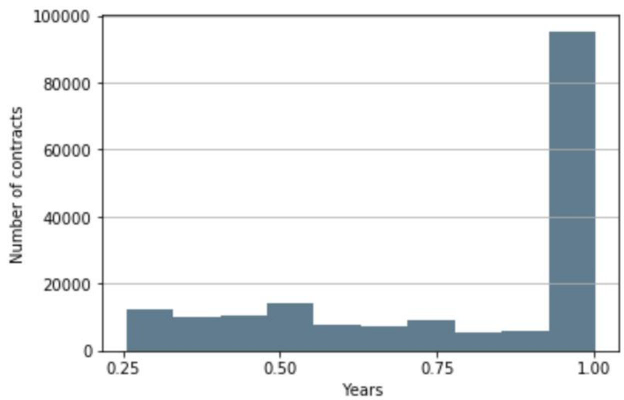


Panel B: Home purchase transactions

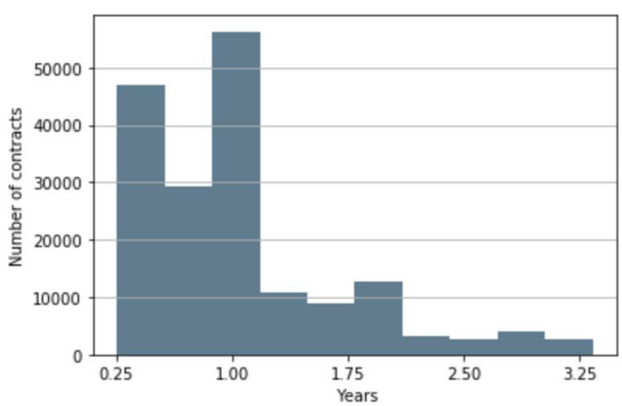
Figure 2: **Spatial distribution of rental and home purchase transactions.** This figure exhibits the spatial distribution of our sample transactions between 2015 and 2019 in Beijing, China. Panel A contains 92,948 rental contracts signed between individual landlords and the PropTech rental agency. Panel B covers 463,590 second-hand home purchase transactions collected from a major real estate broker's website (Lianjia.com).



Panel A: Landlord's contract duration



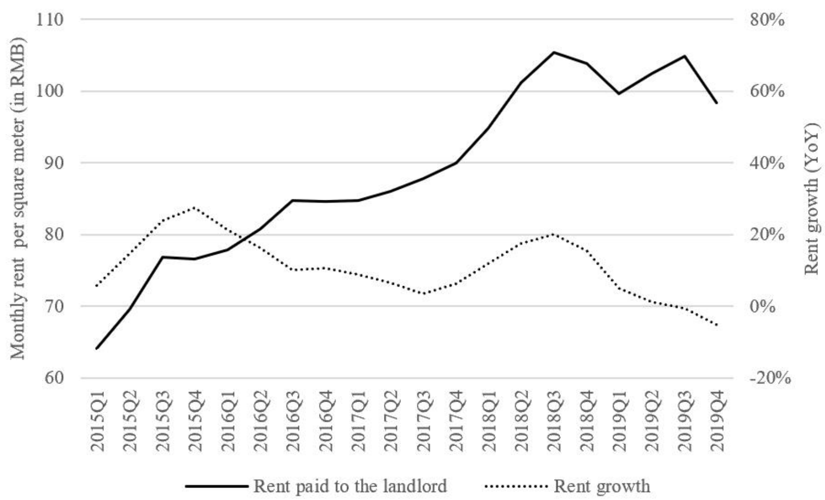
Panel B: Tenant's initial contract duration



Panel C: Tenant's total contract duration

Figure 3: **Duration of rental contracts.** This figure exhibits the histogram of landlords' contract duration (in Panel A), tenants' initial contract duration (in Panel B), and tenants' total contract duration (in Panel C). Our sample contains 92,948 landlord-platform and 177,581 tenant-platform contracts signed between 2015 and 2019 in Beijing, China.

Panel A: Time trend of price growth



Panel B: Time trend of rent growth

Figure 4: **Growth trends of housing prices and rents.** The figure presents the quarterly trend of the aggregate housing and rental market conditions in Beijing between 2015 and 2019. Panel A displays the average housing price (per square meter) and its year-on-year growth. Panel B displays the average rent the PropTech platform paid to landlords (per month per square meter) and its year-on-year growth.

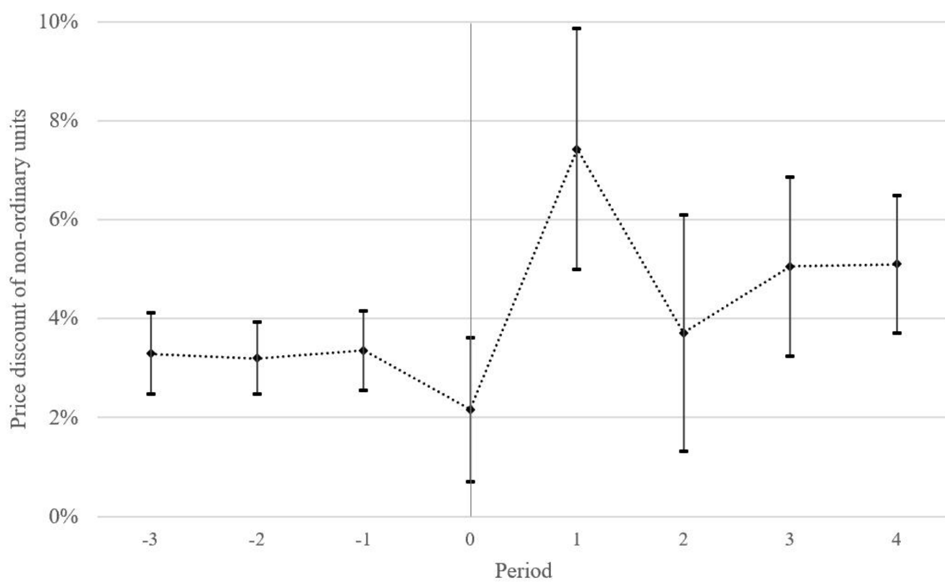


Figure 5: **Price discounts of nonordinary units.** This figure plots the estimated price discounts of nonordinary units relative to ordinary units by semiannual period both before and after the House Purchase Restriction (HPR) policy, which was implemented between 2016M10 and 2017M3 (Period 0). We define nonordinary (ordinary) units as properties with structural area size over (under) 140 square meters and match each nonordinary unit with ordinary units that are located in the same residential block, have the same number of bedrooms, living rooms, and renovation expenses, and are signed in the same pre- or post-HPR period. For each nonordinary-unit transaction in month t, we compute its price discount relative to all matched ordinary-unit transactions between month t-2 and month t. The dotted line represents the trend of the average price discount, and solid lines represent 95% confidence intervals.

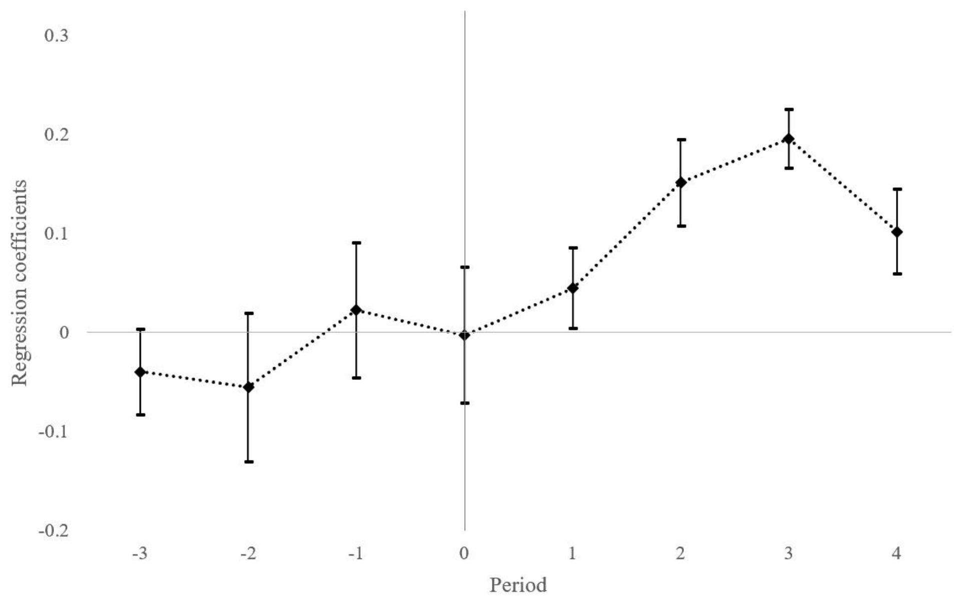


Figure 6: **Pre-trend analysis.** This figure plots the regression coefficients of interaction terms between semiannual period dummies and the nonordinary unit indicator where the independent variable is the landlord-platform contract duration. Our sample covers the semiannual period both before and after the House Purchase Restriction (HPR) policy, which was implemented between 2016M10 and 2017M3 (Period 0). We define nonordinary (ordinary) units as properties with structural area size over (under) 140 square meters and match each nonordinary unit with ordinary units that are located in the same residential block, have the same number of bedrooms, living rooms, and renovation expenses, and are signed in the same pre- or post-HPR period. The 95% confidence interval is drawn based on standard errors clustered at the period and block level.

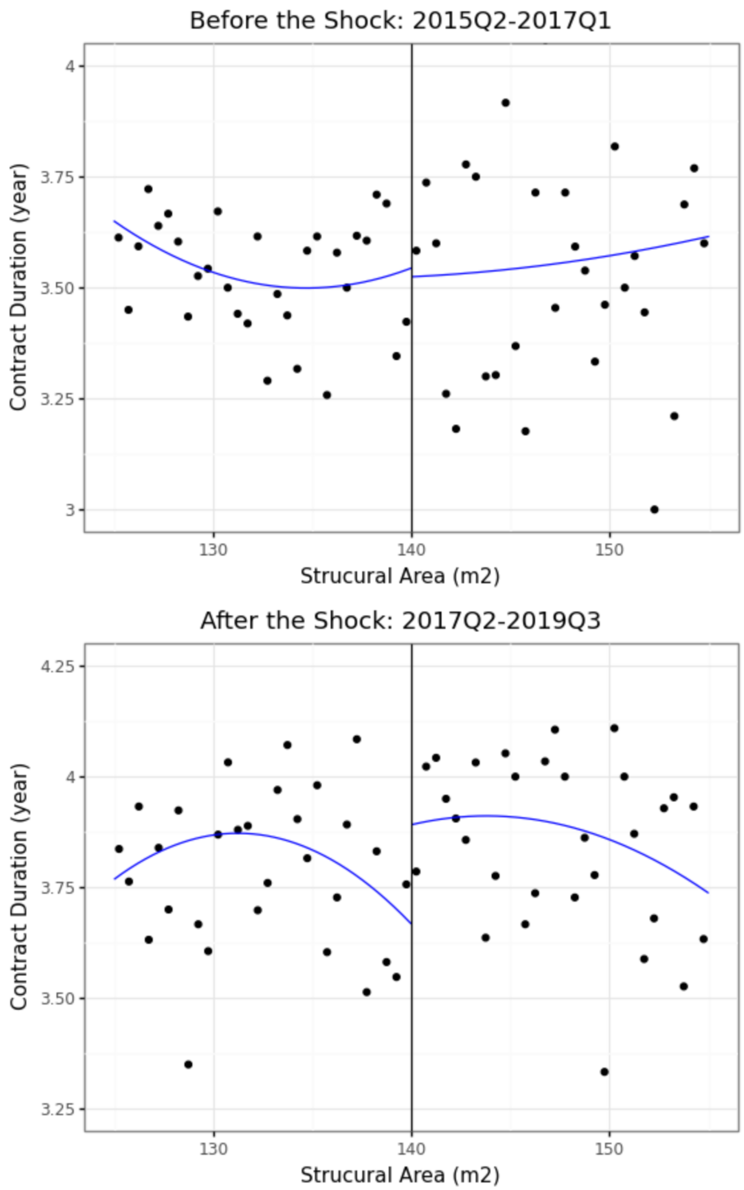


Figure 7: **The HPR policy shock.** This figure plots the average duration of landlord-platform contracts around the HPR policy cutoff of 140 square meters. The sample period in the upper (lower) panel is between 2015Q2 and 2017Q1 (between 2017Q2 and 2019Q3), i.e., before (after) the HPR policy. We restrict the sample to rental units with sizes between 125 and 155 square meters. We select the number of bins using the mimicking variance evenly spaced method and the spacings estimators as in Calonico et al. (2015). We use a second-order global polynomial to approximate the population conditional mean functions.

Table 1: Variable Definitions

Variable	Definition
Panel A: landlord-platform contract characteristics	
Dur_L	The duration of the rental lease between the landlord and the platform.
$RenoCost$	The ex-post total renovation expense the rental agency spent on the property (before leasing to tenants), scaled by the annual rent received by the landlord.
$RentSpread$	The percentage difference between the rents paid by the tenants and the rents received by the landlords.
I(Landlord renewal)	An indicator that equals 1 if the landlord renews the lease with the rental platform when the original lease expires and 0 otherwise.
Panel B: tenant-platform contract characteristics	
$Initial\_Dur\_T$	The duration of the first rental contract a tenant signed with the rental platform for a housing unit.
$Total\_Dur\_T$	The total duration of all contracts the tenant signed with the rental platform for a housing unit (considering all renewals).
$Remain\_Dur\_L$	The remaining duration of the lease contract between the landlord and the rental platform when the tenant rents the unit.
$Rent\_T$	The monthly rent (in RMB) the tenant pays to the rental platform for the housing unit.
Panel C: Housing market conditions	
$PriceGrowth$	The percentage change in average property price relative to the price 12 months ago. The price each month for each rental unit is the average per-square-meter price in all housing transactions for properties within a two-kilometer neighborhood in the past 12 months, measured at the signature date of the landlord-platform contract.
$RentGrowth$	The rate of change in the average per-square-meter rent in the deals signed in the past 12 months within a two-kilometer radius relative to the average rent signed between the past 24 to 13 months, measured at the signature date of the landlord-platform contract.
$PriceGrowth\_exp$	$PriceGrowth$ measured at the expiration date of the landlord-platform contract.
$RentGrowth\_exp$	$RentGrowth$ measured at the expiration date of the landlord-platform contract.
Panel D: Housing unit characteristics	
$Size$	The size (in m^2) of the structural area of the rental housing unit.
$PropertyAge$	The age (in ten years) of the housing unit.
$GreenRatio$	The green plot ratio of the housing complex.
I(1 bedroom)	An indicator that equals 1 if the housing unit has 1 bedroom and 0 otherwise.
I(3+ bedrooms)	An indicator that equals 1 if the housing unit has 3 or more bedrooms and 0 otherwise.
I(Entire unit)	An indicator that equals 1 if the housing unit is leased for the entire rental and 0 otherwise.
I(Elevator)	An indicator that equals 1 if the building of the housing unit has an elevator and 0 otherwise.
I(Heating)	An indicator that equals 1 if the housing unit has public heating service and 0 otherwise.
Panel E: Tenant characteristics	
$CommuteDist$	The distance (in kilometers) between the housing location and the work location
$TenantAge$	The age of the tenant in years.
I(Female)	An indicator that equals 1 if the tenant is female and 0 otherwise.
I(Local)	An indicator that equals 1 if the tenant is a local citizen and 0 otherwise.
I(Bachelor+)	An indicator that equals 1 if the tenant has a bachelor's degree or above and 0 otherwise.
I(IT industry)	An indicator that equals 1 if the tenant works in the IT industry and 0 otherwise.
I(Finance industry)	An indicator that equals 1 if the tenant works in the finance industry and 0 otherwise.

Table 2: Descriptive Statistics

This table reports the summary statistics of our main variables during the sample period between 2015 and 2019. Panel A contains 92,948 landlord-platform contracts signed in Beijing, 13,749 of which have an expiration date between 2018 and 2019. Panel B contains 177,581 tenant-platform contracts. Panel C contains 148,140 block-month observations of local housing prices and rent growth. Panels D and E present the characteristics of rental units and tenants, respectively.

Variables	Mean	Std.	Min	25^{th}	Median	75^{th}	Max
Panel A: landlord-platform contract characteristics							
Dur_L (year)	3.88	1.01	1.00	3.00	4.00	5.00	6.00
RenoCost	0.37	0.24	0.00	0.17	0.35	0.54	1.03
RentSpread	0.22	0.22	−0.11	0.13	0.19	0.25	1.67
I(Landlord renewal)	0.86	0.35	0.00	1.00	1.00	1.00	1.00
Panel B: tenant-platform contract characteristics							
Initial_Dur_T (year)	0.79	0.26	0.25	0.53	0.98	1.00	1.00
Total_Dur_T (year)	1.04	0.66	0.25	0.53	0.99	1.20	3.34
Remain_Dur_L (year)	3.19	1.38	0.42	2.17	3.17	4.25	5.58
Rent_T (in thousand RMB)	3.39	1.55	1.53	2.36	2.86	3.86	8.49
Panel C: Housing market conditions							
PriceGrowth	0.13	0.18	−0.08	−0.01	0.06	0.27	0.53
RentGrowth	0.12	0.08	−0.05	0.07	0.11	0.16	0.38
Panel D: Housing unit characteristics							
Size (m^2)	72.32	27.72	30.93	53.10	64.43	86.97	158.66
PropertyAge	16.82	7.47	2.00	11.00	16.00	21.00	38.00
GreenRatio	0.31	0.07	0.10	0.30	0.30	0.35	0.50
I(1 bedroom)	0.29	0.45	0.00	0.00	0.00	1.00	1.00
I(3+ bedrooms)	0.22	0.41	0.00	0.00	0.00	0.00	1.00
I(Entire unit)	0.52	0.50	0.00	0.00	1.00	1.00	1.00
I(Elevator)	0.64	0.48	0.00	0.00	1.00	1.00	1.00
I(Heating)	0.89	0.32	0.00	1.00	1.00	1.00	1.00
Panel E: Tenant characteristics							
CommuteDist (KM)	8.22	7.86	0.13	1.78	6.16	12.35	39.85
TenantAge	32.92	4.74	25.00	30.00	32.00	35.00	51.00
I(Female)	0.48	0.50	0.00	0.00	0.00	1.00	1.00
I(Local)	0.06	0.24	0.00	0.00	0.00	0.00	1.00
I(Bachelor+)	0.50	0.50	0.00	0.00	1.00	1.00	1.00
I(IT industry)	0.29	0.45	0.00	0.00	0.00	1.00	1.00
I(Finance industry)	0.13	0.33	0.00	0.00	0.00	0.00	1.00

Table 3: Housing Price Growth and Rental Supply Duration

This table reports the regression results where the dependent variable is the duration of first-time landlord-platform contracts signed between 2015 and 2019 in Beijing, China. *PriceGrowth* (*RentGrowth*) is the local housing price (rent) growth measured using home purchase (rental) transactions within a two-kilometer neighborhood of a rental unit. Our control variables include agency-paid renovation expenses *RenoCost*, rent spread received by the PropTech agency *RentSpread*, and a set of housing characteristics. We include contract signature year-month and district fixed effects in all specifications. Standard errors in parentheses are clustered by year-month and residential block. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

	Dur_L		
	(1)	(2)	(3)
PriceGrowth	-0.46^{***}		-0.43^{***}
	(0.14)		(0.15)
RentGrowth		-0.54^{***}	-0.52^{***}
		(0.12)	(0.12)
RenoCost	1.79^{***}	1.79^{***}	1.79^{***}
	(0.09)	(0.09)	(0.09)
RentSpread	-0.48^{***}	-0.49^{***}	-0.49^{***}
	(0.06)	(0.06)	(0.06)
Log(Size)	0.04	0.04	0.04
	(0.03)	(0.03)	(0.03)
PropertyAge	0.06^{***}	0.06^{***}	0.06^{***}
	(0.01)	(0.01)	(0.01)
GreenRatio	-0.12	-0.11	-0.11
	(0.08)	(0.08)	(0.08)
I(1 bedroom)	-0.14^{***}	-0.14^{***}	-0.14^{***}
	(0.02)	(0.02)	(0.02)
I(3+ bedrooms)	0.12^{***}	0.12^{***}	0.12^{***}
	(0.02)	(0.02)	(0.02)
I(Entire unit)	0.03	0.03	0.02
	(0.03)	(0.03)	(0.03)
I(Elevator)	0.00	-0.00	-0.00
	(0.01)	(0.01)	(0.01)
I(Heating)	-0.02	-0.03	-0.03
	(0.02)	(0.02)	(0.02)
District F.E.	Yes	Yes	Yes
Year-month F.E.	Yes	Yes	Yes
N	92,948	92,948	92,948
Adj. R^2	0.25	0.25	0.25

Table 4: HPR Policies and Rental Supply Duration: DID Analysis

This table reports our DID regression results where the dependent variable is landlords' initial contract duration *Dur_L* in Panel A and the balance test results in Panel B. We define nonordinary (ordinary) units as properties with structural area size over (under) 140 square meters and match each nonordinary unit with ordinary units that are located in the same residential block, have the same number of bedrooms, living rooms, and renovation expenses, and are signed in the same pre- or post-HPR period. $PostHPR$ equals one if the month is after March 2017, when the HPR policy took effect, and zero otherwise. Our control variables include agency-paid renovation expenses $RenoCost$, rent spread received by the PropTech agency $RentSpread$, and a set of housing characteristics. We include contract signature year-month and district fixed effects. Standard errors are clustered by contract signature year-month and residential block. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

Panel A: DID Regression results	Dur_L		
	(1)	(2)	(3)
PostHPR × NonOrdinary	0.15***	0.15***	0.10**
	(0.05)	(0.05)	(0.04)
PostHPR	0.23***		
	(0.05)		
NonOrdinary	−0.01	−0.02	−0.02
	(0.04)	(0.04)	(0.04)
Controls	No	No	Yes
District F.E.	No	No	Yes
Year-month F.E.	No	Yes	Yes
N	6,980	6,980	6,980
Adj. R^2	0.02	0.04	0.27

Panel B: Balance tests	NonOrdinary (N=2,061)	Ordinary (matched sample) (N=4,919)	*Diff.*
Size	150.05	111.10	38.95***
PriceGrowth	0.20	0.20	0.00
RentGrowth	0.13	0.13	0.00
RenoCost	0.26	0.25	0.01
RentSpread	0.22	0.23	−0.02**
PropertyAge	1.26	1.29	−0.02
GreenRatio	0.35	0.34	0.00
I(Entire unit)	0.03	0.08	−0.06***
I(Elevator)	0.87	0.85	0.02
I(Heating)	0.80	0.84	−0.04*

Table 5: HPR Policies and Contract Duration: RD Analysis

This table reports the results from a regression discontinuity design where the dependent variable is landlord-agency contract duration *Dur_L*. We restrict our sample to contracts signed between 2015Q2 and 2019Q1 with sizes between 125 and 155 square meters. Following Calonico et al. (2019), we use the MSE-optimal and CER-optimal bandwidths. We define nonordinary (ordinary) units as properties with structural area size over (under) 140 square meters and match each nonordinary unit with ordinary units that are located in the same residential block, have the same number of bedrooms, living rooms, and renovation expenses, and are signed in the same pre- or post-HPR period. *PostHPR* equals one if the month is after March 2017, when the HPR policy took effect, and zero otherwise. Our control variables include agency-paid renovation expenses *RenoCost*, rent spread received by the PropTech agency *RentSpread*, and a set of housing characteristics. We include contract signature year-month and district fixed effects. Standard errors in parentheses are clustered by year-month and residential block. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

	Dur_L			
	MSE bandwidth ($4.13m^2$)		CER bandwidth ($2.17m^2$)	
	(1)	(2)	(3)	(4)
PostHPR×NonOrdinary	0.22***	0.20**	0.31**	0.27**
	(0.08)	(0.08)	(0.12)	(0.12)
NonOrdinary	−0.08	−0.06	−0.09	−0.10
	(0.07)	(0.11)	(0.10)	(0.15)
Controls	No	Yes	No	Yes
District F.E.	No	Yes	No	Yes
Year-month F.E.	Yes	Yes	Yes	Yes
N	1,403	1,403	903	903
Adj. R^2	0.06	0.27	0.09	0.28

Table 6: The Impact of Lagged and Extreme Growth Rates

This table reports the regression results regarding the impact of lagged and extreme housing price and rent growth rates on rental supply duration. *PriceGrowth* (*RentGrowth*) is the local housing price (rent) growth measured using home purchase (rental) transactions within a two-kilometer neighborhood of a rental unit. In Panel A, the independent variables are past housing price and rent growth with different lags, where Growth^{t-i} represents the growth calculated i months ago. In Panel B, I(price (rent) growth∈top25%) is an indicator equal to 1 if the price (rent) growth of the property is in the top quartile in the signature month. Our control variables include agency-paid renovation expenses *RenoCost*, rent spread received by the PropTech agency *RentSpread*, and a set of housing characteristics. We include contract signature year-month and district fixed effects. Standard errors in parentheses are clustered by year-month and residential block. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

	Dur_L		
	(1)	(2)	(3)
Panel A: The impact of lagged housing price growth			
PriceGrowth $^{(t-12)}$	-0.55^{***}		-0.52^{***}
	(0.15)		(0.153)
PriceGrowth $^{(t-24)}$	-0.51^{***}		-0.49^{***}
	(0.14)		(0.14)
RentGrowth $^{(t-12)}$		-0.24^{*}	-0.15
		(0.13)	(0.13)
RentGrowth $^{(t-24)}$		-0.18^{**}	-0.12
		(0.08)	(0.08)
PriceGrowth $^{(t)}$	-0.72^{***}	-0.44^{**}	-0.69^{***}
	(0.15)	(0.16)	(0.16)
RentGrowth $^{(t)}$	-0.50^{***}	-0.65^{***}	-0.59^{***}
	(0.12)	(0.16)	(0.16)
N	84,914	84,914	84,914
Adj. R^2	0.25	0.25	0.25
Panel B: The impact of extreme housing price growth			
PriceGrowth × I(PriceGrowth∈top25%)	-0.12^{**}		-0.12^{**}
	(0.05)		(0.05)
I(PriceGrowth ∈ top25%)	0.03^{*}		0.02
	(0.02)		(0.02)
RentGrowth × I(RentGrowth∈top25%)		-0.56^{***}	-0.56^{***}
		(0.17)	(0.17)
I(RentGrowth ∈ top25%)		0.04	0.04
		(0.03)	(0.03)
PriceGrowth	-0.38^{*}	-0.44^{***}	-0.38^{*}
	(0.21)	(0.14)	(0.21)
RentGrowth	-0.51^{***}	-0.00	0.00
	(0.12)	(0.16)	(0.16)
N	92,948	92,948	92,948
Adj. R^2	0.25	0.25	0.25
All Panels			
Controls	Yes	Yes	Yes
District F.E.	Yes	Yes	Yes
Year-month F.E.	Yes	Yes	Yes

Table 7: Heterogeneity Effects on Rental Supply Duration: Landlord Characteristics

This table reports the regression results where the dependent variable is landlords' initial contract duration *Dur_L*. Landlord characteristics include I(Multi), which indicates the landlords rent multiple properties through the agent, and *LandlordAge*, the age of the landlord (scaled by 100). *PriceGrowth* (*RentGrowth*) is the local housing price (rent) growth measured using home purchase (rental) transactions within a two-kilometer neighborhood of a rental unit. Our control variables include agency-paid renovation expenses *RenoCost*, rent spread received by the PropTech agency *RentSpread*, and a set of housing characteristics. We include contract signature year-month and district fixed effects. Standard errors in parentheses are clustered by year-month and residential block. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

	Dur_L					
	(1)	(2)	(3)	(4)	(5)	(6)
I(Multi)	-0.46^{***}	-0.65^{***}	-0.34^{***}			
	(0.06)	(0.08)	(0.08)			
PriceGrowth × I(Multi)	-1.02^{***}		-1.11^{***}			
	(0.22)		(0.22)			
RentGrowth × I(Multi)		-0.13	-0.76^{**}			
		(0.38)	(0.32)			
LandlordAge				0.70^{***}	0.64^{***}	0.52^{***}
				(0.05)	(0.07)	(0.08)
PriceGrowth × LandlordAge				0.46^{**}		0.57^{***}
				(0.21)		(0.21)
RentGrowth × LandlordAge					1.05^{*}	1.38^{**}
					(0.55)	(0.53)
PriceGrowth	-0.02	-0.32^{**}	0.02	-0.64^{***}	-0.42^{***}	-0.70^{***}
	(0.16)	(0.14)	(0.16)	(0.18)	(0.13)	(0.18)
RentGrowth	-0.58^{***}	-0.50^{**}	-0.20	-0.56^{***}	-1.10^{***}	-1.28^{***}
	(0.13)	(0.22)	(0.19)	(0.12)	(0.30)	(0.29)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
District F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Year-month F.E.	Yes	Yes	Yes	Yes	Yes	Yes
N	86,754	86,754	86,754	86,754	86,754	86,754
Adj. R^2	0.31	0.31	0.31	0.27	0.27	0.27

Table 8: Heterogeneity Effects on Rental Supply Duration: Housing Unit Characteristics

This table reports the regression results where the dependent variable is landlords' initial contract duration *Dur_L*. Housing unit characteristics include a 3-bedroom indicator, an entire-unit-rental indicator, and agency-paid renovation expense. *PriceGrowth* (*RentGrowth*) is the local housing price (rent) growth measured using home purchase (rental) transactions within a two-kilometer neighborhood of a rental unit. Our control variables include agency-paid renovation expenses *RenoCost*, rent spread received by the PropTech agency *RentSpread*, and a set of housing characteristics. We include contract signature year-month and district fixed effects. Standard errors in parentheses are clustered by year-month and residential block. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

	Dur_L		
	(1)	(2)	(3)
PriceGrowth × I(3+ bedrooms)	0.46***		
	(0.10)		
RentGrowth × I(3+ bedrooms)	0.63***		
	(0.18)		
PriceGrowth × I(Entire unit)		−0.34**	
		(0.14)	
RentGrowth × I(Entire unit)		−0.55*	
		(0.30)	
PriceGrowth × RenoCost			1.72***
			(0.31)
RentGrowth × RenoCost			0.28
			(0.71)
PriceGrowth	−0.53***	−0.27*	−1.06***
	(0.15)	(0.15)	(0.21)
RentGrowth	−0.66***	−0.28	−0.71***
	(0.13)	(0.17)	(0.24)
Controls	Yes	Yes	Yes
District F.E.	Yes	Yes	Yes
Year-month F.E.	Yes	Yes	Yes
N	92,948	92,948	92,948
Adj. R^2	0.25	0.25	0.26

Table 9: Determinants of Landlords' Contract Renewal Rate

This table reports regression results where the dependent variable is a renewal indicator I(Landlord Renewal), which equals one if the landlord renews the leasing contract with the rental agency when it expires and zero otherwise. *PriceGrowth_exp* (*RentGrowth_exp*) refers to local housing price (rent) growth measured at the expiration date of the first-time landlord-platform contracts. Our control variables include the initial rental duration *Dur_L*, agency-paid renovation expenses *RenoCost*, rent spread received by the PropTech agency *RentSpread*, and a set of housing characteristics. We include contract expiration year-month and district fixed effects. Standard errors in parentheses are clustered by year-month and residential block. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

	I(Landlord Renewal)		
	(1)	(2)	(3)
PriceGrowth_exp	-0.26^{**}		-0.26^{**}
	(0.11)		(0.11)
RentGrowth_exp		0.09	0.08
		(0.06)	(0.06)
Dur_L	0.07^{***}	0.07^{***}	0.07^{***}
	(0.01)	(0.01)	(0.01)
Controls	Yes	Yes	Yes
District F.E.	Yes	Yes	Yes
Year-month F.E.	Yes	Yes	Yes
N	13,742	13,742	13,742
Adj. R^2	0.50	0.50	0.50

Table 10: The Term Structure of Rent

This table reports regression results where the dependent variables are per-square-meter rent (in the left panel) and rent (in the right panel). Panel A presents the term premium of rents using indicators that equal one if the rounded duration is equal to four, five, or six years. In Panel B, I(Dur_L>*median*) is an indicator that equals one if the duration is greater than the sample median (4 years). *PriceGrowth* (*RentGrowth*) is the local housing price (rent) growth measured using home purchase (rental) transactions within a two-kilometer neighborhood of a rental unit. Our control variables include agency-paid renovation expenses *RenoCost*, rent spread received by the PropTech agency *RentSpread*, and a set of housing characteristics. We include contract signature year-month and district fixed effects. Standard errors in parentheses are clustered by year-month and residential block. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

	Rent_L			
	Rent per m^2		Monthly rent	
	(1)	(2)	(3)	(4)
Panel A: Term Structure of Rent				
Dur_L	1.02***		71.38***	
	(0.20)		(14.28)	
I(Dur_L=4)		2.38***		158.41***
		(0.51)		(36.46)
I(Dur_L=5)		3.43***		223.97***
		(0.33)		(27.95)
I(Dur_L=6)		5.91***		608.19***
		(0.59)		(78.28)
Controls	Yes	Yes	Yes	Yes
District F.E.	Yes	Yes	Yes	Yes
Year-month F.E.	Yes	Yes	Yes	Yes
N	92,948	92,948	92,948	92,948
Adj. R^2	0.69	0.69	0.71	0.71
Panel B: The Impact of Housing Price and Rent Growth				
PriceGrowth × I(Dur_L>*median*)	2.63**	2.94**	163.30*	185.78*
	(1.18)	(1.26)	(91.65)	(99.97)
RentGrowth × I(Dur_L>*median*)		3.86		279.61
		(3.47)		(279.94)
I(Dur_L>*median*)	1.94***	1.44***	131.89***	96.01**
	(0.25)	(0.55)	(23.47)	(48.46)
Controls	Yes	Yes	Yes	Yes
District F.E.	Yes	Yes	Yes	Yes
Year-month F.E.	Yes	Yes	Yes	Yes
N	92,948	92,948	92,948	92,948
Adj. R^2	0.69	0.69	0.71	0.71

Table 11: Duration Matching Between Tenants and Landlords

This table reports regression results where the dependent variable is the tenants' initial rental duration $Initial\_Dur\_T$ (in the left panel) and total rental duration $Total\_Dur\_T$ (in the right panel). The key independent variable is the landlord's remaining contract duration when the tenant signed the initial contract. We also include a set of tenant characteristics such as age, gender, education, occupation, rent, and commuting distance. Other control variables include agency-paid renovation expenses *RenoCost*, rent spread received by the PropTech agency *RentSpread*, and a set of housing characteristics. We include contract expiration year-month and district fixed effects. Standard errors in parentheses are clustered by year-month and residential block. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively. All coefficients and standard errors are enlarged 100 times.

	Initial_Dur_T		Total_Dur_T	
	(1)	(2)	(3)	(4)
Remain_Dur_L	0.62***	0.57***	1.32***	1.21***
	(0.08)	(0.08)	(0.33)	(0.32)
CommuteDist		−0.03***		−0.16***
		(0.01)		(0.03)
I(Female)		0.50***		3.33***
		(0.14)		(0.48)
TenantAge		0.09***		0.59***
		(0.02)		(0.08)
I(Local)		−1.16***		−2.70***
		(0.27)		(0.64)
I(Bachelor+)		2.50***		10.45***
		(0.25)		(1.32)
I(IT industry)		2.30***		6.52***
		(0.22)		(0.91)
I(Finance industry)		1.61***		6.41***
		(0.26)		(1.10)
Log(Rent_T)		2.79***		7.28***
		(0.37)		(1.12)
Controls	No	Yes	No	Yes
District F.E.	No	Yes	No	Yes
Year-month F.E.	Yes	Yes	Yes	Yes
N	177,581	177,581	177,581	177,581
Adj. R^2	0.14	0.15	0.17	0.19

Online Appendix

A Robustness

A.1 Block Fixed Effects

In our main text, to establish how housing price growth and rent growth affect rental housing duration, we focus on both cross-section and time series of alternative market variations so we control for time and district fixed effects. In this subsection, we replace district fixed effects with block fixed effects to isolate unobserved block characteristics and focus on the influence of time-series variations in local price growth. As with the results reported in Panel A of Table A1, both price growth and rent growth are still significantly negative and the magnitude is approximately 47% and 62% of the coefficients in Table 3. The above results indicate that within each block, landlords supply rental housing with shorter duration under greater price growth and rent growth.

[Table A1 here]

In Panel B of Table A1, we test whether price growth and rent growth affect the upward-sloping term structure with block fixed effects. We find that both coefficients of price growth and rent growth are significantly positive, suggesting higher market growth increases the scope of the term structure of rents, which is consistent with the results in Table 10.

A.2 Regressions in Different Sample Periods

We run regressions in different periods to see how our main results vary over time. Table A2 presents the results. We find that the coefficients on price growth are strongly and significantly negative before 2018, which is consistent with our prediction because home prices increase the fastest during this period. After 2018, the coefficient is no longer significant. These results may suggest that the HPR policy effectively reduced extrapolative expectations of housing price prospects, thus reducing the correlation between past housing price growth and rental duration. As a comparison, the effect of rent growth remains significant in the latter period.

[Table A2 here]

A.3 Alternative Variable Measures

For robustness, we alter the variable construction for price growth and rent growth and Table A3 presents the results. In Column (1), we only consider transactions of houses with the same number of bedrooms as the rental unit to construct the "bedroom-number-adjusted" price growth and rent growth. In Column (2), we use a six-month rather than a twelve-month look-back window. In Column (3), we use a radius of one kilometer instead of two kilometers. Our main results are robust to all these alternative specifications.

[Table A3 here]

A.4 The Effects of Volume Growth

In our simple model, we assume that the housing market is perfectly liquid. The liquidity of the housing sale market may also play a role in determining the option value of market switching and the landlord's rental duration. To test this hypothesis, we construct volume growth as the percentage change in the total number of second-hand housing transactions and expect an adverse relationship between volume growth and rental duration. We find that volume growth has a significantly negative impact on long-term rental supply in Column (1) of Table A4. In Column (1) of Table A4, we further confirm that volume growth enlarges the scope of the rent term structure.

[Table A4 here]

A.5 Renovation Costs

We further investigate the relationship between renovation expenses and landlords' rental supply duration. Column (1) of Table A5 presents the regression results on the impact of landlords' contract duration on renovation expenses. Consistent with our prediction, renovation expenses are strongly and positively associated with contract duration. The economic magnitude is large and statistically highly significant, suggesting that renovation expenses are a major determinant of contract duration. The coefficient of 1.71 in Column (1) can be interpreted as a one-standard-deviation increase in renovation expense (i.e., 24% of annual rent) being associated with an increase in the duration of 0.41 years (or 5 months), which is economically meaningful. This positive impact of agency-paid renovation costs on landlord-platform contract duration implies that the rental agency could obtain a longer-term rental housing supply from landlords by offering renovation services.[11]

Column (2) in Table A5 presents the results on the impact of renovation expenses on landlords' renewal decisions. We find that renovation expenses have a coefficient of -0.74, implying that units that incur higher renovation expenses are less likely to be renewed by landlords. Our interpretation is that landlords receive less value added from leasing with the PropTech platform once their rental units have been remodeled and furnished. After the quality of the rental unit has been improved by the renovation in the initial contract, landlords no longer need the PropTech platform's renovation service and hence find it less profitable to lease through the agency.

Column (3) in Table A5 reports the impact of renovation expenses on the PropTech platform's rental spread, i.e., the difference between the rent received from tenants and the rent paid to the landlords. The estimated coefficient is 0.18, which is both economically and statistically significant. This result indicates a strong connection between rental spread and renovation expenses, consistent with our hypothesis that renovation expenses enhance the rental payoff and improve the profitability of the PropTech platform.

A.6 The Model and Testable Hypotheses

We build a simple model of landlords' maturity choice to motivate our empirical analysis of rental housing supply. The model delivers several predictions for the contract duration of rental housing supply.

[11] In Appendix Table A3, we use alternative measures of price and rent growth, and our results still hold.

A.6.1 Baseline Model

Opportunity Set. Our model has three periods: $t = 0, 1, 2$. A landlord is born in period 0 with one unit of real estate assets (i.e., a house). The landlord is risk neutral and maximizes her expected final wealth. At $t = 0$, the landlord chooses from three mutually exclusive investment opportunities using her real estate assets: signing a short-term leasing contract (S) that expires in period 1, signing a long-term leasing contract (L) that expires in period 2, or converting the house into a reserved asset (C).

We assume that if the landlord chooses L at $t = 0$, then her real estate capital will be locked up and she cannot switch to C or S in the next period. For instance, if the penalty against the early termination of the long-term leasing contract is prohibitively high, then the landlord will never unilaterally terminate the long-term contract in period 1. This assumption ensures the stability of the long-term contract by excluding the possibility of early termination, which effectively shortens the contract duration.

We also assume that the housing market is perfectly liquid; that is, if the landlord chooses C or S at $t = 0$, then she can again choose between C and S at the beginning of $t = 1$. The flexibility to move between C and S reflects our implicit assumption of frictionless markets in which real estate assets can be converted into cash or other forms of investment quickly and without cost.

Payoffs. The value of the property at $t = 0$ is p_0. Long-term rental contracts (L) pay a rent of l in both periods and return the housing unit to the landlord in period 2. Short-term rental contracts (S) pay a cash flow of s_1 and return the house in period 1 and, if renewed in period 1, pay an expected rent $E[\tilde{s}_2]$ and return the house in period 2. For simplicity, we assume that any income received at $t = 1$ cannot be reinvested.

The interest rate on deposits is an exogenous constant r_c. The expected home price in period 1 is $E[\tilde{p}_1]$. Hence, the payoff from choosing cash (C) in period 0 is $c_1 = r_c p_0$, and the expected payoff of C in period 1 (i.e., selling the house in period 1 and storing the proceeds as bank deposits) is $E[c_2] = r_c E[\tilde{p}_1]$.

The landlord faces uncertainty about the next-period rent $\tilde{s}_2$ and housing price at $t = 1$ and

$t = 2$ ($\tilde{p}_1$ and $\tilde{p}_2$, respectively). For simplicity, we assume p_2 to be equal to the realization of $\tilde{p}_1$.[12] We assume a simple distribution for $\tilde{s}_2$ that it will increase to s_2^H with a probability of π^H, decline to s_2^L with a probability of π^L, and remain at s_1 with a probability of π^M in the second period. We assume a similar distribution for the housing price. $\tilde{p}_1$ can be high (p_1^H), remain constant ($p_1^M = p_0$), or decline (p_1^L) with probability γ^H, γ^M, and γ^L, respectively. To capture the idea that the rental, housing, and bond markets are initially in equilibrium, we assume that $E[\tilde{s}_2] = s_1$, $E[\tilde{p}_2] = E[\tilde{p}_1] = p_0$, and $s_1 = r_c p_0$; that is, the landlord is indifferent between holding the property and holding cash at $t = 0$.

A.6.2 Hypothesis Development

Optimal Investment Path. The landlord chooses from the following set of investment paths:

$$\Phi = \{(S,S),(L,L),(C,C),(S,C),(C,S)\}. \tag{A1}$$

The landlord solves the investment problem by comparing the expected payoff from each investment path. We focus on when the landlord chooses (L,L). Because the payoffs from S and C in the second period are random, the option to switch investments is valuable. If the landlord chooses S or C in the first period, then the actual expected payoff in the second period depends on the distributions of $\tilde{s}_2$ and $\tilde{p}_1$ and the value of r_c. For instance, if both the home price and rent become high at $t = 1$, then the choice between C and S depends on which is higher, $r_c P_1^H$ or s_2^H.

If C or S is chosen in the first period, then the landlord's expected payoff in the second period is as follows:

$$\begin{aligned} E[r_2^S] = E[r_2^C] &= \pi^H \gamma^H max\{s_2^H, r_c p_1^H\} + \pi^H(1-\gamma^H)s_2^H + \gamma^H(1-\pi^H)r_c p_1^H \\ &+ \pi^M \gamma^M max\{s_2^M, r_c p_1^M\} + \pi^M \gamma^L s_2^M + \pi^L \gamma^M r_c p^M + \pi^L \gamma^L max\{s_2^L, r_c p_1^L\} \end{aligned} \tag{A2}$$

This setup generates the familiar upward-sloping term structure of rent because $E[r_2^C] = E[r_2^S] > l$, even if $E[\tilde{s}_2] = l$. The landlord is indifferent between choosing S and L if the condition

[12] We find that adding randomness to p_2 does not lead to any additional insight but rather complicates the analysis.

$l - s_1 = E[r_2^S] - l$ holds, which means that the long-term contract must pay more to compensate for the forgone option to switch.

Testable Hypotheses. The model yields an intuitive empirical prediction: If the expectation of next-period housing price increases or the expectation of rent increases, the landlord becomes less willing to choose L in the first period. This implication closely corresponds to those from existing theories of the term structure of interest rates, such as that by Cox et al. (1985), which uses a general equilibrium model to show that expectations and investment alternatives, among other factors, determine the term structure of bond prices. To summarize, we test the following two hypotheses:

- H_1: Recent local housing price growth reduces the duration of rental housing supply;
- H_2: Recent local rent growth reduces the duration of rental housing supply.

Table A1: Analysis with Block Fixed Effects

This table investigates the determinants of the landlords' initial contract duration and the term structure of rent with block fixed effects. We repeat the analysis of Table 3 in Panel A and the analysis of Table 10 in Panel B. The only difference is that we control for block fixed effects instead of district fixed effects. We exclude property age, I(Elevator), I(Heating), and green plot ratio from control variables because they hardly change within each block. Standard errors in parentheses are clustered by year-month and residential block. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

Panel A: the initial contract duration

	Dur_L		
	(1)	(2)	(3)
PriceGrowth	-0.22^{***}		-0.20^{**}
	(0.09)		(0.09)
RentGrowth		-0.33^{***}	-0.32^{***}
		(0.06)	(0.06)
Controls	Yes	Yes	Yes
Block F.E.	Yes	Yes	Yes
Year-month F.E.	Yes	Yes	Yes
N	92,948	92,948	92,948
Adj. R^2	0.28	0.28	0.28

Panel B: the term structure of rent

	Rent_L per m^2		
	(1)	(2)	(3)
PriceGrowth × I(Dur_L>$median$)	0.95^{***}		1.23^{***}
	(0.30)		(0.30)
RentGrowth × I(Dur_L>$median$)		2.69^{***}	3.45^{***}
		(0.84)	(0.86)
I(Dur_L>$median$)	2.32^{***}	2.15^{***}	1.88^{***}
	(0.08)	(0.11)	(0.13)
Controls	Yes	Yes	Yes
Block F.E.	Yes	Yes	Yes
Year-month F.E.	Yes	Yes	Yes
N	92,948	92,948	92,948
Adj. R^2	0.89	0.89	0.89

Table A2: Regressions in Different Sample Periods

This table repeats the regressions of Table 3 in different sample periods. The sample period is from 2015 to 2017 in the left panel and 2018 to 2019 in the right panel. Standard errors in parentheses are clustered by year-month and residential block. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

	Dur_L					
	2015-2017			2018-2019		
	(1)	(2)	(3)	(4)	(5)	(6)
PriceGrowth	-0.62^{***}		-0.58^{***}	0.09		0.10
	(0.15)		(0.16)	(0.25)		(0.24)
RentGrowth		-0.47^{***}	-0.45^{***}		-0.64^{**}	-0.64^{**}
		(0.14)	(0.14)		(0.25)	(0.24)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
District F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Year-month F.E.	Yes	Yes	Yes	Yes	Yes	Yes
N	44,772	44,772	44,772	48,176	48,176	48,176
Adj. R^2	0.25	0.25	0.25	0.24	0.24	0.24

Table A3: Alternative Variable Measurement

This table repeats the regression in Column (3) of Table 3 with alternative variable definitions. In Column (1), we measure the price growth and rent growth using transactions of units that have the same number of bedrooms as the rental unit instead of using all transactions. In Column (2), we measure price growth and rent growth using transactions within a six-month look-back period. In Column (3), we measure price growth and rent growth using transactions within a one-kilometer radius. Standard errors in parentheses are clustered by year-month and residential block. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

	Dur_L		
	(1) bedroom adjusted	(2) 6-month look-back	(3) in 1-km radius
PriceGrowth	-0.40^{***}	-0.26^{**}	-0.29^{***}
	(0.14)	(0.11)	(0.10)
RentGrowth	-0.23^{***}	-0.29^{**}	-0.24^{***}
	(0.07)	(0.11)	(0.06)
Controls	Yes	Yes	Yes
District F.E.	Yes	Yes	Yes
Year-month F.E.	Yes	Yes	Yes
N	92,744	92,940	92,143
Adj. R^2	0.25	0.25	0.25

Table A4: The Effects of Volume Growth

This table investigates the effects of volume growth. In Column (1), we additionally include volume growth as an independent variable to the regression in Column (3) of Table 3. In Column (2), we additional include volume growth and its interaction terms with $I(\text{Dur\_L}>median)$ as independent variables to the regression in Column (2) of panel B in Table 10. We compute volume growth as the percentage change in the total number of second-hand housing transactions within a two-kilometer neighborhood in the past 12 months relative to month t-12. Standard errors in parentheses are clustered by year-month and residential block. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

	Dur_L	Rent_L per m^2
	(1)	(2)
VolumeGrowth	-0.17^{***}	-17.98^{***}
	(0.04)	(2.22)
PriceGrowth	-0.57^{***}	-44.07^{***}
	(0.15)	(8.35)
RentGrowth	-0.47^{***}	2.01
	(0.12)	(6.35)
VolumeGrowth × $I(\text{Dur\_L}>median)$		1.16^{**}
		(0.49)
PriceGrowth × $I(\text{Dur\_L}>median)$		4.22^{***}
		(1.42)
RentGrowth × $I(\text{Dur\_L}>median)$		0.01
		(3.72)
$I(\text{Dur\_L}>median)$		1.69^{***}
		(0.54)
Controls	Yes	Yes
District F.E.	Yes	Yes
Year-month F.E.	Yes	Yes
N	92,948	92,948
Adj. R^2	0.25	0.69

Table A5: Renovation Expenses and Rental Supply Duration

This table reports the results from regressions in which the dependent variables are landlords' initial contract duration in Column (1), an indicator of landlord renewal at contract expiration in Column (2), and rental spread in Column (3). *RenoCost* is the agency-paid renovation expenses. Our control variables include the rent spread received by the PropTech agency *RentSpread* and a set of housing characteristics. We include contract expiration year-month and district fixed effects. Standard errors in parentheses are clustered by year-month and residential block. ***, **, and * indicate $p < 0.01$, $p < 0.05$, and $p < 0.10$, respectively.

	(1) Dur_L	(2) I(Landlord Renewal)	(3) RentSpread
RenoCost	1.71***	−0.74***	0.18***
	(0.09)	(0.07)	(0.01)
Controls	Yes	Yes	Yes
District F.E.	Yes	Yes	Yes
Year-month F.E.	Yes	Yes	Yes
N	92,948	13,743	92,948
Adj. R^2	0.24	0.44	0.13

Figure A1: Landlord-platform Contracts in a PropTech Platform: An Example

Note: This figure demonstrates a typical version of a rental contract signed between an individual landlord and a rental agency. The rental agency pays a fixed rent to the property owner and will not charge the property owner renovation fees unless the landlord initiates an early termination. When the renovation is completed, the rental agency will rent the dwelling unit out to tenants and charge a higher rent. The rental agency profits from the spread between the rents received from tenants and the rents paid to the property owner, as well as management fees received from the owner.

合同编号：[redacted]

财产委托管理服务合同 Agency agreement on property management

委托人（甲方）：[redacted]

Property owner

证件号：[redacted]

受托方（乙方）：[redacted]

统一社会信用代码：[redacted]

Rental agency company

依据《中华人民共和国合同法》及有关法律、法规的规定，甲乙双方在平等、自愿的基础上，就房屋出租委托代理的有关事宜达成约定如下：

第一条 委托管理财产基本情况 Basic info on the property

（一）财产类别：房屋（以下称为房屋），房屋坐落于：[redacted] Property address

建筑面积[redacted]平方米，房屋居室为：[redacted] number of rooms (incl. bedrooms, living rooms, bathrooms, kitchen)

Structural area

（二）房屋权属状况：甲方持有（房屋所有权证/公有住房租赁合同/房屋买卖合同/其他房屋来源证明文件），房屋所有权证书编号[redacted]或房屋来源证明名称：[redacted]，房屋所有权人（公有住房承租人、购房人）姓名或名称：[redacted]，房屋[redacted]设定抵押。甲方须确保有权出租该房屋，包括但不限于确保房屋相关共有权人同意由甲方出租房屋等。如因房屋产权问题导致本合同不能依约履行，所产生的任何责任与乙方无关，由此产生的一切责任由甲方承担。 Property ownership documents

（三）房屋供暖方式：房屋的供暖方式为[redacted]。 Heating

（四）人均居住面积：乙方承租人的人均居住面积须符合深圳市人均居住面积标准。 Whether the living area per person meets the required minimum

第二条 独家委托代理 Exclusive agency terms

（一）甲方同意将房屋独家委托给乙方全权管理并全权代理出租。

Term of the agency agreement

（二）委托代理权限自[redacted]至[redacted]。乙方独家委托代理权限包括：代理甲方出租房屋并办理与承租人之间的洽商、联络事宜；代理甲方签署与房屋租赁相关的任何协议、合同等文件（包括租赁合同的解除或变更协议、补充协议等）；代理甲方向承租人收取租金、押金、定金等相关费用；监督承租人按照房屋租赁合同的约定履行义务；以合同确认为准对房屋进行除主体结构和主体管道之外的装饰装修、改造。

（三）委托代理期限届满或本合同终止后，乙方应将房屋交回。

第三条 资产收益 Returns on the property