NBER WORKING PAPER SERIES

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Working Paper 27665
http://www.nber.org/papers/w27665

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
August 2020

This paper was previously circulated under the title “Valuation of Long-Term Property Rights under Political Uncertainty.” Zhiguo He acknowledges financial support from the John E. Jeuck Endowment at the University of Chicago Booth School of Business. We thank Scott Baker, Kwong Wing Chau, Lennon Choy, Bryan Kelly, Wenlan Qian, Johannes Stroebel, Yongxiang Wang, David M. Webb, Shang-jin Wei, Jason Wu, Constantine Yannelis, Bernard Yeung, and seminar partic- ipants at various institutions and conferences for helpful insights and discussions. Bowen Dong and Zi Ye at the Fama-Miller Center at Chicago Booth provided excellent research assistance. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

Valuing Long-Term Property Rights with Anticipated Political Regime Shifts
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NBER Working Paper No. 27665
August 2020
JEL No. G11,G12,G18,K25,N25,O53,P26,R30

## ABSTRACT

We identify exposure to political risk by exploiting a unique variation around land lease extension protection after 2047 in Hong Kong's housing market due to historical arrangements under the "One Country, Two Systems" design. Relative to properties that have been promised an extension protection, those with legally unprotected leases granted by the current government are sold at a substantial discount of around 8%, and those with colonial leases suffer an additional discount of about 8%. Incorporating estimated structural parameters that suggest an additional 20% ground rent after 2047, our model matches these empirical discounts well across long-term lease horizons. We find that the discount increases as time approaches 2047 and is higher in areas where residents feel more pessimistic about the city's future.

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# 1. Introduction

It is widely recognized that political factors play a significant role in asset valuations and economic activity (see, e.g., Fisman, 2001; Baker et al., 2016). In this paper, we examine Hong Kong's property market and identify a causal link between the anticipated political regime shift and long-term property rights, as indicated by housing prices. Our setting offers several unique advantages for studying this topic. First, Hong Kong, which is caught in the middle of the conflict between China and the western world, has become a political battleground for the fate of the unprecedented political experiment "One Country, Two Systems." Second, all land in Hong Kong is contracted through leaseholds through which land tenure is granted by the government for a fixed term; these are subject to extension at the end of their terms possibly by a different government, exposing property rights to substantial political risk. Third, the political outlook of Hong Kong, for historical reasons, will resolve on a predetermined future date (July 1$^{st}$, 2047) when the current authority in power—Hong Kong Special Administrative Region (HKSAR)—ceases to exist. Finally, Hong Kong's housing market is notoriously expensive, with significant implications for welfare.

The main empirical challenge in examining the relationship between political regime shift and valuation of long-term properties is the difficulty in disentangling exogenous variation in political policy shift from fundamental economic conditions that also affect property prices. We overcome this challenge by exploiting the heterogeneity among land lease extension protections that are linked to the expiry of the HKSAR in 2047. The expiration of the "One Country, Two Systems" on July 1$^{st}$, 2047, as established by historical design, poses a potentially significant political risk for any lease extensions beyond that date. In line with this hypothesis, we find the most pronounced difference when comparing land leases that expire on June 30$^{th}$, 2047, with a promised 50-year extension protection, to those that expire immediately after that date and are thus legally unprotected.

Our empirical analysis is guided by a structural asset pricing framework, where we incorporate different land lease extension policies after 2047 into housing valuation. In a standard Gordon growth model, there is a "natural" rent as well as a *ground rent* mandated by the government for leasing the land. The ground rent can be viewed as a "tax" paid by the property owner and equals a percentage of the property's rateable (rental) value that is assessed annually by the government based on market rents. The percentage used to calculate the ground rent, i.e., ground rent rate, is subject to change at the next lease extension in the future, rather than kept constant at 3% per today's practice.[1]

[1]Suppose that a homeowner could collect an annual rent of HKD 100,000 in the market (regardless of whether the house is actually being rented). Given a 3% of the ground rent rate, this homeowner needs to pay the government HKD 3,000 per year; this payment goes up to HKD 25,000 per year if the ground rent rate increases to 25%.

Our model captures the key idea that homeowners expect a substantial increase in the government-imposed ground rent schedule at a predetermined future date—July 1st, 2047—when the guaranteed "One Country, Two Systems" policy is set to expire. For example, at some year $t$ before 2047, the HKSAR could make a 50-year extension decision that would be in effect beyond 2047 (up to $t + 50$). If the new government in Hong Kong upheld this decision beyond 2047, the lease extension protection mechanism suggests that house prices will increase as their lease expiration approaches 2047; subsequently there would be a sharp decline immediately after the deadline, followed by another increase for leases with expiration years further away from 2047. Thus, our model implies a "periodic" housing price pattern with a discrete downward jump at the HKSAR expiry date.

We provide strong empirical support for our hypothesis implied by the model using the property transactions in Hong Kong and hedonic regressions. Relative to the control group of properties with leases set to expire on June 30th, 2047, and expected to receive an extension to 2097, properties with leases expiring immediately after that date are sold at a 14.1% discount, together with an estimated price discount schedule that smoothly decays with the lease's expiration year after 2047. Our placebo test, which utilizes rental transaction data, confirms that the estimates are not influenced by any unobservable factors that could affect property consumption values. Additionally, our results remain robust when using a more exogenous control subgroup whose lease terms were historically determined following the Second Convention of Peking in 1898, and more importantly, several progressively tightened specifications. For instance, to address potential biases due to differences in property attributes, we construct a matched sample by pairing each estate in the main treatment lease group (those expiring after July 1st, 2047, but before 2064) with the nearest estate in the control group based on their structural characteristics, thus allowing us to control for granular estate pair fixed effects. The price discount is even greater in this potentially stricter specification.

We also find properties with colonial British leases are sold at significantly greater discount—about another 8%—than other leases expiring in similar years, suggesting that homeowners assess a reneging risk in these legacy leases due to the expectation that the future government will still be under China's rule and thus more aligned with the HKSAR than the colonial British government.[2] We hence extend our baseline model by incorporating a reneging risk in the colonial British leases, allowing for differential reneging intensities before and after 2047. Also, homeowners of colonial British leases may face an extra land premium charge, in addition to ground rent, when those leases are reneged on or expire.

Based on the reduced-form discount estimates mentioned above, we are able to obtain in-

[2] "Colonial British leases" refer to leases that were auctioned by the British government before the Sino-British Joint Declaration (JD) signed in 1984 and that were never regranted thereafter. More detailed definitions are explained in Section 2.3 and footnote 10.

sights into the structural parameters of our main model with reneging risk, which is estimated using the standard generalized method of moments (GMM). Our estimation results indicate that, following the cessation of the HKSAR in 2047, homeowners expect to pay an additional 21% of the net rental value on top of the current ground rent rate at extension. Moreover, homeowners do not expect any reneging risk on colonial British leases before 2047, but they do anticipate these leases to be reneged on every 61 years after 2047. During these times, they will face extra land premium charges of approximately 7% and 21% of the house value before and after 2047 at extension, respectively. It is worth noting that the 21% additional ground rent rate is relatively lower than the required extension cost in the U.K. and Singapore.

Our findings suggest that the differential treatment by the new regime after 2047 with respect to land leases that have already been promised by HKSAR and those that have not been promised will have significant implications for the property market in Hong Kong. This implies that the new government post-2047 is expected to honor the remaining part of the 50-year protection promised by the HKSAR for existing land leases. Otherwise, we would not observe the "periodic" pattern revealed by the data. Indeed, when we modify our model to incorporate reneging risk in noncolonial leases before 2047, the estimation results indicate that homeowners do not anticipate any reneging risk for noncolonial leases.[3] This highlights the importance of political stability and the credibility of government commitments in the valuation of long-term property rights. In other words, our analysis suggests that there is a low likelihood of the future Hong Kong government posing an "expropriation" risk regarding the leasehold agreement pledged by the HKSAR. Our paper's emphasis on demonstrating the future regime's respect for legacy contracts, as highlighted in our literature review, distinguishes it from the vast literature on political connections (e.g., Fisman, 2001).

Our analysis suggests that the reneging risk of colonial British leases significantly contributes to approximately half of the baseline effect. While anticipated tax hikes by the future government may lead to economic agents choosing to spend less on maintenance or investment, which can overestimate the ground rent rate based on differentials in the current housing valuations across different leases, our findings indicate that though endogenous responses in maintenance and investment by homeowners exist, they are not the dominant channel. Once we control for lease types (colonial or noncolonial), old properties in the main treatment group only have an additional 2.6–2.9 percentage point discount, which is either not statistically significant or only marginally significant. We also analyze the estimated price discount over time and attempt to disentangle a natural "appreciation" effect, where the discount naturally increases as time approaches 2047, from potentially time-varying political uncertainty. Using our structural model and estimated parameters, we show that the majority of the effect can be

[3]In addition, this modified model has very similar objective value to our baseline model, suggesting that the additional model freedom does not provide any extra explanatory power.

explained by the natural "appreciation" effect, rather than time-varying political uncertainty.

The estimated price discounts in Hong Kong are influenced by local political sentiments and individual beliefs, which interact in a complex political economic equilibrium. To capture the unique political sentiments in Hong Kong, we construct two measures: the percentage of pro-democracy seats from district council elections and the percentage of migrants from mainland China. Additionally, we examine the beliefs of buyers and sellers by identifying mainland and local buyers and sellers. Our analysis reveals that one standard deviation (SD) increase in pro-democracy seats and mainland migrants in the local district is associated with an additional discount of 5.2 and 8.2 percentage points, respectively. Mainland buyers tend to be more optimistic than local buyers, while mainland sellers tend to be more pessimistic than local sellers regarding political uncertainty in the distant future. Furthermore, we investigate the interaction between local sentiment and individual beliefs and find that mainland sellers become more optimistic in areas with a high percentage of mainland migrants. However, there is no difference among mainland sellers across districts. This finding may be driven by Hong Kongers' rising antagonistic sentiments toward cultural influences from the mainland. Additionally, the price discount associated with districts with a high percentage of mainland migrants mainly reflects the sentiment of local buyers and sellers.

To place the paper in the literature, our study focuses on the expected "expropriation" associated with a political regime shift event that occurs on a predetermined date. This pertains to the first moment (e.g., Fisman, 2001), rather than political uncertainty, which pertains to the second moment (e.g., Pástor and Veronesi, 2012, 2013; Kelly et al., 2016; see more in the literature review). However, it is equally plausible that political uncertainty surrounding the predetermined regime change date affects the housing market in Hong Kong through the risk/uncertainty premium channel. Therefore, in this article we sometimes use the term "political risk" or "political uncertainty" broadly to refer to the political factors surrounding July 1$^{st}$, 2047, that may impact the housing market in Hong Kong.

Using U.K. and Singapore housing transactions, Giglio et al. (2015) estimate the "very long-run discount rate" by studying the price discounts of leaseholds with maturities ranging from 99 to 999 years relative to perpetual ownership contracts in freeholds. Our paper, which is primarily centered on political expropriation and its impact on cash flows of leaseholders, distinguishes itself from Giglio et al. (2015) who focus on the discount rate. Nevertheless, when we also estimate the discount rate in the Hong Kong housing market in Section 5.5, we obtain a discount rate of 2.44%. This is remarkably close to the estimated discount rate of 2.6% in Giglio et al. (2015), suggesting the possibility of integrated financial markets among these three British-system economies with similar leasehold systems.

As a potential alternative explanation for the observed price discounts, Giglio et al. (2015) have delved into the hold-up problem that freeholders may pose during lease extensions,

whereby a freeholder with strong bargaining power might charge unreasonably high premia for the lease extension. While they ultimately concluded that hold-up frictions could not account for the price disparities they observed across leases, this issue forms a critical intersection between our paper and Giglio et al. (2015). Like in Singapore, the largest freeholder in Hong Kong is the government; but unlike Singapore, leaseholders face uncertainty surrounding the entity that represents the Hong Kong government, due to the timed political experiment "One Country, Two Systems." Our paper precisely exploits the heterogeneity in land lease extension protections that are intricately linked to the expiration of the HKSAR on July $1^{st}$, 2047. In comparison to Giglio et al. (2015), we explicitly incorporate into our analysis the "hold-up" problem with potentially elevated ground rent imposed on the future Hong Kong government, and further provide estimates for these pivotal parameters to quantify these economic forces.

The paper is organized as follows. After a literature review, Section 2 discusses the institutional details of housing markets in Hong Kong. We lay out the theoretical framework of housing assets with varying land leases in Section 3, and present baseline empirical analyses in Section 4. In Section 5, we estimate the full model that accounts for reneging risk. Section 6 studies various driving factors for estimated price discounts, and Section 7 concludes.

**Literature Review** As mentioned above, our paper is closely related to Giglio et al. (2015) who study the housing markets in U.K. and Singapore. We study housing transactions in Hong Kong, which has received little attention from academic researchers, with the notable exceptions of Bhattacharya et al. (2021) and Fan et al. (2023).

The literature on property rights dates back to Coase (1960), and it has been shown that property rights, law, and institutions have a significant impact on long-term economic growth, investment, financial development, management of natural resources, and household welfare.[4] For instance, Acemoglu and Johnson (2005) argue that "property rights institutions," which protect citizens against expropriation by the government, play a more important role in fostering economic growth than "contracting institutions," which enable private contracts between citizens. In this context, our study can be viewed as a mixture of both: leasehold agreements are a form of long-term contracting between citizens and governments, but the unique political environment in Hong Kong, with anticipated political regime shifts, means that the long-term property rights granted by the previous government may be subject to the discretion of the next government, exposing the associated asset values to political risk.

Our paper connects to the literature on the impact of political connections during political regime transitions, such as Fisman (2001), Martinez-Bravo (2014), and Fisman et al. (2018).

[4]The vast literature includes, but is not limit to, De Long and Shleifer (1993); Besley (1995); La Porta et al. (1998); Besley and Burgess (2000); Olson (2002); Acemoglu and Johnson (2005); Field (2007); Goldstein and Udry (2008); Galiani and Schargrodsky (2010), and Abdulai et al. (2011).

Similarly, our approach, which considers contract expiration years, is akin to that of Martinez-Bravo et al. (2017), who examine the effect of how long "legacy" district mayors remained in office (to finish their five-year terms) during Indonesia's unexpected transition to democracy. Moreover, in the context of the land market in mainland China, Chen and Kung (2019) study political rents by estimating price differentials between princeling firms (connected to Politburo members) and other firms without such connections for land parcels of similar quality.

In addition to not involving political connections or corruption, our paper differs significantly from the literature mentioned above in two other ways. First, in terms of methodology, most studies in this field rely on abrupt and unexpected regime shifts—a feature that may be subject to criticism—to support credible identifications. However, our empirical design takes advantage of a predetermined regime change date (July 1$^{st}$, 2047) and a wide range of historical expiration dates set before the signing of the JD in 1984. Second, in the literature on political connections, such as Fisman (2001), it remains unclear whether the decrease in market value of connected firms following the decline of connected politicians' power is due to the loss of previously promised, potentially lucrative, long-term contracts (including those set to expire after the anticipated political regime shift) or future such deals. However, our examination of contract-level data demonstrates that the reduction in value is primarily due to the latter—namely, the hiked ground rent rate when renewing a new contract with worse terms in our context.[5]

Our paper is also related to the finance literature that studies asset pricing implications of political uncertainty/risk, such as stock prices (Pástor and Veronesi, 2012), risk premia (Pástor and Veronesi, 2013), equity options prices (Kelly et al., 2016), and idiosyncratic volatility and firm investment (Hassan et al., 2019). However, most of the existing literature focuses on financial markets in countries with developed economies and stable political environments. Our paper is perhaps more relevant in the context of the impact of political factors on asset pricing in emerging markets with protracted political indeterminacy. Finally, our focus is primarily on directional economic policy changes, which we believe play a dominant role in shaping the economic environment in Hong Kong today.[6]

The results presented in this paper also contribute to the growing literature on climate finance, which investigates how uncertainty about climate change is reflected in asset prices across various markets. Using methods similar to ours, researchers in this field have found that the housing market does price future climate risks to some extent, but that the pricing is highly heterogeneous, suggesting substantial differences in beliefs across locations (e.g.,

[5]Although Chen and Kung (2019) also study deal-level data, this question is not applicable to their context as typically corruption is not conducted via explicit contracting.

[6]The directional economic policy changes are more related to "cash-flow" shocks rather than "discount rate" shocks (Campbell and Shiller, 1987). A bit broadly, our paper is also related to the role of Hong Kong's financial markets in mainland China's capital market reform (e.g., Ma et al., 2021; He et al., 2023).

Bernstein et al., 2019; Engle et al., 2020; Keys and Mulder, 2020; Goldsmith-Pinkham et al., 2022; Luo et al., 2022). Our study highlights the importance of local political sentiment and individual beliefs in shaping the pricing of political risk, which is similar to the role of cross-sectional measures of climate change beliefs and individual political preferences in the climate finance literature (Baldauf et al., 2020; Giglio et al., 2021; Bernstein et al., 2022).

# 2. Hong Kong's Housing Markets: Past and Present

In this section, we discuss the relevant institutional details of housing markets in Hong Kong, highlighting the history of how leaseholds have changed over the past several decades.

## 2.1. A Brief History of Hong Kong

Hong Kong has been incorporated in the Chinese empire since the Qin Dynasty (221–206 BC). The British Empire took possession of Hong Kong Island in 1841 during the First Opium War with Qing China and then of Kowloon in 1860 after winning the Second Opium War. The British further forced the Second Convention of Peking (1898) on the weakened Qing Dynasty, stipulating that China must lease the New Territories to Britain for 99 years until June 30$^{\text{th}}$, 1997. This provision became the legal basis of the handover of Hong Kong in its entirety, including Hong Kong Island, Kowloon, and the New Territories, to China in 1997.

Negotiations between the Chinese and British governments began in the early 1980s, leading to the signing of the Sino-British Joint Declaration (JD) on December 19$^{\text{th}}$, 1984, and its ratification on May 27$^{\text{th}}$, 1985. The JD lays the groundwork for the transfer of sovereignty over Hong Kong from the United Kingdom to the People's Republic of China based on the "One Country, Two Systems" principle proposed by the late Chinese leader Deng Xiaoping. To implement the JD, the Basic Law was enacted under the Constitution of China to implement the JD in 1990 and came into effect on July 1$^{\text{st}}$, 1997, as the de facto constitution of the HKSAR, under which Hong Kong enjoys a high degree of autonomy and will retain its capitalist society for at least fifty years, until July 1$^{\text{st}}$, 2047.

Since the handover in July 1997, Hong Kong has undergone significant changes in all aspects of society. While the Basic Law guarantees a high degree of autonomy, concerns over the possibility of Beijing's interference in Hong Kong's affairs, especially civil and political rights, have been present since the handover and have intensified recently (e.g., the 2014 Umbrella Revolution Occupy Central movement and the 2019 social unrest; see Cantoni et al., 2019). After the 2004 Legislative Council (LegCo) election, political parties and politicians from varying ideologies formed two major political alignments: the pro-establishment camp, which is perceived to be more supportive of the HKSAR and the Chinese government; and

the pro-democracy camp, which is viewed as the opposition camp, with one of its main goals being to achieve universal suffrage as stipulated in the Basic Law.

## 2.2. The Economy and Housing Market in Hong Kong

As China has surged to become the second largest economy in the world, Hong Kong's economy has become increasingly more dependent on the mainland over the years. Sky-high property prices have diminished the prospect of young adults being able to afford their own homes; while some scholars have raised doubts, many are of the opinion that the housing market upswing is being driven by property investors from mainland China.[7] The wealth gap has widened significantly to record levels, and all these factors have contributed to the population's general discontent with the governance of Hong Kong (Taylor, 2019; The Economist, 2019).

We choose to study the effect of political factors through the lens of the housing market in Hong Kong for two reasons. First, the housing market consists of very long-term assets whose equilibrium price, as a present value of expected net cash flows in the future, including those beyond the current land lease term, can be susceptible to expropriation risk due to the shift in political regime. Second, housing is the dominant source of household wealth, especially in Hong Kong, where home prices have appreciated rapidly over the last two decades. According to a report by Demographia (2019), Hong Kong has the least affordable housing market among all 309 cities worldwide based on the median price-to-income ratio; and if households react to changes in political risk in asset markets, housing would be their most significant decision due to its magnitude of impact.

## 2.3. Land Tenure System and Land Policy in Hong Kong

Although almost all land in Hong Kong was owned by the British government during the colonial era and is now owned by China, the chief executive of Hong Kong has the authority to grant i) government leases and ii) licenses for individuals or corporations to occupy state land for a limited period of time, known as leaseholds. Additionally, the chief executive is permitted to use the Land Resumption Ordinance to order the requisition of any land for public purposes, which may involve reneging on the original land contracts.

The provisions in i) include the chief executive's power to extend nonrenewable leases at their expiration dates. Throughout the paper, we use renew/renewal, extend/extension, and regrant interchangeably. The HKSAR Lands Department seeks to provide clarity, consistency,

[7]For example, www.cnbc.com/2018/09/07/china-investors-set-to-investment-more-in-overseas-property-investment.html. However, a recent empirical study by Fan et al. (2023) finds that mainland buyers only accounted for 3.7% of the Hong Kong housing market, with only about 1.4% price premia over locals.

and certainty in the land lease terms.[8] However, due to the inherent uncertainty associated with the future of Hong Kong, achieving certainty in this context may be challenging.

**Leaseholds Granted Prior to 1984** Table A.1 provides an overview of six different types of land leases.[9] The earliest land leases in Hong Kong date back to 1843 with a term of 999 years (Type 1). From 1843 to 1898, the British government auctioned "75" year leases or "99" year leases (Type 2), which could be regranted at expiration by paying an additional land premium and adjusted ground rent rate. From 1899 to 1985, the British government widely implemented "75 + 75" or "99 + 99" year leases, with a single right of renewal for another 75 or 99 years after the initial term (Type 3). It is worth noting that Type 1 and Type 3 leases, as well as some Type 2 leases, are colonial British leases, which may carry a significant risk of reneging on lease contracts, as we will explore in Section 5.[10]

**Leaseholds Granted or Regranted After 1984** Type 4 leases are nonrenewable leases expiring during the transition period, which were automatically extended to June 30$^{\text{th}}$, 2047, according to the JD. The 1984 JD allows for new leases to be granted during the transition period for terms expiring no later than June 30$^{\text{th}}$, 2047. All new leases granted during this period are set to expire on June 30$^{\text{th}}$, 2047, with terms ranging from 50 to 62 years, making them Type 5 leases in Table A.1.

After the handover in 1997, the HKSAR began granting new land leases that expire 50 years after the initial land auction date (Type 6). In contrast to the colonial British leases, Type 4–6 leases and some Type 2 leases are noncolonial or HKSAR leases.

Notably, the 1984 JD does not explicitly address the extension of historical leases after 1997. Upon its establishment, the HKSAR announced on July 15$^{\text{th}}$, 1997, that nonrenewable leases could be extended for another 50-year term at the sole discretion of the HKSAR upon expiration without an additional premium (see more in Subsection 2.4). For instance, leases expiring on June 30$^{\text{th}}$, 2047, would be automatically extended to 2097.

[8] Some land leases in Hong Kong have a renewal option in the original contract (i.e., renewable leases), while others do not have such an option (i.e., nonrenewable leases). Once a landowner has exercised a renewal option, the lease also becomes a nonrenewable lease. Please see Table A.1 for further details. More information on land policies can be found at https://www.landsd.gov.hk /tc/service/landpolicy.htm.

[9] Webb (2010), in his online reports, explains the historical context of lease tenures since 1841. In identifying land leases, we begin with Webb's collection and validate every detail with our own data and other sources including official texts of JD, the Basic Law, and Hong Kong government websites.

[10] "Colonial British leases" refer to the existing leases in our data that were auctioned by the British government before the JD and were never regranted as nonrenewable leases after the JD. For example, a 75-year lease that was auctioned in 1843 and had its first extension in 1918 and second extension in 1993 would no longer be considered a colonial British lease after the 1993 extension. However, a 75-year lease that was auctioned in 1984 and will expire in 2059 would be considered a colonial British lease. Similarly, a 75+75 lease that was auctioned in 1915 and had its renewal option exercised in 1990 (regranted as a renewable lease) would still be considered a colonial British lease because it was never regranted as a nonrenewable lease after the JD.

**Land Policies** The government has three options to consider when deciding on land lease extensions. The first is whether to extend nonrenewable leases at their expiration. For example, if a 75-year nonrenewable lease was auctioned in 1850 and a 75+75 lease was auctioned in 1900, the government has full discretion to decide whether and how to extend them at their respective expiration dates, which are 1925 and 2050 (after exercising a renewal option in 1975), respectively.

The second tool is the method of calculating ground rent at extension. For HKSAR leases, the ground rent for the new term is recalculated as 3% of the rateable value, which is an estimate of the annual rent assessed by the government annually based on open market rents for similar properties in the locality. However, for colonial British leases, the leaseholders only need to pay 3% of the rateable value evaluated at the beginning of the lease, which is known as nominal ground rent rate, and remains fixed throughout the entire lease period. This fixed ground or nominal rent was a common practice before the JD.

The third tool is to determine the land premium required for the extension of nonrenewable leases. In 1946, the colonial British government announced that it would offer extension by charging the full and fair land lease value unless the land was needed for public purposes (Webb, 2010). During the transition period as well as after the handover, according to the JD and the HKSAR announcement on July 15$^{\text{th}}$, 1997, respectively, no additional land premium payment has been required for lease extension.

However, it is important to note that this policy of zero additional premium as well as 3% of rateable value, which is more generous than similar policies in other countries (U.K. and Singapore, as mentioned in Subsection 5.3), may be subject to change. These anticipated changes will be reflected in house transactions prices.

## 2.4. The Legitimacy of Leasehold Extensions beyond 2047

Current HKSAR practices are to i) extend nonrenewable leases with an annual ground rent rate of 3% of the rateable value (adjusted to reflect the market value), ii) set the nominal ground rent rate for colonial British leases at 3% of the rateable value (evaluated at the start year of the lease term), and iii) require no additional land premium. These practices aim to provide clarity and minimize disruption to the housing market. However, the land lease extension policy in Hong Kong has always been subject to policy uncertainty. This is particularly relevant now since the arrangements under the "One Country, Two Systems" design are set to expire in 2047. This expiration date makes all the land leases that have been extended by the HKSAR beyond this point a focal point for potential policy changes. Any future changes to the policy, such as requiring an additional land premium or increasing the ground rent rate beyond the current 3% level, could impact the value of properties and have

implications for both leaseholders and potential buyers.

To address this concern, on July 15$^{\text{th}}$, 1997, the HKSAR affirmed its constitutional authority to grant land leases beyond July 1$^{\text{st}}$, 2047, on the following grounds.[11] First, Article 7 of the Basic Law entrusts the HKSAR with the power to manage and grant land leases without being limited to a duration of 50 years. Second, under Article 120, all leases granted or extended before 1997 and all rights in relation to such leases shall continue to be protected under the Basic Law. Third, Article 123 stipulates that leases expiring after 1997 without right of extension shall be dealt with by the HKSAR, thus not imposing any restriction on the HKSAR's power to grant leases beyond 2047. Finally, there is no provision in the Basic Law that restricts the otherwise unlimited power of HKSAR to grant land leases beyond 2047. Therefore, the HKSAR can legitimately extend leases beyond July 1$^{\text{st}}$, 2047. In Subsection 3.3, we discuss our model's assumptions, including the issue of whether the HKSAR can legitimately extend leases.

# 3. A Baseline Model of Housing Valuation

In this section, we present the theoretical framework for our analysis. In Subsection 3.2, we provide a stylized example to illustrate the impact of political regime shift on housing valuation for different extension dates.

## 3.1. Model Setup

Consider a standard infinite-horizon Gordon growth model in which a housing asset generates a "natural" gross rent (or gross rental income) $\hat{R}_t$, for $t \in [0, \infty)$. For ease of illustration, our model is cast under the risk-neutral measure (we discuss the role of risk premium later in Subsection 5.4). We normalize the time-0 housing natural rent $\hat{R}_0$ to $\frac{1}{1-\omega}$. Here, $\omega$ represents the percentage of repairing costs and taxes in the gross rent (including the current 3% mentioned in Subsection 2.3). Given a constant discount rate $r$ and a constant growth rate $g$, we have

$$\hat{R}_t = \frac{e^{gt}}{1-\omega}.$$

Before the lease expires, the homeowner's net cash flow from the property is

$$R_t \equiv \hat{R}_t (1-\omega) = e^{gt}. \tag{1}$$

However, the current house value not only depends on the ground rent rate today, but also the expected ground rent rate in the future after the current lease expires. Let $L$ denote

[11] See https://www.landsd.gov.hk/en/resources/land-info-stat/land-tenure-system-land-policy.html.

the nearest land lease expiration date, after which the government may extend the lease for another $T$ years by charging an additional ground rent rate (on top of the 3% of the rateable). We define this additional rate as $f_s^{(\tau)}$ at a future time $s$ by

$$f_s^{(\tau)} \equiv f(s;\tau) \in [0,1]. \tag{2}$$

We highlight that $f_s^{(\tau)}$ depends also on a fixed time in the future $\tau > t$, which is linked to the political fate of Hong Kong. This predetermined future time $\tau$ is the date on which the policy uncertainty resolves to a large extent, in the case of Hong Kong, July 1$^{\text{st}}$, 2047; we will provide a more detailed explanation in Subsection 3.2. In our model, we assume a deterministic schedule of $f_s^{(\tau)}$ under the risk-neutral measure.

For a given extension date $L$, the additional ground rent rate in Eq. (2) applies to the following $T$-year interval $t \in [L, L+T]$. Hence, for any future time $s > L$, the owner's cash flow is given by:

$$R_s = \hat{R}_s(1-\omega)(1 - f^{(\tau)}_{L+T\cdot N(s)}) = e^{gs}\left(1 - f^{(\tau)}_{L+T\cdot N(s)}\right), \tag{3}$$

$N(s) \equiv \lfloor \frac{s-L}{T} \rfloor$ denotes the greatest integer that is smaller than $\frac{s-L}{T}$. Before the extension (i.e., for $s \in [t, L]$), there is no additional ground rent rate, and hence $R_s = e^{gs}$. The underlying assumption, which will be discussed in Subsection 3.3, is that the current government will honor the lease contract covering $[N(s), N(s)+T]$, even though this contract was granted by the previous government (HKSAR). One can calculate the current house price $P_t$ at time $t$ to be

$$P_t = \mathbb{E}_t\left[\int_t^\infty e^{-r(s-t)} e^{gs}\left(1 - \mathbf{1}_{s>L}\cdot f^{(\tau)}_{L+T\cdot N(s)}\right) ds\right]. \tag{4}$$

For purposes of illustration, we consider only the ground rent rate in the baseline model. However, Subsection 5.2 introduces both a "land premium" and the potential for lease renegotiation in our main model. The land premium is an upfront payment made by the lessee to the government at the expiration date in exchange for the right to occupy the land for another term, and lease reneging captures the differences between HKSAR leases and colonial British leases.

## 3.2. An Illustrating Example

For illustration, we set $t = 0$ and consider a simple schedule of additional ground rent rate:

$$f_s^{(\tau)} = \gamma \mathbf{1}_{\{s \geq \tau\}}, \quad \text{with} \quad \gamma > 0. \tag{5}$$

In our context, the predetermined time $\tau$ is July 1$^{\text{st}}$, 2047. Specifically, the HKSAR will extend land leases for another 50 years ($T = 50$) without additional ground rent rate if they expire before June 30$^{\text{th}}$, 2047, but will require additional ground rent rate $\gamma$ for those set to expire after July 1$^{\text{st}}$, 2047. The schedule in Eq. (5) captures the key idea that the greatest political uncertainty in Hong Kong's housing market gets resolved at a predetermined future date when the Basic Law and HKSAR expire, after which the expected additional ground rent rate $\gamma$ will be imposed.[12]

Denote $\kappa \equiv r - g$. The value of a house with a land lease expiring at $L$ is

$$P(L;\tau) = \int_0^L e^{-\kappa s} ds + \int_L^\infty e^{-\kappa s} \left(1 - f^{(\tau)}_{L+T\cdot N(s)}\right) ds. \tag{6}$$

Consider two examples. If $L < \tau$ and $L + T \geq \tau$, the homeowner can extend the land lease to $L + T$ before the uncertainty resolution date $\tau$, implying that

$$P(L;\tau) = \int_0^{L+T} e^{-\kappa s} ds + \int_{L+T}^\infty e^{-\kappa s} (1-\gamma)\, ds = \frac{1 - \gamma e^{-\kappa(L+T)}}{\kappa}. \tag{7}$$

In contrast, if $L \geq \tau$, then the house value is

$$P(L;\tau) = \int_0^{L} e^{-\kappa s} ds + \int_{L}^\infty e^{-\kappa s} (1-\gamma)\, ds = \frac{1 - \gamma e^{-\kappa L}}{\kappa}. \tag{8}$$

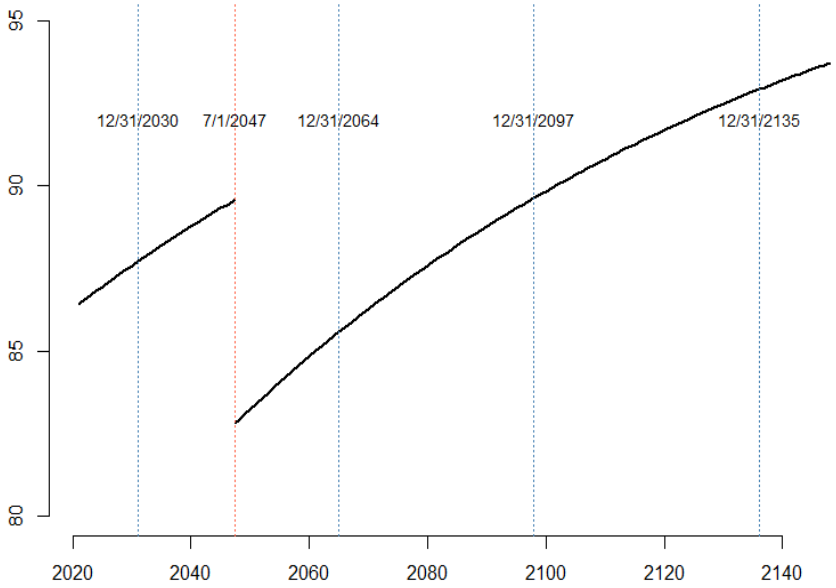
Figure 1, with $\tau = 07/01/2047$ indicated by a red dashed vertical line, plots housing value $P(L;\tau)$ as a function of the lease expiration date $L$. We also plot the cutoff years in blue dotted vertical lines at several boundaries of leasehold groups used in Section 4.

We observe that $P(L;\tau)$ first increases with the lease expiration date $L$, jumps downward at $L = \tau$, and then slowly grows back at $L = \tau + T$ with almost the same height as the previous cycle.[13] This periodic pattern in valuation can be best illustrated by investigating the lease group with $L = \tau - T$ (say, land leases expiring on June 30$^{\text{th}}$, 2047) and the lease group with $L = \tau + T$ (e.g., land leases expiring on June 30$^{\text{th}}$, 2097): the former group can be successfully extended right before $\tau$ and hence enjoy the standard ground rent rate 3% for another $T = 50$ years, which exactly matches the ground rent rate schedule faced by the latter lease group.

[12] In general, $\gamma$ also captures risk premium of political uncertainty under the physical measure. See related discussion in Section 5.3.

[13] In Figure 1 the house value with leases expiring in the remote future (say 12/31/2135) is slightly higher (than those expiring right before 7/1/2014) simply because they are protected fully by the current lease. This is no longer the case in the main model with reneging developed in Section 5.

**Figure 1.** Model-Implied House Values Count across Leases




This figure plots the model implied home value as a function of lease expiration date $L$. The political uncertainty will be largely resolved on 7/1/2047, when a new Hong Kong government replaces the current HKSAR. Vertical lines indicate several lease expiration dates.

## 3.3. Discussion of Key Model Assumptions

It is worth pausing to highlight the key assumptions of our model. In particular, we assume that the extension decisions made by the HKSAR before 2047 at year $n$—but in effect beyond 2047 (up to $n + 50$)—will be honored by the new government in Hong Kong, despite the expiration of the HKSAR government on July 1$^{\text{st}}$, 2047. Land leases that expire right before 2047 are assumed to face no discount in the next 50 years, whereas those expiring right after face a discount, leading to the discrete drop at $L = \tau$ in Figure 1.

Exactly on this point, Subsection 2.4 has discussed the legitimacy of the HKSAR's decision to extend land leases that are set to expire before 2047 to beyond 2047. To support this discussion, we point to the formal affirmation issued by the HKSAR on July 15$^{\text{th}}$, 1997, which stated that "there is no provision in the Basic Law to restrict the otherwise unlimited power of the HKSAR to grant land leases beyond 2047." This statement appears to imply endorsement from Beijing, and the authorization of the HKSAR to renew land leases serves as an important safeguard for a specific group of leaseholders' property rights in the long run, extending beyond the HKSAR's tenure. Moreover, this pattern of policy consistency is evident in the prior negotiations involving China, the U.K., and Hong Kong.

Of course, it is uncertain whether the leases granted by HKSAR will be respected in the event of the failure of the "One Country, Two Systems" experiment. However, it is important to emphasize that our analyses remain valid in such a scenario. First, our key

prediction of a significant price discount at $L = \tau$ only requires a differential treatment by the new regime (in power after 2047) with respect to the land leases that have already been promised by HKSAR versus those that have not. This differentiation, which would persist even in the most extreme circumstances, is in line with the fundamental principle of "policy continuity" observed throughout Hong Kong's history and Beijing's approaches to China's economic reforms, including its own land policy.[14]

Second, we have not yet addressed the leases that were granted by the colonial British government prior to 1997. Our empirical findings suggest that there is a discrepancy between these colonial leases and leases that were granted or renewed after the JD, with the former being sold at a larger price reduction. In Section 5, we expand our model to consider the risk of reneging.

Lastly, and arguably most critical to our study, we assume that the noncolonial HKSAR leases will be respected. This assumption is strongly supported by the data, which reveal a substantial price discount for properties with leases that expire immediately after July 1$^{st}$, 2047. This indicates that investors anticipate the Chinese central government will honor the long-term property rights agreements that were promised by HKSAR. Moreover, Section 5 of our study extends the standard model to consider potential default risks in both colonial and noncolonial leases. Our analysis shows a negligible estimate on the latter; for more detailed discussion, see Subsection 5.3.

# 4. Empirical Design and Main Results

This section begins by introducing the primary data sources, our sample design, and descriptive statistics. We then explain our primary empirical design, which is guided by the theory developed in Section 3. Finally, we present the baseline analysis, along with a battery of robustness tests.

[14]Historical precedents in Hong Kong can be traced back to the Land Leases Annex (Annex III) in the JD, which was signed during a period of political uncertainty and market turbulence. The Annex guarantees that all leased lands granted by the British Hong Kong government expiring after June 30$^{th}$, 1997, and all rights in relation to such leases, shall continue to be recognized and protected by the HKSAR. In mainland China, which has not started collecting property taxes so far, a similar policy was set by the Ministry of Land regarding the extension of 20- or 30-year land leases in Qingdao, Shenzhen, and Wenzhou, stating that homeowners would not have to pay an extension fee to continue using their residences after the shorter lease expires (Hsu, 2017). For literature on these issues, see Fang et al. (2016) and Chen et al. (2020), among others. Recently, the Ministry of Natural Resources of China made announced a new national property registration system https://www.scmp.com/economy/china-economy/article/3218469/chinas-controversial-property-tax-appears-clear-major-hurdle-questions-remain-start-date, which suggests that China is taking significant steps toward implementing a property tax in the near future.

## 4.1. Data Sources

This paper relies on three primary sources of data; two have been obtained from the same data vendor and the third is publicly available.

**Residential Transactions and Amenities** In Hong Kong, all property transactions must be registered with the Land Registry. We obtained all residential property transactions in Hong Kong from EPRC Ltd., which has purchased all electronic transaction data from the Land Registry. Our EPRC data covers the period from January 1992 to February 2020 and contains a comprehensive set of information on housing characteristics and transaction details in Hong Kong. The most important information for our study is the land lease expiration year. Other property information includes address, building construction year and month, district name or code, floor and unit numbers, property amenities (e.g., swimming pool, club house), transaction sale date, transaction prices, and names of buyers and sellers.[15]

We have also geocoded all the buildings in our sample and calculated their distance to nearby amenities using their latitudes and longitudes. These amenities, such as the Mass Transit Railway (MTR), bus stops, hospitals, schools (K–12), universities, and the coastline, are included as control variables in our hedonic regression analysis.

**Land Sales** In the EPRC data, only the year of land lease expiration is provided, without information on the date of expiration. Since it is important for us to separate leases expiring before and after July 1$^{st}$, 2047, we obtain the land auction data from the Land Registry website and match the land transaction price and auction date to the housing transaction data using the land lot number.

**Hong Kong Quinquennial Census Data and Local Elections** To obtain demographic characteristics of the residents, we use the 1% Quinquennial Population Census data from 2001, 2006, 2011, and 2016. Each of the census data sets contains rich information on apartments, households, and persons with district of residence disclosed. We capture several important district-level characteristics. Additionally, to measure the political sentiment at the district level, we collect the percentage of pro-democracy seats from Hong Kong district council elections in 1999, 2003, 2007, 2011, 2015, and 2019.

[15] Bhattacharya et al. (2021) study the spillover effect of "haunted" houses, those associated with a murder, suicide, or other unnatural death, on the prices of nearby houses using the same transaction data used in this paper.

## 4.2. Data Sample

We apply several filters to construct the final sample of transactions. First, we focus on private housing transactions with market-driven prices.[16] Second, we require observations to have no missing values for land lease expiration year, transaction price and date, and floor number. Also, due to potential inconsistency in property registration about housing characteristics before and after the handover on July 1$^{st}$, 1997, we exclude transactions before 1998.[17] Third, we exclude houses, townhomes, and non-arm's length transactions (e.g., deeds of gift, assignments, changes of name, and subagreements), and transactions in the Islands District which mainly consists of various islands such as Lantau Island, Lamma Island, Cheung Chau Island, etc. Lastly, we trim the top and bottom 1% extreme values in unit and total transaction price.

Our final sample contains 551,790 residential housing transactions located in 17 districts and 45 subdistricts, all of which were sold between January 1998 and February 2020. Table 1 reports the summary statistics of the variables used in our analysis based on the full sample. First, the average sale price of the units is HKD 2,801,066 (roughly USD 363,552) in total and HKD 5,541 (USD 719) per square feet. The total price varies widely, ranging from HKD 663,650 to HKD 16.78 million. The net living area of the units ranges from 258 to 1,157 square feet, with an average of 528 square feet. The median age of buildings at the time of sale is 15 years, and the median building completion year is 1992. On average, the units have 2 bedrooms and 2 living rooms. In Subsection 4.5, we will conduct balance tests to compare the differences in all the variables between the main treatment and control groups.

## 4.3. Empirical Design

The variation in exposure to political uncertainty is identified by grouping various land leases as explained in Section 2.3 based on expiration year.

**Control Lease Group** We first identify all leases scheduled to expire on June 30$^{th}$, 2047, as our control lease group. This group will be automatically extended to 2097 with an additional 50 years of protection according to the current HKSAR policy. As explained in Subsection 2.3, there exist two categories of land leases that are set to expire in the year 2047, and for our purpose it is essential to distinguish them based on whether they expire before or after

[16] We exclude government housing projects from our analysis, which house 46% of the population in Hong Kong, according to the housing statistics published by the Transport and Housing Bureau of HKSAR in 2019.

[17] We observed changes in reporting practices after the handover in 1997. Before 1998, most transactions were reported as having zero living rooms, while after 1998, most transactions were reported as having more than one living room. Additionally, before 1998, information about bay windows was missing in 99% of transactions, but this improved after the handover.

Table 1: Summary Statistics

| Variable | N | Mean | SD | Min | 1st | 5th | Median | 95th | 99th | Max |
|---|---|---|---|---|---|---|---|---|---|---|
| Log(Price) | 551,790 | 1.03 | 0.65 | −0.41 | −0.24 | 0.00 | 0.99 | 2.13 | 2.53 | 2.82 |
| Log(Unit Price) | 551,790 | 8.62 | 0.54 | 7.44 | 7.57 | 7.78 | 8.57 | 9.56 | 9.77 | 9.90 |
| Building Age | 551,790 | 16.01 | 9.03 | 2 | 2 | 3 | 15 | 32 | 38 | 40 |
| Building Completion Year | 551,790 | 1992 | 8.98 | 1959 | 1972 | 1978 | 1992 | 2006 | 2012 | 2018 |
| Net Living Area Area | 551,790 | 528.57 | 163.80 | 258 | 277 | 306 | 504 | 852 | 1,043 | 1,157 |
| Floor | 551,790 | 18 | 12 | 0 | 1 | 3 | 16 | 41 | 56 | 80 |
| No of Bedrooms | 526,155 | 2 | 1 | 0 | 0 | 0 | 2 | 3 | 3 | 4 |
| No of Living Rooms | 530,719 | 2 | 1 | 0 | 0 | 0 | 2 | 2 | 2 | 4 |
| Bay Window Size | 551,790 | 20.32 | 15.37 | 0 | 0 | 0 | 22 | 44 | 54 | 250 |
| Distance To MRT | 551,790 | 702 | 886 | 8 | 24 | 59 | 423 | 2,462 | 4,708 | 10,633 |
| Distance To Bus Stop | 551,790 | 314 | 276 | 8 | 12 | 48 | 258 | 711 | 1,312 | 3,365 |
| Distance To Hospital | 551,790 | 1,644 | 1,268 | 80 | 251 | 394 | 1,359 | 3,978 | 6,565 | 10,589 |
| Distance To School | 551,790 | 138 | 196 | 0 | 5 | 22 | 101 | 303 | 946 | 2,526 |
| Distance To University | 551,790 | 3,564 | 2,466 | 85 | 309 | 611 | 3,022 | 8,348 | 10,311 | 10,311 |
| Distance To Coastal Line | 551,790 | 1,358 | 1,635 | 17 | 31 | 72 | 732 | 5,441 | 7,338 | 8,227 |

The table presents summary statistics of all the variables used in the analysis. Our sample contains all second-hand housing transactions in Hong Kong from 1998 to February 2020 with the following exclusions: transactions with missing date, total price, unit price, net living area size, building unique ID, lease expiration date, latitude, longitude, or floor number; complexes that belong to public housing projects; houses or townhouses; transactions in Island district, which consists of several islands that are not part of Kowloon peninsula or Hong Kong Island.

July 1st, 2047, as the latter is part of the treatment lease group.

Focus on the former group first. According to the JD, which became effective on May 27th, 1985, all existing nonrenewable leases that were going to expire before June 30th, 1997, were automatically extended to June 30th, 2047. These leases primarily cover land in New Kowloon and the New Territories (Type 4 in Table A.1) and a small portion of such leases cover land in Hong Kong Island and Old Kowloon. And, any land leases auctioned between May 27th, 1985, and June 30th, 1997, are set to expire on June 30th, 2047 (Type 5).

Second, any land that was auctioned in the second half of the year 1897 with a 75-year lease or in the second half of the year 1849 with a 99-year lease (part of Type 2) will expire in the second half of 2047.[18] Finally, any land auctioned by the newly established HKSAR between July 1st and December 31st, 1997, will expire between July 1st and December 31st, 2047 (Type 6).[19]

[18] We collected the historical land auction information from the *Hong Kong Government Gazette* and verified that the land leases of matched properties in our data were all auctioned in the second half of 1897 and are thus set to expire during the second half of 2047.

[19] There were twelve land lots auctioned between July 1st–December 31st, 1997. We found eight of these lots in the EPRC data by matching the land lot number. Thus, properties with those eight land lots will expire between July 1st and December 31st, 2047. The other four unmatched land lots could have been developed as nonresidential properties or could be held by developers (in Hong Kong, given the volatile housing market, it is common for developers to wait as long as decades).

**Treatment Lease Groups** Our treatment leases can be classified into nine groups based on their lease expiration year. The first three groups consist of leases that will expire before 2047, which will be extended for an additional 50-year period. These groups are categorized by their lease expiration years: 2029–2033, 2034–2039, and 2040–2046 (Type 2 in Table A.1). The next five groups contain leases that will expire after July 1$^{st}$, 2047, and are categorized as: July 1$^{st}$, 2047–2049, 2050–2052, 2053–2064, 2065–2097, and 2098–2135. According to our theory, the first post-2047 lease group should be the most exposed to political uncertainty caused by the predetermined regime shift, and the exposure diminishes as the lease expiration year moves further away. Finally, there is a group with "distant" leases that expire in the remote future (2842–2959). This group contains the 999-year leaseholds that were granted before the 1960s.

In later analyses, we also combine the earliest three post-2047 lease groups, i.e., July 1$^{st}$ 2047–2049, 2050–2052, 2053–2064, together and refer to them as the *main treatment* group. These leases are most subject to political uncertainty according to our theory. Additionally, these three lease groups include land leases that were granted by both the HKSAR and the colonial British government (see footnote 10 for details), while those expiring after 2064 were exclusively granted by the colonial British government. Our later analysis will explore the heterogeneity across these two leases to identify the reneging risk.

We construct our lease groups in a way such that they all have sufficient observations for our empirical analysis, as reported in Table A.2, even though there may not be enough transactions for an individual lease expiration year, as shown in Figure A.1. Panel C of Figure A.1 also illustrates the number of leases for the main treatment and control groups across all districts, demonstrating that all districts, except the Islands, have a substantial number of transactions for both lease groups.

**Empirical Specification** As explained earlier, we use leases expiring on June 30$^{th}$, 2047 as our control group. In the baseline specification, we estimate the price discounts of all other (treatment) lease groups relative to the control lease group in the following hedonic specification (Rosen, 1974):

$$\ln(P_{i,t}) = \sum_{n=1}^{N} \beta_n \cdot Lease_n + \eta \cdot X_{i,t} + \alpha_{d \times m(t)} + \varepsilon_{i,t}, \tag{9}$$

where $P_{i,t}$ is the unit sale price of house $i$ at time $t$; $X_{i,t}$ is a full set of housing characteristics, including the number of bedrooms and living rooms, bay window, bay window size, floor area, age of the building, direction faced, swimming pool, club house, and neighborhood amenities (e.g., distance to MTR), all used as categorical variables (e.g., dummies for one, two, or three

bedrooms) to capture potential nonlinear effects; $\alpha_{d\times m(t)}$ represents the district $\times$ year-month fixed effects. The estimates of $\beta_n$ may be biased if there is a correlation between $Lease_n$ and $X_{i,t}$, which is a concern we will investigate and address in Subsection 4.5.

Our model in Section 3 predicts a sharp downward jump at $L = \tau$ in Figure 1, suggesting that properties in the post-2047 lease groups have the highest exposure to political uncertainty and therefore bear the largest discount. Our theory predicts that the 50-year extension policy effectively minimizes the exposure of leases to political uncertainty for lease groups set to expire around 2047; in other words, $\beta_n$ in Eq. (9) should be negative. For pre-2047 leases, the nearer the year of expiry is to 2047, the more significant the protection promised by HKSAR, resulting in a lower (absolute value of) price discount. Conversely, our theory predicts a discount schedule for post-2047 leases that decreases with their expiry years, implying that the closer the expiry year is to 2047, the higher the price discount. We will confirm these theoretical predictions in our baseline regression.

Finally, for distant leases that expire in the remote future (the 2842–2959 group, whose leases have 999-year terms issued by the colonial British government), our baseline model predicts a price premium compared to the control group due to the protection promised by the colonial British Hong Kong government prior to the JD in 1984. However, as we will demonstrate shortly, colonial British leases carry a significant risk of reneging on leases' contracts. In our main model in Section 5, we account for this risk and show that the distant lease groups will either sell at a slight discount or not at all, in comparison to the control group.

## 4.4. Baseline Analysis

Table 2 presents the results of our analysis, with the dependent variable being the logarithm of unit price in all columns. Our baseline specification is reported in Column (3), where we control for property attributes and district by year-month fixed effects.In Columns (1) and (2), we replace district with year-month fixed effects that have less restrictive district plus year-month and subdistrict plus year-month fixed effects, respectively. In Column (4), we substitute property attributes for more restrictive property attributes by year to isolate potential variation in individual hedonic factors over time. In Column (5), we control for more granular subdistrict by year-month fixed effects. In all regressions, standard errors are two-way clustered by estate and year-month.[20]

[20]We have chosen Column (3) as the baseline specification over Column (5) that controls for subdistrict by year-month fixed effects. One significant factor that favors Column (3) is the proportion of cohorts containing both treatment and control leases, which aid in pinpointing the price discount we are seeking to identify. In Column (3), across all the district by year-month cohorts, we have a sufficient number of them (67%) with both treatment and control leases. In contrast, while Column (5) accounts for finer fixed effects, only 43% of subdistrict by year-month cohorts contain properties with both treatment and control leases. Besides, we

Table 2: Baseline Analysis

| Dep Var | Log(Unit Price) | | | | |
|---|---|---|---|---|---|
| Sample | All Sales | | | | |
| | (1) | (2) | (3) | (4) | (5) |
| I(2030 ≤ Lease ≤ 2033) | −0.067 | 0.032 | −0.057 | −0.054 | 0.056 |
| | (0.041) | (0.036) | (0.043) | (0.053) | (0.034) |
| I(2034 ≤ Lease ≤ 2039) | −0.057 | −0.076** | −0.038 | 0.002 | −0.058** |
| | (0.038) | (0.030) | (0.038) | (0.038) | (0.029) |
| I(2040 ≤ Lease ≤ 2046) | −0.054 | −0.088** | −0.024 | −0.009 | −0.051 |
| | (0.053) | (0.042) | (0.057) | (0.056) | (0.047) |
| I(7/1/2047 ≤ Lease ≤ 2049) | −0.146*** | −0.123*** | −0.141*** | −0.124*** | −0.116*** |
| | (0.028) | (0.025) | (0.028) | (0.026) | (0.023) |
| I(2050 ≤ Lease ≤ 2052) | −0.134*** | −0.102*** | −0.127*** | −0.121*** | −0.092*** |
| | (0.028) | (0.025) | (0.028) | (0.027) | (0.024) |
| I(2053 ≤ Lease ≤ 2064) | −0.139*** | −0.099*** | −0.127*** | −0.090*** | −0.089*** |
| | (0.033) | (0.030) | (0.032) | (0.028) | (0.028) |
| I(2065 ≤ Lease ≤ 2097) | −0.123*** | −0.095*** | −0.105*** | −0.090*** | −0.082*** |
| | (0.035) | (0.031) | (0.035) | (0.034) | (0.030) |
| I(2098 ≤ Lease ≤ 2135) | −0.039 | −0.007 | −0.022 | −0.014 | 0.014 |
| | (0.038) | (0.028) | (0.038) | (0.037) | (0.027) |
| I(2842 ≤ Lease ≤ 2959) | −0.075** | −0.087*** | −0.052 | −0.034 | −0.061** |
| | (0.035) | (0.026) | (0.035) | (0.035) | (0.026) |
| Property Attributes | Yes | Yes | Yes | | Yes |
| Property Attributes × Year | | | | Yes | |
| District + Month FE | Yes | | | | |
| Subdistrict + Month FE | | Yes | | | |
| District × Month FE | | | Yes | Yes | |
| Subdistrict × Month FE | | | | | Yes |
| $N$ | 551,790 | 551,790 | 551,790 | 551,790 | 551,790 |
| Adjusted $R^2$ | 0.919 | 0.930 | 0.929 | 0.941 | 0.943 |

This table presents the baseline hedonic housing price regression results using the entire sample of housing transaction records in Hong Kong from 1998 to February 2020. The dependent variable is the logarithm of unit price. For all columns except for Column (4), control variables include a full set of property and building characteristics specified in Eq. (9). Column (4) controls for the interactions of property characteristics and transaction year. From Column (1) to Column (5), different location fixed effects are applied as the bottom rows indicate. Standard errors are two-way clustered by estate and year-month. Significance levels are denoted by ***= 1%, **= 5%, *= 10%.

According to our baseline Column (3), properties with leases expiring immediately after July 1st, 2047, are sold at a statistically significant discount of 14.1% compared to the control group whose leases expire on June 30th, 2047. Similarly, the other three post-2047 lease groups (2050–2052, 2053–2064, and 2065–2097) are also sold at statistically significant discounts of 12.7%, 12.7%, and 10.5%, respectively. The estimates from more restrictive alternative specifications in Columns (4) and (5) are slightly smaller than those in the baseline results,

have included Column (4) to test the time-varying effects of property attributes; and the findings in Columns (3) and (4) reveal consistent results, indicating that the time-varying effects of property attributes may not be a significant concern. Notably, Column (4) incorporates 8,267 fixed effects, which is about twice the number of fixed effects employed in Column (3). In light of the limited sample size, we have made the decision to designate Column (3) with a higher statistical power as the preferred baseline specification.

but still significant at the 1% level. For example, in Column (5), properties with leases expiring between July 1st, 2047, and 2049 are sold at a discount of approximately 11.6%. These results are consistent with our model prediction that discounts decrease for land leases expiring in the distant future.

Properties in the lease groups set to expire before 2047 are sold similarly to those in the control group, in the sense that their estimated discounts in Column (3) are not statistically different from zero. However, their point estimates are all negative, indicating price discounts. Moreover, the magnitude of these discounts shrinks smoothly as the lease expiration year approaches 2047 (from the left).[21] Combining these estimates with those of post-2047 lease groups, we confirm that the broad empirical pattern matches the model prediction in Figure 1.

Finally, in all of our specifications, the coefficient on the "distant" lease group (expiring during 2842–2959) is negative, indicating a possible price discount. As we have explained in the latter part of Subsection 4.3, these land leases are all legacy leases granted by the colonial British government. Although the negative point estimates of their price discount are not always statistically significant depending on specifications, they suggest a possible risk of reneging, which we will examine further in Section 5.[22]

Based on the baseline estimates in Column (3), one can calculate the weighted average discount for properties in our main treatment group, with leases expiring after June 30th, 2047 but before 2064, to be 13.0%. Therefore, without this discount, properties in these lease groups would have been sold at a price that is 15% ($= \frac{13.0\%}{1-13.0\%}$) higher than their current price. Using the median home price of HKD 6,900K in 2019 in our data, we estimate that Hong Kong homeowners have lost an average of HKD 1,035K per property. Based on the median household income of HKD 348,000 (HK Census and Statistics Department, 2019), this wealth loss is equivalent to three years' worth of median household income in Hong Kong. This figure is quantitatively large, as in U.S. cities with price-to-income ratios ranging from 2 to 8, it could afford homes with median values in some cities. Importantly, these numbers already account for the present value of future cash flows, rendering the timing of these materializations immaterial.

[21] The caveat is that this particular pattern, which is present in both Columns (1) and (3), is not stable in other columns. This is likely due to the low statistic power of our test for the lease groups expiring before 2047.

[22] Specifically, this group contains 999-year leases which, unlike other leases, do not specify any land use in the original contracts and are more likely to fall out of compliance with contemporary zoning codes. Anecdotally, the government will modify these leases to a 50-year term upon redevelopment. For example, Pokfulam Gardens, a large development of six 28-story high-rises, is built on a lot with a 75-year lease granted in 1931. When it was regranted in 2006, the government changed the lease to 50 years.

## 4.5. Robustness Tests

In this section, we present various robustness checks for our baseline results.

**Progressively Tightened Specifications and Matched Sample** One potential concern with our identification strategy is that leases are unlikely to be randomly assigned due to the widely known expiration date of HKSAR. Table 3 presents summary statistics separately for the control and main treatment lease groups, i.e., those expiring after July 1$^{st}$, 2047, but before 2064, in Columns (5) and (6), respectively.

To examine covariate balance, we estimate regressions of each property attribute on an indicator for the main treatment group. Column (1) reports the results without any fixed effects, while Column (2), which is our baseline specification in Table 2, includes district by year-month fixed effects; each number in these columns represents the estimated coefficient of the "main treatment group" indicator variable in one separate regression. Column (1) shows that the unit price of properties in the main treatment group is a statistically significant 43.6% of premium (as opposed to discount identified in Table 2) over those in the control group, while insignificant with district by year-month fixed effects; this suggests the importance of controlling for structural characteristics. However, most structural characteristics and amenities, except for floor, building age, and building completion year, are not significantly different between the two groups.

To address concerns regarding our identification strategy, we conduct several robustness tests using progressively tightened fixed effects and a matched sample approach that pairs adjacent estates with similar characteristics. Table 4 Panel A presents the results of these tests using a sample that includes transactions from both the control and main treatment lease groups. We control for different progressively tightened location fixed effects in each column. Column (1) follows the baseline specification in Table 2 and focuses on the main treatment effect using the subsample. The results show that properties with leases expiring between July 1$^{st}$, 2047, and 2064 sell at a statistically significant discount of 13.3% using the unit price, consistent with the average effect across the three subgroups (7/1/2047–2049, 2050–2052, 2053–2064) in Table 2. Column (2) includes property attributes interacted with year to account for any time-varying differences in structural characteristics that may be correlated with the lease groups. The estimate of discount is 11.7%, slightly smaller than that in Column (1). Column (3) controls for subdistrict by year-month instead of district by year-month, and Column (4) controls for subdistrict grid by year-month, where we divide each subdistrict into four grids based on their centroids (latitudes and longitudes), to compare lease groups located in a finer location. The estimated discounts are 11.1% and 11.0%, respectively, which are slightly below the baseline estimate but still statistically and economically significant.

Table 3: Covariate Balance Table

| | Regressions | | | | Summary Stats | | | |
|---|---|---|---|---|---|---|---|---|
| | Main Sample | | Matched Sample | | Main Sample | | Matched Sample | |
| | Dep Var: Covariate<br>Indep Var: I(Main Treatment Group) | | | | Main Treatment | Control | Main Treatment | Control |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Log(Unit Price) | 0.436*** | 0.029 | −0.018 | −0.071** | 8.946 | 8.510 | 8.822 | 8.840 |
| | (0.048) | (0.030) | (0.120) | (0.033) | (0.507) | (0.525) | (0.498) | (0.509) |
| Building Age | −6.979*** | −9.281*** | −0.074 | −0.627 | 9.461 | 16.44 | 9.132 | 9.187 |
| | (1.167) | (1.253) | (1.176) | (0.402) | (8.016) | (8.412) | (6.294) | (6.407) |
| Net Living Area | 37.67* | 10.89 | −8.626 | −3.685 | 551.5 | 513.8 | 537.1 | 535.0 |
| | (19.41) | (17.75) | (33.82) | (14.73) | (162.1) | (157.0) | (125.2) | (121.9) |
| Floor | 7.084*** | 6.136*** | −1.912 | −1.553 | 24.06 | 16.98 | 24.88 | 25.92 |
| | (1.365) | (1.269) | (4.107) | (1.414) | 15.90 | 10.96 | 16.19 | 16.01 |
| No. of Bedrooms | 0.000 | 0.002 | 0.015 | 0.015 | 2.056 | 2.056 | 2.097 | 2.031 |
| | (0.096) | (0.087) | (0.150) | (0.063) | (0.977) | (0.983) | (0.871) | (0.807) |
| No. of Living Rooms | 0.140* | 0.115* | −0.055 | −0.027 | 1.750 | 1.610 | 1.802 | 1.792 |
| | (0.074) | (0.064) | (0.122) | (0.034) | (0.711) | (0.766) | (0.644) | (0.691) |
| Bay Window Size | 0.190 | −0.497 | 0.028 | 0.700 | 22.80 | 22.61 | 24.86 | 23.90 |
| | (2.098) | (1.877) | (4.298) | (0.962) | (13.54) | (15.24) | (13.46) | (11.87) |
| Bldg Completion Year | 10.58*** | 9.281*** | 0.720 | 0.627 | 2002 | 1991 | 2002 | 2000 |
| | (1.362) | (1.253) | (0.938) | (0.402) | (8.855) | (7.305) | (4.306) | (4.066) |
| MRT Distance | −106.6 | −0.605 | 12.60 | 41.06 | 691.8 | 798.4 | 859.5 | 802.6 |
| | (176.1) | (156.7) | (621.7) | (43.4) | (900.3) | (944.5) | (1,193) | (1,151) |
| Bus Stop Distance | 39.34 | 28.46 | 20.55 | −7.845 | 352.2 | 312.8 | 310.0 | 321.5 |
| | (38.19) | (35.65) | (87.5) | (68.3) | (277.4) | (291.8) | (257.6) | (220.3) |
| Hospital Distance | −139.6 | 62.62 | −16.68 | 97.13 | 1548 | 1688 | 1752 | 1753 |
| | (233.6) | (214.1) | (714.6) | (90.5) | (1,181) | (1,381) | (1,373) | (1,394) |
| School Distance | −22.38 | −12.75 | −10.30 | −16.86 | 127.5 | 149.9 | 109.5 | 120.1 |
| | (20.63) | (22.22) | (29.8) | (22.7) | (107.6) | (229.6) | (104.9) | (91.2) |
| University Distance | −660.5 | 41.57 | −192.0 | −161.4 | 3,349 | 4,009 | 3,594 | 3,687 |
| | (419.3) | (171.8) | (1,265) | (101.2) | (2,365) | (2,538) | (2,811) | (2,731) |
| Coastal Line Distance | −354.1 | −15.13 | 11.34 | −26.69 | 1,253 | 1,607 | 999.6 | 972.2 |
| | (225.7) | (149.5) | (642.2) | (143.9) | (1,633) | (1,742) | (1,453) | (1,606) |
| District × Month FE | | Yes | | | | | | |
| Estate Pair × Month FE | | | | Yes | | | | |
| N | 456,330 | 456,330 | 29,310 | 29,310 | 92,407 | 363,923 | 14,655 | 14,655 |

The table presents summary statistics of all the variables used in the analysis. Our sample contains all second-hand housing transactions in Hong Kong from 1998 to February 2020 with the following exclusions: transactions with missing date, total price, unit price, net living area size, building unique ID, lease expiration date, latitude, longitude, or floor number; complexes that belong to public housing projects; houses or townhouses; transactions in Island district, which consists of several islands that are not part of Kowloon peninsula or Hong Kong Island. Significance levels are denoted by ***= 1%, **= 5%, *= 10%.

Additionally, we employ a matched sample approach by pairing each estate in the main treatment group with the nearest estate in the control group and matching properties within each estate pair to have similar age and other characteristics using both manual criteria and propensity score matching (PSM) procedure. A detailed description of the matching procedure

Table 4: Robustness Tests

Panel A: Identification

| Dep Var | Log(Unit Price) | | | | |
|---|---|---|---|---|---|
| Sample | Main Treatment + Control Leases | | | | Matched Sample |
| | (1) | (2) | (3) | (4) | (5) |
| I(Main Treatment Group) | −0.133*** | −0.117*** | −0.111*** | −0.110*** | −0.180*** |
| | (0.021) | (0.020) | (0.020) | (0.019) | (0.031) |
| Property Attributes | Yes | | Yes | Yes | Yes |
| Property Attributes × Year | | Yes | | | |
| District × Month FE | Yes | Yes | | | |
| Subdistrict × Month FE | | | Yes | | |
| Subdistrict Grid × Month FE | | | | Yes | |
| Estate Pair × Month FE | | | | | Yes |
| $N$ | 456,330 | 456,330 | 456,330 | 456,330 | 29,310 |
| Adjusted $R^2$ | 0.936 | 0.947 | 0.946 | 0.958 | 0.980 |

Panel B: HKSAR Leases and Rental Transactions

| Dep Var | Log(Unit Rent) | | Log(Unit Price) | | | |
|---|---|---|---|---|---|---|
| Sample | Rentals 11/2018-2/2020 | | Sales All Years | | Sales 11/2018-2/2020 | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| I(Main Treatment Group) | −0.004 | −0.009 | −0.133*** | −0.153*** | −0.088*** | −0.101*** |
| | (0.017) | (0.017) | (0.021) | (0.022) | (0.027) | (0.028) |
| × I(HKSAR Lease) | | 0.016 | | 0.076*** | | 0.053** |
| | | (0.011) | | (0.025) | | (0.018) |
| Property Attributes | Yes | Yes | Yes | Yes | Yes | Yes |
| District × Month FE | Yes | Yes | Yes | Yes | Yes | Yes |
| $N$ | 17,464 | 17,464 | 456,330 | 456,330 | 14,942 | 14,942 |
| Adjusted $R^2$ | 0.809 | 0.809 | 0.933 | 0.934 | 0.748 | 0.751 |

This table presents the results of robustness tests. Panel A shows the pricing effect of the main treatment group in different settings. The samples in columns (1) to (4) include transactions from both the control and main treatment lease groups. The sample in column (5) is the matched sample. Column (1) controls for property characteristics with district by transaction month fixed effects. Column (2) controls for the interaction of property characteristics and transaction year with district by transaction month fixed effects. Columns (3) to (5) have the same control as column (1) but tighter geographical fixed effects: subdistrict, subdistrict grid (dividing each subdistrict into four grids based on their latitudes and longitudes), and estate pair. The estate pair is the matched estate pair in our matching sample. The matching procedure is described in Appendix A. Panel B compares the pricing effect of the rental sample and transaction sample. Columns (1) and (2) use the rental sample from November 2018 to February 2020. Columns (3) and (4) use the transaction sample including both the control and main treatment groups. Columns (5) and (6) use the transaction sample for which we can find a building match in the rental sample and restrict the sample period to be the same as the rental sample. For both panel A and B, standard errors are two-way clustered by estate and year-month. Significance levels are denoted by ***= 1%, **= 5%, *= 10%.

can be found in Appendix A. To assess the quality of the match, we plot the residuals of the property attributes of the two lease groups obtained from the regression of each hedonic characteristic on the estate pair by year-month fixed effects based on the matched sample in Figure A.2. The results indicate that there are little differences in all structural characteristics, including age and floor, and neighborhood amenities between the two groups. We further examine the covariate balance based on the matched sample in Table 3. In Column (3), we

report the covariate balance without any fixed effects, while in Column (4) we add estate pair by year-month fixed effects. We also provide separate summary statistics (mean and standard errors) for the main treatment and control groups in Columns (7) and (8), respectively. The results show that there is no significant difference in any structural characteristics between the main treatment and control groups, with or without controlling for fixed effects.

By using the matched sample, we can control for even more granular estate pair fixed effects, which represent the finest level of location control we can achieve—we need at least two estates with different leases to identify the variation in political risk. The hedonic regression with property attributes and estate pair by year-month fixed effects based on the matched sample is reported in Column (5) of Panel A of Table 4. The results show that properties in the main treatment group sell at a statistically significant discount of 18.0% compared to the control group, which is even larger than the baseline estimate of 13.3% in Column (1) when we compare properties without matching. This larger estimate is expected because in the baseline analysis, the control group consists of older properties, which may cause a downward bias for our discount estimate.

**A More Exogenous Control Group** Our second attempt to address the endogeneity issue of nonrandom lease assignment takes advantage of a rich institutional feature. Our main control group can be further divided into three subgroups: control i) corresponds to Type 5 land leases in Table A.1, whose leases were granted after the JD; control ii) corresponds to Type 2 leases, which were granted before the JD and are located on Hong Kong Island and in Old Kowloon; and finally, control iii) constitutes Type 4 leases, which were granted before the JD and are located in New Kowloon and the New Territories districts. Each group was formed due to different historical reasons. The origin of control iii) dates back to the Second Convention of Peking in 1898, when leases were set to expire on June 27$^{\text{th}}$, 1997, but were extended to June 30$^{\text{th}}$, 2047, according to the JD, and thus this group is the most exogenous control group. In contrast, control i) can be potentially endogenous to market conditions in the post-JD period; for example, it is possible that land granted in the post-JD period was more likely to go to developers who had either closer relationships with, or more confidence in, mainland China compared to other periods. Control ii) can be similarly endogenous due to its "+75" extension policy.

Table A.3 presents the results using control iii) as the only control lease group, with control i) and ii) included as additional explanatory variables. When we control for district by year-month fixed effects, we find that the coefficients on all treatment lease groups are similar to the baseline results. Furthermore, the coefficients on control i) and ii) are close to zero and statistically insignificant, indicating little endogeneity concern in the control group. We obtain similar results when we substitute property attributes with more restrictive property

attributes by year.

**A Placebo Test Based on Rental Value** Our third method can be viewed as a placebo test. If the estimated price discounts of different land leases are all due to their different exposures to future potential hikes in ground rent rate, then land leases should not affect these properties' rental value, which is solely determined by their consumption values.

To check this, we focus on our main treatment lease groups, and collect a sample of rental transactions from November 2018 to February 2020 obtained from one large brokerage platform in Hong Kong. Unlike homeowners, renters who care more about housing amenities should be less impacted by uncertainty in the distant future. Therefore, to the extent that rents capture the consumption value of the property, this helps alleviate concerns over unobserved structural heterogeneity among different lease groups. Column (1) in Table 4 Panel B presents the analysis and shows that the coefficients on the main treatment group are not statistically significant, suggesting that the consumption values of properties in the main treatment and control groups are very similar. In contrast, the estimates from housing transactions in Column (5) are statistically significant at the 1% level and negative, whether using all sales in the main treatment and control groups or only those matched to the rental sample.

Columns (4) and (6) in Panel B also include an interaction between the main treatment group and a dummy variable that equals one if the property lease is issued by the HKSAR. The significant positive coefficient on this interaction term suggests a substantial price differential between HKSAR leases and colonial British leases (see Subsection 2.3 for more details). The next section further investigates this important issue.

# 5. Model Extension and Estimation

In this section, we study the price differential of land leases granted by the HKSAR relative to those by the British Hong Kong government, and explore the possibility of a "reneging" risk inherent in the leases originally granted by the colonial government. Our extended model incorporates this feature.

## 5.1. Colonial British versus Noncolonial HKSAR Leases

The reneging risk refers to a scenario under which the future government may renege on the land leases granted by previous governments after 2047. This is likely because neither the JD, nor the Basic Law prescribe any arrangements beyond 2047 and thus the future government will not be legally bound to honor the existing leases. Under existing laws, the government can invoke the Land Resumption Ordinance to order the requisition of any land for public

purposes.[23] We argue that leases granted under British Hong Kong are subject to greater reneging risk than those granted by the HKSAR since the future government will still be under China's rule even in the worst-case scenario.

To empirically investigate the risk of reneging, we interact our main treatment group with an indicator for the HKSAR leases, which captures the price differential between the colonial British and HKSAR leases. The results, presented in Table 5, show that, within the same years of lease expiration, properties with HKSAR leases are traded at a premium of 7–8 percentage points, which is about half of the base effect, across various specifications relative to those with colonial British leases. These findings are consistent with the regression results in Column (4) of Table 4 Panel B, which is based only on properties in the main treatment and control groups. Furthermore, we find no significant difference in unit rent between these two different leases, as reported in Column (2) of Panel B. This suggests that the different value discounts are not driven by differences in the consumption value.

## 5.2. Full Model and Estimation

The empirical results presented in Subsection 5.1 suggest that market participants perceive the possibility of the Hong Kong government reneging on land leases issued by the colonial British government, which we incorporate into our model in this section. We also adjust the formula to take into account the difference between rateable and nominal ground rent rate (see the discussion in Subsection 2.3). Furthermore, we discuss identification issues and estimated parameters based on the standard GMM method.

**Reneging Risk** In order to model the risk of reneging on colonial British leases (as defined in footnote 10), we make the assumption that it will either be replaced with another 50-year HKSAR lease at the expiration date of the lease, or it will be reneged on before that date, which we refer to as a *reneging event*. In both scenarios, the homeowner will be charged a one-time additional land premium as a fraction of the market value of the property, denoted by $\delta^{pre} \geq 0$ (if the lease expires or is reneged on before $t < \tau$), or $\delta^{post} \geq 0$ (if the lease expires or is reneged on at $t \geq \tau$), where $\tau = 7/1/2047$. The homeowner will then receive a new 50-year lease contract with an extra ground rent rate schedule given by Eq. (2).

The reneging shock is modeled as a Poisson event that is *i.i.d.* across all colonial British leases with different reneging intensity before and after $\tau$, denoted by $\lambda^{pre} > 0$ and $\lambda^{post} > 0$. Our assumption ensures parsimony while capturing the potentially different reneging intensity

[23] The ordinance has been used 13 times since the handover in 1997 to turn the city's idle land into public housing. It was used successfully for the Yan Tin Estate in Tuen Mun district in northwestern Hong Kong, which was constructed in 2018 and now provides 42,687 units for 13,500 residents, 10 years after the government reclaimed the land.

Table 5: Leases Granted by British Hong Kong versus HKSAR

| Dep Var | Log(Unit Price) | | | | |
|---|---|---|---|---|---|
| Sample | All Sales | | | | |
| | (1) | (2) | (3) | (4) | (5) |
| I(2030 ≤ Lease ≤ 2033) | −0.053 | 0.046 | −0.042 | −0.043 | 0.070* |
| | (0.041) | (0.038) | (0.042) | (0.052) | (0.036) |
| I(2034 ≤ Lease ≤ 2039) | −0.057 | −0.077** | −0.039 | 0.001 | −0.059** |
| | (0.038) | (0.030) | (0.038) | (0.038) | (0.030) |
| I(2040 ≤ Lease ≤ 2046) | −0.060 | −0.090** | −0.030 | −0.015 | −0.053 |
| | (0.055) | (0.042) | (0.058) | (0.057) | (0.046) |
| I(7/1/2047 ≤ Lease ≤ 2049) | −0.172*** | −0.147*** | −0.168*** | −0.148*** | −0.139*** |
| | (0.028) | (0.024) | (0.028) | (0.026) | (0.023) |
| I(2050 ≤ Lease ≤ 2052) | −0.156*** | −0.123*** | −0.150*** | −0.141*** | −0.113*** |
| | (0.031) | (0.027) | (0.030) | (0.028) | (0.026) |
| I(2053 ≤ Lease ≤ 2064) | −0.146*** | −0.109*** | −0.135*** | −0.097*** | −0.099*** |
| | (0.032) | (0.029) | (0.031) | (0.028) | (0.027) |
| I(2065 ≤ Lease ≤ 2097) | −0.117*** | −0.095*** | −0.099*** | −0.085** | −0.082*** |
| | (0.035) | (0.031) | (0.035) | (0.034) | (0.029) |
| I(2098 ≤ Lease ≤ 2135) | −0.037 | −0.004 | −0.020 | −0.012 | 0.016 |
| | (0.038) | (0.028) | (0.038) | (0.037) | (0.028) |
| I(2842 ≤ Lease ≤ 2959) | −0.072** | −0.081*** | −0.049 | −0.032 | −0.056** |
| | (0.035) | (0.027) | (0.035) | (0.035) | (0.027) |
| I(Main Treatment Group) × I(HKSAR Lease) | 0.080*** | 0.075*** | 0.085*** | 0.074*** | 0.076*** |
| | (0.027) | (0.022) | (0.027) | (0.025) | (0.021) |
| Property Attributes | Yes | Yes | Yes | | Yes |
| Property Attributes × Year | | | | Yes | |
| District + Month FE | Yes | | | | |
| Subdistrict + Month FE | | Yes | | | |
| District × Month FE | | | Yes | Yes | |
| Subdistrict × Month FE | | | | | Yes |
| $N$ | 551,790 | 551,790 | 551,790 | 551,790 | 551,790 |
| Adjusted $R^2$ | 0.920 | 0.931 | 0.929 | 0.941 | 0.943 |

This table presents the regression results of each treatment group and the interaction between the main treatment and the dummy of HKSAR leases, using the entire sample of housing transactions in Hong Kong from 1998 to February 2020. For all columns except for column (4), control variables include a full set of property and building characteristics specified in Eq. (9). Column (4) controls for the interactions of property characteristics and transaction year. From column (1) to column (5), different fixed effects are applied as the bottom rows indicate. Standard errors are two-way clustered by estate and year-month. Significance levels are denoted by ***= 1%, **= 5%, *= 10%.

before and after July 1st, 2047, and essentially allows the real housing transaction data to reveal the perceived reneging risk for colonial British leases. As a result, the value of a house with a colonial British lease can be calculated as

$$P(L;\tau,Brit)=\mathbb{E}\left[\int_0^{L\wedge\mathcal{T}} e^{-\kappa s}ds+e^{-\kappa(L\wedge\mathcal{T})}\cdot(1-\delta^{pre}\mathbf{1}_{s<\tau}-\delta^{post}\mathbf{1}_{s\geq\tau})\cdot P(L\wedge\mathcal{T}+50;HK)\right]. \tag{10}$$

Here, $\mathcal{T}$ denotes the reneging event with intensity $\lambda^{pre}\mathbf{1}_{s<\tau}+\lambda^{post}\mathbf{1}_{s\geq\tau}$, and $P\left(L\wedge\mathcal{T}+50;HK\right)$ is the value of a standardized Hong Kong land lease that expires on $L\wedge\mathcal{T}\equiv\min(L,\mathcal{T})$ and costs $f^{\tau}_{L\wedge\mathcal{T}}$ to extend another 50 year-term standing at $L\wedge\mathcal{T}$, as given in Subsection 3.1.

**Discussion of Parameter Identification** We briefly discuss how the model uses empirical patterns in data moments to identify various parameters. First of all, reneging intensities ($\lambda^{pre}$ and $\lambda^{post}$) and a one-time land premium charge ($\delta$) apply to colonial British leases only, while additional ground rent rate $\gamma$ affects both HKSAR leases and colonial British leases (the latter will be renewed to standard 50-year HKSAR leases upon expiration or reneging). As a result, the discount on treated HKSAR leases compared to the control group informs us more about $\gamma$ while the relative discount between British and HKSAR leases in the same (treated) lease group tells us more about the other three parameters.

Even among colonial British leases, the heterogeneity in lease expiration years helps parameter identification. We highlight three important facts. First, one can separately identify the reneging intensity $\lambda^{post}$ and the land premium charge $\delta$ by comparing the discounts for leases that are expiring very soon after 2047 versus those expiring in the remote future. To see this, note the homeowner needs to pay the one-time land premium charge $\delta$ when either the current lease expires or when they are hit by a reneging event, whichever occurs first. Therefore leases that will not expire until much later are likely to be reneged on before their expiration date, and their discounts will be affected by both $\lambda^{post}$ and $\delta$. However, leases that expire soon are less likely to be reneged on and hence should be predominantly affected by $\delta$.

Second, consider different model implications of additional ground rent rate $\gamma$ and reneging intensity $\lambda^{post}$. For leases that expire soon after 2047, the value of $\gamma$ would have a significant impact, while its effect on distant leases (2842–2959) should be minimal due to their long contractual protection, provided that the likelihood of reneging is not high. (This is indeed the case for the estimated parameters in all models reported in Table 6.) In contrast, the reneging intensity $\lambda^{post}$ has a greater impact on those distant leases, as reneging destroys the guarantees, while it has a relatively small effect on leases that expire soon after 2047.

Finally, in contrast to $\lambda^{post}$, a higher $\lambda^{pre}$ will *amplify* the discount of those distant leases (2842–2959) because of less protection, but at the same time *reduce* the discount of leases that expire soon (07/2047–2049). The intuition for the latter is simple: in the limit as $\lambda^{pre}$ goes to infinity, all leases are expected to be renewed before the regime shift date in 2047, and the model predicts no relative discount for leases right before (the control group) and after this date (those expiring on 07/2047–2049). This point is useful when we discuss the possibility of reneging risk for HKSAR leases in Subection 5.3.

**Ground Rent Rate: Rateable versus Nominal** For ease of exposition, in Subsection 3.1 we assumed the annual ground rent rate to be 3% of rateable, the market-based annual rent reevaluated every year. However, there is an exception in practice: colonial British leases only pay a nominal ground rent equal to 3% of gross rent evaluated at the beginning of the leases and fixed throughout the term (see Subsection 2.3). We hence modify Eq. (10) in the

Appendix B to accommodate the nominal ground rent setting.

**Estimation Method and Results** We now conduct an estimation exercise based on the structural model developed in Section 3, using the standard GMM method. This allows us to back out the deep structural parameters (e.g., $\gamma$) based on the reduced-form estimated price discounts of various treatment lease groups given in Table 2.

The only predetermined parameter in our estimation is $\kappa$, which is set based on recent housing statistics in Hong Kong. Specifically, $\kappa = r - g = 2\% \times (1 - 28\%) = 1.44\%$, where 2% is the average gross rent yield (annual gross rent divided by housing value), and 28% is the benchmark expense ratio as $\kappa$ essentially captures the house owners' net rent yield (annual net rent divided by housing value).[24] Subsection 5.4 considers different values of $\kappa$ for robustness.

Denote the set of remaining parameters as $\Theta \equiv \{\gamma, \lambda^{pre}, \lambda^{post}, \delta^{pre}, \delta^{post}\}$ and $\beta_n(\Theta)$ is then the model-implied average discount for each leasehold group $n \in \{1, 2, ..., N\}$ as follows:

$$\beta_n(\Theta) = \frac{\sum_{L_i \in n} \{\ln P_{t_i}(L_i; \Theta) - \ln P_{t_i}(L = \tau; \Theta)\}}{\#\text{ of transactions in group } n}, \tag{11}$$

where $i$ indexes each housing transaction in our data, $L_i$ denotes its land lease expiration date, and $t_i$ denotes its transaction date.[25] In other words, conditional on a set of parameters $\Theta$, the expression

$$\ln P_{t_i}(L_i; \Theta) - \ln P_{t_i}(L = \tau; \Theta)$$

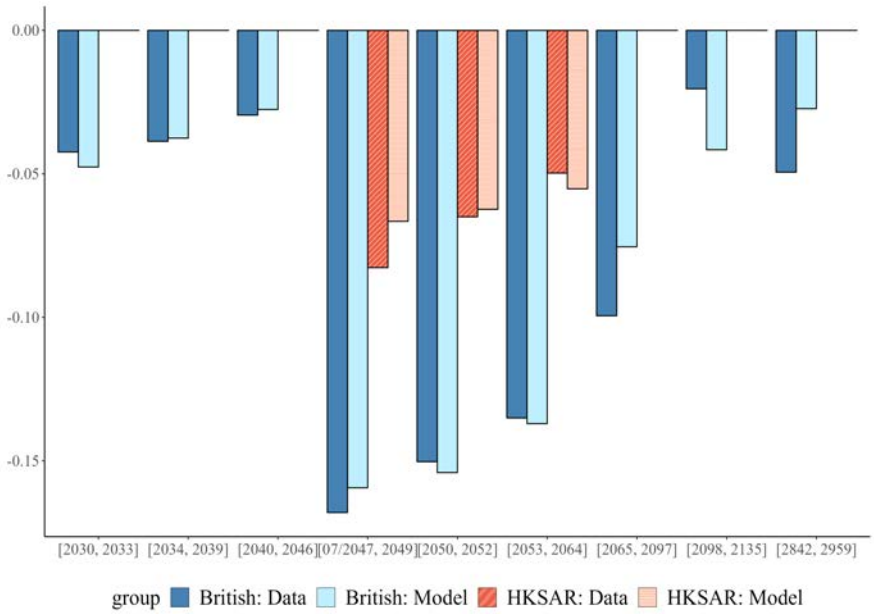
gives the model-implied price discount relative to the control lease group for transaction $i$ in lease group $n$, and the term $\beta_n(\Theta)$ is the average model-implied discount for all transactions in the leasehold group $n$.

We estimate $\Theta$ using a two-step GMM procedure (Hansen, 1982). There are twelve moment conditions, corresponding to the twelve treatment lease groups in total (nine lease groups, three of which have both British and HKSAR leases). The details of the two-step GMM procedure, which uses $\left\{\hat{\beta}_n\right\}$ in Column (3) of Table 2, are outlined in Appendix C. We impose nonnegativity constraints on all parameters, and some of them may bind in estimation due to economic interpretations of these structural parameters. The results are reported in Table 6, Column (1), along with the standard errors in parentheses.

[24] Information on gross rent yields is obtained from the government report: https://www.legco.gov.hk/research-publications/chinese/2021issh09-private-domestic-rental-market-in-hong-kong-20201210-c.pdf. The expense ratio includes 3% ground rent rate, 5% rates, and 20% repair cost set by the government: https://www.gov.hk/en/residents/taxes/property/deduction/statutory.htm.

[25] Since the EPRC only records the lease expiration year (but no actual date), we assume $L_i$ to be the last day (December 31$^{st}$) of the leasehold year except for leaseholds that belong to the control group, for which we set their expiring dates to be June 30$^{th}$, 2047.

**Figure 2.** Model Estimation




This figure presents the model-implied discounts and those estimated from hedonic regressions (Column (3) of Table 5) across twelve lease groups. We set $\kappa = r - g = 1.44\%$, and the estimated parameters are $\lambda^{pre} = 0.00\%$, $\lambda^{post} = 1.65\%$, $\delta^{pre} = 6.21\%$, $\delta^{post} = 20.81\%$, $\gamma = 21.03\%$.

Figure 2 shows the relative discounts of each lease group compared to the control group, both from the regression analysis (dark colors) and the model estimation (light colors) as well as British (blue) and HKSAR (orange) leases. The model generally fits well with the regression analysis, as evidenced by the close price discounts between model and regression for all lease groups except for two lease groups (2098–2135 and 2842–2959), where the model overpredicts and underpredicts the price discounts, respectively.

## 5.3. Economic Magnitudes

We now discuss the economic magnitude of estimated parameters.

**Economic Magnitude of Additional Ground Rent Rate** Column (1) of Table 6 reports $\hat{\gamma} = 21\%$ (significant at 1% level), implying that after 2047 Hong Kong homeowners expect to pay about 21% higher ground rent rate to extend their land leases.

There are three points worth stressing. First, this seemingly large expected additional ground rent rate takes into account all political uncertainty in the future with the most imminent uncertainty in mid-2047, from the perspective of the first two decades of the 21st century. Second, $\hat{\gamma}$, which is uncovered from housing prices and therefore reflects the "risk-neutral measure," typically differs from the expectation under the "physical measure." Since an increase in ground rent rate is likely associated with worse economic conditions (and

therefore a higher marginal value of wealth), the expected ground rent rate under the physical measure is likely to be lower than $\hat{\gamma} = 21\%$ (under the risk-neutral measure). Third, as was briefly discussed in Subsection 6.1, although an "endogenous investment" mechanism could potentially overestimate $\hat{\gamma}$, our reduced-form estimation reported in Table 7 suggests that this effect is limited.[26]

Is a 21% additional ground rent rate too burdensome or too low? To answer this question, we first compare the estimate with rates in the U.K. and Singapore, the two countries that have similar leasehold land tenure systems as Hong Kong. In the U.K., households have to pay the full market value (of land + structure) over the extended lease terms to the landowner, which is essentially 100% of net rent. The new Hong Kong government, post-July $1^{st}$, 2047, has the complete authority to follow the precedent to impose ground rent up to 100% on land leases upon expiration. Singapore followed the same policy as the U.K. until 2008, after which only the market value of land has been required to extend the lease while the building value is waived. Thus, 11–20% of net rent expected in Hong Kong is still considerably more affordable than expenses in the U.K. and Singapore. Moreover, the freehold system in the U.S. requires homeowners to pay property tax, which is equivalent to the ground rent from an economist's perspective. Assuming a typical property unit in Hong Kong with a gross rent yield of 2% and a 20% expense ratio, the current 8% of annual gross rent (ground rent + rates) plus an additional 20% (15%) of net rent yields an expected property tax rate of 22.4% (18.8%) the gross rent in total. The number is comparable to property tax rates in U.S. cities: for example, the corresponding rate as a ratio to gross rent is 18.5% in New York City and 32% in Chicago.

Second, the paper implicitly assumes that the additional ground rent rate is imposed by the new Hong Kong government, backed by mainland China. Is this policy, which is essentially a form of housing tax, reasonable from the perspective of mainland China? It is important to note that this policy should not be compared to China's current "zero property tax" policy, which may be replaced with a property tax in the near future; see Beijing's recent announcement of a national property registration system implementation and related information in footnote 14. Similarly, Hong Kong's reliance on land sales as a major source of government revenue, accounting for 18.8% of the HKSAR's total revenue in the past two decades, is also a matter of debate and concern.[27] Our paper highlights that the expiration of current land leases in 2047 presents an opportunity for the government to revise its revenue-generating model by increasing the ground rent. Thus, regardless of whether it is China or

[26]There, we show that the age of the house, all else equal, can explain only about 2.6–2.9 percentage points of the estimated 16% (valuation) discount for the British leases in the main treatment group.

[27]The data on land premium revenue and total government revenue are obtained from the Publications and Press Releases section of the Treasury of the HKSAR government. For example, the 2021–2022 statistics were retrieved from this webpage: https://www.try.gov.hk/internet/eharch_annu_accr0322.html.

another regime that gains control over Hong Kong on July 1st, 2047, it is likely that the next government will adopt alternative measures, such as a higher housing tax, to address the issue of heavy reliance on land sales revenue.

**Economic Magnitude of Reneging Risk** Regarding the parameters on reneging risk in colonial British leases, Table 6 reports $\hat{\lambda}^{pre} = 0$, implying that homeowners with colonial leases expiring before June 30th, 2047, need not worry about the lease being reneged on prior to their lease contract end date. However, they are expected to pay a one-time land premium of $\hat{\delta}^{pre} = 6.2\%$. For colonial leases expiring after July 1st, 2047, the reneging risk is estimated to be $\hat{\lambda}^{post} = 1.6\%$, implying that homeowners can expect the lease to be reneged on every 61 years after July 1st, 2047. Furthermore, they will be required to pay a one-time land premium of $\hat{\delta}^{post} = 20.8\%$ upon receiving a 50-year HKSAR-style extension contract (together with a newly added $\hat{\gamma} = 21\%$ on top of the existing 3% ground rent). To illustrate these estimates, suppose there are two identical 50-year leases, one with a colonial British lease and the other with an HKSAR lease. As of January 1st, 2023, the former is predicted to be traded at an effective price discount of 9.83% relative to the latter.[28]

We have explained in Subsection 2.4 the current land lease extension policy in Hong Kong, i.e., the original terms of colonial British leases are protected by Article 120 of the Basic Law, legally up to June 30th, 2047. This is consistent with our estimated parameter $\hat{\lambda}^{pre} = 0$ (with a standard error of 0.004), which implies zero reneging risk for colonial leases expiring before June 30th, 2047.[29] However, it is possible that a future Hong Kong government may renegotiate the colonial leases, resulting in a nonzero reneging risk for leases expiring after June 30th, 2047 ($\hat{\lambda}^{post} = 1.6\%$, with a standard error of 0.003).

Regarding the one-time renewal premium, note that although the current HKSAR policy is to extend any expiring leases for another 50 years with no additional premium, the HKSAR has the full discretion to raise the charge (i.e., $\delta^{pre}$ and $\delta^{post}$).[30] Put differently, though homeowners with colonial leases expiring before June 30th, 2047, may expect no reneging risk, they will need to pay a one-time land premium of $\hat{\delta}^{pre} = 6.2\%$ to extend their leases. In other words, homeowners should not assume that the current land policy (i.e., no one-time land premium charges) will hold for colonial land leases even before June 30th, 2047.

[28] Suppose the lease term is 100 years, and the colonial British lease pays a fixed nominal rent in 2023 instead of 3% of rateable value. In this case, the implied discount will be 9.83%. Both leases expire after 2047, with the 50-year lease expiring in 2073 and the 100-year lease expiring in 2123.

[29] Because the estimated $\hat{\lambda}^{pre} = 0$ is at the lower bound of $\lambda^{pre} \geq 0$, the distribution of $\hat{\lambda}^{pre}$ is asymptotically half-normal (Hansen, 2021).

[30] The exact language used on the government website is "The extension of such leases is wholly at the discretion of the HKSAR." See https://www.landsd.gov.hk/en/resources/land-info-stat/land-tenure-system-land-policy.html.

**Reneging Risk for Leases Issued and Renewed by HKSAR** What if the political situation deteriorates to the point where Beijing reneges (and charges a substantial land premium) not only on colonial leases but also on noncolonial ones granted by the HKSAR before June 30$^{\text{th}}$, 2047, thereby violating the land policy encoded in the Basic Law? To account for this potentially dire political scenario, we consider the possibility of all land leases being reneged on before July 1$^{\text{st}}$, 2047. This model extension allows for reneging risk, modeled as a Poisson event with intensity $\lambda^{pre}$, on both colonial and noncolonial leases.[31] Further, to accommodate the differential treatment between colonial and noncolonial leases, we allow for an HKSAR lease-specific land premium $\delta^{pre}_{HK}$ for noncolonial leases that expire or are reneged on before June 30$^{\text{th}}$, 2047. Note that the land premium $\delta^{pre}_{HK}$ paid by HKSAR leases—either upon expiration or renewal—captures Hong Kong homeowners' expected future expropriation imposed by the new Hong Kong government backed by Beijing after 2047.

Even without structural estimation, note that the very existence of a substantial discount (about 14%) for leases in the main treatment group (colonial leases) relative to those in the control group (noncolonial leases)—as recovered by reduced-form regressions in Subsection 4.4—is evidence against the existence of a considerable risk of reneging before June 30$^{\text{th}}$, 2047. Indeed, the estimated $\hat{\lambda}^{pre}$ remains at 0 (with a standard error of 0.019) in Column (2) of Table 6, indicating that homeowners expect the HKSAR to honor the land policy coded in the Basic Law until June 30$^{\text{th}}$, 2047. In addition, the estimated extra premium charge for noncolonial leases $\hat{\delta}^{pre}_{HK}$ is only about 1.7% and statistically insignificant, notably smaller compared to that of colonial leases (7.5%). These results suggest that Hong Kong homeowners expect the post-2047 new Hong Kong government to honor the leases renewed by the current HKSAR government.

This last piece of our estimation results has an interesting implication for the literature on political connections. The literature, exemplified by Fisman (2001), studies the response of market values of connected firms, which are equal to discounted future cash-flows, to certain political shocks. However, the existing studies have not conclusively determined whether the decrease in the market value of connected firms following the decline of the power of connected politicians is due to the loss of previously promised, potentially lucrative, long-term contracts (including those set to expire after the anticipated political regime shift) or future profitable deals. Our estimation results, which include zero pre-2047 reneging $\hat{\lambda}^{pre}$ and a tiny (insignificant) $\hat{\delta}^{pre}_{HK}$, imply that in the context of our paper, the value loss is primarily due to the latter, namely the expectation of a higher ground rent when renewing a new contract with worse terms upon expiration.

[31] The common reneging intensity $\lambda^{pre}$ is motivated by the possibility of "a political catastrophe," which applies to both land leases; though, colonial and noncolonial contracts might be exposed to this "catastrophic event" differently due to different land renewal premium charges.

Table 6: Parameter Estimations

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | Base | Extension | Base: Alternative $\kappa$ | | | | Estimated $\kappa$ |
| Gross Rental Yield | 2.00% | 2.00% | 1.00% | 3.00% | 4.00% | 5.00% | 2.69% |
| Net Rental Yield ($\kappa$) | 1.44% | 1.44% | 0.72% | 2.16% | 2.88% | 3.60% | 1.94%*** |
| | | | | | | | [0.006] |
| Reneging Risk | | | | | | | |
| $\lambda^{Pre}$ | 0.000 | 0.000 | 0.000 | 0.000 | 0.004 | 0.009** | 0.000 |
| | [0.004] | [0.019] | [0.003] | [0.004] | [0.004] | [0.005] | [0.008] |
| $\lambda^{Post}$ | 0.016*** | 0.019*** | 0.015*** | 0.020*** | 0.019*** | 0.017*** | 0.018*** |
| | [0.003] | [0.003] | [0.002] | [0.004] | [0.004] | [0.004] | [0.005] |
| Extra Land Premium | | | | | | | |
| $\delta_{HK}^{Pre}$ | | 0.017 | | | | | |
| | | [0.047] | | | | | |
| $\delta^{Pre}$ | 0.062*** | 0.075*** | 0.040*** | 0.088*** | 0.106*** | 0.119*** | 0.080*** |
| | [0.007] | [0.026] | [0.005] | [0.011] | [0.014] | [0.018] | [0.011] |
| $\delta^{Post}$ | 0.208*** | 0.217** | 0.127*** | 0.312*** | 0.504*** | 0.835*** | 0.277** |
| | [0.022] | [0.104] | [0.012] | [0.029] | [0.056] | [0.116] | [0.140] |
| Additional Ground Rent Rate | | | | | | | |
| $\gamma$ | 0.210*** | 0.237 | 0.272*** | 0.214*** | 0.245*** | 0.296*** | 0.209*** |
| | [0.008] | [0.197] | [0.008] | [0.008] | [0.010] | [0.012] | [0.015] |
| $N$ | 551,790 | 551,790 | 551,790 | 551,790 | 551,790 | 551,790 | 551,790 |

This table reports the two-step GMM estimation results for our base model and extension model as shown in Columns (1) and (2). Columns (3) to (6) show the estimation results under alternative discount rates. The discount rate $\kappa$ equals to $1 - 0.28 = 0.72$ multiplying the corresponding Gross rental yield. Column (7) show the estimation results including $\kappa$. Standard errors are reported in [ ]; significance levels are denoted by ***= 1%, **= 5%, *= 10%.

## 5.4. Model Estimates under Alternative Discount Rates

Our baseline parameter estimation in Subsection 5.2 is based on a discount rate of $\kappa = r - g = 1.44\%$, which is determined externally by recent prevalent statistics in Hong Kong's housing market. Columns (3) to (6) of Table 6 as well as Figure **??** present the estimation results for different $\kappa$'s, corresponding to different gross rent yields as $\kappa = (1 - \text{expense ratio}) \times$ gross rent yield. Note that this discount rate allows for a wide interpretation and can capture various economic forces, including but not limited to risk premia in the aggregate market and individual beliefs regarding political uncertainty in the future. We observe that as the discount rate doubles the current level (i.e., gross rent yield = 4%), $\hat{\lambda}^{post}$ increases from 1.6% to 1.9%, and all homeowners expect to pay higher additional ground rent rate to extend their land leases after June 30$^{\text{th}}$, 2047, up to 24.5% from 21%.[32]

[32]We observe that the estimated $\hat{\gamma}$ is nonmonotonic in the externally specified discount rate, as it increases to 0.274 when $\kappa$ drops to 1%. The intuition behind this is as follows: a lower $\kappa$ generates a larger discount, which can be offset by either a smaller $\lambda$ or a smaller $\delta$—this is what we observe for $\kappa > 2\%$. However, when $\kappa$ becomes even lower, it translates to a very large impact on the remotely expiring leases, which needs to be offset by a significant reduction in $\delta$'s. This leaves us with a too low model-implied discount for leases expiring soon after 2047, and the model resorts to a higher value of $\gamma$ to fit the data moments.

## 5.5. Estimating $\kappa$ and Connection to Giglio et al. (2015)

So far in our model, we have pre-set $\kappa = 1.44\%$ based on external industry data (specifically, price-rental data) from the housing market in Hong Kong. This decision was deliberate, serving the purpose of distinguishing our study, primarily centered on political expropriation and its impact on cash flows, from the primary focus of Giglio et al. (2015) who study the discount rate. In order to compare our estimates of discount rate, we also expand GMM estimation to allow $\kappa$ to be estimated along with other parameters. They are reported in Column (7) of Table 6. It yields an estimated $\kappa$ to be 1.94%, which is notably close to the $r-g = 1.9\%$ derived by Giglio et al. (2015). Together with a long-run average real growth rate of rental during our sample period of 1992 to 2020, which equals to 0.5% in Hong Kong, we obtain an estimated discount rate of 2.44%. Again, remarkably, the estimate of 2.44% derived from Hong Kong data closely aligns with the estimated discount rate of 2.6% in Giglio et al. (2015) based data from the U.K., suggesting the possibility of integrated financial markets among these three British-system economies with similar leasehold systems.

In addition, we would like to emphasize the key connection between our paper and Giglio et al. (2015). As a potential alternative explanation for the observed substantial discounts on leasehold properties, Giglio et al. (2015) have delved into the hold-up problem that freeholders may pose during lease extensions, whereby a freeholder with strong bargaining power might charge unreasonably high premia for lease extension. While they ultimately concluded that hold-up frictions could not account for the price disparities they observed across leases, this issue forms a critical intersection between our paper and Giglio et al. (2015). As explained in their Section II.B., the U.K. boasts a private market for freeholders and leaseholders, and legislation and court practices have systematically mitigated concerns related to freeholder hold-up problems in the U.K. Giglio et al. (2015) argue that, in fact, the legal environment in the U.K. favors leaseholders when they engage in negotiations with freeholders as their land leases approach expiration Badarinza and Ramadorai (2015). In stark contrast, in Singapore, the largest freeholder is the government, represented by the Singapore Land Authority.

In Hong Kong, as elaborated upon in our paper, the sole freeholder is the Hong Kong government. While this may seem similar to the institutional setup in Singapore, a pivotal distinction lies in the uncertainty surrounding the entity that represents the Hong Kong government. Unlike the U.K. and Singapore, Hong Kong's property market faces substantial political risks due to the timed political experiment "One Country, Two Systems." Our paper precisely exploits the heterogeneity in land lease extension protections that are intricately linked to the expiration of the HKSAR on July $1^{st}$, 2047, as the yet-to-be-known future government of Hong Kong after that date creates a significant uncertainty regarding the extension of leases expiring after the date (relative to those expiring before). In comparison to Giglio et al.

(2015), we explicitly incorporate into our analysis the "hold-up" problem, characterized by elevated ground rent and reneging due to the anticipated political regime shift. Furthermore, we provide estimates for these pivotal parameters to quantify these economic forces.

# 6. Plausible Economic Mechanisms

This section investigates various factors that could contribute to the observed pattern on price discounts, some of which have important implications on the interpretation of our estimate.

## 6.1. Endogenous Maintenance or Age-Dependent Reneging?

Homeowners may choose to spend less on maintenance or investment, precisely due to expected tax hikes following the new political regime, which would also result in lower price for treatment groups. This implies that estimates on expected hike of ground rent in Table 2 may be overestimated, partially reflecting the effect of undermaintenance driven by political risk.

To address this concern, we add interaction terms of main treatment groups with an indicator of old buildings, defined as those six or more years old at the time of the transaction.[33] Presumably, the effect of endogenous investment matters more for older buildings that require substantial maintenance services. As shown in Column (1) of Table 7, old properties are indeed sold at an additional discount of 3.6 percentage points, significant at the 5% level, relative to new properties in the main treatment group with a 10.5% price discount.

However, while this observed additional age effect when comparing the main treatment group against the control (i.e., a positive DID coefficient) suggests the existence of an endogenous maintenance channel, it might be confounded by the reneging risk on colonial British leases, which tend to be on older properties (see footnote 33).[34] Anecdotal evidence suggests that the reneging risk associated with colonial British leases increases with property age. For instance, the HKSAR has the power to terminate any lease by ordering the requisition of land for public purposes according to the Land Resumption Ordinance, and the public data suggest that older buildings are more susceptible to having their leases terminated under the Land Resumption Ordinance.[35] We leave the modeling of age-dependent reneging risk, which

[33] In our main treatment sample, the median (mean) age for properties with HKSAR leases is 6 (6.8) while properties of colonial British leases are slightly older with a median (mean) of 7 (10.6). The results are robust to alternative cutoffs.

[34] The reneging risk on colonial British leases is documented in Table 5 for baseline specification and replicated in Column (2) of Table 7 for the main treatment group. The effect 8.2% in Table 7 differs slightly from 8.5% in Table 5, as we collapse three lease groups in Table 5 into one main treatment group in Table 7.

[35] We collected all notices issued by the HKSAR Lands Department regarding land resumption or any notices related to land, such as the Occupation of Land under Railways Ordinance, from January 2009 to April 2023. There have been 38 cases involving the revocation of land for residential buildings, affecting a total of 340 residential buildings. It is worth noting that the median age of the residential buildings involved in these

could be potentially interesting, for future research.

We are able to disentangle these two related yet distinct mechanisms by separating all properties in the main treatment group into British new versus old and HKSAR new versus old properties in Column (3), with HKSAR new properties serving as the reference group. Results show that the HKSAR new properties in the main treatment group exhibit a 5.3% price discount compared to the control group. Relative to the HKSAR new properties, HKSAR old properties in the main treatment group have an additional 2.6% discount, but this difference is not statistically significant, suggesting a relatively small pure maintenance effect.[36] In sharp contrast, British new and old properties in the main treatment group show significantly higher discounts of 7.8% and 10.7%, respectively, relative to HKSAR new properties. The difference between British old and new properties in Column (3) is 2.9 percentage points ($= -0.107 - (-0.078)$), which is marginally significant at the 10% level. Interestingly, this magnitude is slightly larger than the 2.6% difference observed between HKSAR old and new properties, providing further evidence for the endogenous maintenance effect, as old British leases may be more vulnerable to future expropriation risk. Taken together, our evidence suggests that the baseline discount is primarily driven by the reneging risk of colonial British leases, as opposed to endogenous responses in maintenance and investment by homeowners.[37]

We also estimate the same model specification using our rental data and present the results in Columns (4)–(6). Consistent with the findings in Table 4 Panel B, we do not observe any significant coefficients, including those on the main treatment group and its possible age-lease interaction terms, indicating that these factors have little impact on renters. However, this does not rule out the possibility of a maintenance mechanism. Even if the negative age-lease interaction effects in the housing price regression are driven by endogenous maintenance, the potential segmentation between rental and primary residence markets may results in no significant age-lease interaction effects in rental properties.[38]

cases is 57 years. Therefore, even relatively new properties (such as those with ages greater than 6 in Table 7) should factor in the possibility of future reneging risk when valuing a house.

[36] Although the discount of HKSAR new properties relative to the control group (5.3%) is not statistically significant, that of HKSAR old properties, which is $5.3\% + 2.6\% = 7.9\%$, is statistically significant at the 1% level.

[37] It is important to clarify that we cannot determine whether the absolute magnitude of the endogenous maintenance effect, which we have identified as ranging from 2.6% to 2.9%, is sufficiently small or not. However, given that location may be a more significant determinant of real estate prices in Hong Kong than structural characteristics (e.g., Choy et al., 2007), we believe that the endogenous maintenance effect, which is related to the property's structure, is likely to be small.

[38] Landlords who operate rental properties and aim to maximize rental income may not be affected by an expected hike in ground rent for several reasons. Firstly, the ground rent imposed by the government applies to the properties' rateable values, which are determined by the market. Therefore, these expenses act as a lump sum tax that is independent of the maintenance conditions of the landlords' rental properties, resulting in no impact on their maintenance incentives. Secondly, landlords have the right incentive to perform maintenance due to market pressure from tenants.

Table 7: Colonial British Leases and Maintenance

| Dep Var | Log(Unit Price) | | | Log(Unit Rent) | | |
|---|---|---|---|---|---|---|
| Sample | All Sales | | | Rentals | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| I(Main Treatment Group) | −0.105*** | −0.072** | −0.053 | 0.003 | 0.001 | −0.006 |
| | (0.025) | (0.029) | (0.034) | (0.017) | (0.020) | (0.022) |
| × I(Age ≥ 6) | −0.036** | | | −0.009 | | |
| | (0.015) | | | (0.016) | | |
| × I(British Leases) | | −0.082*** | | | −0.015 | |
| | | (0.026) | | | (0.011) | |
| × I(HKSAR Lease & Age ≥ 6) | | | −0.026 | | | 0.020 |
| | | | (0.020) | | | (0.023) |
| × I(British Lease & Age < 6) | | | -0.078** | | | 0.008 |
| | | | [0.031] | | | [0.018] |
| × I(British Lease & Age ≥ 6) | | | −0.107*** | | | −0.009 |
| | | | (0.031) | | | (0.020) |
| Property Attributes | Yes | Yes | Yes | Yes | Yes | Yes |
| District × Month FE | Yes | Yes | Yes | Yes | Yes | Yes |
| $N$ | 551,790 | 551,790 | 551,790 | 19,435 | 19,435 | 19,435 |
| Adjusted $R^2$ | 0.929 | 0.929 | 0.929 | 0.803 | 0.803 | 0.804 |

This table presents the effect of age and lease type (auctioned by the colonial British government or HKSAR) for the main treatment group. Columns (1) to (3) use the transaction sample, while columns (4) to (6) use the rental sample. The regression controls for the full set of property characteristics, with district by transaction month fixed effects. Standard errors are two-way clustered by estate and year-month. Significance levels are denoted by ***= 1%, **= 5%, *= 10%.

## 6.2. Natural Time "Appreciation" Effect versus Time-Varying Political Uncertainty?

Political uncertainty regarding the fate of Hong Kong has been hovering over society since the 1984 JD, but its severity and impact have varied over time and have often been more pronounced during periods of heightened public sentiment. How does the estimated price discount vary over time?

Panel A of Figure 3 displays the estimated price discounts of colonial British leases in the main treatment group over time. We focus on colonial British leases that have relatively large discounts due to significant reneging risk; otherwise the estimates will be confounded to the potential time-varying composition of transactions.[39] Two significant points follow. Firstly, price differentials have been statistically significant since the beginning of our sample period, starting from 1998, with a discount of around 7.5%. This indicates that the price difference has persisted over time. Secondly, there has been an increase in the intensity of discounts over time, especially around 2005, but since 2015, the discounts have stabilized at approximately 20%.

[39]In the earlier version of our paper, we presented the price discounts for both colonial British leases in the main treatment group over time, which had similar patterns as shown in Figure 3, albeit with smaller magnitudes.

The pattern observed in Figure 3 could be explained by two distinct economic mechanisms. The first mechanism is the time-varying political uncertainty, which may intensify over time. The second mechanism is the natural time "appreciation" effect, where the price discount for the treatment groups increases with their transaction years as the deadline of 2047 approaches. In other words, the observed pattern in the figure could be entirely due to the natural "appreciation" effect, rather than a change in political uncertainty.

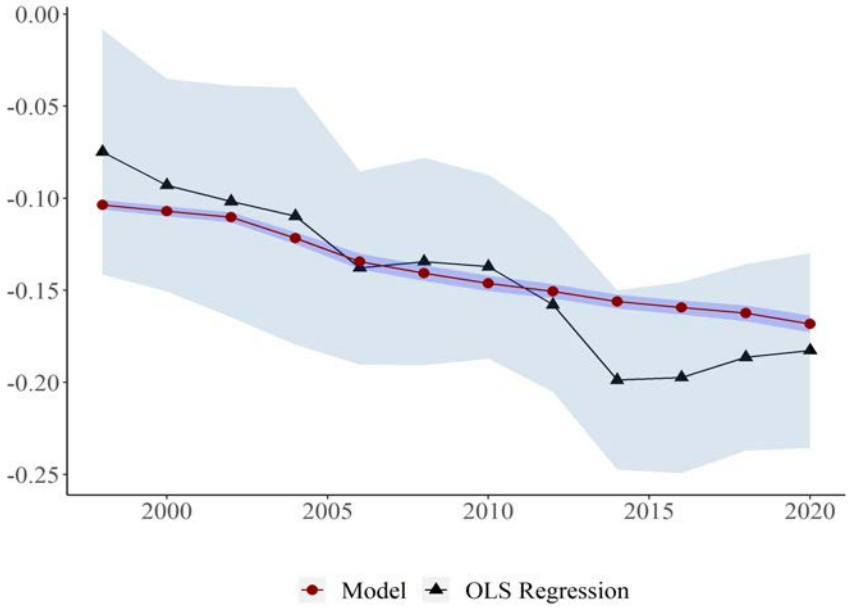
Due to the significant time trends present in the figure, using an event study or DID specification may not be appropriate. Nonetheless, we conduct a test to explore the possibility of a change in political uncertainty by visually identifying 2005 as a potential event date and conducting DID regressions using different time windows around 2005 ($\pm$1 year, $\pm$2 years, and $\pm$3 years). The results are presented in Table A.4. The coefficient on the interaction term of the main treatment group and the post-2005 dummy is not significant when comparing transactions sold within $\pm$1 year of December 31$^{st}$, 2005. However, the coefficient becomes significant when we expand the sample to include more years. This observation is consistent with the presence of a natural "appreciation" effect.

Our theoretical framework and its associated GMM estimation provide a structural method to disentangle and gauge the relative importance between the natural "appreciation" effect and a changing political uncertainty. First, using the parameters reported in Table 6, we calculate the model-implied discounts in our sample for colonial British leases over time, and plot them (marked by red circles) in Panel A of Figure 3, along with a 95% confidence interval based on our GMM-estimated standard errors. By keeping the same model parameters (and hence "political uncertainty") constant across the entire sample, the model-implied price discounts capture the natural "appreciation" effect alone. As shown in the figure, the natural "appreciation" effect, in the absence of any changes in political uncertainty, closely matches the time-series pattern of the estimated discount in the main treatment group, not just qualitatively but also quantitatively (within the 95% confidence interval of their OLS estimates, indicated by shaded area). Hence, statistically, we cannot reject the hypothesis that there is no change in political uncertainty during our sample period.

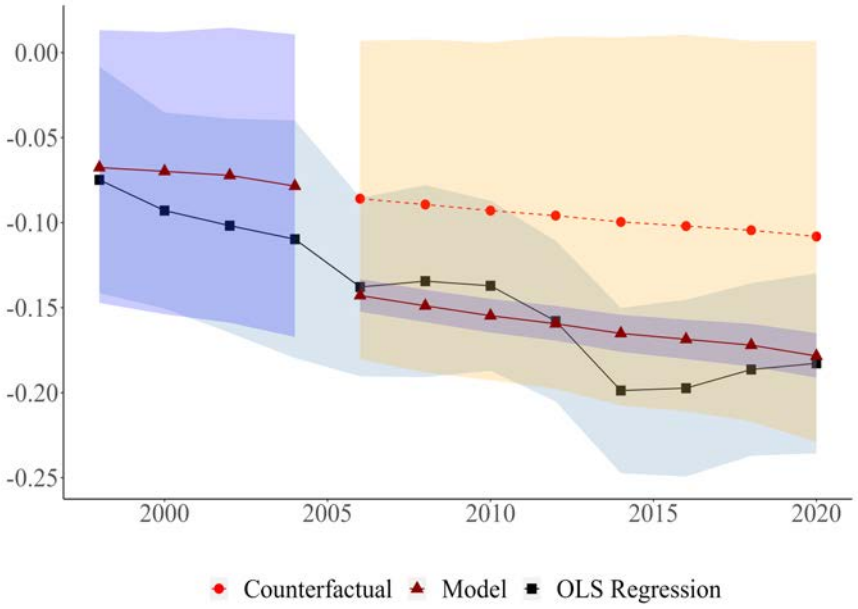
Second, Panel B of Figure 3 further decomposes the time trend of British discounts into two components: the natural "appreciation" effect and the effect due to a potential change in political uncertainty. To do this, we first reestimate our model by allowing for different sets of parameters before and after 2005. This gives us the model-implied discounts for properties sold before and after 2005, which are marked by red triangles in the figure. We then plot a counterfactual model-implied price discount for properties sold after 2005 (marked with red circles) using the pre-2005 parameter estimators, which would be the price discount if there were no change in political uncertainty (i.e., if the parameters were the same as before 2005). We also plot the associated confidence intervals for these model-implied discounts, based on

**Figure 3.** Price Discounts over Time

*Panel A: Dynamic Estimates*




*Panel B: Natural "Appreciation" Effect versus Time-Varying Uncertainty*




This figure plots the price discounts, either from OLS regression or model estimation, of the colonial British leases in the main treatment group over time. Panel A estimates the model using the entire sample from 1998 to 2020. Panel B uses the same sample while allowing for different model parameters before and after 2005.

our GMM estimation.

The key takeaway from the exercise shown in Panel B is that the confidence intervals of the counterfactual price discounts (yellow shaded area) are quite wide due to the lower statistical

power of the pre-2005 estimators, likely because of the limited size of our pre-2005 sample. Therefore, the estimated discounts are not significantly different from the counterfactual model-implied discounts, again suggesting no indication of a change in political uncertainty.

## 6.3. The Role of Mortgage Access

Similar to those in the United States, Hong Kong's mortgage terms are typically 30 years. This means that collateral values underlying properties in the treatment group sold after July 1st, 2017, will be exposed to significant risk, leaving lenders at risk if borrowers choose to default in the future. This endogenous response from lenders, via the standard housing financing channel, may affect the property equilibrium market price and hence contribute to the price discount identified in our empirical exercise.

While we lack loan-level data to formally evaluate this channel, there is one noteworthy piece of evidence that deserves attention. Local media extensively covered this issue in 2016 as the 2017 deadline approached, prompting the HKSAR government to clarify its authority to grant land leases with terms extending beyond June 30th, 2047. This clarification was aimed at instilling confidence in the banking sector as well as the Hong Kong Institute of Surveyors.[40] Lenders, with the support of the HKSAR government, continue to approve mortgages on properties with land leases expiring after July 1st, 2047. Therefore, if we consider endogenous banking credit as one of the important channels through which political uncertainty impacts housing prices, the HKSAR's decisive actions around 2016 could explain the stabilization of the estimated price discount after 2015 as shown in Figure 3.

## 6.4. Local Political Sentiments

To capture local political sentiments in Hong Kong and their potential relation with the estimated price discounts, we examine time-varying socioeconomic characteristics at the district level.

**Local Political Sentiment Measures** Our socioeconomic characteristics at the district level come from the census data as well as district council elections.[41] We focus on two district-

[40] In fact, the HKSAR government provided written responses to address LegCo's inquiry on this topic. For instance, on a statement released on November 27th, 2019, it says "The Government has particularly explained to relevant professional sectors matters related to lease extension, including communicating with the *banking* sector via the Hong Kong Monetary Authority (HKMA) in October 2016, making clear that the Government has unequivocal policy to deal with extension of land leases, including reaffirming its authority to grant land leases with terms extending beyond June 30, 2047; as well as meeting with the Hong Kong Institute of Surveyors in May 2017 to explain the specifics in the execution of land lease extension. The professions considered the Government's policy as clear and unequivocal."

[41] The census survey is conducted by the Census and Statistics Department of the HKSAR every five years, while the district council is elected every four years. For each census year (2001, 2006, 2011, 2016), we match

level characteristics unique to Hong Kong: percent of pro-democracy seats, and percent of residents who were born in mainland China (hereafter, mainland migrants). The average percent of pro-democracy seats is 30%, but with a wide range from 4 to 100 percent; and mainland migrants account for 31% of the Hong Kong population.

Local councilors get to choose five seats on the LegCo (70 seats) and 117 seats on the 1,200-member panel that selects the city's chief executive. Local elections have become even more important since 2014 when the Occupy Central movement failed to achieve its political goals and more people switched to elections as a way to express their political opinion. The percentage of pro-democracy seats from district council elections captures local sentiments in Hong Kong's political future. As shown in Panel (A) of Figure A.3, after suffering some defeats in previous elections, the pro-democracy camp in conjunction with localist groups in 2019 won 17 out of 18 district councils, a victory by the largest margin in the history of Hong Kong. In the meantime, Panel (A) also illustrates the significant cross-sectional variation in the percent of pro-democracy seats across districts.

The percentage of mainland migrants provides a measure of local sentiments against cultural influences from mainland China. Since the handover, there has been growing anxiety that Hong Kong will no longer belong to Hong Kongers, as a large influx of mainland tourists and migrants had been blamed anecdotally by some locals for their lost Hong Kong identity. Panel (B) of Figure A.3 shows that mainlanders are spread across the city, and their presence was pronounced in the early censuses, but has declined slightly recently.[42]

We now take the percentage of pro-democracy seats and the percentage of mainland migrants as our two primary measures of local sentiments, and explore their relations with price discounts. Table 8 includes the interaction of the main treatment group and the percentage of pro-democracy seats, as well as the percentage of mainland migrants. The coefficients on the interaction terms are all significant at the 1% level and give the incremental effect of district-level variations. In Column (2), we find a negative coefficient on the interaction, suggesting that, in addition to the −14.6% price discount, a SD increase in pro-democracy seats in the local district (i.e., 18%) is associated with an additional discount of 5.2 percentage points (or a 36% increase in the base effect) for the main treatment group. Similarly, Column (3) shows that on top of the −13.1% average price discount, a one SD increase of mainland migrants in

the census variables to all the transactions since the prior census year (e.g., transactions in 2012 and later are matched with 2016 census variables). From each local election (1999, 2003, 2007, 2011, 2015, 2019), we match the percentage of pro-democracy seats for each district to all the transactions from two years before the election year through two years after (e.g., transactions in 2018–2020 are matched with 2019 pro-democracy seats). Panel A of Table 8 reports the summary statistics of district characteristics based on the merged data.

[42]Panel A of Table A.5 reports summary statistics of the district characteristics, and Panel B reports the correlations among the district characteristics. The two local sentiment measures are positively correlated with each other (with $\rho = 0.34$). Panel C presents similar analysis as Table 8, but includes interaction terms of the HKSAR leases dummy with the two district variables.

Table 8: Local Political Sentiments and Price Discount

| Dep Var | Log(Unit Price) | | | | | |
|---|---|---|---|---|---|---|
| Sample | All Sales | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| I(Main Treatment Group) | −0.133*** | −0.146*** | −0.132*** | −0.128*** | −0.113*** | −0.091*** |
| | (0.021) | (0.020) | (0.021) | (0.021) | (0.023) | (0.025) |
| × % of Pro-Democracy Seats | | −0.050*** | | −0.047*** | | |
| | | (0.012) | | (0.012) | | |
| × % of Mainland Migrants | | | −0.082*** | −0.077*** | | |
| | | | (0.024) | (0.024) | | |
| × I(High % Pro-Democracy Seats) | | | | | −0.083*** | |
| | | | | | (0.021) | |
| × I(High % Mainland Migrants) | | | | | | −0.103*** |
| | | | | | | (0.025) |
| × Median Age | | −0.018 | −0.042*** | −0.020 | −0.028* | −0.050*** |
| | | (0.015) | (0.014) | (0.015) | (0.015) | (0.014) |
| × Median Income | | −0.004 | −0.040 | −0.032 | −0.001 | −0.047 |
| | | (0.027) | (0.030) | (0.028) | (0.026) | (0.029) |
| × % of College Above | | 0.018 | 0.029 | 0.031 | 0.015 | 0.046 |
| | | (0.031) | (0.030) | (0.029) | (0.030) | (0.030) |
| × % of Home Owners | | 0.021 | −0.002 | −0.010 | 0.026 | 0.015 |
| | | (0.023) | (0.025) | (0.023) | (0.023) | (0.023) |
| Property Attributes | Yes | Yes | Yes | Yes | Yes | Yes |
| District × Month FE | Yes | Yes | Yes | Yes | Yes | Yes |
| $N$ | 551,790 | 551,790 | 551,790 | 551,790 | 551,790 | 551,790 |
| Adjusted $R^2$ | 0.929 | 0.930 | 0.930 | 0.931 | 0.930 | 0.930 |

This table presents the district-level variation of price discounts for our main treatment group. The dependent variable is the log of unit price. We calculate the percentage of pro-democracy seats and the percentage of Mainland Migrants using district voting data and Census data, respectively. The variables I(High % of Pro-Democracy Seats) and I(High % of Mainland Migrants) are defined as indicators for values above the median of the district cross-section. The regression controls for district by year-month fixed effects and property attributes. Standard errors are two-way clustered by estate and year-month. Significance levels are denoted by ***= 1%, **= 5%, *= 10%.

the local district (i.e., 6%) is associated with an additional discount of 8.2 percentage points (or a 63% increase in the base effect). Column (4) includes interactions with both measures in a horse-race setting and finds similar estimates as in Columns (2) and (3).

In Columns (5)–(6), we replace the percentage measures with indicators showing whether the district is above the median value of each variable (within each cohort year), respectively. Properties in the main treatment group that are located in districts with a high proportion of pro-democracy seats (high percentage of mainland migrants) see an additional 8.6% (10.6%) increase in the price discount on top of the 11.2% (9.0%) base discount. Taken together, these results confirm that the two series provide valid measures of local political sentiment and that the housing price discount due to future political uncertainty increases where we see heightened local sentiment.

Figure A.4 plots the evolution of price discounts across districts with different sentiments.

Regardless of which measure we use, price discounts in districts with greater local political sentiment are always more negative than those in districts with less sentiment. But in districts with greater local sentiment, we observe a significant price discount even before 2005. A significant price discount did not emerge in the districts with less sentiment until after 2005 when citywide sentiments increased. The comparison suggests that the estimated price discounts in the main treatment group capture political uncertainty, which is manifested through changes in public political sentiment, whether local or citywide.

**Plausible Social and Economic Mechanisms** There are several plausible mechanisms through which the local sentiment measures affect price discounts identified in our paper. The pro-democrats generally embrace liberal values, and hence residents in places where pro-democratic camps won more seats should be more sensitive to the future of "One Country, Two Systems." Moreover, since the elections have been widely viewed as a de facto referendum on the ongoing pro-democracy protest out of the fear and panic of losing a "high degree of autonomy," residents in districts with a high percentage of pro-democracy seats may feel more uncertain over Hong Kong's future, which links to the estimated price discount naturally.

Moving on to the percentage of mainland migrants, we believe this captures Hong Kongers' rising antagonistic sentiments toward cultural influences from the mainland. Hong Kongers over time have grown increasingly fearful of losing their own identity, and the resulting anxiety is particularly high where there are a lot of mainland migrants. Such anxiety stems partly from their eroding social position, and partly from mainland China's overwhelming political and economic dominance over the HKSAR. Consequently, in places where more mainland residents are present and the potential cultural conflict between Hong Kongers and mainlanders is on full display, local residents tend to be more pessimistic about the future of the city.

## 6.5. The Effect of Individual Beliefs

We now explore the perspectives of buyers and sellers from the mainland China, who are identified through their names in the transaction data (Fan et al., 2023). Our premise is that relative to Hong Kongers, mainlanders may have different private valuations regarding the political uncertainty embedded in the treatment leases. Mainland buyers, due to their experience in China, tend to be more optimistic about the future of "One Country, Two Systems" and thus may be willing to pay higher prices. However, mainlanders who have lived in Hong Kong but have decided to sell their houses might be those who are more pessimistic about Hong Kong's future.

We restrict our sample to transactions in which buyers/sellers are identified as either a mainlander or Hong Konger, and include an interact term of the main treatment group

dummy and individual mainland buyers or sellers, with local-buyer–local-seller as the base. Results are reported in Column (1) of Table A.6. The monotonic relationship observed in transaction prices across different buyer-seller pairs indicates that mainland buyers tend to be more optimistic compared to their local counterparts, and this difference of $-0.017$ is statistically significant at the 5% level. We also find that mainland sellers tend to be more pessimistic than their local counterparts, though this difference is not statistically significant.

How do districts with a high percentage of mainland migrants relate to individual mainland buyers and sellers? To explore this, we employ a triple DID specification that interacts the main treatment group dummy with both district-level and individual mainland variables. Results are reported in Columns (2) and (3) using continuous and dummy variables of the percentage of mainland migrants, respectively. The triple interaction terms reveal that in districts with a high percentage of mainland migrants, mainland sellers are actually more optimistic than local sellers, while there is no significant difference between mainland-buyers–local-sellers and local buyer-sellers, which serves as our reference group. Specifically, mainland sellers sell for an additional price premium of 6.0% (to local buyers) or 6.4% (to mainland buyers) in Column (3) compared to local sellers in the same district. It is worth noting that the positive coefficient (0.060) on the triple interaction term with mainland seller largely offsets the negative coefficient ($-0.048$) on the double interaction term with mainland sellers in Column (3). The growing optimism of mainland sellers in places with high percentages of mainland migrants may be explained by polarization in those districts, partially driven by Hong Kongers' rising antagonistic sentiments toward mainlanders, as mentioned in Subsection 6.4.[43]

# 7. Conclusion

We find that the property market prices in future political regime shifts, as the value of housing assets depends on the continuity of land ownership far into the future. The difference in lease extension policies results in a 14.1% discount for the treatment group, reflecting historical arrangements that are set to expire in 2047 and creating uncertainty about any lease extensions beyond that point.

The estimates imply that beyond 2047, homeowners expect to pay an additional 21% of the net rental value at extension. They do not expect any reneging risk on colonial British leases before 2047 but anticipate a reneging risk every 61 years after 2047. Furthermore, colonial British leases are expected to face additional land premium charges of approximately 6% and

[43] As shown in Table 8, there is a significant price discount in districts with a high percentage of mainland migrants. In Column (3) of Table A.6, we find that this discount is primarily driven by the sentiment of local buyers and sellers, as we observe an additional discount of 8.6% relative to locals in the control group.

21% of house value before and after 2047 at extension, respectively.

Our paper provides compelling empirical evidence that political factors can have a crucial impact on the valuation of long-term property rights. It is worth noting that since our paper began to circulate draft form, the HKSAR government has added a notice to its website acknowledging the challenges posed by the large number of leases set to expire in 2047. The notice states that the government "will make reference to past experience in legislation and work out suitable arrangements to cater for the significant volume of lease extension cases at an appropriate juncture."

# References


Abdulai, Awudu, Victor Owusu, and Renan Goetz, 2011, Land Tenure Differences and Investment in Land Improvement Measures: Theoretical and Empirical Analyses, *Journal of Development Economics* 96, 66–78.

Acemoglu, Daron, and Simon Johnson, 2005, Unbundling Institutions, *Journal of Political Economy* 113, 949–995.

Badarinza, Cristian, and Tarun Ramadorai, 2015, Long-run discounting: evidence from the uk leasehold valuation tribunal, *Available at SSRN 2412296* .

Baker, Scott R., Nicholas Bloom, and Steven J. Davis, 2016, Measuring Economic Policy Uncertainty, *Quarterly Journal of Economics* 131, 1593–1636.

Baldauf, Markus, Lorenzo Garlappi, and Constantine Yannelis, 2020, Does climate change affect real estate prices? Only if you believe in it, *Review of Financial Studies* 33, 1256–1295.

Bernstein, Asaf, Stephen B Billings, Matthew T Gustafson, and Ryan Lewis, 2022, Partisan residential sorting on climate change risk, *Journal of Financial Economics* 146, 989–1015.

Bernstein, Asaf, Matthew T Gustafson, and Ryan Lewis, 2019, Disaster on the horizon: The price effect of sea level rise, *Journal of Financial Economics* 134, 253–272.

Besley, Timothy, 1995, Property Rights and Investment Incentives: Theory and Evidence from Ghana, *Journal of Political Economy* 103, 903–937.

Besley, Timothy, and Robin Burgess, 2000, Land Reform, Poverty Reduction, and Growth: Evidence from India, *Quarterly Journal of Economics* 115, 389–430, Publisher: Oxford Academic.

Bhattacharya, Utpal, Daisy Huang, and Kasper Meisner Nielsen, 2021, Spillovers in Prices: The Curious Case of Haunted Houses, *Review of Finance* 25, 903–935.

Campbell, John Y, and Robert J Shiller, 1987, Cointegration and tests of present value models, *Journal of Political Economy* 95, 1062–1088.

Cantoni, Davide, David Y. Yang, Noam Yuchtman, and Y. Jane Zhang, 2019, Protests as strategic games: Experimental evidence from Hong Kong's antiauthoritarian movement, *Quarterly Journal of Economics* 134, 1021–1077.

Chen, Ting, and James Kai-sing Kung, 2019, Busting the "princelings": The campaign against corruption in china's primary land market, *Quarterly Journal of Economics* 134, 185–226.

Chen, Zhuo, Zhiguo He, and Chun Liu, 2020, The financing of local government in China: Stimulus loan wanes and shadow banking waxes, *Journal of Financial Economics* 137, 42 – 71.

Choy, Lennon HT, Stephen WK Mak, and Winky KO Ho, 2007, Modeling Hong Kong real estate prices, *Journal of Housing and the Built Environment* 22, 359–368.

Coase, Ronald, 1960, The Problem of Social Cost, *Journal of Law and Economics* 56, 837 – 877.

De Long, J Bradford, and Andrei Shleifer, 1993, Princes and merchants: European city growth before the industrial revolution, *The Journal of Law and Economics* 36, 671–702.

Demographia, 2019, 16th Annual Demographia International Housing Affordability Survey: 2020, *Demographia* http://demographia.com/dhimedia2020.pdf.

Engle, Robert F, Stefano Giglio, Bryan Kelly, Heebum Lee, and Johannes Stroebel, 2020, Hedging climate change news, *Review of Financial Studies* 33, 1184–1216.

Fan, Yi, Maggie Rong Hu, Wayne Xinwei Wan, and Zhenping Wang, 2023, A Tale of Two Cities: Mainland Chinese Buyers in Hong Kong Housing Market, *Review of Finance, forthcoming* .

Fang, Hanming, Quanlin Gu, Wei Xiong, and Li-An Zhou, 2016, Demystifying the Chinese housing boom, *NBER Macroeconomics Annual* 30, 105–166.

Field, Erica, 2007, Entitled to Work: Urban Property Rights and Labor Supply in Peru, *Quarterly Journal of Economics* 122, 1561–1602.

Fisman, Raymond, 2001, Estimating the value of political connections, *American Economic Review* 91, 1095–1102.

Fisman, Raymond, Jing Shi, Yongxiang Wang, and Rong Xu, 2018, Social ties and favoritism in Chinese science, *Journal of Political Economy* 126, 1134–1171.

Galiani, Sebastian, and Ernesto Schargrodsky, 2010, Property Rights for the Poor: Effects of Land Titling, *Journal of Public Economics* 94, 700–729.

Giglio, Stefano, Matteo Maggiori, Krishna Rao, Johannes Stroebel, and Andreas Weber, 2021, Climate change and long-run discount rates: Evidence from real estate, *Review of Financial Studies* 34, 3527–3571.

Giglio, Stefano, Matteo Maggiori, and Johannes Stroebel, 2015, Very Long-Run Discount Rates, *The Quarterly Journal of Economics* 130, 1–53.

Goldsmith-Pinkham, Paul, Matthew T Gustafson, Ryan C Lewis, and Michael Schwert, 2022, Sea level rise exposure and municipal bond yields, Technical report, National Bureau of Economic Research.

Goldstein, Markus, and Christopher Udry, 2008, The Profits of Power: Land Rights and Agricultural Investment in Ghana, *Journal of Political Economy* 116, 981–1022.

Hansen, Bruce E., 2021, *Econometrics*, https://www.ssc.wisc.edu/ bhansen/econometrics/.

Hansen, Lars Peter, 1982, Large Sample Properties of Generalized Method of Moments Estimators, *Econometrica* 50, 1029–1054.

Hassan, Tarek A., Stephan Hollander, Laurence van Lent, and Ahmed Tahoun, 2019, Firm-Level Political Risk: Measurement and Effects, *Quarterly Journal of Economics* 134, 2135–2202.

He, Zhiguo, Yuehan Wang, and Xiaoquan Zhu, 2023, Homemade foreign trading, *University of Chicago, Becker Friedman Institute for Economics Working Paper* .

Hsu, Sara, 2017, Good News For Chinese Homeowners: Premier Li Offers Some Clarity On Land Leases, *Forbes* https://www.forbes.com/sites/sarahsu/2017/03/21/good-news-for-chinese-homeowners-premier-li-offers-some-clarity-on-land-leases/.

Kelly, Bryan, Lubos Pástor, and Pietro Veronesi, 2016, The Price of Political Uncertainty: Theory and Evidence from the Option Market, *Journal of Finance* 71, 2417–2480.

Keys, Benjamin J, and Philip Mulder, 2020, Neglected no more: Housing markets, mortgage lending, and sea level rise, Technical report, National Bureau of Economic Research.

La Porta, Rafael, Lopez-de-Silanes Florencio, Andrei Shleifer, and Robert W. Vishny, 1998, Law and finance, *Journal of Political Economy* 106, 1113–55.

Luo, Shikong, Alan Tidwell, and Sherwood Clements, 2022, Does political uncertainty affect residential development?, *The Journal of Real Estate Finance and Economics* 1–21.

Ma, Chang, John H Rogers, and Sili Zhou, 2021, The effect of the China connect, *Available at SSRN 3432134* .

Martinez-Bravo, Monica, 2014, The role of local officials in new democracies: Evidence from Indonesia, *American Economic Review* 104, 1244–1287.

Martinez-Bravo, Monica, Priya Mukherjee, and Andreas Stegmann, 2017, The non-democratic roots of elite capture: Evidence from Soeharto mayors in Indonesia, *Econometrica* 85, 1991–2010.

Olson, Mancur, 2002, Power and prosperity: Outgrowing communist and capitalist dictatorships, *Science and Society* 66.

Pástor, Lubos, and Pietro Veronesi, 2012, Uncertainty about Government Policy and Stock Prices, *Journal of Finance* 67, 1219–1264.

Pástor, Lubos, and Pietro Veronesi, 2013, Political Uncertainty and Risk Premia, *Journal of Financial Economics* 110, 520–545.

Rosen, Sherwin, 1974, Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition, *Journal of Political Economy* 82, 34–55.

Taylor, Chloe, 2019, Hong Kong Named the Most Expensive City In the World for Expats, *CNBC* https://www.cnbc.com/2019/06/26/hong-kong-named-the-most-expensive-city-in-the-world-for-expats.html.

The Economist, 2019, The Turmoil in Hong Kong Stems in Part from Its Unaffordable Housing, *The Economist* https://www.economist.com/china/2019/08/22/the-turmoil-in-hong-kong-stems-in-part-from-its-unaffordable-housing.

Webb, Devid, 2010, Hong Kong Land Lease Reform, *Webb-site Reports* https://webb-site.com/articles/leases1.asp.

## Table A.1: Summary of Lease Types

| Auction Date | Lease Type | Land Proceeds |
|---|---|---|
| Before JD ($\leq$ 4/1/1985) | Hong Kong Island & Old Kowloon:<br>(1) 999-year leases (auctioned from 1843 to 1898 and expiring from 2842 to 2897). They pay nominal ground rent.<br>(2) 75-year leases (auctioned from 1843 to 1898, expiring from 1918 to 1973 if no extension, expiring from 1993 to 2048 after first extension, expiring on 6/30/2047 after second extension; 99 years lease (rare, auctioned from 1843 to 1898, expiring from 1942 to 1997 if no extension, expiring from 2041 to 2083 after first extension. Both types will be extended to 6/30/2047 instead of another 75 or 99 years after the JD.) Most of them in our sample pay nominal ground rent, except those extended after the JD and set to expire on 6/30/2047 are required to pay 3% of rateable as ground rent following the handover.<br>(3) 75+75-year leases (auctioned from 1899 to 1985 and expiring from 2049 to 2135); 99+99-year leases (rare, auctioned from 1899 to 1985 and expiring from 2097 to 2183). The "+" indicates that a one-time renewal option is included in the covenants which allows the lease owner to renew the lease for another 75 or 99 years after the first 75 or 99 years. They pay nominal ground rent evaluated at the auction date for the first 75 or 99 years and the ground rent is reevaluated at the renew date for the second 75 or 99 years.<br>New Kowloon & New Territories:<br>(4) Nonrenewable leases that expire on 6/27/1997 due to historical reasons. According to the Joint Declaration, these leases will be automatically renewed to 6/30/2047. Thus, they will expire in 2047 in our data. | |
| Transition (4/1/1985–6/30/1997) | (5) Nonrenewable leases expiring on 6/30/2047. They have paid 3% of rateable as ground rent since 7/1/1997. | Split between U.K. & HKSAR |
| Post-Handover ($\geq$ 7/1/1997) | (6) Nonrenewable leases expiring on (auction date + 50 years). They have paid 3% of rateable as ground rent since 7/1/1997. | HKSAR |

This table presents a summary of different land leases in the history of Hong Kong. The JD was signed on Dec 19, 1984, and went into effect on May 27, 1985. However, according to our data, leases were set to expire in 2047 even if the land was auctioned from April 1, 1985, to May 26, 1985. So we use April 1, 1985, as the starting date for this policy. For Type (2), when leases of this type end, they could be extended for another 75 or 99 years by paying premium and updated rent if the government did not need the land for public proposes. If a 75-year lease was sold in 1897 and got extended once in 1972, then it will be set to expire in 2047 in our data. It is important to separate leases before or after 6/30/2047 in our paper. Thus, we collect 75-year leases sold in 1897 from the Hong Kong Government Gazette. We do not find any 75-year lease sold before 6/30/1897. We find two 75-year leases sold between 7/1/1897 and 12/31/1897, and we classify them as leases expiring in the second half year of 2047. Furthermore, if a 99-year lease was sold in 1849 and got extended once in 1948, then it will expire in 2047 in our data. We do not find any 99-year leases sold in 1849 according to Hong Kong Government Gazette. "Nominal ground rent" refers to 3% of annual rent evaluated at the beginning of the lease (if no extension) or at the most recent lease extension date, fixed throughout the entire term. On the contrary, "3% of rateable" refers to 3% of annual rent reevaluated every year.

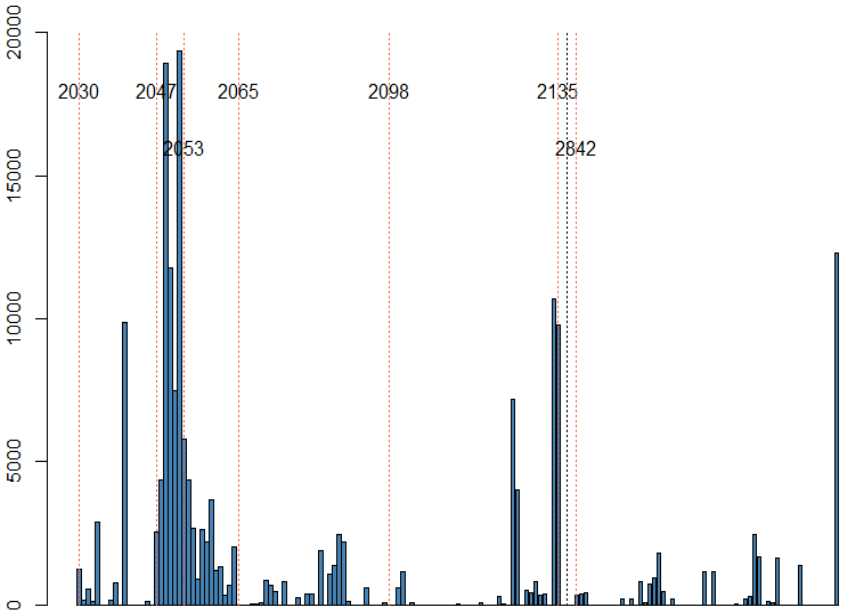
Online Appendix for

# Valuation of Long-Term Property Rights with Political Regime Shifts

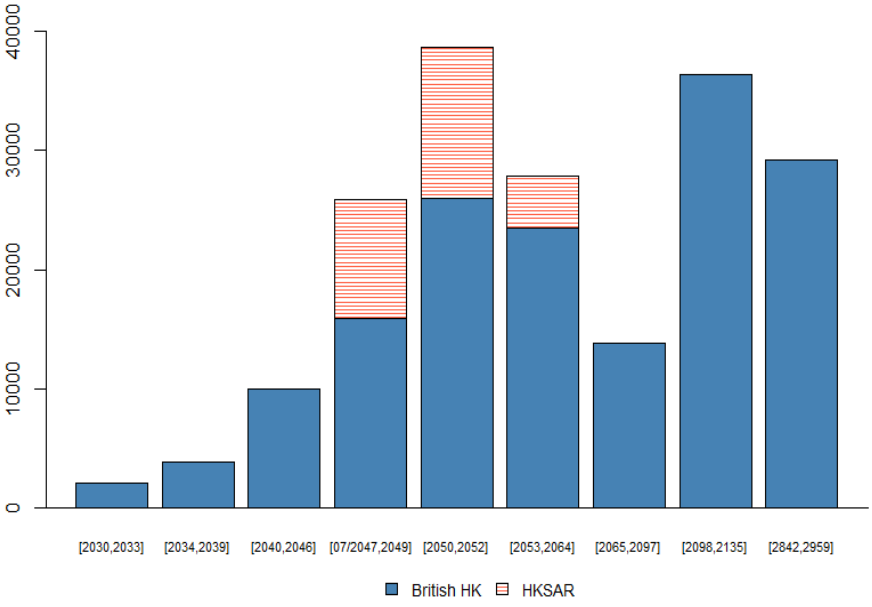
by Zhiguo He, Maggie Hu, Zhenping Wang and Vincent Yao

**Figure A.1.** Distribution of Transactions by Lease Groups

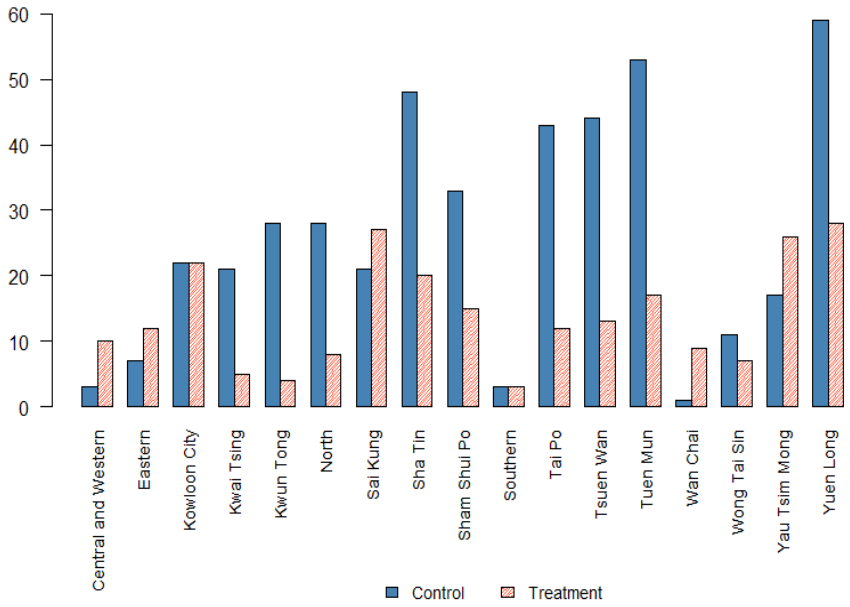
*Panel A: Number of Transactions By Expiration Year*




*Panel B: Number of Transactions by Lease Group*



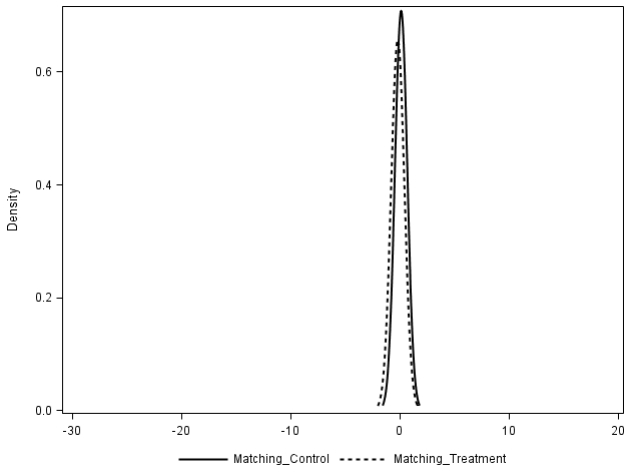
*Panel C: Number of Leases by District*



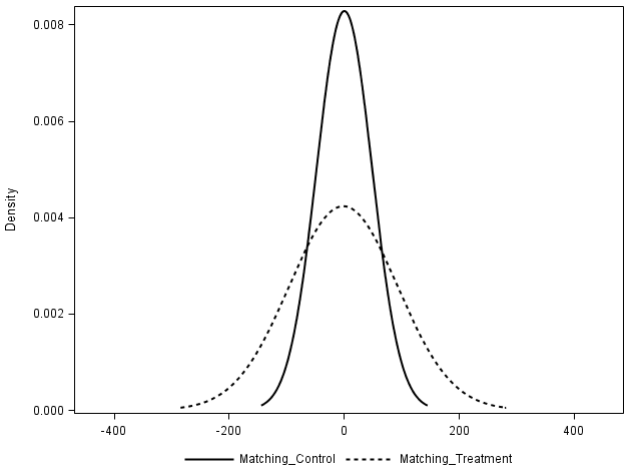

Panel A plots the number of transactions by lease expiration year from 2030 to 2135 and from 2842 to 2959. Panel B plots the number of transactions by lease groups and lease types (colonial British leases or HKSAR leases). Panel C plots the number of leases for the control group and main treatment group by each district.

**Figure A.2.** Distribution of Residuals

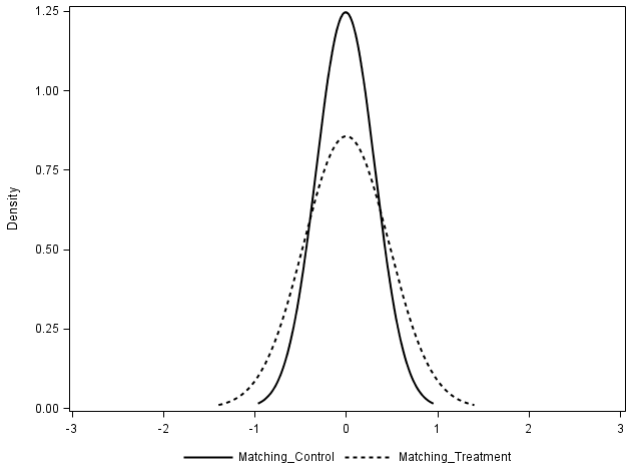
*(A) Building Age*



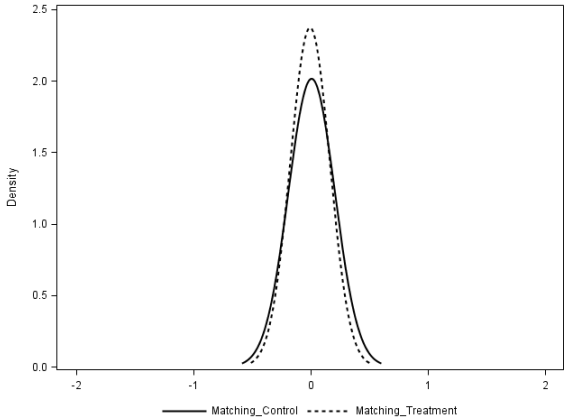

*(B) Net Living Area*



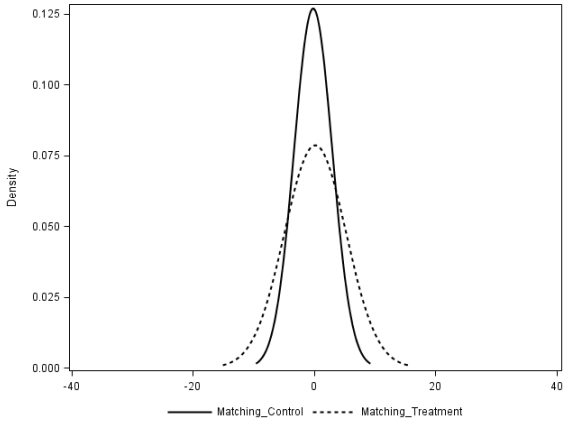

*(C) No of Bedrooms*



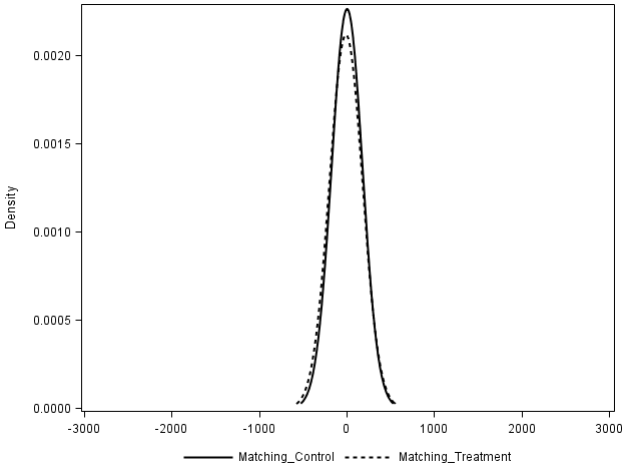

*(D) No of Living Rooms*



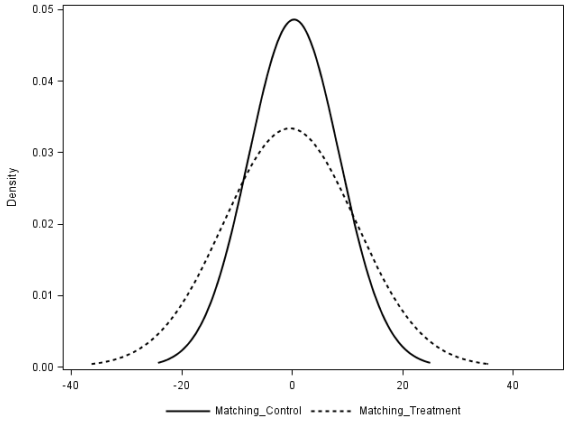

*(E) Bay Window Size*



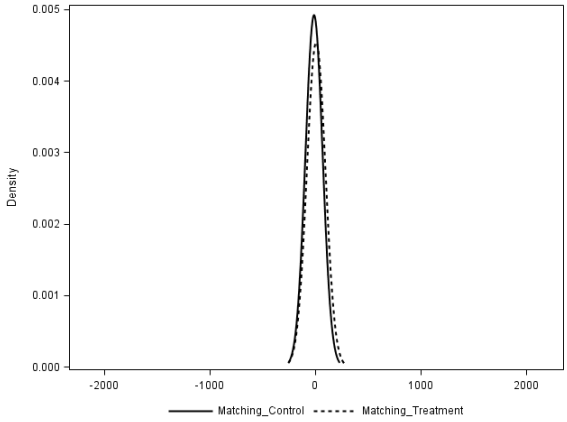

*(F) Turnover*



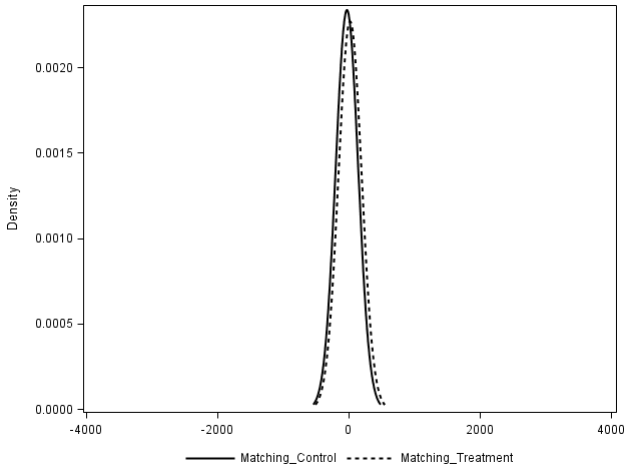
*(G) Distance to MRT stations*



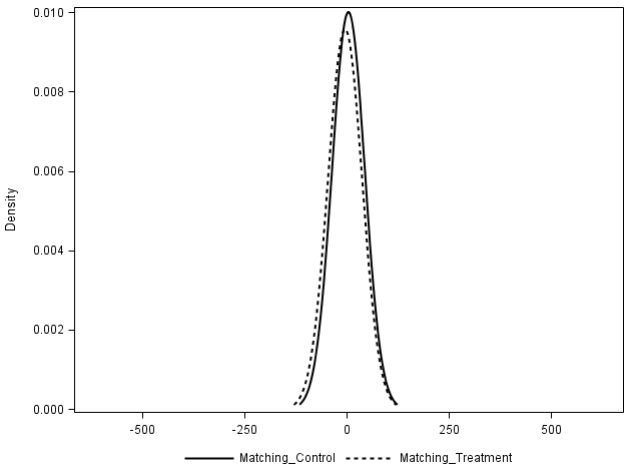

*(H) Distance to Bus Stops*



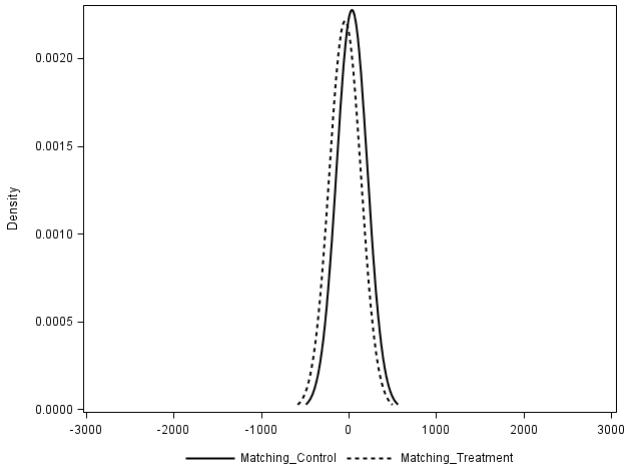

*(I) Distance to School*



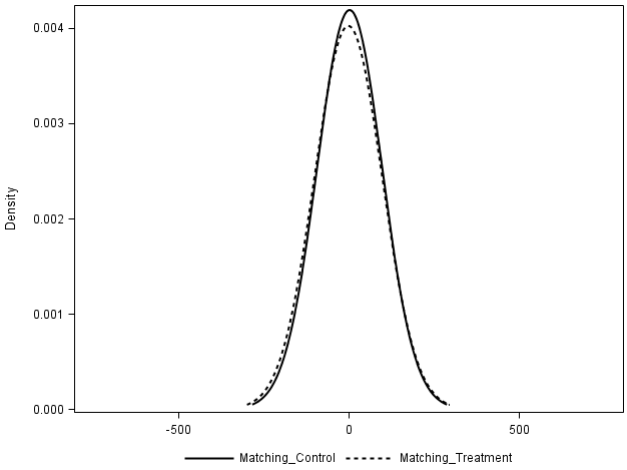

*(J) Distance to University*




*(K) Distance to Coastal Line*



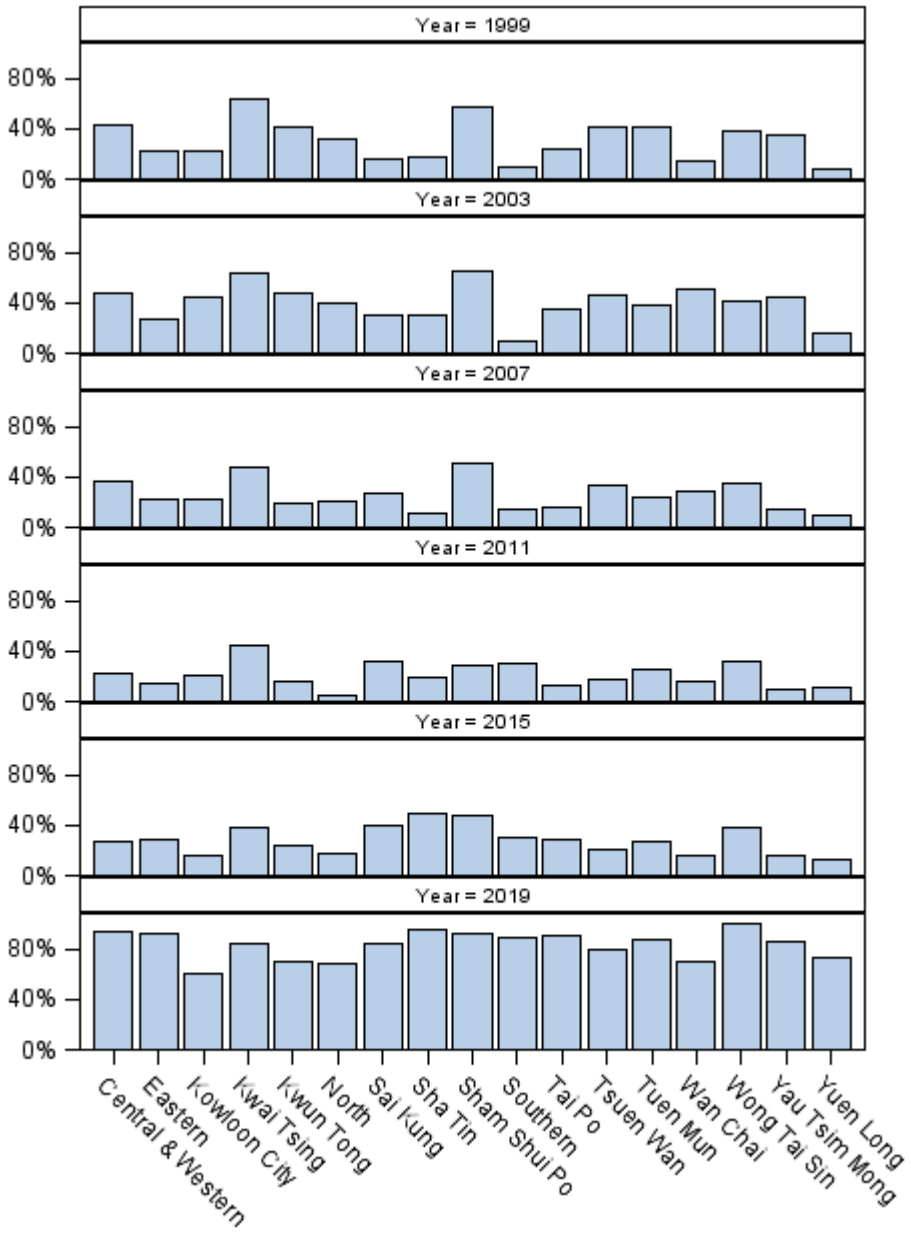

*(L) Distance to Hospital*



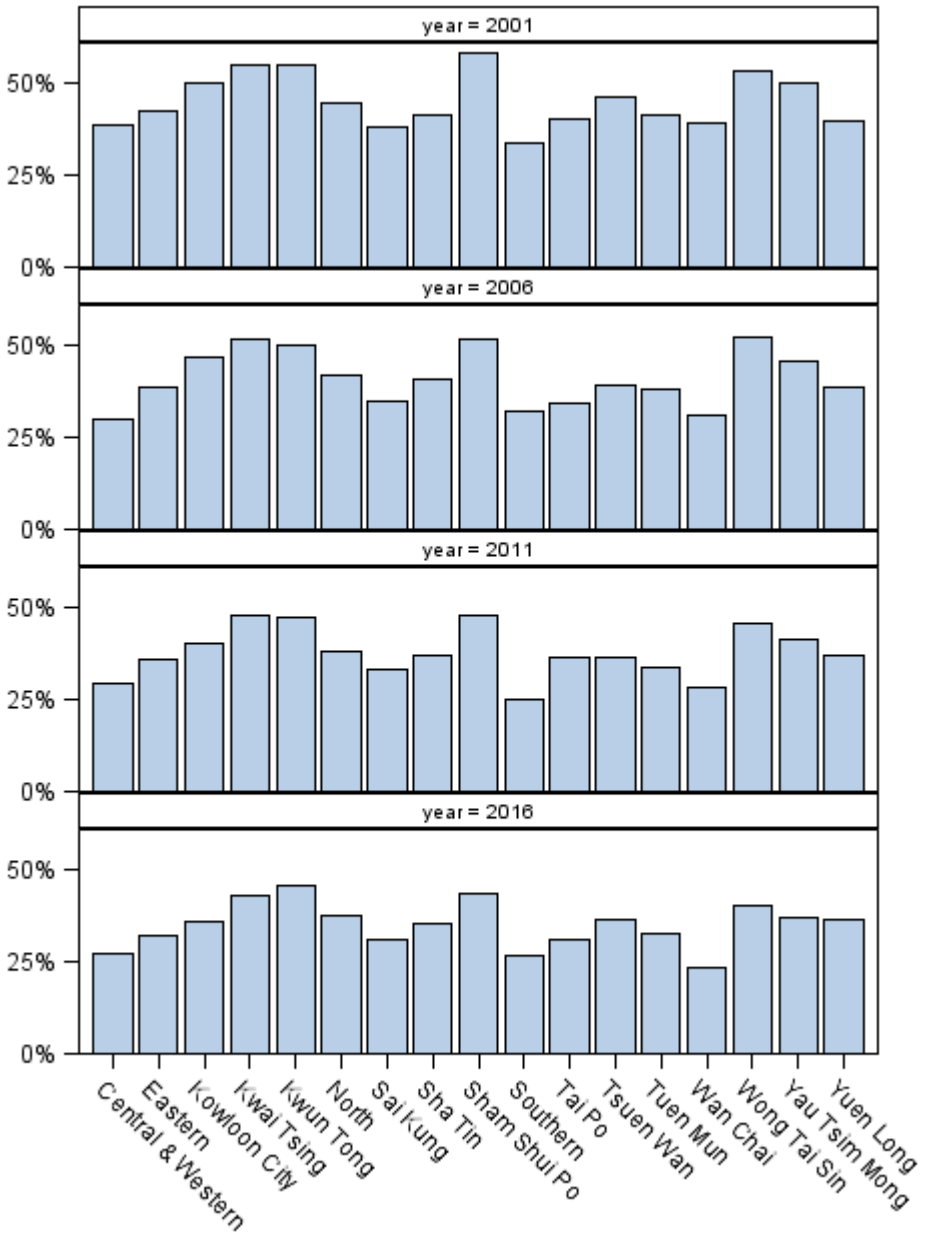

Using the matched sample, this figure plots the density of residuals from regressing each property characteristic on the fixed effects of the interaction between estate pair and transaction month, for our control group and main treatment group, respectively. The range of the $x$-axis is decided by the residual from regressing each property characteristic on the fixed effects of the interaction between district and transaction month, using the baseline regression sample.

**Figure A.3.** District Characteristics Over Time

*Panel A: % of Pro-Democracy Seats*



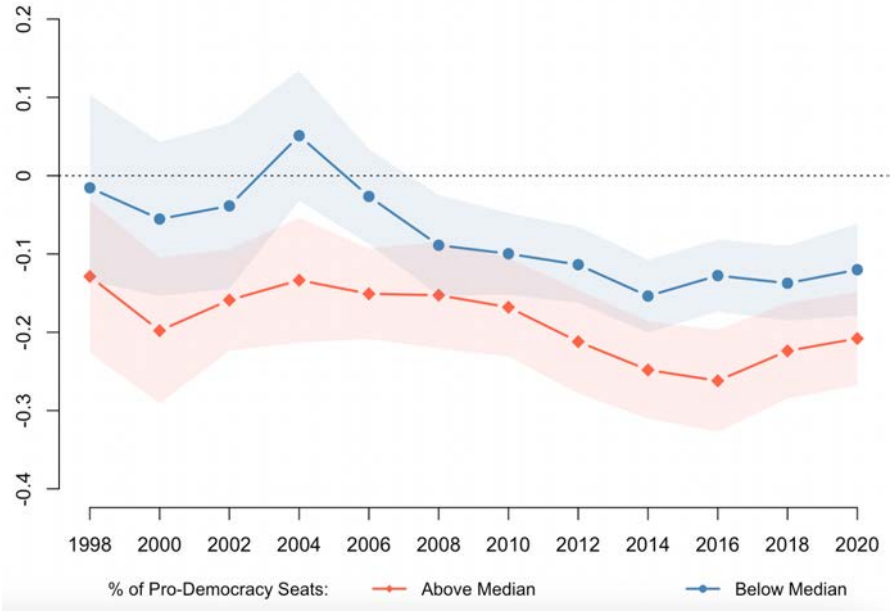
*Panel B: % of Mainland Migrants*



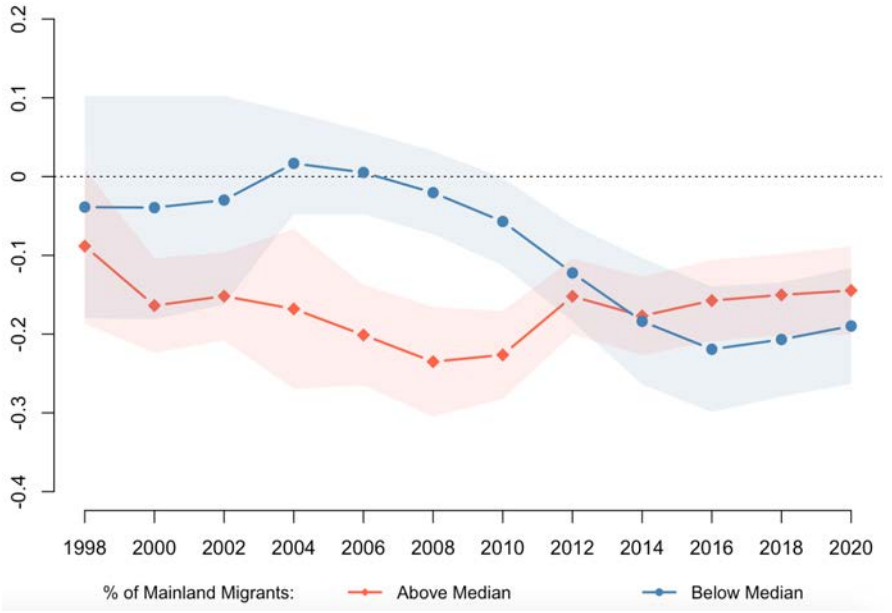

Panel A plots % of pro-democracy seats by voting year and districts. Panel B plots % of mainland migrants by census year and districts.

**Figure A.4.** Estimates over Time

*Panel A: Districts with High Versus Low % of Pro-Democracy Seats*




*Panel B: Districts with High Versus Low % of Mainland Migrants*




Panel A plots the estimated price discounts over time for the main treatment group with percentage of pro-democracy seats above (below) median in blue (red). Panel B plots the estimated price discounts over time for the main treatment group which have the percentage of mainland migrants above (below) median in blue (red). All regressions control for the full set of property characteristics with district by transaction month fixed effects as in Eq. (9).

Table A.2: Distributions by Lease Group and Year

| | Sale Year | | | | All |
|---|---|---|---|---|---|
| Lease Group | 1998-2005 | 2006-2010 | 2011-2015 | 2016-Feb 2020 | Years |
| Panel A: Number of Transactions | | | | | |
| 2030 to 2033 | 678 | 960 | 315 | 157 | 2,110 |
| 2034 to 2039 | 1,621 | 1,404 | 631 | 222 | 3,878 |
| 2040 to 2046 | 4,569 | 3,131 | 1,502 | 805 | 10,007 |
| 6/30/2047 | 120,869 | 134,766 | 72,002 | 36,286 | 363,923 |
| 7/1/2047 to 2049 | 1,746 | 7,573 | 4,094 | 2,489 | 15,902 |
| 2050 to 2052 | 1,120 | 9,886 | 9,457 | 5,577 | 26,040 |
| 2053 to 2064 | 3,550 | 4,975 | 6,997 | 7,963 | 23,485 |
| 2065 to 2097 | 4,177 | 5,465 | 2,825 | 1,354 | 13,821 |
| 2098 to 2135 | 15,368 | 12,251 | 5,800 | 3,019 | 36,438 |
| 2842 to 2959 | 12,656 | 10,458 | 4,443 | 1,649 | 29,206 |
| HKSAR Leases | 1,534 | 12,098 | 7,925 | 5,423 | 26,980 |
| Panel B: Number of Estates | | | | | |
| 2030 to 2033 | 4 | 4 | 5 | 6 | 6 |
| 2034 to 2039 | 4 | 4 | 4 | 2 | 4 |
| 2040 to 2046 | 3 | 3 | 2 | 2 | 3 |
| 6/30/2047 | 353 | 353 | 342 | 328 | 376 |
| 7/1/2047 to 2049 | 18 | 24 | 24 | 22 | 26 |
| 2050 to 2052 | 14 | 37 | 36 | 33 | 38 |
| 2053 to 2064 | 22 | 30 | 48 | 61 | 71 |
| 2065 to 2097 | 40 | 34 | 28 | 23 | 43 |
| 2098 to 2135 | 43 | 41 | 33 | 28 | 46 |
| 2842 to 2959 | 64 | 59 | 55 | 44 | 66 |
| HKSAR Leases | 18 | 40 | 54 | 79 | 84 |
| Panel C: Number of Districts | | | | | |
| 2030 to 2033 | 3 | 3 | 3 | 3 | 3 |
| 2034 to 2039 | 3 | 3 | 3 | 2 | 3 |
| 2040 to 2046 | 3 | 3 | 2 | 2 | 3 |
| 6/30/2047 | 17 | 17 | 17 | 16 | 17 |
| 7/1/2047 to 2049 | 8 | 12 | 12 | 12 | 12 |
| 2050 to 2052 | 9 | 16 | 16 | 16 | 16 |
| 2053 to 2064 | 6 | 13 | 16 | 15 | 16 |
| 2065 to 2097 | 5 | 6 | 6 | 5 | 6 |
| 2098 to 2135 | 5 | 5 | 5 | 5 | 5 |
| 2842 to 2959 | 6 | 6 | 6 | 6 | 6 |
| HKSAR Leases | 10 | 11 | 14 | 15 | 15 |

This table presents number of transactions (Panel A), number of estates (Panel B), and number of districts (Panel C) by these lease subgroups and sale year groups.

Table A.3: A More Exogenous Control Group

| Dep Var | Log(Unit Price) | |
|---|---|---|
| | (1) | (2) |
| I(2023 ≤ Lease ≤ 2033) | −0.035 | −0.025 |
| | (0.048) | (0.059) |
| I(2034 ≤ Lease ≤ 2039) | −0.018 | 0.026 |
| | (0.043) | (0.042) |
| I(2040 ≤ Lease ≤ 2046) | 0.005 | 0.024 |
| | (0.063) | (0.062) |
| I(Lease=6/30/2047 & After JD) | 0.028 | 0.029 |
| | (0.019) | (0.019) |
| I(Lease=6/30/2047 & Before JD and in HKL+KIL) | 0.023 | 0.032 |
| | (0.033) | (0.032) |
| I(7/1/2047 ≤ Lease ≤ 2049) | −0.128*** | −0.108*** |
| | (0.032) | (0.030) |
| I(2050 ≤ Lease ≤ 2052) | −0.114*** | −0.106*** |
| | (0.030) | (0.028) |
| I(2053 ≤ Lease ≤ 2064) | −0.114*** | −0.073** |
| | (0.036) | (0.032) |
| I(2065 ≤ Lease ≤ 2097) | −0.089** | −0.070* |
| | (0.040) | (0.039) |
| I(2098 ≤ Lease ≤ 2135) | −0.005 | 0.008 |
| | (0.043) | (0.041) |
| I(2842 ≤ Lease ≤ 2959) | −0.036 | −0.014 |
| | (0.040) | (0.040) |
| Property Attributes | Yes | |
| Property Attributes × Year | | Yes |
| District × Month FE | Yes | Yes |
| $N$ | 551,790 | 551,790 |
| Adjusted $R^2$ | 0.929 | 0.941 |

This table presents the hedonic regression results using the baseline sample. We separate the control group into three subgroups: the first set is denoted by indicator I(lease = 6/30/2047 & After JD); the second set is denoted by indicator I(lease = 6/30/2047 & Before JD and in (HKL, KIL)); the last set, granted before the JD and located in New Kowloon and New Territories, is used as the control group. Both regressions control for district by transaction year-month fixed effects. Additionally, column (1) controls for property attributes while column (2) controls for property attributes interacted with transaction year. Standard errors are two-way clustered by estate and year-month. Significance levels are denoted by ***= 1%, **= 5%, *= 10%.

Table A.4: Price Discount before and after 2005

| Dep Var | Log(Unit Price) | | |
|---|---|---|---|
| Sample | ±1 Year | ±2 Years | ±3 Years |
| | (1) | (2) | (3) |
| I(Main Treatment Group) | $-0.073^{***}$ | $-0.061^{**}$ | $-0.066^{***}$ |
| | (0.022) | (0.023) | (0.023) |
| × I(Year > 2005) | −0.010 | $-0.040^{**}$ | $-0.045^{**}$ |
| | (0.010) | (0.017) | (0.019) |
| Property Attributes | Yes | Yes | Yes |
| District × Month FE | Yes | Yes | Yes |
| $N$ | 56,741 | 128,690 | 174,553 |
| Adjusted $R^2$ | 0.837 | 0.849 | 0.863 |

This table reports the pricing effect of the main treatment group and whether there is a change before and after 2005. Each regression is based on transactions sold within a time window centered around December 31, 2005, as indicated by the column title (e.g., ±1 year). All regressions control for the full set of property characteristics and include district by transaction month fixed effects, as specified in Eq. (9). Standard errors are two-way clustered by estate and year-month. Significance levels are denoted by ***= 1%, **= 5%, *= 10%.

## Table A.5: Local Political Sentiments and Price Discount

Panel A: Summary Statistics

| Variable | N | Mean | SD | Min | 1st | 5th | Median | 95th | 99th | Max |
|---|---|---|---|---|---|---|---|---|---|---|
| % of Pro-Democracy Seats | 551,790 | 0.30 | 0.18 | 0.04 | 0.04 | 0.10 | 0.26 | 0.70 | 0.92 | 1.00 |
| % of Mainland Migrants | 551,790 | 0.39 | 0.06 | 0.24 | 0.25 | 0.31 | 0.37 | 0.50 | 0.55 | 0.58 |
| Median Age | 551,790 | 40.42 | 2.59 | 34 | 34 | 35 | 41 | 44 | 45 | 45 |
| Median Income | 551,790 | 12,422 | 2,111 | 9,000 | 9,200 | 10,000 | 12,500 | 16,300 | 16,500 | 16,800 |
| % of College or Above | 551,790 | 0.17 | 0.06 | 0.05 | 0.06 | 0.08 | 0.16 | 0.26 | 0.32 | 0.38 |
| % of Home Owners | 551,790 | 0.51 | 0.08 | 0.29 | 0.29 | 0.32 | 0.54 | 0.61 | 0.62 | 0.62 |

Panel B: Correlation

| | % of Pro-Democracy Seats | % of Mainland Migrants | Median Age | Median Income | % of College or Above | % of Home Owners |
|---|---|---|---|---|---|---|
| % of Pro-Democracy Seats | 1.00 | | | | | |
| % of Mainland Migrants | 0.34 | 1.00 | | | | |
| Median Age | 0.00 | −0.40 | 1.00 | | | |
| Median Income | 0.33 | 0.16 | 0.26 | 1.00 | | |
| % of College or Above | 0.01 | −0.45 | 0.84 | 0.09 | 1.00 | |
| % of Home Owners | −0.28 | −0.67 | 0.51 | −0.24 | 0.64 | 1.00 |

Panel C: Adding Interaction with HKSAR Leases

| Dep Var | Log(Unit Price) | | | | | |
|---|---|---|---|---|---|---|
| Sample | All Sales | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| I(Main Treatment Group) | −0.153*** | −0.155*** | −0.146*** | −0.148*** | −0.114*** | −0.114*** |
| | (0.022) | (0.021) | (0.021) | (0.021) | (0.024) | (0.028) |
| × % of Pro-Democracy Seats | | −0.056*** | | −0.054*** | | |
| | | (0.013) | | (0.013) | | |
| × % of Mainland Migrants | | | −0.063*** | −0.057*** | | |
| | | | (0.021) | (0.021) | | |
| × I(High % Pro-Democracy Seats) | | | | | −0.091*** | |
| | | | | | (0.026) | |
| × I(High % Mainland Migrants) | | | | | | −0.072** |
| | | | | | | (0.028) |
| × HKSAR Leases | 0.082*** | 0.076*** | 0.080*** | 0.075*** | 0.076*** | 0.103*** |
| | (0.026) | (0.024) | (0.026) | (0.024) | (0.026) | (0.035) |
| × % of Pro-Democracy Seats | | −0.000 | | 0.002 | | |
| | | (0.018) | | (0.019) | | |
| × % of Mainland Migrants | | | −0.008 | −0.008 | | |
| | | | (0.033) | (0.032) | | |
| × I(High % Pro-Democracy Seats) | | | | | 0.000 | |
| | | | | | (0.036) | |
| × I(High % Mainland Migrants) | | | | | | -0.039 |
| | | | | | | (0.042) |
| Property Attributes | Yes | Yes | Yes | Yes | Yes | Yes |
| District × Month FE | Yes | Yes | Yes | Yes | Yes | Yes |
| $N$ | 551,790 | 551,790 | 551,790 | 551,790 | 551,790 | 551,790 |
| Adjusted $R^2$ | 0.929 | 0.930 | 0.930 | 0.931 | 0.930 | 0.930 |

This table presents the district-level variation of price discounts for our main treatment group. Panel A reports the summary statistics of raw values. Panel B reports the correlations of standardized values. Panel C presents similar analysis as Table 8 with additional interaction terms of the HKSAR leases dummy with the four district-level variables. Standard errors are two-way clustered by estate and year-month. Significance levels are denoted by ***= 1%, **= 5%, *= 10%.

Table A.6: Mainlander Transactions and Price Discount

| Dep Var | Log(Unit Price) | | |
|---|---|---|---|
| Sample | All Sales | | |
| | (1) | (2) | (3) |
| I(Main Treatment Group) | −0.128*** | −0.125*** | −0.086*** |
| | (0.021) | (0.020) | (0.025) |
| × I(Mainland Buyer) × I(Local Seller) | 0.008 | 0.012* | 0.011 |
| | (0.006) | (0.007) | (0.009) |
| × I(Mainland Buyer) × I(Mainland Seller) | −0.005 | −0.003 | −0.036* |
| | (0.012) | (0.012) | (0.018) |
| × I(Local Buyer) × I(Mainland Seller) | −0.017** | −0.018** | −0.048*** |
| | (0.007) | (0.008) | (0.017) |
| × % of Mainland Migrants | | −0.069*** | |
| | | (0.020) | |
| × I(Mainland Buyer) × I(Local Seller) | | 0.007 | |
| | | (0.007) | |
| × I(Mainland Buyer) × I(Mainland Seller) | | 0.052*** | |
| | | (0.015) | |
| × I(Local Buyer) × I(Mainland Seller) | | 0.047*** | |
| | | (0.012) | |
| × I(High % of Mainland Migrants) | | | −0.086*** |
| | | | (0.025) |
| × I(Mainland Buyer) × I(Local Seller) | | | 0.007 |
| | | | (0.011) |
| × I(Mainland Buyer) × I(Mainland Seller) | | | 0.064*** |
| | | | (0.021) |
| × I(Local Buyer) × I(Mainland Seller) | | | 0.060*** |
| | | | (0.021) |
| I(Mainland Buyer) × I(Local Seller) | | 0.011*** | 0.010*** |
| | | (0.003) | (0.003) |
| I(Mainland Buyer) × I(Mainland Seller) | | −0.019** | −0.021*** |
| | | (0.008) | (0.008) |
| I(Local Buyer) × I(Mainland Seller) | | 0.000 | −0.001 |
| | | (0.003) | (0.003) |
| Property Attributes | Yes | Yes | Yes |
| District × Month FE | Yes | Yes | Yes |
| $N$ | 551,790 | 551,790 | 551,790 |
| Adjusted $R^2$ | 0.931 | 0.930 | 0.929 |

This table presents the pricing effect of buyer-seller type classified by their identity as mainland or local. Columns (2) and (3) display the effect of the interaction between buyer-seller type and district-level population identity, measured by the percentage of mainland migrants or the dummy variable I(high % of mainland migrants), which equals 1 when the percentage of mainland migrants is larger than the cross-section median. All regressions control for property characteristics and district by year-month fixed effects, as in the baseline regression. They also include additional controls such as the interaction term of the main treatment indicator with median age, median income, % of college above, and % of homeowners. Standard errors are two-way clustered by estate and year-month. Significance levels are denoted by ***= 1%, **= 5%, *= 10%.

# A. The Matching Procedure

We perform the matching process in the following steps:

- We identify each unique estate in the main treatment group and matched it to all estates in the control group that are located in the same district and within 1.5 kilometer. Each pair of matched estates is assigned an estate pair identification number.
- We examine all transactions in the matched estates and only include pairs of transactions that meet the following restrictions: 1) a difference in the building completion year of less than 2 years; 2) a difference in building age at the time of transaction within 25% of that of the treated unit; 3) a difference in net living area of less than 30% of that of the treated unit; 4) a difference in floor number within 20% of that of the treated unit; 5) a difference in the estimated PSM score of less than 0.1.[44]
- We further select the control group transactions with the nearest PSM score to each transaction in the main treatment group to achieve a matching ratio. This final step allows us to create matched pairs with similar observable characteristics in both groups, yielding a more accurate estimate of the causal effect of the expected regime change on property prices.

# B. Valuing British Leases with Nominal Ground Rent

In Subsection 3.1 the net cash flow $R_s = e^{gs}$ at any time $s$ is considered under the setting of current baseline ground rent, which is 3% of rateable, i.e., annual rent reevaluated every year. To take the nominal rent into account, we show that Eq. (10) needs to be modified as:

$$P(L;\tau,Brit) = \mathbb{E}\left[\int_0^{L\wedge\mathcal{T}} (C_1 e^{-\kappa s} - C_2)ds + e^{-\kappa(L\wedge\mathcal{T})}\cdot(1-\delta^{pre}\mathbf{1}_{s<\tau}-\delta^{post}\mathbf{1}_{s\geq\tau})\cdot P(L\wedge\mathcal{T}+50;HK)\right].$$

More specifically, we adjust the net cash flow before $L\wedge\mathcal{T}$ using $C_1$ and $C_2$, where $C_1 = \frac{1-\omega+0.03}{1-\omega}$, and $C_2 = \frac{0.03\times e^{gT_B}}{1-\omega}$, where $\omega$ is the percentage of repairing costs and taxes in the gross rent, and $T_B$ is the auctioned date for a lease that has never been extended or the most recent extension date for a lease that has been extended before. Essentially, these leases pay a ground rent as 3% of annual rent evaluated at $T_B$, instead of 3% of the rateable.

[44]The PSM score represents the predicted probability of being treated, which was estimated using a logistic regression of a dummy variable that equals 1 for transactions in the main treatment group and 0 for those in the control group. In our regression, we included all housing characteristics, time, and location fixed effects as explanatory variables.

# C. GMM Estimation

In the estimation, we have $N = 12$ moments for each treatment leasehold group $n \in \{1, 2, ..., N\}$. For leasehold group $n$, its corresponding sample moment is

$$\frac{1}{\sum_{i=1}^{I} D_{i\in n}} \sum_{i=1}^{I} \left\{ \beta_{L_i,t_i}(\Theta) - \left( \hat{\beta}_n + \hat{\varepsilon}_{i,t} \right) \right\} D_{i\in n} = 0. \tag{12}$$

Denote the set of model parameters by $\Theta \equiv \{\gamma, \lambda^{pre}, \lambda^{post}, \delta^{pre}, \delta^{post}\}$. (In Section 5.5 we also include $\kappa$ as the set of estimated parameters.) The term $\beta_{L_i,t_i}(\Theta)$ is the model-implied discount for the transaction $i$ at the transaction date $t_i$ given the lease expiration date $L_i$. Specifically, $\beta_{L_i,t_i}(\Theta) = \ln P_{t_i}(L_i; \Theta) - \ln P_{t_i}(L = \tau; \Theta)$. Next, $\hat{\beta}_n$ is the estimated discount for leasehold group $n$ in the baseline regression (9), while $\hat{\varepsilon}_{i,t}$ is the estimated residual. Finally, $D_{i\in n} = 1$ if transaction $i$ belongs to the leasehold group $n$, and equals zero otherwise. We estimate the GMM by the two-step method developed by Hansen (1982).

When conducting the GMM estimation, we take the following initial parameter values for Column 1-6 in Table 6: $\{\lambda_0^{pre} = 0.005, \lambda_0^{post} = 0.02, \delta_0^{pre} = 0.07, \delta_0^{post} = 0.2, \gamma_0 = 0.2, \delta_{HK,0}^{pre} = 0.02\}$. For Column 7 that includes $\kappa$, the initial parameter values are those estimated values from Column 1 plus the pre-set value of $\kappa = 1.44\%$.

Table : Leases Granted by British Hong Kong Versus HKSAR

| | Log(Unit Price) | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| I(2030 ≤ Lease ≤ 2033) | −0.039 | 0.053 | −0.031 | −0.036 | 0.074** |
| | (0.040) | (0.039) | (0.041) | (0.049) | (0.037) |
| I(2034 ≤ Lease ≤ 2039) | −0.049 | −0.073** | −0.033 | 0.004 | −0.057* |
| | (0.038) | (0.031) | (0.038) | (0.038) | (0.030) |
| I(2040 ≤ Lease ≤ 2046) | −0.054 | −0.090** | −0.022 | −0.008 | −0.053 |
| | (0.055) | (0.043) | (0.057) | (0.057) | (0.047) |
| I(7/1/2047 ≤ Lease ≤ 2049) | −0.219*** | −0.171*** | −0.217*** | −0.190*** | −0.162*** |
| | (0.035) | (0.030) | (0.036) | (0.033) | (0.029) |
| I(2050 ≤ Lease ≤ 2052) | −0.156*** | −0.132*** | −0.144*** | −0.136*** | −0.119*** |
| | (0.035) | (0.031) | (0.034) | (0.030) | (0.029) |
| I(2053 ≤ Lease ≤ 2064) | −0.132*** | −0.098*** | −0.124*** | −0.091*** | −0.090*** |
| | (0.033) | (0.029) | (0.032) | (0.028) | (0.028) |
| I(2065 ≤ Lease ≤ 2097) | −0.113*** | −0.091*** | −0.096*** | −0.085** | −0.079*** |
| | (0.035) | (0.031) | (0.035) | (0.034) | (0.029) |
| I(2098 ≤ Lease ≤ 2135) | −0.031 | −0.002 | −0.015 | −0.010 | 0.018 |
| | (0.038) | (0.028) | (0.038) | (0.037) | (0.028) |
| I(2842 ≤ Lease ≤ 2959) | −0.066* | −0.080*** | −0.044 | −0.030 | −0.057** |
| | (0.035) | (0.027) | (0.035) | (0.035) | (0.027) |
| I(7/1/2047 ≤ Lease ≤ 2049) × I(HKSAR Lease) | 0.186*** | 0.129*** | 0.191*** | 0.160*** | 0.126*** |
| | (0.045) | (0.043) | (0.046) | (0.041) | (0.040) |
| I(2050 ≤ Lease ≤ 2052) × I(HKSAR Lease) | 0.064 | 0.089** | 0.054 | 0.042 | 0.079** |
| | (0.048) | (0.039) | (0.048) | (0.042) | (0.038) |
| I(2053 ≤ Lease ≤ 2064) × I(HKSAR Lease) | −0.045 | −0.035 | −0.017 | −0.010 | −0.019 |
| | (0.040) | (0.034) | (0.038) | (0.035) | (0.030) |
| Property Attributes | Yes | Yes | Yes | | Yes |
| Property Attributes x Year | | | | Yes | |
| District + Month FE | Yes | | | | |
| Subdistrict + Month FE | | Yes | | | |
| District × Month FE | | | Yes | Yes | |
| Subdistrict × Month FE | | | | | Yes |
| $N$ | 551,790 | 551,790 | 551,790 | 551,790 | 551,790 |
| Adjusted $R^2$ | 0.920 | 0.931 | 0.930 | 0.941 | 0.943 |