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ABSTRACT

We empirically analyze the pricing of political uncertainty in long-term property rights, guided by a theoretical model of housing assets subject to contract extension in the remote future. To identify exposure to political uncertainty, we exploit a unique variation around land lease extension protection beyond 2047 in Hong Kong's housing market due to the historical arrangements under the "One Country, Two Systems" design. A reduced-form approach reveals that relative to properties that have been promised an extension protection, those with legally unprotected leases granted by the current Hong Kong government are sold at a substantial discount of around 8%. Similar contracts issued during the colonial era suffer an additional discount of about 8% due to their reneging risk. Our parsimonious model matches well these empirical discounts across long-term lease horizons, and the estimated structural parameters imply that to extend their leases homeowners expect about an additional 20% ground rent after 2047. The discount is higher when people's confidence declines and where residents feel more uncertain of the city's future, but lower when the transaction involves a mainland buyer and a local seller.

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1. Introduction

It has been widely recognized that political uncertainty plays a significant role in asset valuations as well as economic activity (for example, Pástor and Veronesi, 2013; Baker et al., 2016; Hassan et al., 2019). While most of the existing evidence on the connection between political uncertainty and asset pricing is from financial markets in developed economies typically associated with established and stable political environments, one would expect this universal economic force to prevail the most in emerging market economies, especially those struggling with protracted indeterminacy in their political systems complicated by colonial history.

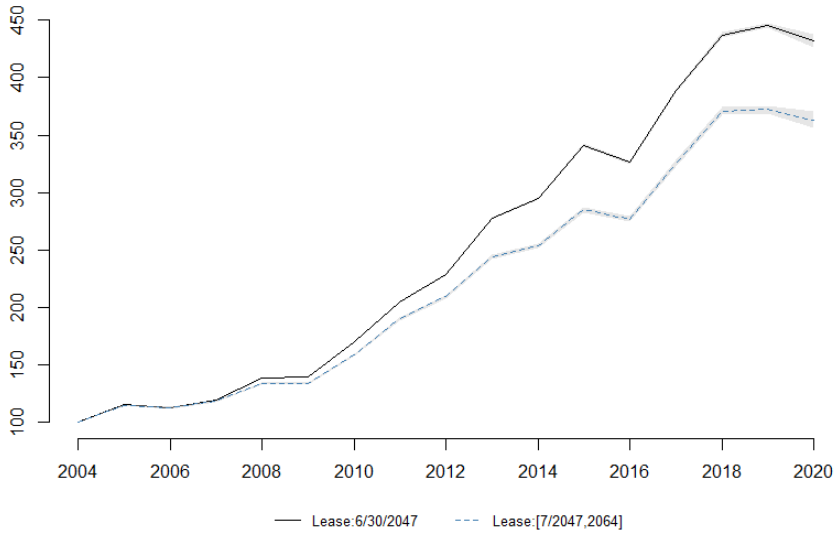
We fill this gap by studying Hong Kong's property market and identifying a causal link between its ongoing political uncertainty and long-term property rights, reflected by housing prices. Although Hong Kong's economy has straddled the boundary between being developed and emerging, our setting offers several advantages to study this topic.[1] First, Hong Kong, 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," especially since the social unrest there that began in 2019. Second, all land in Hong Kong is contracted through leaseholds, in which land tenure is granted to lessees by the government for a fixed term; these are subject to extension at the end of their terms possibly by a different government, hence exposing property rights to substantial political risk. Third, the political outlook of Hong Kong, for historical reasons, features an impending uncertainty that will resolve on a predetermined future date (July 1st, 2047) when the current authority in power—Hong Kong Special Administrative Region (HKSAR)—ceases to exist. Fourth, as the predominant long-term asset and liability on the balance sheet of households, housing valuation should be affected by the political uncertainty, whether imminent or in the future. This last point is particularly relevant for Hong Kong, a city known for its notoriously expensive housing market, hence any noticeable difference in the housing market can be sizable and meaningful for quantifying the real and financial effect of political uncertainty.

We identify the impact of political uncertainty on long-term property rights via studying housing prices; and throughout this paper, political uncertainty concerns the expected change of certain economic policies employed by the future Hong Kong government. That is to say, we study the directional economic policy change in Hong Kong (due to political reasons), which is the first moment as opposed to the second moment.[2]

[1] Morgan Stanley Capital International (MSCI) classifies Hong Kong as a developed market because of its world-renowned financial market (https://www.msci.com/market-classification), while the United Nations still lists Hong Kong as an emerging economy in 2019 (https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/WESP2019_BOOK-web.pdf).

[2] Arguably, the directional policy change plays a more dominant role in shaping the economic and business environment in Hong Kong today. Previous papers that study the impact of directional change of specific policies include but are not limited to Handley and Limão (2017) who show the effect of reduced trade policy

Figure I. Hone Kong Home Price Indices across Two Groups of Leases



This figure plots the home price indices estimated using the repeat sales methods (Bailey et al., 1963; Case and Shiller, 1989) based on residential housing transactions for two groups of land leases in Hong Kong from 2004 to 2020. The first group of land lease (solid line) expires on 6/30/2047, while the second (dashed line) expires between 7/1/2047 and 12/31/2064. The 95% confidence intervals of price indices are indicated by the gray shaded area.

The main empirical challenge in exploring the relationship between political uncertainty and valuation of long-term properties is the difficulty in isolating exogenous variation in the political uncertainty. Political uncertainty is often highly correlated with fundamental economic conditions, which then affect supply and demand in the asset market. We overcome the challenge by exploiting the heterogeneity among land lease extension protections that are linked to the expiry of the HKSAR in 2047. This methodology takes its most stark form when comparing land leases expiring on June 30$^{\text{th}}$, 2047, right before the expiry of the HKSAR, that have been promised a 50-year extension protection, to those expiring immediately after that date, hence left legally unprotected. The different treatment is rooted in the historical arrangements of the "One Country, Two Systems" design, which are all set to expire on July 1$^{\text{st}}$, 2047, giving rise to the greatest political uncertainty regarding any lease extension after that point.

Although our later analysis focuses on the degree of difference between the above-mentioned two housing assets (i.e., those with land leases expiring on June 30$^{\text{th}}$, 2047 versus those with leases expiring after that date), we show as important motivating evidence that home price

uncertainty on China's export growth to the Unites States when China obtained permanent most favored nation status after it became a member of the World Trade Organization (WTO), and Bianconi et al. (2020) who study how such reduced trade policy uncertainty affects stock returns.

trajectories of these two groups appear to diverge over time, potentially driven by the worsening political outlook in Hong Kong over the past two decades. Figure I plots the home price indices we estimate using the repeat sales methods based on housing transactions with the two different land leases. It shows that the two real estate assets trended similarly from 2004 to 2010, but have since become increasingly divergent. From 2004 to 2019, houses with land leases expiring after June 30$^{\text{th}}$, 2047 have appreciated by 264% (17.6% annualized rate), but 82 percentage points (5.5 percentage points based on annualized rate) less than those with leases expiring on that date.

Our empirical analysis, which mainly adopts a reduced-form approach, is guided by a structural asset pricing framework where we incorporate different land lease extension policies facing the political uncertainty after 2047 into housing valuation. In the model, there is a "natural" housing market 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 open market rents for similar properties in the area.[3] The percentage used to calculate the ground rent, which we call ground rent rate, is subject to change upon the next lease extension in the future, rather than kept constant at 3% per today's practice. This uncertainty in the future ground rent schedule is linked to the political fate of Hong Kong, which is determined by the complicated political struggle between all parties in Hong Kong, the HKSAR, and Beijing.

Our model captures the key idea that the greatest political uncertainty in Hong Kong's housing market occurs at a predetermined future date—July 1$^{\text{st}}$, 2047—when the Basic Law and the HKSAR are set to expire. Suppose that the 50-year extension decision made by the HKSAR before 2047 say at year n—but in effect beyond 2047 (up to $n+50$)—will be respected by the new government in Hong Kong, as affirmed by the HKSAR itself. Then, the lease extension protection predicts that house prices should increase as their lease expiration years approach 2047, followed by a discrete downward jump right after 2047. Therefore under this assumption, our model implies a "periodic" housing price pattern with a discrete downward jump at the HKSAR expiry date, and further posits a price discount schedule that smoothly decays with the expiration years of the lease after 2047. In other words, properties with lease contracts expiring in the distant future either sell at a small discount, if at all, relative to the control group.

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

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

whose leases are set to expire on June 30th, 2047, and expect to receive an extension to 2097, properties with leases expiring immediately after that date are sold at a 14.1% discount. The estimated price discount relative to the control group decays as the expiration year moves further away from 2047, and the prices of those set to expire after 2097 are similar to the control group. The results are robust when we use a more exogenous control subgroup whose lease terms were historically determined following the Second Convention of Peking in 1898 as well as using matched samples. Our placebo test using the rental transaction data confirms that the estimates are not driven by any unobservables that would affect the consumption values of properties.

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 property rights of colonial British leases are subject to another layer of political uncertainty.[4] 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. We hence extend our baseline model by incorporating a reneging risk in the colonial British leases, allowing differential reneging intensity before and after the HKSAR ceases to exist in 2047. Also, we assume that homeowners of colonial British leases may face an extra land premium charge, in additional to ground rent, to extend when those leases are reneged or expire.

The above mentioned reduced-form discount estimates inform us the deep structural parameters of the full-blown model, which is estimated using the standard GMM method. The resulting estimation implies that after the HKSAR ceases to exist in 2047, homeowners expect to pay an additional 20% of the net rental value in addition to current ground rent charges on the noncolonial leases at extension; homeowners expect no reneging risk on colonial British leases before 2047 but expect those leases to be reneged every 59 years after 2047, while colonial British leases face extra land premium charges at about 7% and 21% of house value before and after 2047 at extension, respectively when they are reneged or expire. The estimated additional ground rent goes down to 11% when we address the concern over endogenously determined investment in the properties. Overall, 11–20% additional ground rent is still relatively lower than the required extension cost in the U.K. and Singapore as well as the property tax rate in the U.S.

It is worth emphasizing that the predicted pattern of a "periodic" discount relies on the differential treatment by the new regime (in power after 2047) with respect to land leases that will have already been promised by HKSAR versus those that will not have been promised;

[4] "Colonial British leases" refer to leases that were auctioned by the British government before the Sino-British Joint Declaration (JD) signed in 1984 and were never regranted thereafter. More detailed definitions are are explained in Section 2.3.1 and footnote 9.

the "periodic" pattern revealed by the data should disappear if the market believes that it is impossible for the new Hong Kong government post 2047 to honor the remaining part of the 50-year protection promised by the HKSAR. Indeed, when we modify our model to incorporate reneging risk in noncolonial leases before 2047, the estimation results reveal that homeowners expect no such risk for noncolonial leases. In addition, this modified model has very similar objective value with our baseline model, indicating no extra explanatory power given to additional model freedom.

We establish the link between the relative valuation discount embedded in land leases and the political uncertainty faced by Hong Kong, by showing the discount comoves over time with citywide confidence in Hong Kong's future. To further provide plausible economic mechanisms, we construct two local political sentiment measures that are time-varying district-level characteristics unique to Hong Kong. The first measure is the percentage of pro-democracy seats from district council elections, which captures the local residents' discontent due to the fear of losing a "high degree of autonomy." The second is the percentage of migrants from mainland China recorded on Hong Kong's censuses each five-year period, capturing Hong Kongers' rising antagonistic sentiments against cultural influences from the mainland.

As expected, both measures help explain the observed lease discount present in the Hong Kong housing market. In addition to the significant price discount associated with citywide political uncertainty in the leases expiring after 2047, a one standard deviation (SD) increase in pro-democracy seats as well as of mainland migrants at the district level is associated with an additional discount of 4.9 percentage points (or 39% increase in the base effect) and 7.7 percentage points (or 61% increase in the base effect) for the treatment lease group. The two measures, which reflect both causes and consequences in a complicated political economy equilibrium in Hong Kong, trace a significant role of sentiments in political uncertainty on the estimated price discount in the remote future.

Our last piece of evidence comes from comparing mainland and local buyers and sellers, identified through buyer and seller names in the transaction data. We find that mainland buyers tend to be more optimistic than local buyers, and mainland sellers tend to be more pessimistic than local sellers concerning political uncertainty in the far future. The individual beliefs of different buyers and sellers only diverge in more recent years as political uncertainty regarding Hong Kong's future has intensified.

Literature Review. In related work, Giglio et al. (2015) estimate the price discount of leaseholds with maturities ranging from 99 to 999 years relative to perpetual ownership contracts in freeholds using U.K. and Singapore housing transactions. Both their and our papers belong to a large literature on exploring the effect of long-run factors on asset valuation; this literature also includes another paper of theirs (Giglio et al., 2021), which studies the ap-

propriate long-run discount rate for investments in climate change abatement using housing assets.

However, in contrast to the focus on the "very long-run discount rate" in Giglio et al. (2015), our paper aims to identify exposure to political uncertainty based on different land leases regarding extension protection. While our setting in Hong Kong's housing market also contains land leases that have been largely influenced by the same British system, there are also leases granted by the HKSAR that are exposed to a different degree of political uncertainty. Moreover, our treatment of land leases differs from the control group primarily in their having extension protection beyond 2047, not the original terms as in Giglio et al. (2015). Finally, we quantify the effect of political uncertainty and link it to time-varying and location-specific political sentiments.

The literature on property rights is an active field that can date back to Coase (1960). There is ample evidence that property rights institutions have a first-order effect on long-term economic growth, investment, financial development, management of natural resources, and household welfare (Besley, 1995; Besley and Burgess, 2000; Acemoglu and Johnson, 2005; Field, 2007; Goldstein and Udry, 2008; Galiani and Schargrodsky, 2010; Abdulai et al., 2011). We emphasize the role of political uncertainty where the long-term property rights granted by the previous government might be subject to the discretion of next government.

In a number of papers, Pástor and Veronesi analyze the effect of political uncertainty on financial assets and find that political uncertainty is priced in stock prices (Pástor and Veronesi, 2012), risk premium (Pástor and Veronesi, 2013), and equity options prices (Kelly et al., 2016). Hassan et al. (2019) construct a new measure of political risk at the firm level and document that political decision-making can incur social costs by creating idiosyncratic political risk for individual firms and reducing corporate investment, and Hansen (2014) develops analytical methods to investigate the implications of the pricing of long-term uncertainty.

Instead, we highlight how political uncertainty affects a major asset class on households' balance sheets in the context of Hong Kong.[5] Since most of the above-mentioned papers focus on financial markets in countries with developed economies and established and stable political environments, our paper is perhaps more relevant for studying "political uncertainty," in that Hong Kong is an economy that has been struggling with protracted indeterminacy in its political system, but at the same time possesses a well-functioning property market so that researchers can measure the economic effect of political uncertainty. Finally, we clarify that in our framework, it is the first moment of the policy change (i.e., the expected increase of ground rent by the future Hong Kong government), as opposed to the second moment, that

[5]In the context of the land market in mainland China, Chen and Kung (2019) study the political rents by estimating the price differentials between the princeling firms (connected to Politburo members) and other firms without such connections for land parcels of similar quality. Their paper is tightly linked to the study of political economy and corruption (Fisman, 2001), while ours are not.

plays the key role.

The remainder of the paper is structured as follows. We explain the institutional details of housing markets in Hong Kong in Section 2. In Section 3, we lay out the theoretical framework using a pricing model of housing assets with different land leases to incorporate the effect of political uncertainty on asset pricing. We describe the data sources and empirical design in Section 4, and conduct our main baseline analysis. We present the full model which accommodates reneging risk and estimate this model via the generalized method of moments (GMM). In Section 6, we study the empirical relation between political uncertainty and price discounts by exploiting variations in citywide, district-level, and individual transaction–level measures of sentiments in political uncertainty. Section 7 concludes.

2. Hong Kong's Housing Markets: History and the Present

In this section we discuss the relevant institutional details of housing markets in Hong Kong, highlighting the historical changes of leaseholds over the past several decades.

2.1. A Brief History of Hong Kong

Hong Kong has been loosely incorporated into the Chinese empire since the Qin Dynasty (221–206 BC), starting out as a farming and fishing village and salt production site. The British Empire took possession of Hong Kong Island in 1841 during the First Opium War with Qing China, making the island a British crown colony. Britain also won the Second Opium War, forcing the Qing China to cede Hong Kong Island and years later Kowloon "in perpetuity" as ratified in the 1860 Treaty of Nanking. In the wake of China's defeat in the First Sino-Japanese War (1894–1895), the British forced the Second Convention of Peking (1898) on the weakened Qing Dynasty, stipulating that China must lease the New Territories (now split into New Kowloon and New Territories) to Britain for 99 years until June 30$^{\text{th}}$, 1997; this stipulation became the legal basis of the handover of Hong Kong in its entirety, including Hong Kong Island, Kowloon and New Territories, to China in 1997.

In the early 1980s, the negotiations began between the two governments, leading to the JD signed on December 19$^{\text{th}}$, *1984*, and ratified 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 (PRC) based on the "One Country, Two Systems" principle proposed by late Chinese leader Deng Xiaoping. 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 experienced 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 to trigger a series of massive protests, most notably the 2014 Umbrella Revolution or Occupy Central movement, and the ongoing social unrest, which caught wide attention as well as academic interest (Cantoni et al., 2019). After the 2004 Legislative Council (LegCo) election, political parties and politicians from different political ideologies formed two broad 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 identified as the opposition camp, with one of its main goals being to achieve universal suffrage of the HKSAR's chief executive and the LegCo as laid out in the Basic Law (Articles 45 and 68).

2.2. The Economy and Housing Market in Hong Kong

As China's economy has surged to second in the world by GDP, Hong Kong's economy has become increasingly more dependent on the mainland over the years, causing a significant shift in people's economic lives in Hong Kong. The sky-high property prices in the past two decades have diminished the prospect that young adults might be able to afford their own homes in their lifetime. Though there is only scarce evidence, it is widely believed that the housing market boom is fueled by mainland property investors.[6] The gap between the rich and the poor has widened significantly to record levels, and all these factors have contributed to the population's general discontent with Hong Kong's governance (Taylor, 2019; The Economist, 2019; Xie, 2019).

We choose to study the effect of political uncertainty through the lens of the housing market in Hong Kong for two reasons. First, compared to other markets, the housing market consists of very long-term assets and liabilities, with the typical mortgage term being 30-years. Thus, the price of a property, as a present value of expected net cash flows in the future, including those beyond the current land lease term, can be exposed to risk due to a change in political uncertainty.

Second, housing is the dominant source of household wealth, even more so in Hong Kong given its rapid home price appreciation over the past two decades. Although the housing market in Hong Kong has received little attention from academic researchers (with the notable exception of Bhattacharya et al. (2020) and Fan et al. (2021)), Demographia (2019) rates the

[6]For example www.cnbc.com/2018/09/07/china-investors-set-to-investment-more-in-overseas-property-investment.html. However, Fan et al. (2021), based on the same data set as in this paper, show that on average mainland investors have only paid about 1.4% more than other investors in the past two decades, and the price spillover effect is small.

housing in Hong Kong the most unaffordable among all 309 worldwide cities based on the ratio of median home price to median household income, known as the price to income ratio. Hong Kong's price to income ratio stands at 20.8, far exceeding the "severely unaffordable" threshold of only 5.1. Thus if households respond to the changes in political uncertainty in asset markets, housing would be the most important decision choice by magnitude.

2.3. Land Tenure System and Land Policy in Hong Kong

Although almost all lands in Hong Kong was owned by the British government during the colony era and is now owned by the PRC, the chief executive has the authority to lease and grant state land to the public for ownership over a limited period of time; this is legally defined as *leasehold* as opposed to *fee simple* prevalent in the United States. The chief executive can do so by: (1) granting government leases for a certain period, or (2) granting licences for individuals or corporations to occupy government land for special purposes for a certain period (usually shorter than a government lease). The chief executive is allowed to invoke the Land Resumption Ordinance to order the requisition of any land for public purposes—i.e., reneging on the original land contract.

The provisions in (1) also include the chief executive's power to extend the nonrenewable leases at its expiration date.[7] The HKSAR Lands Department sets the policy to be premised on the basic guiding principles of policy continuity in the arrangements, simplicity in procedures, and certainty in the tenure of leases. In other words, the government seeks to provide clarity, consistency, and certainty in the land lease terms. However, "certainty" here is apparently limited by the inherent political uncertainty faced by the "One Country, Two Systems" principle and the HKSAR. This is exactly the focus of our paper.

2.3.1. Leaseholds Granted Prior to 1984

Table I summarizes different types of land leases.[8] The earliest land leases in Hong Kong date back to 1843 with a term of 999 years, labeled as 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 additional land premium and adjusted ground rent. Throughout the text, we use renew/renewal, extend/extension, and regrant interchangeably. From 1899 to 1985, the British government had widely implemented "75 + 75" year leases, with a single

[7] Some land leases in Hong Kong have a renewal option in the original contract (i.e., renewable leases) while others have no such renewal option (i.e., nonrenewable leases). Once a land owner has exercised a renewal option, the lease also becomes a nonrenewable lease. See Table I for details.

[8] 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.

right of renewal ("+") for another 75 years period after the initial 75-year term. Exceptions include a few leases granted for "99 + 99" years. All these leases are located in Hong Kong Island and Old Kowloon, which are classified as Type 3 in Table I. They are renewable leases in their first 75 or 99 years, but considered nonrenewable once the owners exercised their renewal options. There are also nonrenewable leases in New Kowloon and the New Territories that expired on June 27th, 1997 as stipulated in the Second Convention of Peking (Section 2.1).

2.3.2. Leaseholds Granted or Regranted After 1984

The 1984 JD states that new leases could be granted during the transition period (between JD and June 30th, 1997) for terms expiring no later than June 30th, 2047. Because of this, almost all leases (Type 5 in Table I) granted from when the JD took effect (May 27th, 1985) through June 30th, 1997, are set to expire on June 30th, 2047, so their terms range from 50 to 62 years. Any nonrenewable leases expiring during the transition period would be automatically extended to June 30th, 2047. All Type 4 leases and some Type 2 leases belong to this category.

However, the 1984 JD did not explicitly address the right to extend historical leases after the handover in 1997. The HKSAR, upon its establishment, announced on July 15th, 1997, that nonrenewable leases may, upon expiry and at the sole discretion of the HKSAR, be extended for another term of 50 years without an additional premium. Thus, for example, leases expiring on June 30th, 2047, would be automatically extended to 2097.

The HKSAR also granted new land leases after the handover. These land leases, corresponding to Type 6 in Table I, will expire 50 years after the initial land auction date.

2.3.3. Variation in Government Land Policies

The government has three tools at its disposal when considering land lease extensions. The first is whether to extend nonrenewable leases upon their expiry. For a 75-year nonrenewable lease auctioned in 1850 and a 75+75 lease auctioned in 1900, the government has the full discretion to decide whether and how to extend them at their expiration date, 1925 and 2050 (after a renewal option had been exercised in 1975), respectively.

The second is recalculating the ground rent applied to the new term at extension. It was determined to be a 3% (percentage charge) multiplied by the rateable value, which is an estimate of the annual rent achievable for the property assessed by the government annually based on open market rents for similar properties in the locality. This is applied to Type 4–6 leases and some Type 2 leases in Table I. The 3% charge was enacted in 1973 under the Government Leases Ordinance (Cap. 40) and was adopted in the JD (Annex III) as well as the Basic Law (Article 121). However, colonial British leases (Type 1 and 3, and some of

Type 2 leases) only need to pay 3% of the rateable evaluated at the beginning of the leases (named nominal ground rent), fixed throughout the entire lease period.[9] Such fixed ground or nominal rent was the common practice before the JD.

The third is to determine land premium required at extension of nonrenewable leases. In 1946, the colonial British government announced that unless land was needed for public purposes, it would offer extension by charging the full and fair land lease value (Webb, 2010). During the recent transition period as well as after the handover, per JD and the HKSAR announcement on July 15th, 1997, respectively, the payment of an additional land premium has not been required for lease extension. However, this policy of zero additional premium may be subject to change, a scenario that we incorporate in our modeling later.

2.4. The Legitimacy of Leasehold Extensions Beyond 2047

Thus far, HKSAR practices have been to i) extend the nonrenewable leases requiring an annual ground rent of 3% of rateable value that is adjusted in step with its market value but without an additional land premium for all HKSAR leases; and ii) set the ground rent for the colonial British leases at 3% of rateable value that is fixed throughout the term as specified in the original contracts. These practices aim to provide as much clarity as possible about the land tenure system and land policy and to minimize any possible disruption to the housing market. Despite the practice, several uncertainties of the extension policy remain: (1) whether the government will extend land leases in the future; (2) if so, whether the government will require an additional land premium and/or increase the ground rent to above the current 3% level.

The policy uncertainty regarding the land lease extension policy in Hong Kong, which lies at the center of long-term property rights, has always existed, resulting in market confusion and valuation fluctuations in Hong Kong's housing market throughout its history. More specifically, since the arrangements under the "One Country, Two Systems" design are set to expire in 2047, this makes all the land leases that have been extended by the HKSAR beyond its official expiration date (i.e., July 1st, 2047) a focal point.

To address this concern, on July 15th, 1997, HKSAR affirmed its constitutional authority to grant land leases beyond July 1st, 2047, based on the following grounds:[10] (1) under Article

[9] "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 auctioned in 1843 had its first extension in 1918 and second extension in 1993. After its extension in 1993, which was after the JD, it is no longer a "colonial British lease." On the other hand, a 75-year lease auctioned in 1984, which will expire in 2059, is considered a colonial British lease. Also, for a 75+75 lease auctioned in 1915, it would have exercised its renewal option in 1990 (regranted as renewable lease), and it will expire in 2065. Thus, this lease is a "colonial British lease".

[10] For details, see https://www.landsd.gov.hk/en/resources/land-info-stat/land-tenure-system-land-policy.html.

7, HKSAR is entrusted to manage and grant land leases without being limited to a duration of 50 years; (2) 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; (3) under Article 123, 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; and finally, (4) there is no provision in the Basic Law that restricts the otherwise unlimited power of HKSAR to grant land leases beyond 2047. This gives the legitimacy of lease extension beyond July 1st, 2047, made by the HKSAR. We will come back to this issue in Section 3.3 after presenting our theoretical framework in the next section.

3. A Pricing Model of Housing Assets with Political Uncertainty

The model in this section lays out the theoretical framework that connects political uncertainty with asset pricing towards several goals of this empirically oriented paper. First, we use a stylized example in Section 3.2 to illustrate the role of political uncertainty in determining the equilibrium price of a long-term asset (i.e., a real estate property) with different extension dates over its life horizon. Section 3.3 then clarifies the underlying driving forces of the relative discount in our model. Second, the theoretical framework allows us to incorporate the "reneging risk" assessed on colonial British leases relative to HKSAR ones, a robust empirical pattern documented in Section 5.1.

Last, and perhaps most importantly, in a typical asset pricing model, today's price of a long-term asset depends on the stream of expected cash flows in the future. By establishing a link between the observed housing transaction prices and the (expected) future ground rent as well as reneging risk, which are the primary policy tools of the Hong Kong government (and hence reflect the political uncertainty), the model allows us to back out the implied structural parameters using the price discounts estimated from transaction data. This is exactly what we do in Section 5.

3.1. Model Setup

Consider an infinite-horizon model of a housing asset that generates a "natural" gross rent (or gross rental income) $\hat{R}_t$, for $t \in [0, \infty)$; for the ease of illustration our model is cast under the risk-neutral measure. We normalize the time-0 housing natural rent $\hat{R}_0$ to $\frac{1}{1-\omega}$, where ω is the percentage of repairing costs and taxes in the gross rent; ω includes the ground rent mentioned in Section 2.3, which is 3% of the rateable or $\hat{R}_t$. Assuming a constant discount

rate r and that the rent grows at a constant rate g, we see that

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

Before the lease expires, a homeowner's net cash flow from the property can be expressed as

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

However, the current house value not only depends on the ground rent today, but also the expected ground rent in the future when the lease is up for extension after the current term expires. Denote the nearest land lease expiration date by L; when it expires at time $L > t$, the government may extend the lease for another T years by charging an additional ground rent (beyond 3% of the rateable).

In general, we define the additional ground rent as $f_s^{(\tau)}$,[11] imposed by the government on land leases upon extension 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 $\tau > t$ and is linked to the political fate of Hong Kong, which is determined by the complicated political struggle between all parties in Hong Kong, the HKSAR, and Beijing. This predetermined future time τ is the date on which the policy uncertainty resolves to a large extent, in the case of Hong Kong, July 1st, 2047; we will provide a more detailed explanation in Section 3.2. Also note that the entire profile of $f_s^{(\tau)}$ can be fairly flexible, and under the risk-neutral measure it suffices to consider a deterministic schedule.

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

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

where $N(s) \equiv \lfloor \frac{s-L}{T} \rfloor$ and $\lfloor \frac{s-L}{T} \rfloor$ 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, and hence $R_s = e^{gs}$. The underlying assumption 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).

[11] Here, $f_s^{(\tau)}$ captures both the additional ground rent or premium to be paid by the lessee (the 'owner') to the government in return for the right to occupy the land for another term. The government may charge additional ground rent by increasing the current 3% to a higher percentage. Land premium is an up-front payment due at the time of extension while ground rent is payable annually from the date of extension as a percentage of the rateable.

We will discuss this important assumption in Section 3.3.

Based on the above assumptions, we can calculate the house price P_t at time t to be

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

3.2. An Illustrating Example

As an illustration, we set $t = 0$ in this subsection. For the purpose of parsimony, given the additional ground rent at extension $\gamma \in [0, 1]$, we consider a simple schedule of additional ground rent to be:

$$f^{(\tau)}_s = \gamma \mathbf{1}_{\{s \geq \tau\}}. \tag{5}$$

The predetermined time τ is right after the deadline of the current HKSAR land policy under which the government will extend the lease for another T years without charging any additional ground rent; recall the discussion in Section 2.3.2. In the context of our paper, the HKSAR will extend land leases for another 50 years ($T = 50$) without additional ground rent if they expire before June 30$^{\text{th}}$, 2047, but will require additional ground rent for those set to expire after July 1$^{\text{st}}$, 2047. This current practice in Hong Kong corresponds to $\tau =$ July 1$^{\text{st}}$, 2047.

The simplified schedule in Eq. (5) captures the key idea that the greatest political uncertainty in Hong Kong's housing market occurs at a predetermined future date τ (i.e., July 1$^{\text{st}}$, 2047) when the Basic Law and HKSAR expire, after which the expected additional ground rent γ will be imposed. In one stark interpretation, $1-\gamma$ can be viewed as the probability that the post-2047 Hong Kong government will maintain the current practice by extending the land lease every 50 years at 3% of the rateable; γ is the probability of the post-2047 Hong Kong government taking back the land completely (or charging a ground rent/premium sufficient to eliminate the ownership value completely) when leases are due for extension after July 1$^{\text{st}}$, 2047. In other words, γ can be considered as expected additional ground rent charged at the lease expiration date, in addition to 3% of the rateable.

Now consider a house with land lease expiring at L with its value denoted by $P(L; \tau)$. Denote $\kappa \equiv r - g$, and we have

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

If $L < \tau$ and $L + T \geq \tau$, the homeowner can extend the land lease to $L + T$ before the uncertainty resolution date τ, 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

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

For illustration, Figure II plots the model-implied house value $P(L;\tau)$ as a function of the lease expiration date L. As explained, τ corresponds to July 1$^{\text{st}}$, 2047, indicated by a red dashed line (vertical). In Figure II, we also plot the cutoff years in blue dotted lines (vertical) at several boundaries of leasehold groups defined in Section 4.

We see that $P(L;\tau)$ first increases with the lease expiration date L, dips at $L = \tau$, and then slowly grows back at $L = \tau + T$ with almost the same height as the previous cycle but slightly greater due to the standard discount effect. This periodic pattern in valuation can be best illustrated by investigating the lease group with $L = \tau - \epsilon$ (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 τ and hence enjoy the standard ground rent 3% for another $T = 50$ years, which exactly matches the ground rent schedule faced by the latter lease group.

3.3. Discussion: What Drives the Value Discount due to Political Uncertainty?

It is worth pausing to highlight the key assumptions of our model. Although the HKSAR government is expected to expire in 2047 and this expiration is the underlying source of political uncertainty regarding the land lease extension policy after 2047, we assume that the extension decisions made by HKSAR before 2047 at year n—but in effect beyond 2047 (up to $n + 50$)—will be respected by the new government in Hong Kong. This is why in the model land leases that expire right before 2047 face no discount in the next 50 years but those expiring right after do, driving the discrete drop at $L = \tau$ in Figure II.

Exactly on this point, Section 2.4 explains the legitimacy of the HKSAR extending land leases that are set to expire before 2047 to beyond 2047. For instance, the last point in the formal affirmation issued by the HKSAR on July 15$^{\text{th}}$, 1997, states, "there is no provision in the Basic Law that restrict the otherwise unlimited power of the HKSAR to grant land leases beyond 2047." This policy announcement appeared to have implicit approval from Beijing, and the legitimacy of the HKSAR to extend land leases offers an important protection of the long-term property rights for a particular group of land leases beyond the HKSAR's own term. Indeed, this precedence of policy continuity is reflected in the previous negotiations between the United Kingdom, China, and Hong Kong.

To be fair, we do not know whether these leases granted by HKSAR will be fully honored

or not under the scenario of the collapse of "One Country, Two Systems" experiment. What we want to stress, before we move on to the next section, is that the possibility of this dire political scenario does not invalidate our analysis. 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 differential treatment, which would exist even under the most extreme scenario, reflects the guiding principle of "policy continuity" that has been present throughout Hong Kong's history, as well as in Beijing's practices in China's economic reform including its land policy.[12]

Second, we have yet to discuss the leases granted by the colonial British government before 1997. Our empirical results later suggest that there exists a differential treatment between colonial leases and leases granted or regranted after the JD in relation to political uncertainty, with the former sold at a greater price discount. We extend our model to incorporate the reneging risk in Section 5.

Finally, and perhaps most importantly, the underlying assumption that these noncolonial HKSAR leases will be honored is strongly supported by our empirical finding of a significant price discount associated with properties whose leases expire right after July 1^{st}, 2047, suggesting investors expect Beijing to honor the long-term property right arrangements promised by the HKSAR. In fact, Section 5 extends the baseline model to allow for potential reneging risk in both colonial and noncolonial leases, and finds a negligible estimate on the latter.

4. Empirical Design and Main Results

In this section, we first introduce main data sources along with our sample design and descriptive statistics. We then examine the distribution across different land lease groups, which forms our main empirical design guided by the theory developed in Section 3. Lastly, we present the baseline analysis to show that estimated price discounts exhibit the empirical pattern predicted by our model with political uncertainty, together with a battery of robustness tests.

[12]Historical precedents in Hong Kong came from the Land Leases annex (Annex III) in the JD, which was signed amid periods of political uncertainty and market turbulence. The annex guarantees that all leased lands granted by the British Hong Kong government which expire beyond June 30^{th}, 1997, and all rights in relation to such leases, shall continue to be recognized and protected under the law of HKSAR. The practice in mainland China concerns the extension of 20- or 30-year land leases in Qingdao, Shenzhen, and Wenzhou, which resulted in a policy set by the Ministry of Land that homeowners would not have to pay a extension fee to continue to use their residences after the shorter lease expires (Hsu, 2017). For background information on China's land policy and its housing market, and their connections with local government financing problems in China, see Fang et al. (2016) and Chen et al. (2020), among others.

4.1. Data Sources

This paper uses three major sources of data, two of which are acquired from the same data vendor while the third is publicly available.

4.1.1. Residential Transactions and Amenities

In Hong Kong, all property transactions have to be registered with the Land Registry. We obtain all residential property transactions in Hong Kong from EPRC Ltd., a data vendor that has purchased all electronic transaction data from the Land Registry and added other attributes such as net floor area and district codes. Our EPRC data set starts in January 1992 and is updated through February 2020. It contains a comprehensive set of information on housing characteristics and transaction details in Hong Kong: for instance, address, building construction year and month, district name or code, floor and unit numbers, property characteristics (e.g., swimming pool, club house), transaction information (sale date and transaction prices), whether the transaction is a first- or second-hand market transaction, and names of buyers and sellers.[13]

We highlight the land lease expiration year (e.g., 2047) in the transaction data, which is used in our study to identify different lease groups. As explained in Sections 2 and 3, the land lease groups play an important role in linking property value and policy uncertainty in Hong Kong. We also geocoded all the buildings in our sample and calculated their distance to nearby amenities using their latitudes and longitudes. The amenities include the Mass Transit Railway (MTR), bus stops, hospitals, schools (K–12), universities, and the coastline. Proximity to any of these nearby amenities is an important determinant of the fundamental value of the estate.

4.1.2. 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 1st, 2047, we obtain the land auction data from the Land Registry website, which includes all land transactions between the Hong Kong government and land developers and for each land transaction, a unique land lot number, which can be matched to the housing transaction data, along with land transaction price and auction date. The land auction date, however, may significantly differ from the building completion date in housing transactions data due to developers holding onto the land as a real option.

[13] Bhattacharya et al. (2020) 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.

4.1.3. 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 quarters (apartments), households, and persons with district of residence disclosed. We capture several important district-level characteristics. In addition, to measure the political sentiment at the district level, we collect the percent of pro-democracy seats from Hong Kong district council elections in 1999, 2003, 2007, 2011, 2015 and 2019.

4.2. Sample Design and Summary Statistics

We apply several filters to construct the final sample of transactions. First, according to the housing statistics published by the Transport and Housing Bureau of HKSAR, 54% of the population in Hong Kong lives in private housing units as of 2019, while the rest of the population lives in public housing, including public rental housing and government-subsidized sale flats. We focus on private housing in Hong Kong only, a sector whose transaction prices are fully driven by market forces.[14] We hence exclude all the government housing projects based on a list of home ownership scheme courts in Hong Kong.

We also require observations to have no missing values for land lease expiration year, transaction price and date, and floor number. This excludes transactions before 1998 due to missing data on several unit characteristics in early years. We also exclude houses, townhomes, and non–arm's length transactions (e.g., deeds of gift, assignments, changes of name and subagreements), and transactions in Island district (the smallest district). 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 sold from January 1998 to February 2020.

Table II Panel A reports the summary statistics of all the variables used in our analysis. First, the average sale price of the units is HKD 2,801,066 (logged value of 2.80 = 1.03) in total and HKD 5,541 (logged value = 8.62) per square feet. Using an exchange rate of 0.13 HKD to USD, they are valued at USD 363,552 in total and USD 719 per square feet. The total price varies widely, ranging from HKD 663,650 to HKD 16.78 million. Hong Kong is known for its small living quarters with net living area ranging from 258 to 1,157 sq feet, with an average of 528. The average age of buildings at the time of sale is 16 years. The building completion year is well populated from 1959 to 2018 with more than half of the transactions involving those built after 1992. Number of bedrooms and living rooms are both 2 on average. In our sample, most of units have a bay window, which reduces the net living area. We also

[14]The market share for private housing transactions could far exceed 54%, considering that public housing faces transaction restrictions such as requiring low-income buyers. In our raw data, about 10% of transactions are government-subsidized sales, which are excluded from our sample.

calculate market turnover at the individual land lease by year level as the ratio of the number of transactions in a given year to the number of unique properties that have ever transacted in our data. The average turnover rate is 7.9% in our sample period.

4.3. Identifying Lease Groups

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

4.3.1. Control Lease Group

We first identify all leases set to expire on June 30$^{\text{th}}$, 2047, as our control lease group, which, according to the current HKSAR policy, will be automatically extended to 2097 and hence are subject to the least degree of political uncertainty in our model as laid out in Section 3. Recall that only the year of land lease expiration is provided in our EPRC data, and thus we take the following steps to identify our control group.

As explained in Section 2.3, there are four types of land leases that are set to expire in 2047 based on Hong Kong's historical land lease policies. First, according to the JD, which became effective on May 27$^{\text{th}}$, 1985, all existing nonrenewable leases that were going to expire before June 30$^{\text{th}}$, 1997, were automatically extended to June 30$^{\text{th}}$, 2047. These leases primarily cover land in New Kowloon and New Territories (Type 4 in Table I) and a small portion of such leases cover land in Hong Kong Island and Old Kowloon (Type 2 in Table I). We will come back to these leases later in Section 4.6. Second, any land leases auctioned between May 27$^{\text{th}}$, 1985, and June 30$^{\text{th}}$, 1997 are set to expire on June 30$^{\text{th}}$, 2047 (Type 5). These two groups of land leases form our control group.

In contrast, the other two types of leases are not part of our control group. Any land that happened to be auctioned in the year of 1897 with a "75 + 75" year lease (part of Type 2 in Table I) will also expire in 2047, but only in the second half of the year according to the historical auction data.[15] Finally, any land auctioned by the newly established HKSAR between July 1$^{\text{st}}$–December 31$^{\text{st}}$, 1997, will expire between July 1$^{\text{st}}$–December 31$^{\text{st}}$, 2047, which constitutes part of Type 6 in Table I.[16]

[15] We collected all such land auction information from the *Hong Kong Government Gazette* (https://lib.hku.hk/hkgro/index.jsp) and verified that the land leases of matched properties in our data were all auctioned in the second half of 1897 and thus are set to expire during the second half of 2047.

[16] We identify such land by collecting land auction data from the Land Registry website, which has recorded all Hong Kong government land auctions since April 1985. The land auction data include the unique land lot number with land transaction price and date. There were twelve land lots auctioned between July 1$^{\text{st}}$–December 31$^{\text{st}}$, 1997, eight of which could be found in the EPRC data by matching the land lot number. Thus, properties with those eight land lots will expire between July 1$^{\text{st}}$ and December 31$^{\text{th}}$, 2047. The other four unmatched land lots could have been developed as nonresidential properties or could be held by developers as real options. In Hong Kong, given the volatile housing market, it is common for developers to wait for a few

4.3.2. Treatment Lease Groups

Our treatment leases include three broad categories. The first category contains all the leases set to expire before 2047 ("pre-2047" leases), which will also be automatically extended until up to 2096 and thus are also subject to a similar degree of political uncertainty as the control group. To test the sharp predictions delivered by our model as shown in Figure II, we further decompose the pre-2047 leases into three subgroups: viz. 2029–2033, 2034–2039, and 2040–2046 (Type 2 in Table I).

On the other hand, leases set to expire after July 1st, 2047, but before 2097 have relatively high exposure to the ongoing and expected political uncertainty since neither the Basic Law, nor policies set forth by HKSAR have clarified the future of these leases beyond 2047. These post-2047 leases are further decomposed into four subgroups: viz. July 1st 2047–2049, 2050–2052, 2053–2064, and 2065–2097. According to our theory, the first post-2047 lease subgroup should the most exposed to political uncertainty; the exposure diminishes as the lease expiration year moves further away. In later analysis we also combine the earliest three subgroups (July 1st 2047–2049, 2050–2052, 2053–2064) together and call them the main treatment group.

The third group consists of leases that are set to expire after 2097, so we call this group "distant" leases. There are two subgroups of distant leases (2098–2135 and 2842–2959); here, the last lease group contains the 999-year leaseholds that were granted before the 1960s. Panels A and B of Figure III plot the number of transactions by individual lease expiration year and by lease group (except the control lease group), respectively. It shows that while there are not enough transactions for an individual expiration year, the lease groups are constructed such that they all have sufficient observations to be used in the empirical analysis.

4.3.3. Summary by Lease Group

In Table III, we report the number of transactions (Panel A), number of estates (Panel B), and number of districts (Panel C) by these lease groups and sale year groups (e.g., 1998–2005, 2006–2010, 2011–2015, 2016–February 2020). The table shows that all leasehold groups are well represented across sale year cohorts using number of transactions, estates, or districts. The largest lease group contains the leases set to expire on June 30th, 2047, which account for 66% of the sample.

4.4. Empirical Design and Predictions

As mentioned, in our empirical specification throughout, we set the lease group June 30st, 2047, as the main control group, which includes all transactions with land leases expiring on

years or even decades before developing the land into building properties.

June 30st, 2047.

In the baseline specification, we estimate the relative price discounts of all other leasehold groups, whose leases are subject to different exposures due to ongoing political uncertainty relative to the main 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 total or unit sale price of house i at time t; $X_{i,t}$ is a full set of housing characteristics, including the number of bedrooms (in categories: 1, 2, 3), the number of living rooms (in categories: 0, 1, 2, 3), bay window indicator, bay size (in 10 equally sized categories), the floor area (in 10 equally sized categories), age of the building (in 10 equally sized categories), direction facing dummies, swimming pool indicator, club house indicator, and neighborhood (estate) amenities; $\alpha_{d \times m(t)}$ represents the district $\times$ year-month fixed effects. Neighborhood amenities include a set of calculated distances to MTR, bus stops, hospitals, schools, universities, and coast line; each of them is defined in 10 equally sized categories. Standard errors are two-way clustered at the estate and year-month level.

Our model in Section 3 predicts that the control group has the lowest exposure to ongoing political uncertainty, owing to the promised 50-year extension policy from HKSAR. As a result, we expect all estimated $\hat{\beta}_n$ in Eq. (9) to be negative (i.e., properties in the treatment lease groups are sold at a discount relative to those in the control group due to their expected political uncertainty). In contrast, properties in the post-2047 lease groups whose leases are set to expire after the HKSAR ceases to exist have the highest exposure to political uncertainty and should bear the largest discount, corresponding to the sudden drop at $L = \tau$ in Figure II.

The 50-year extension policy also applies to other pre-2047 lease groups and thus effectively mitigates their exposure to political uncertainty. However, our theory predicts that the value of 50-year extension protection is greater for the leases with expiration years closer to 2047 and thus $\hat{\beta}_n$ on these lease groups is anticipated to be negative, but to a lesser extent. Lastly, our theory posits a price discount schedule that decays with their expiration years, implying that transactions in the distant groups either sell at a small discount, if at all, relative to the control group.

4.5. Baseline Analysis

Hong Kong is comprised of three parts (Hong Kong Island, Kowloon, and the New Territories) and divided into eighteen districts with each represented by a district council. We control for district by year-month fixed effects in Eq. (9). Panels A and B of Figure IV plot the district-level distribution of transactions in the control lease group, which expires on June 30^{th}, 2047,

and the main treatment group, which expires between July 1^{st}, 2047, and December 31^{st}, 2064, respectively. In Panel C, we present the number of leases for the control group and main treatment group across all districts. The pattern shows that while all districts except the Islands are well populated with both lease groups, the control group is more concentrated in Sha Tin while the treatment group has more observations in southern part of the New Territories and most districts in Kowloon.

Panel B of Table II presents summary statistics based on the control lease group and main treatment lease group, respectively. On average, the unit (total) price of the units in the control group is 51% (44%) lower than those in the main treatment lease group. All structural characteristics and amenities except the number of bedrooms are significantly different for the two lease groups, likely driven by their locations. Hence, in Figure A.1, we plot the residuals of the property attributes of the two lease groups, obtained from the regression of each hedonic characteristic on the district by year fixed effects. We find little differences in net living area, number of bedrooms, bay window, land-level turnover, and almost all the neighborhood amenities between the groups after controlling for the location and time, but buildings in the control group are still older and located further away from MRT stations on average. We control all of these characteristics in our later regressions.

Table IV presents the results from different regressions, with dependent variables of logarithm of unit price in Columns (1)–(4) and logarithm of total price in Columns (5)–(8). Our baseline specification is reported in Columns (1) and (5) where we control for property attributes and district by year-month fixed effects. In Columns (2) and (6), we control for property attributes by year and district by year fixed effects to allow for time-varying (annually) coefficients on individual property attributes in addition to the district-level home price trends. In Columns (3) and (7), we estimate the baseline specification but based on a restrictive sample that excludes properties missing data on number of bedrooms and living rooms.

Results in Columns (1) and (5) suggest that relative to the control group whose leases are to expire at June 30^{th}, 2047, properties with leases expiring immediately after July 1^{st}, 2047, are sold at a 14.1% discount using unit price or 14.9% in terms of total price, both significant at the 1% level. The other three post-2047 lease groups—those set to expire in 2050–2052, 2053–2064, and 2065–2097—sell at statistically significant discounts as well of 12.7%, 12.7%, and 10.5% using unit price, and of 12.7%, 13.0%, and 10.7% using total price, respectively. Estimates from alternative specifications reported in other columns are quite similar to our baseline results but with slightly smaller magnitude. For instance, in Columns (2) and (6), for our main treatment group with leases expiring July 1^{st}, 2047–2049, properties are sold at a discount of about 12.4% (12.8%) using unit (total) price. Consistent with our model prediction, discounts decay for land leases that expire in the remote future.

In Columns (4) and (8) of Table IV, we include market turnover rate as an additional control to the baseline specification. Market turnover rate, which captures "market liquidity" of the properties under different leases, might be an endogenous outcome driven by political uncertainty and hence we report these results separately. However, estimates are also very similar when we control for market turnover rate, suggesting on that turnover is not a significant factor explaining the price discount.

Properties in the lease groups set to expire before 2047 are sold similarly to those in the control group with estimates of price differentials not statistically different from 0. However, in terms of magnitude, their discounts relative to the control group shrink smoothly when lease expiration year approaches 2047 for pre-2047 or is further from 2047 for the post-2047 lease groups. The broad empirical pattern matches that in Figure II, confirming that properties with "pre-2047" leases face a small and similar degree of political uncertainty as laid out in the model.

Finally, the coefficients on the "distant" lease groups are negative—but always insignificant—in each of the specifications. For example, the coefficient on 999-year leases (the 2842–2959 group) is 5.2% (5.4%) for unit (total) price. These large point estimates of price discount relative to the control group, though insignificant, warrant some discussion as they are likely driven by two features of these leases. First, they are all legacy leases granted by the colonial British government, subject to a reneging risk that we introduce in Section 5. Second, the 2842–2959 group contains 999-year leases which, unlike other leases, do not specify any land use (e.g., residential, commercial, industrial, institutional, transport, recreational) in the original contracts, making them 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.[17]

Based on the baseline estimates in Column (4), we can calculate the aggregate effect on all properties with leases expiring after July 1st, 2047, but before 2097. Without the estimated price discount, properties in these lease groups would have been sold at 13.6% discount (= 12.0% / (1 − 12.0%) based on the weighted average discount 12.0%). Based on their average sale price of HKD 4.78 million and total sales of HKD 119 billion in 2019, lost property sales revenue for Hong Kong homeowners is estimated to be HKD 652,000 per property and HKD 16.2 billion in total, equivalent to 0.6% of Hong Kong's GDP in 2019. The estimated cost of political uncertainty, however, does not necessarily imply net welfare loss because the scope of this paper is limited and other parties may benefit from the lower property price.

[17]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.

4.6. A More Exogenous Control Group Based on a Historical Treaty

Is it possible that our control lease group, with land leases expiring on June 30^th, 2047, are endogenously affected by political uncertainty regarding the future of "One Country, Two Systems" in Hong Kong? We leverage a rich institutional feature of Hong Kong's land market to address this concern regarding identification.

Although our main control lease group contains leases expiring on June 30^{th}, 2047, they can be further divided into three finer subgroups: control a), whose leases were granted after the JD; control b), whose leases were granted before the JD and which are located on Hong Kong Island and in Old Kowloon; and finally, control c) whose leases were granted before the JD and are located in New Kowloon and the New Territories districts. Note, control a) corresponds to Type 5 land leases in Table I, control b) could be traced to Type 2 land leases, and control c) constitutes Type 4 leases. Each group was formed due to different historical reasons. The origin of control c) dates back to the Second Convention of Peking in 1898, which leased the New Territories (New Kowloon used to be part of New Territories) to Britain until June 30^{th}, 1997, and thus all land leases in those districts were set to expire on June 27^{th}, 1997, which was extended to June 30^{th}, 2047, according to the JD in 1985. From the perspective of causal inference, land leases of control c) are the most exogenous control group, as they were granted almost one-and-a-half centuries ago and thus are not endogenously affected by any contemporary factors.

In contrast, control a) can be potentially endogenous to market conditions in the post-JD period, which might affect transaction prices in this subgroup differently from those in the treatment groups. For example, it is quite possible that land granted in the post-JD period was more likely to go to developers who had closer relationships with or have more confidence in mainland China compared to other periods.

Table V reports the results based on the baseline specification but using control c) as the control lease group. We include indicators for controls a) and b) as additional explanatory variables. First, we find that coefficients on all the treatment lease groups change little from the baseline results. Second, coefficients on control groups a) and b) are close to zero and statistically insignificant. This suggests that property prices in these two control groups are similar to those in the control group c), implying a negligible (potential) endogeneity concern in control groups as well as the baseline results in Table IV.

4.7. Robustness Tests

One potential concern with the baseline analysis is that transaction heterogeneity between the control and treatment groups might affect our findings. We first restrict our sample to only transactions that are repeat sales, excluding properties that have only been transacted once

from 1998 to 2020. In Table VI, we run the baseline hedonic regression in Columns (1) and (5) based on the overall sample that contains transactions in the control and main treatment lease groups. Relative to the control group, properties with leases expiring in July 1st, 2047–2064 sell at statistically significant discount of 13.3% using unit price and 13.6% using total price, corresponding to the average effect on the three disaggregated lease groups in Table IV. We further run the same hedonic regression in Columns (2) and (6) based on a restricted sample where we can identify repeat sales of the same property and obtain slightly smaller discount estimates (10.7% and 12.4% for unit and total prices, respectively).

Our second test uses a propensity score matching (PSM) methodology based on location, time, and housing characteristics that we use in Eq. (9).[18] The results reported in Columns (3) and (7) suggest a similar discount of 11.9% for unit and total price. Finally, Columns (4) and (8) estimate our main specification employing a generalization of the propensity score matching (i.e., entropy balance weighting), which involves a reweighting scheme that is more flexible than nearest-neighbor matching (Hainmueller, 2012). They suggest that properties with leases in the main treatment group are sold at a discount of 15.6% (15.4%) using unit (total) price, even greater than the baseline estimates.

4.8. A Placebo Test Based on Rental Value

We also study the effect of political uncertainty regarding land leases on rents, as a placebo outcome, in the treatment lease groups based on a sample of rental transactions from November 2018 to February 2020 obtained from one large brokerage platform in Hong Kong.[19] Unlike home buyers/sellers, renters who care more about housing amenities should be indifferent to the uncertainty in the land leases expiring in the remote future. To the extent that rents capture the consumption value of the property, this helps alleviate concerns over unobserved structural heterogeneity among different lease groups. Table VII presents the analysis of rents with Columns (1) and (2) reporting regressions of unit and total rents, respectively, and Columns (3) and (4) reporting regressions of unit and total housing prices based on the housing transactions matched with the rental sample. Columns (1) and (2) show that coefficients on the main treatment group are not statistically significant and magnitudes are virtually zero, suggesting that the consumption values of properties in the main treatment and control groups are very similar. In contrast, the estimated price discounts in Columns (3) and (4) are, if anything, stronger than the baseline result in Table IV (18% vs. 14%). This is because

[18]The PSM yields a sample of 46,874 transactions using the "nearest-neighbor" option, evenly split between the control and treatment groups. The detailed procedure is available in Table VI notes.

[19]The sample of rental transactions is obtained from the website of Centaline Property, one of the largest real estate agencies (https://hk.centanet.com/findproperty/list/transaction). The contracts range from November 2018 to February 2020 which matches the coverage of our property transaction data.

our rental sample is in later years (2018–2020) and we will show shortly that the discount due to political uncertainty increases over time in Section 6.1.

5. Reneging Risk: 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. This strong empirical pattern present in our data suggests a potential "reneging" risk embedded in the leases originally granted by the colonial government. We then extend our baseline model to capture this feature, which is estimated to inform us about the magnitude of our underlying model parameters in light of estimated land lease discounts.

5.1. The Price Differential between British Hong Kong and 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 the existing laws, the government can invoke the Land Resumption Ordinance to order the requisition of any land for public purposes.[20] We argue that leases granted under the British Hong Kong would be subject to greater reneging risk than those granted by the HKSAR since the future government will be still under China's rule even in the worst-case scenario.

To empirically investigate this reneging risk, we identify land leases that were granted by the HKSAR, whose expiration years range from 2047 to 2064 in our data.[21] In Table VIII, we further interact our treatment group, 2047–2064, with an indicator as to whether the lease was granted under the HKSAR (after July 1st, 1997), which captures the relative price differential between British Hong Kong and HKSAR leases within the lease group 2047–2064. We find that, within the same expiration years, properties with land leases granted by the HKSAR government are traded at a premium at 7–8 percentage points (about half of the base effect)

[20]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 government reclaimed the land.

[21]We collect all land publicly auctioned by HKSAR and match it with property transactions using the land lot number in our data; we also collect all the buildings initiated by the Urban Renewal Authority of Hong Kong, which issues a new HKSAR lease for the land they redevelop. The most remote HKSAR lease expiration year in our data is 2064 because i) we only include second-hand transactions, and ii) there is some delay in developing land into properties.

in various specifications relative to colonial British leases. This is consistent with how market participants might perceive the Hong Kong government reneging on land leases issued by the colonial British government to be at least possible.

5.2. Full Model and Estimation

We first extend our model with the possibility of reneging on colonial British leases, and adjust the formula to take into account the difference between rateable and nominal ground rents (see discussion in 2.3.3). We then explain how we estimate our model parameters and discuss the results and implications. This way, we use the reduced-form discount estimates from Section 4.5 and Section 5.1 can inform us the magnitudes of structural parameters of the model.

5.2.1. Model Extensions

Reneging Risk Motivated by the evidence in Table VIII, we extend our baseline model by incorporating a reneging risk applied to colonial British leases.[22] The land lease will be extended to another 50-year HKSAR lease at its expiration date, or reneged before that; we call the latter a *reneging event*, which we will explain shortly. In both scenarios, the homeowner will be charged with a one-time additional land premium as a fraction of the house market value denoted by $\delta^{pre} \geq 0$ (if expiring or reneging at $t < \tau$) or $\delta^{post} \geq 0$ (if expiring or reneging at $t \geq \tau$), where $\tau = 7/1/2047$. Then the homeowner receives a new 50-year lease contract facing the extra ground rent schedule given in Eq. (2).

We model this reneging shock as a Poisson event that is *i.i.d.* across all leases in the second category, with different reneging intensity before and after τ, denoted by $\lambda^{pre} > 0$ and $\lambda^{post} > 0$. Recall that Annex III in the JD (see footnote 12) guarantees all land leases granted by the British Hong Kong government shall be protected by the HKSAR; but the HKSAR only exists through June 30$^{\text{th}}$, 2047, not even considering the anecdotal reports mentioned above (see footnote 20). Our assumption ensures parsimony while capturing the potentially different reneging intensity before and after July 1$^{\text{st}}$, 2047, and essentially lets the real housing transaction data reveal us the perceived renegotiation risk for British colonial leases.

Thus, 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 expiring on $L\wedge\mathcal{T}\equiv\min(L,\mathcal{T})$ and paying

[22] See the definition in footnote 9.

$f^{\tau}_{L\wedge\mathcal{T}}$ to extend another 50 year-term standing at its extension date $L\wedge\mathcal{T}$, as given in Section 3.1.

Finally, note that the reneging intensity λ and the one-time land premium charge δ at the time of extension are separately identified because λ will affect all contracts that are expiring in the future, while δ will differentially hit more on leases expiring in the near term.

Ground Rent: Rateable vs Nominal For ease of exposition, in Section 3.1 we assumed the annual ground rent to be 3% of rateable, the market-based annual rent reevaluated every year. However, there is an exception in practice: the 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 Section 2.3.3). In our data, all treatment groups except those auctioned by the HKSAR government after July 1$^{\text{st}}$, 1997, belong to the colonial British category. We hence modify Eq. (10) in the Appendix A.1 to accommodate the nominal ground rent setting.

5.2.2. Estimation Method and Results

We have estimated the price discount of discrete treatment lease groups using a reduced-form method. However, these estimates are in terms of housing value and we need to convert them to the policy parameters used by the Hong Kong government. We hence 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 additional ground rent γ as well as the magnitude of reneging risk implied by the regressions.

As the only pre-determined parameter, $\kappa = r - g = 2\% \times (1 - 28\%) = 1.44\%$ is set based on recent housing statistics in Hong Kong. Here, 2% is the average gross rent yield (annual gross rent/housing value) and 28% is the benchmark expense ratio,[23] as κ essentially captures the houseowners' net rent yield (annual net rent/housing value). Section 5.4 considers different values of κ for robustness.

Denote the set of remaining parameters by $\Theta \equiv \{\gamma, \lambda^{pre}, \lambda^{post}, \delta^{pre}, \delta^{post}\}$. $\beta_n(\Theta)$ 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,

[23] 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 of 28% includes 3% ground rent, 5% rates, and 20% repair cost set by the government https://www.gov.hk/en/residents/taxes/property/deduction/statutory.htm.

and t_i denotes its transaction date.[24] In other words, conditional on a set of parameters Θ, 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 consider $\beta_n(\Theta)$ as N moment conditions and estimate Θ using 2-step GMM (Hansen, 1982). We have twelve moment conditions corresponding to each treatment group. Each moment equals to $\hat{\beta}_n$, which is the empirically estimated discount for lease group n in Table IV. Column (1) of Table IX reports the estimation results from the 2-step GMM procedure, with standard errors reported in parenthesis. Please note that our estimation is subject to the constraint that all parameters are non-negative, by invoking the underlying economic interpretations of these structural parameters; as we will see, the non-negativity constraint may bind for certain parameters.

Figure V plots each lease groups' discount relative to the control group from the regression (light blue and light orange) and the model estimation (dark blue and dark orange), respectively. The overall model fit is quite good, shown as the close price discounts between model and regression for all lease groups except two lease groups (viz. 2098–2135 and 2842–2959) for which the model overpredicts and underpredicts the price discount, respectively.

5.3. Economic Magnitudes

We now discuss the economic magnitude of estimated parameters implied by the observed land leases discounts in Hong Kong.

5.3.1. Economic Magnitude of $\hat{\gamma}$

Column (1) of Table IX reports that the estimate of $\hat{\gamma} = 20.3\%$ (significant at 1% level), implying that after 2047 Hong Kong homeowners expect to pay about 20% of additional ground rent to extend their land leases. This seemingly large expected additional ground rent in the remote future takes into account all political uncertainty in the future (from the perspective of the first two decades of the 21st century), with the most imminent uncertainty in mid-2047. Also, $\hat{\gamma}$, which is uncovered from housing prices, typically differs from the expectation under physical measure. Since an increase in ground rent is likely associated with

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

worse economic conditions (so a higher marginal value of wealth), the expected ground rent under physical measure is likely to be lower than $\hat{\gamma} = 20.3\%$ (under risk-neutral measure).

With the caveats mentioned above, we now evaluate its magnitude by addressing the concern over endogenously determined investment in the properties and by comparing with other countries.

Endogenous investment Homeowners may choose to spend less on the maintenance of their properties, precisely because of the expected additional ground rent at extension after 2047, which would be reflected as lower price for the treatment groups. Thus, the price discount of our treatment group might reflect both the higher ground rent at extension and under-maintenance, both driven by political uncertainty. This implies that $\hat{\gamma}$ may be overestimated.

To separate the two, we estimate the specification in Table VIII based on two subsamples defined by their building age at the time of sale: ≤ 5 years and ≥ 6 years old. Presumably, the effect of endogenous investment matters more for older buildings that require substantial maintenance services. Results are reported in Table X. Columns (1) and (3) shows the price discounts of newer buildings, while Columns (2) and (4) presents the price discounts of older buildings. The price discounts associated with extension risk after July 1$^{\text{st}}$, 2047, for new buildings are quantitatively very similar (albeit smaller) to those in Table VIII. For instance, the coefficient on the colonial British lease group July 1$^{\text{st}}$, 2047–2049 is 14.5% (versus 16.8%); for the HKSAR leases, the discount is 6.4% (versus 8.3%).

We hence re-estimate the model using price discounts based on young buildings and obtain a relatively lower $\hat{\gamma}$, about 11%.[25] To the extent that buildings require very little investment in their first few years, 11% provides a conservative estimate of the expected additional ground rent imposed by the future Hong Kong government post-2047.

International comparisons Our model estimates imply that after July 1st, 2047, an additional 11–20% ground rent will be charged on properties in Hong Kong to have their leases extended. Is this extra ground rent burden reasonable?

To answer this question, we compare the estimate with the United Kingdom and Singapore, which have similar leasehold land tenure systems as Hong Kong, as well as the U.S., which uses a freehold land system. In the U.K., one has to pay the full market value (of land + structure) over the extended lease terms to the landowner, which is essentially 100% of net rent. Singapore followed the same policy as the U.K. until 2008, after which only the market value of land is required to extend the lease while the building value is waived. Thus, 11–20%

[25] The parameters for reneging risk do not change that much: the new $\hat{\lambda}^{pre}$ is still 0, $\hat{\lambda}^{post} = 0.016$ (so the colonial British leases are expected to renege in 61 years), $\hat{\delta}^{pre} = 15.1\%$, and $\hat{\delta}^{post} = 21.0\%$.

of net rent expected in Hong Kong is still considerably more affordable than expenses in the U.K. and Singapore.

The freehold system in the U.S. does not require extension but homeowners need to pay property tax annually. 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% (11%) of net rent yields an expected property tax rate of 22.4% (15.9%) the gross rent. 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.[26]

5.3.2. Economic Magnitude of Reneging Risk

Regarding the parameters on reneging risk in colonial British leases, Table IX reports $\hat{\lambda}^{pre} = 0$, implying that for colonial leases that expire before June 30$^{\text{th}}$, 2047, their homeowners should not worry about being reneged earlier before their lease contract ends. However, they expect to pay a one-time $\hat{\delta}^{pre} = 6.9\%$ land premium. For leases expiring after July 1$^{\text{st}}$, 2047, the colonial British leases will suffer a reneging risk $\hat{\lambda}^{post} = 1.7\%$, suggesting that they are expected to be reneged every 59 years after July 1$^{\text{st}}$, 2047; and homeowners need to pay a one-time land premium $\hat{\delta}^{post} = 21.2\%$ upon receiving a 50-year HKSAR-style extension contract (with a new ground rent $\hat{\gamma} = 20.3\%$). To put these estimates into perspective, consider a hypothetical 50-year colonial British lease and an otherwise identical 50-year HKSAR lease. Relative to the latter, the house with the former is traded at an effective price discount of 9.8% on January 1$^{\text{st}}$, 2021.[27]

In Section 2.4, we discuss the current land lease extension policy and potential uncertainty in the future. The original terms of colonial British leases are protected by Article 120 of the Basic Law, legally up to June 30$^{\text{th}}$, 2047. In our model, we allow λ^{pre} and λ^{post} to be different to investigate whether homeowners expect this part of Basic Law (i.e., Article 120) to be honored, both before and after June 30$^{\text{th}}$, 2047. Our estimates confirm that homeowners in Hong Kong expect Article 120 to be respected ($\hat{\lambda}^{pre} = 0$, with a standard error 0.004), but future Hong Kong government may renegotiate the British colonial leases post 2047 ($\hat{\lambda}^{post} = 1.7\%$, with a standard error of 0.003).

Regarding our estimates of the one-time renewal premium δ, it is important to recognize that although current policy of the HKSAR is to extend any expiring leases for another 50

[26] To calculate the equivalent ratios, we use the current gross rent yield of 0.88% and property tax rate of 0.90% (a percentage of market value) in New York City, and the gross rent yield of 5.25% and property tax rate of 2.12% in Chicago (Cook County). We assume the same 20% expense ratio. Current gross rent yield and tax rate are obtained from the 2019 CBRE survey: https://www.cbre.us/research-and-reports/Seattle-Cap-Rate-Survey-H2-2019.

[27] If the lease term is 100 years, then the implied discount will be 9.5% considering that the British lease pays nominal rent fixed at 2021 instead of 3% of rateable. Both of these leases expire after 2047 (2075 for the 50-year lease and 2121 for the 100-year lease, more precisely).

years with no additional one-time land premium charge, the HKSAR has the full discretion to and can increase the charge any time without violating the Basic Law,[28], which is captured by δ^{pre} and δ^{post} in our model. Based on our estimates, homeowners with colonial leases expiring before June 30$^{\text{th}}$, 2047, though expecting no reneging risk, will need to pay a one-time land premium of $\hat{\delta}^{pre} = 6.9\%$ to extend their leases. In other words, homeowners expect the current land policy (i.e., no one-time land premium charges) to no longer hold for colonial land leases even before June 30$^{\text{th}}$, 2047.

What if HKSAR leases might be reneged as well before July 1$^{\text{st}}$, 2047? What if the political situation worsens so much, that Beijing might renege not only colonial leases but also the non-colonial ones granted by the HKSAR before June 30$^{\text{th}}$, 2047, hence violating the land policy coded in the Basic Law? To accommodate this potentially dire political scenario, we consider the possibility of all land leases being reneged before July 1$^{\text{st}}$, 2047, which is modelled as a Poisson event with intensity λ^{pre}. Essentially, this model extension allows for reneging risk even on non-colonial leases. Further, to accommodate the differential treatment between colonial and non-colonial leases, we assume that when the non-colonial leases expire or are reneged before June 30$^{\text{th}}$, 2047, an additional land premium charge ($\hat{\delta}^{pre}_{HK}$) applies.[29]

We highlight that the key empirical pattern documented in Section 4.5 does not support a significant reneging risk before June 30$^{\text{th}}$, 2047 for *both* noncolonial and colonial leases. Intuitively, this is inconsistent with the existence of a substantial discount (about 14%) for the main treatment group (colonial leases) relative to the control group (non-colonial leases), revealed by house prices.

Indeed, our estimation confirms this intuition as shown in Column (2) of Table IX. First of all, the model fit measured by GMM objective function barely changes. We find that the estimated $\hat{\lambda}^{pre}$ remains at 0 (with a standard error of 0.019), suggesting that homeowners believe that the HKSAR will honor the land policy coded in the Basic Law until June 30$^{\text{th}}$, 2047. We also find that $\hat{\delta}^{pre}_{HK}$ is approximately 2.8% for noncolonial land leases, while both $\hat{\delta}^{pre}$ and $\hat{\delta}^{post}$ (that applies to colonial leases) increase a little to 9.0% and 22.5% respectively. This suggests a relatively small additional land premium charged for noncolonial leases compared to that of colonial leases.

[28]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.

[29]The common reneging intensity λ^{pre} is motivated by the possibility of "a political catastrophe" which applies to both contracts; note, colonial and non-colonial contracts might be exposed to this "event" in a different way due to different land renewal premia. One could allow for different reneging intensities λ^{pre}_{HK} or λ^{pre}_{Brit} before 7/1/2047; the results are similar.

5.4. Model Estimates under Alternative Discount Rates

Our baseline parameter estimation in Section 5.2.2 is based on a discount rate of $\kappa = r - g = 1.44\%$, which is determined (externally) by the prevalent statistics in recent Hong Kong's housing market. In this section we study how robust our model estimates are with respect to this discount rate. It is notable 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.

Columns (3) to (6) of Table IX present the estimation results using GMM for different κ. Figure VI plots $\hat{\gamma}$, $\hat{\lambda}$ (pre and post) and $\hat{\delta}$ (pre and post) as well as GMM objective values over different gross rent yield (2% as our baseline), which corresponds to different discount rate (= (1 − ratio) × gross rent yield). The panel shows that model has similar fit across different discount rates. As the discount rate doubles the current level (i.e., gross yield = 4%), $\hat{\lambda}^{post}$ increases from 1.7% to 2.4%. Under the higher discount rate, homeowners with colonial British leases expect to nearly double the $\hat{\delta}^{pre}$ to 13.1% for the leases expiring before June 30$^{\text{th}}$, 2047 and 46.3% for those reneging/expiring after June 30$^{\text{th}}$, 2047, from the baseline estimates. Similarly, all homeowners expect to pay higher additional ground rent to extend their land leases after June 30$^{\text{th}}$, 2047, up to 23.4% from 20.3%. All estimates are statistically significant at 1% level.

6. Political Uncertainty and Price Discounts

In this section, we exploit sentiment measures at citywide, district, and individual levels and explore their relations with the estimated price discounts. In other words, we offer both time-series and cross-sectional evidence that the estimated housing discounts are closely connected to political uncertainty regarding "One Country, Two Systems" in Hong Kong. For ease of illustration, we will focus on the main treatment lease group, July 1$^{\text{st}}$, 2047–2064, as the primary explanatory variable and the logged unit price as the primary dependent variable.

6.1. Citywide Sentiments in Political Uncertainty

We first relate the estimated price discount in the properties with leases expiring after 2047 to the citywide public sentiment in Hong Kong's political outlook. Political uncertainty regarding the fate of Hong Kong has been lingering throughout society since the 1984 JD, but its severity and gravity have been evolving over time and have often manifested more significantly when public sentiment rises. Our paper argues that the severity of political uncertainty should drive the price discounts of different land leases.

Figure VII plots a popular measure of public sentiment toward political risk in Hong Kong, which is based on a survey conducted by the Public Opinion Programme at the University of Hong Kong, a pro-democracy group, on a biannual basis. In this survey, participants are asked about their confidence in Hong Kong's future, as well as their confidence in "One Country, Two Systems." The figure shows that Hong Kong people's confidence in their own future as well as in "One Country, Two Systems" began to decline in 2007. The two series are almost perfectly aligned since 2008, suggesting that people's confidence in the future of Hong Kong is entirely driven by politics. Both series become negative after the "Occupy Central" movement in 2014; and although net confidence had briefly recovered and been positive in 2017, it has remained negative since then.

The movements in public sentiment and underlying political uncertainty should be reflected in our estimated price discount through affecting households' perceptions of the government land lease extension policy after 2047. To explore this, we estimate the treatment group's price discount relative to the control group by transaction year to obtain the price discount over time. Results are plotted in Panel (A) of Figure VIII. Consistent with the view that the discounts of the treatment group are driven by the political uncertainty faced by Hong Kong, the price differentials of leases expiring after 2047 are not statistically significant from zero until after 2003 amid rising anxiety about the anti-subversion law as well as the advent of severe acute respiratory syndrome (SARS), which first appeared in China in 2002 and spread to large parts of Hong Kong in 2003. Since then, the price differential has become significant and negative, and this trend has been exacerbated over time. It has settled at 20% since 2015.

Panel (A) also plots the net confidence in Hong Kong's future. The trends in the confidence series are almost perfectly aligned with the estimated price discounts. As people's confidence in Hong Kong's future declines, the relative price discount associated with political uncertainty in the housing market climbs, hinting at a connection between the estimated price discount and public sentiment in political uncertainty since 2007.

6.2. Local Political Sentiment Measures

The above analysis focuses on the time-series variation of citywide political uncertainty. We now explore time-varying socioeconomic characteristics at the district level to capture different local sentiments in political uncertainty and their relations with the estimated price discounts.

Our socioeconomic characteristics at the district level come from the census data as well as district council elections. 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 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 XI reports the summary statistics of district characteristics based on the merged data. The average median age is 40.4 years old, and the average median monthly income is HKD 12,422. On average, about 17% of adult residents have a college degree or higher, and about 51% are homeowners.

In the next two subsections we explain two additional district-level characteristics that are 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. Mainland migrants include renters as well as homeowners, roughly split 57/43 between them; together, they account for 31% of the Hong Kong population.

6.2.1. Pro-Democracy Seats

We obtain the percent of pro-democracy seats from Hong Kong's district council elections, which are mandated to advise the government on matters affecting the well-being of people, the provision and use of public facilities and services, and the use of public funds allocated to each of the eighteen districts. Councils also undertake the promotion of cultural activities and community outreach activities as a way to monitor grassroots sentiment. Although district councilors deal with local matters, they get to choose five seats on the LegCo (totalling 70 seats) and 117 seats on the 1,200-member panel that selects the city's chief executive.[30]

Local elections have become 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. As a result, the percentage of pro-democracy seats from district council elections not only captures the general discontent of local residents about contemporaneous governance, but also local sentiments in Hong Kong's political future given that this has been the dominant topic in the elections. For example, many of the candidates' campaign flyers during the 2019 local election mentioned a key citywide protest slogan, "five demands, not one less."[31]

[30]The district council system's roots go back to the deadly 1967 riots in Hong Kong, which began over labor grievances. It was set up to provide a channel for officials to better know the feelings of local residents to avoid future mass unrest or riots. Both the district council and LegCo elections are held every four years, but the latter is held one year after the former (e.g., 2019 and 2020, respectively).

[31]The demands are: the complete withdrawal of the extradition bill; establishment of an independent commission of inquiry into police conduct; retraction of the term "riot" to describe the protests; amnesty for arrested protesters; and full democracy.

Panel (A) of Figure IX shows that after suffering some defeats in the 2007, 2011 and 2015 elections, the pro-democracy camp in conjunction with localist groups in 2019 gained control of 17 of the 18 district councils and tripled their seats from around 124 to about 388 amid this record turnover. It was the pro-democracy camp's victory by the largest margin in the history of Hong Kong, and contributes to the significant time-series variation in the local election results within the same districts from 2003 to 2019. The figure also illustrates the significant cross-sectional variation in the percent of pro-democracy seats across districts within the same elections, the focus of our study in Section 6.3.

6.2.2. Mainland Migrants

Figure VII suggests that Hong Kongers' confidence in their own future almost entirely overlaps with their confidence in "One Country, Two Systems." In this regard, the percent of mainland migrants provides a measure of local sentiments against cultural influences from mainland China that has less to do with political encroachments. Since the handover, a large influx of tourists and migrants from the mainland had been blamed anecdotally by some locals for their lost Hong Kong identity.[32] There has been growing anxiety that Hong Kong will no longer belong to Hong Kongers as both local and transnational businesses in the city begin catering almost exclusively to mainlanders by speaking Mandarin Chinese instead of the local Hong Kong dialect, effectively altering the cultural and socioeconomic landscape of the city.

Panel (B) of Figure IX shows that the percentage of mainland migrants was high across all districts in the early censuses, but has decreased slightly in the latest census. While they are spread across the city, they have been most concentrated in the districts of Kowloon, an area of Hong Kong that is attached to the Chinese mainland.

6.2.3. Correlations

Panel B of Table XI reports the correlations among the district characteristics, with most of them being statistically significant at the 1% level. For instance, education (proxied by percentage of college and higher degrees) is negatively correlated with age but positively correlated with income.

The two local sentiment measures, viz. percentage of pro-democracy seats and percentage of mainland migrants, are positively correlated with each other (with $\rho = 0.34$), and both are positively correlated with median income and negatively with percentage who are home-owners. However, median age and education are (negatively) correlated with percentage of mainland migrants only, but not with percentage of pro-democracy seats. This suggests that

[32]The Chinese government relaxed its travel policy in 2003 to allow mainlanders easier access to Hong Kong. Over the past decade, the number of mainland Chinese tourists who have frequently visited Hong Kong has increased exponentially, reaching over 40 million annual arrivals in 2013.

mainland migrants tend to live in older and poorer communities with less educated residents and lower home ownership rates. Consistent with the causes of pro-democracy movements, the percentage of pro-democracy seats tends to be higher in affluent neighborhoods where people do not own or have the prospect of owning homes.

We highlight that the geographic pattern of the proportion of mainland migrants reflected in Panel (B) differs from that of the proportion of pro-democracy seats in Panel (A) of Figure IX. In the 2019 local elections, pro-democracy sentiment is the highest in most of Hong Kong Island (all but Wan Chai), and most of the New Territories districts, but only parts of the Kowloon districts. As we will see later, these two local sentiment measures exhibit quite different power to explain the price discount of the treatment lease group due to political uncertainty. Taking stock, the results suggest that the two measures—percent of pro-democracy seats and mainland migrants—capture different aspects of local sentiments, a fact that we will confirm shortly.

6.3. Local Sentiments and Housing Discounts

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 the price discount associated with political uncertainty. In all the regressions reported below, we standardize district variables to mean 0 and standard deviation 1 within each district-cohort year for easier interpretation.

6.3.1. The Effect of Local Sentiments

In Panel C of Table XI, we follow the specification in Eq. (9) but only show the estimates of the main treatment group (July 1st 2047–2064). In Column (1), the coefficient captures a significant discount of 13.2% in properties with leases expiring between July 1st, 2047, and 2064, corresponding to the average discount among three lease subgroups: July 1st, 2047–2049, 2050–2052 and 2053–2064.

In Columns (2)–(4), we include the interaction of the main treatment lease group and the percentage of pro-democracy seats as well as the percentage of mainland migrants. The coefficient on the treatment group dummy ranges from -0.127 to -0.146, all significant at the 1% level, capturing a base price discount at city level. Coefficients on the interaction terms give the incremental effect of district-level variations and they are all significant at the 1% level. We find a negative coefficient in Column (2) on the interaction between the treatment group with percentage of pro-democracy seats, suggesting that in addition to the -14.6% price discount, a one 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 36% increase of base effect)

for the treatment group. Similarly, results in Column (3) suggest that on top of the −13.1% average price discount, a one SD increase of mainland migrants in the local district (i.e., 6%) is associated with 8.2 percentage points (or 63% increase of base effect) in additional price discount. Column (4) includes interactions with both measures in a horse-race setting and finds similar estimates as in Columns (2) and (3), suggesting that these two measures capture quite distinct local political sentiments, echoing the raw correlation pattern discussed in Section 6.2.3.

In Columns (5)–(6), we replace the percentage of pro-democracy seats or the percentage of mainland migrants with indicators showing whether the district is above the median value of each variable (within each cohort year), respectively. This helps us to quantify a potential nonlinear effect of local sentiments. Column (5) shows that properties in the treatment group located in districts with a high proportion of pro-democracy seats see an additional 8.6% (77% of the base discount) increase of the price discount on top of the 11.2% base discount already observed for properties in the treatment lease groups located in districts with the median percentage of pro-democracy seats. Hence the combined discount is 19.8% for the properties in the former group. Similarly, Column (6) suggests that properties in the treatment group located in the districts with high percent of mainland migrants see an additional 10.6% (118% of the base discount) increase of the price discount on top of 9.0% base discount already observed for properties in the treatment lease groups located in the districts with the median percentage of mainland migrants.

Panel D reports the regression results where we treat leases granted by British Hong Kong and the HKSAR separately. In addition to all the explanatory variables in Panel C, we also control for the double interaction of treatment leases with the indicator for HKSAR leases as well as its triple interaction terms. While results confirm the significant price premium in transactions with leases granted by the HKSAR relative to their British Hong Kong government counterparts, all of the triple interaction terms are statistically insignificant, suggesting no significant difference between the colonial and HKSAR leases in terms of how local sentiments affect price discount.

Taken together, these results confirm that the two series provide valid measures of local sentiment in political uncertainty and that the housing price discount due to future political uncertainty increases where we see increases in local sentiment.

6.3.2. Time-varying Effect

We also repeat the regression analysis in Section 6.1 after splitting the samples based on whether the districts have a higher percentage of pro-democracy seats or high percentage of mainland migrants. The coefficients are plotted in Panels B and C of Figure VIII, respectively.

Compared to the average effects reported in Table XI, the two panels in Figure VIII display the evolution of political uncertainty effects across districts with different sentiments.

Regardless of which measure we use, price discounts in districts with greater local political sentiment are almost 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 result absent from Panel A of Figure VIII. A significant price discount did not emerge in the districts with less sentiment until after 2005 when the citywide sentiments increased. The comparison suggests that estimated price discounts for transactions in the treatment group do capture the price of political uncertainty, which is manifested through the change in public sentiment in political uncertainty, whether local or citywide.

6.3.3. Plausible Social and Economic Mechanisms

There are several plausible mechanisms through which the local sentiment measures can have a significant effect on the price discount in the treatment lease group relative to the control group. First, one of the primary, common goals of the pro-democracy camp is to achieve universal suffrage for the elections of both the chief executive and LegCo. The pan-democrats also generally embrace liberal values such as rule of law, human rights, and civil liberties. Thus, residents in places where pro-democratic camps won more seats should be more sensitive to the future of "One Country, Two Systems," the very principle that provides the foundation for an autonomous Hong Kong. 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. Thus regardless of specific reasons or demographic characteristics of the residents, percentage of pro-democracy seats has a direct effect on the estimated price discount associated with political uncertainty in the remote future.

Moving on to the percentage of mainland migrants in a district, 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 tension and anxiety are particularly high where there are a lot of tourists and mainland migrants, causing not only a shift in culture but also overcrowded public facilities and services.[33] Such anxiety stems partly from their eroding social position, but more importantly

[33]Some of the chief complaints include overwhelming grocery shoppers, parallel businesses, and birth tourism across border. For example, Yam (2016) reports that between 2006 and 2012, over 100,000 pregnant women from mainland China crossed the border to give birth in Hong Kong so that their children could become permanent residents of HKSAR. Despite the fact that the mainland Chinese visitors and immigrants in Hong Kong come from different social backgrounds and possess different intentions, Hong Kongers tend to represent them collectively as "locusts" and employ warlike tropes such as "invasion," "survival," and "defend."

it is induced by mainland China's overwhelming political and economic dominance over the HKSAR. As a result, in places where more mainland residents are present and where the cultural differences between Hong Kongers and mainlanders are on full display, local residents tend to see their lives as more affected by the mainland, and ultimately have become more pessimistic about the future of "One Country, Two Systems."[34]

6.4. The Effect of Individual Beliefs

In the above analysis, we focus on local sentiment from the perspective of Hong Kongers using district-level data. We now explore the perspectives of buyers and sellers from the mainland China, identified through the buyer and seller names in the transaction data.[35] Our premise is that mainland buyers (sellers) may have different private valuations regarding the political uncertainty embedded in the treatment leases as opposed to local buyers (sellers). Because of their experience in China, mainland buyers tend to be more optimistic than local buyers about the future of "One Country, Two Systems," and hence less sensitive to the political uncertainty. On the other hand, mainlanders who have lived in Hong Kong but decided to sell their houses might be those who are more pessimistic about Hong Kong's future and hence more sensitive to the political uncertainty.

We restrict the estimation sample to transactions in which buyers/sellers are identified as either a mainlander or Hong Konger, and report the results in Table XII. Columns (1) and (3) present the regressions of unit price on just mainland buyer and seller dummies, which suggest that a mainland buyer tends to pay a significantly higher price than local buyers for the similar house, as in Fan et al. (2021), while there is no significant difference in prices between mainland and local sellers.

To identify different valuations regarding the political uncertainty, we include the interactions of the treatment group with indicators for mainland buyers and sellers in Columns (2) and (4), respectively. Without controlling for their trading partners, the coefficient on the interaction between the treatment group and mainland buyers is positive but insignificant, while that on the interaction between the treatment lease and mainland sellers is negative and significant (at 5% level). This suggests that properties in the treatment lease group involving a mainland sellers are sold at additional discount by 1.6 percentage points (14 percent of the base discount, significant at the 5% level) compared to those involving a local seller.

We further study the interaction of the main treatment lease group with indicators of

[34]It is worth noting that Hong Kongers still account for the absolute majority of the population as well as homeowners. The average percent of mainland migrants is 39%, and many of them have lived in Hong Kong many years and may have been localized already.

[35]Mainlanders are identified if one of the well-known surnames from mainland China is matched with buyers or sellers in the transaction data following the algorithm developed in Fan et al. (2021). These well-known surnames are distinctly different from those of Hong Kong or Taiwan natives.

various trading party pairs, and present the results using the full sample (Column 6), only transactions in 1998–2007 (Column 7), and 2008–2020 (Column 8), respectively. In Column (6), we find that relative to transactions between a local buyer and seller (the omitted group), those between a mainland buyer and a local seller are sold significantly (at the 10% level) *more* by 1.4 percentage points (12% percent of the base discount). The coefficient on the interaction between mainland-buyer–mainland-seller transactions and the treatment group is not statistically different from zero, suggesting a transaction price similar to the local buyer-seller group. Finally, those between a local buyer and a mainland seller are sold significantly (at 5% level) *less* by 1.6 percentage points (13% percent of the base discount), relative to the local buyer-seller group.

In the context of a housing market where over-the-counter bilateral bargaining is common, the equilibrium transaction prices typically reflect a weighted average of the beliefs of trading partners of a transaction. The monotonicity of transaction prices across different buyer-seller pairs documented in Column (6) suggest that mainland buyers tend to be more optimistic than local buyers and mainland sellers tend to be more pessimistic than local sellers concerning the political uncertainty in the far future. Columns (7) and (8) together suggest that the individual beliefs only diverge in more recent years as political uncertainty regarding Hong Kong's future has intensified.

7. Conclusion

In the context of Hong Kong, where the indeterminacy of its political system is always looming, we find that political uncertainty is priced in the property market where the value of the housing assets depends on the continuity of land ownership in the far future. Housing is also the dominant form of household wealth in Hong Kong, making its exposure to political uncertainty particularly costly to households, financial institutions, and larger society.

We exploit a unique feature in the Hong Kong housing market: land leases expiring on June 30$^{\text{th}}$, 2047, have been promised a 50-year extension protection, while those expiring immediately after that date are left unprotected legally. The different treatment translates to a 14% discount for the second group of leases, and is rooted in historical arrangements in the JD and the "One Country, Two Systems" design, which are both set to expire in 2047, giving rise to the largest political uncertainty regarding any lease extension beyond that point. Citywide and local sentiments in political uncertainty provide plausible mechanisms through which housing prices fall with rising political uncertainty as residents feel more uncertain about Hong Kong's future.

We guide our reduced-form regressions by a structural pricing model of long-term property values with future political uncertainty, which is to be resolved on the predetermined future

date when the HKSAR expires. The model is further extended to incorporate a reneging risk applied to land contracts issued during the colonial era, motivated by the significant price differential between British Hong Kong and HKSAR leases within the same lease group. By estimating the model fully, the reduced-form discount estimates inform us the magnitudes of structural parameters of the model, which are of policy relevance for housing market in Hong Kong.

Our results provide important empirical evidence that political uncertainty could be quite costly to the valuation of long-term property rights. It is worth noting that after this paper was made available online, the HKSAR government added a notice to its website that says, "the Government is fully aware of the challenge of coping with a large number of leases that will expire in 2047," and "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."

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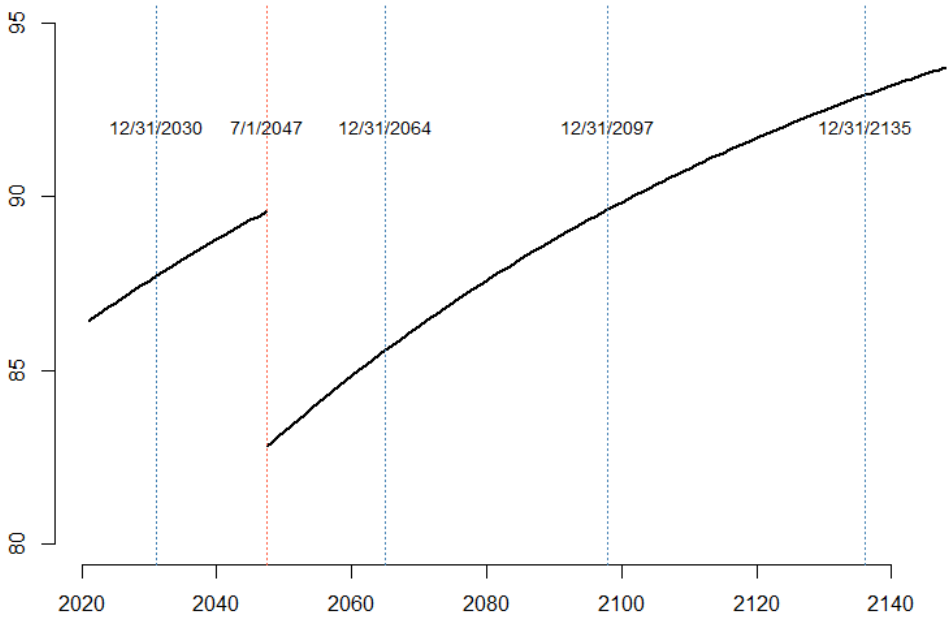
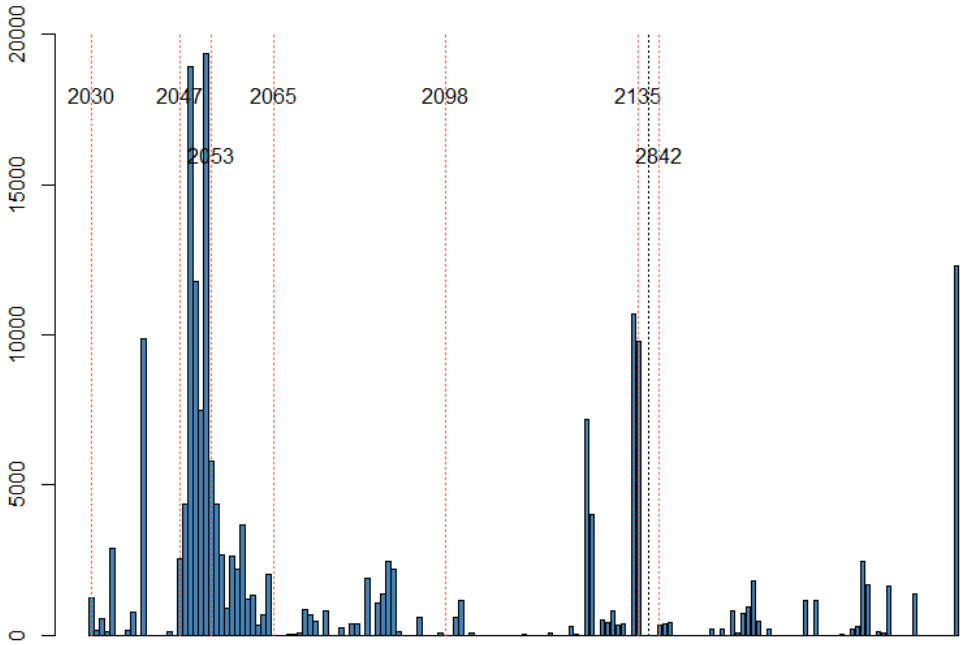
Figure II. Model Implied Price Discounts with Constant Ground Rent Schedule



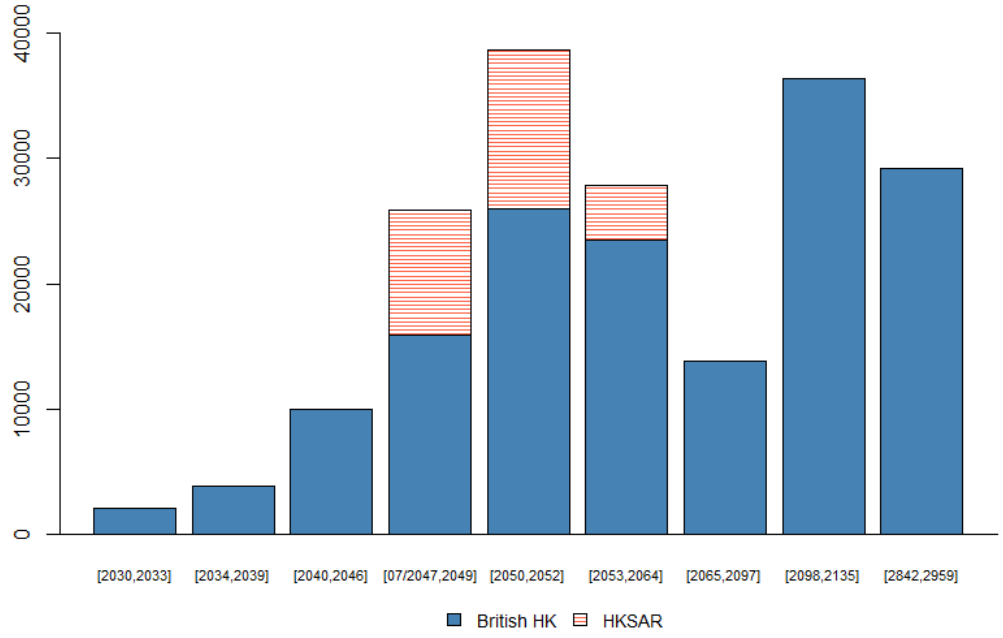
This figure plots the model implied house value as a function of lease expiration date L. The political uncertainty will be largely resolved on $\tau = 7/1/2047$, when a new Hong Kong government replaces the current HKSAR. Red vertical dashed line indicate leases expiring in $\tau = 7/1/2047$. Blue vertical dotted lines indicate several lease expiration date used as boundaries of our lease groups. Parameters: $\kappa = r - g = 0.01$, $\gamma = 0.25$, $t = 1/1/2010$.

Figure III. Distribution of Transactions by Lease Groups

Panel A: Number of Transactions By Leasehold Expiration Year



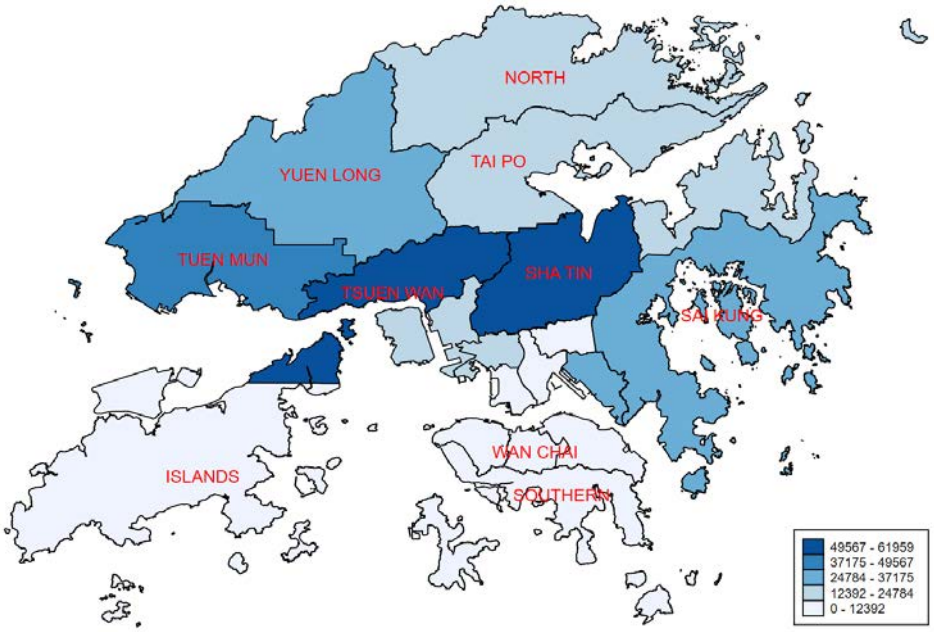
Panel B: Number of Transactions by Lease Group



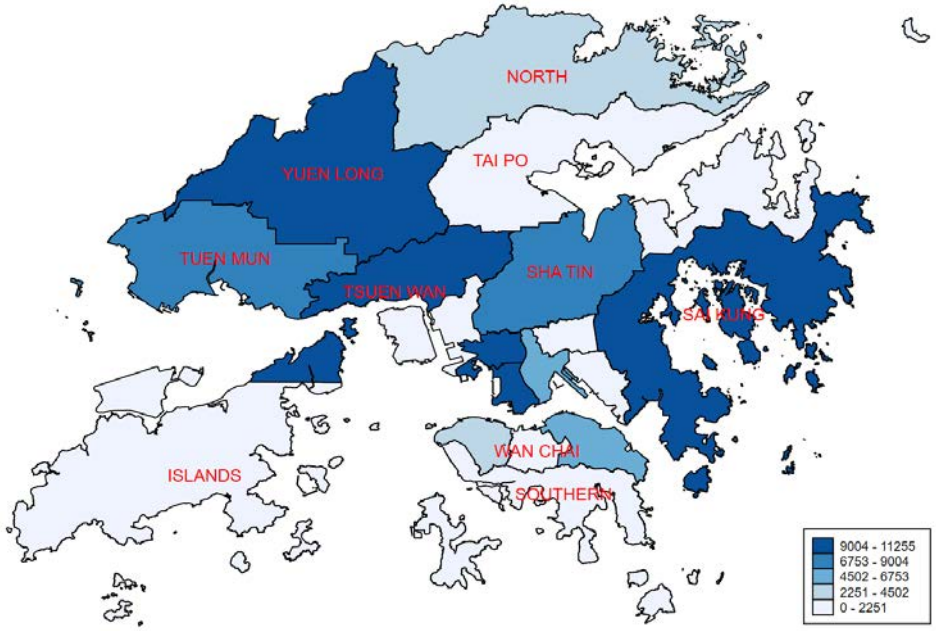
This figure plots the number of housing transactions by individual lease expiration year (except leases expiring on 6/30/2047). Panel A presents the number of transactions by lease expiration year from 2030 to 2135, and from 2842 to 2959. Panel B presents the number of transactions by lease groups and lease types (colonial British leases or HKSAR leases).

Figure IV. Geographic Distribution of Transactions and Leases

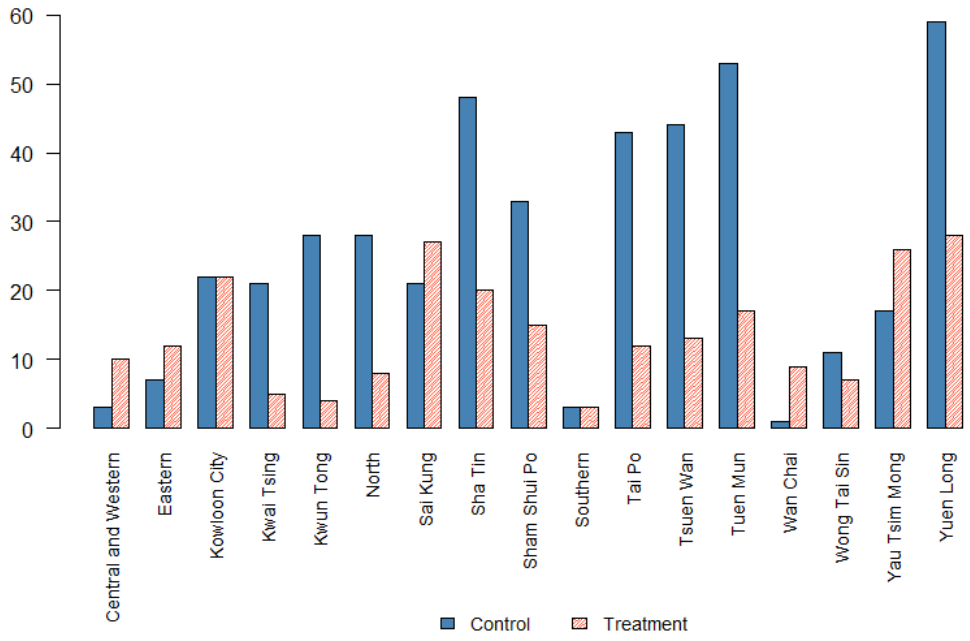
Panel A: Control Lease Group



Panel B: Main Treatment Lease Group

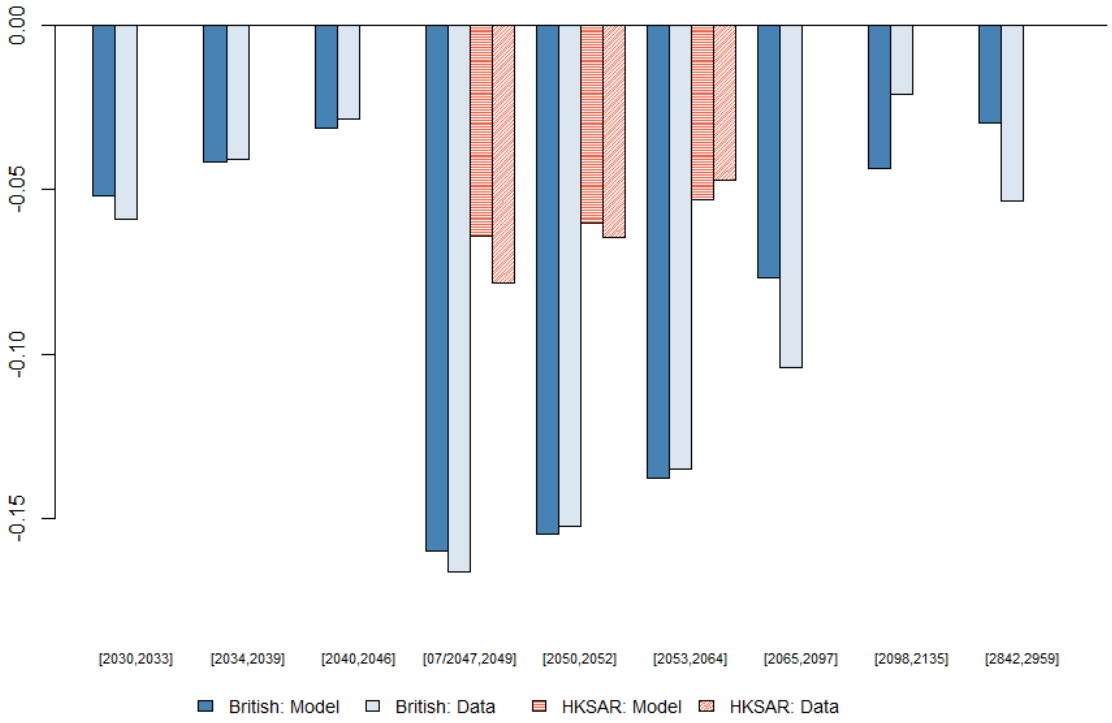


Panel C: Number of Leases



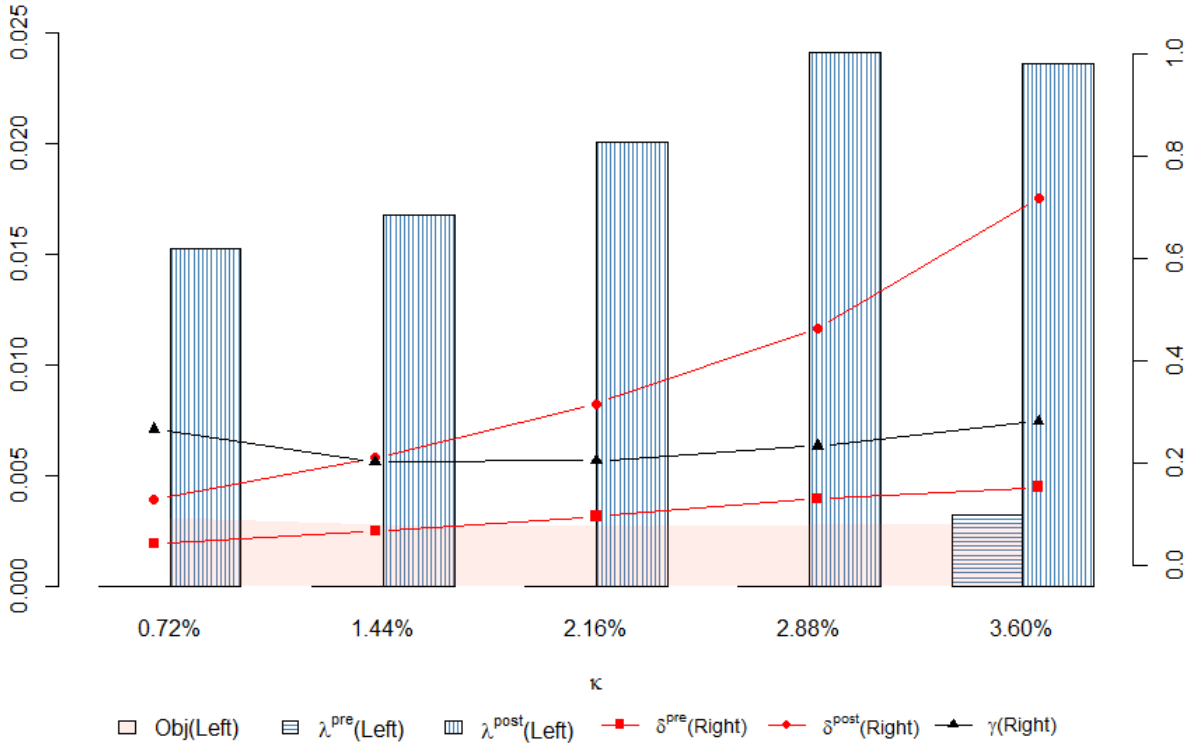
Panel A plots the number of transactions by district for the control lease group with leases expiring on 6/30/2047. Panel B plots the number of transactions by each district for the main treatment lease group with leases expiring between 7/1/2047 and 2064. Panel C plots the number of leases for control group and main treatment group by each district.

Figure V. Model Estimation



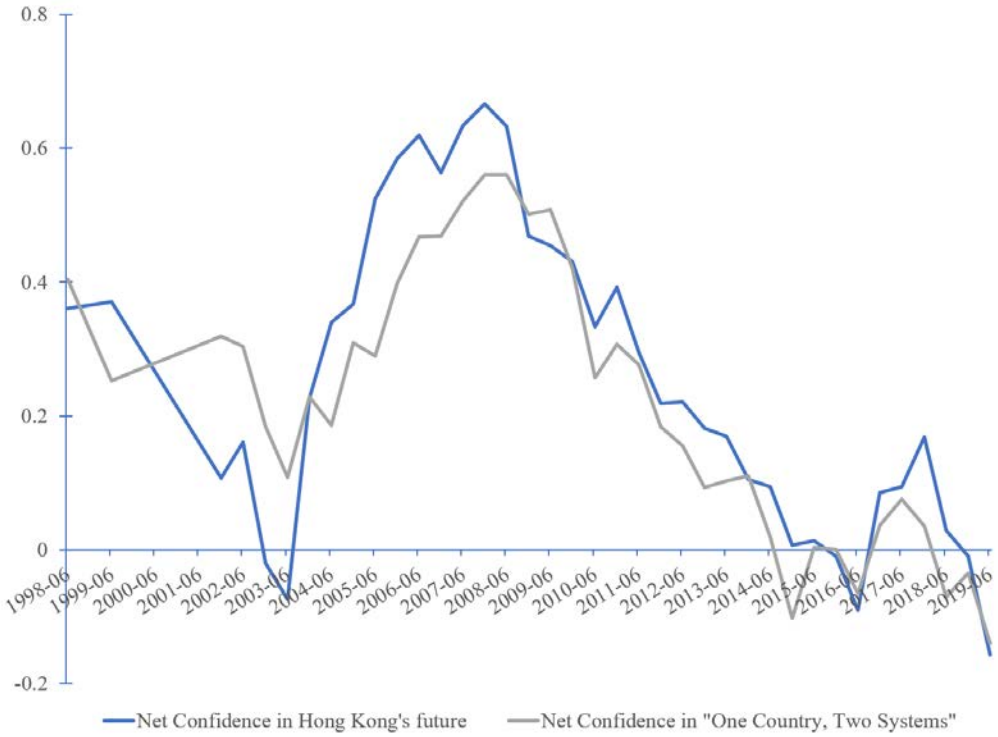
This figure presents the model-implied discounts and discounts estimated from hedonic regressions (Column (1) in Table VIII) across twelve lease groups (including colonial British and HKSAR ones). The resulting parameters from the estimation are $\kappa = r - g = 1.44\%$ (set by matching 2% gross rent yield and 28% expense rate) and $\lambda^{pre} = 0.00\%$, $\lambda^{post} = 1.68\%$, $\delta^{pre} = 6.86\%$, $\delta^{post} = 21.22\%$, $\gamma = 20.32\%$ (optimally chosen to match the empirical moments inside the model).

Figure VI. Model Estimates Under Alternative Discount Rates



This figure presents the 2-step GMM estimation results of our base model given different discount rate $\kappa = r - g$. We vary the gross rental yield from 1% to 5%, and the corresponding discount rate κ as shown in the x-axis equals to $1 - 28\% = 0.72$ multiplying the gross rental yield. Obj, λ^{pre}, and λ^{post} are plotted against the left scale, while δ^{pre}, δ^{post}, and γ are plotted against the right scale.

Figure VII. Citizen's Net Confidence from Surveys

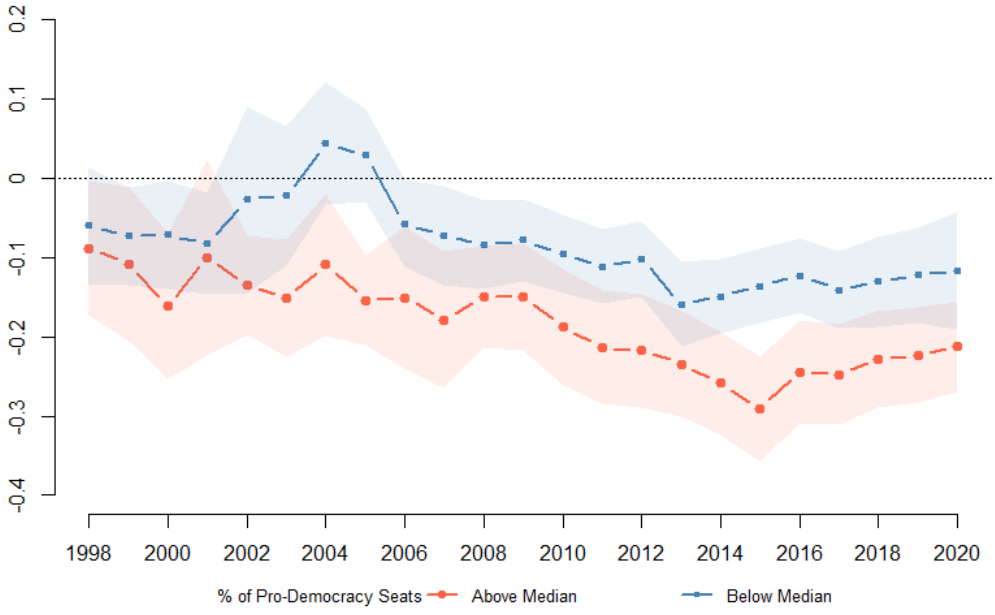


This figure plots two widely used measures of public sentiments toward political risk in Hong Kong over time from 1998 to 2020. The two sentiment measures, Net Confidence in Hong Kong's future and Net Confidence in "One Country, Two Systems," are provided by the public sentiment survey conducted by the Public Opinion Program at the University of Hong Kong on a biannual basis. In this survey, participants are asked about their confidence in Hong Kong's future, as well as their confidence in "One Country, Two Systems."

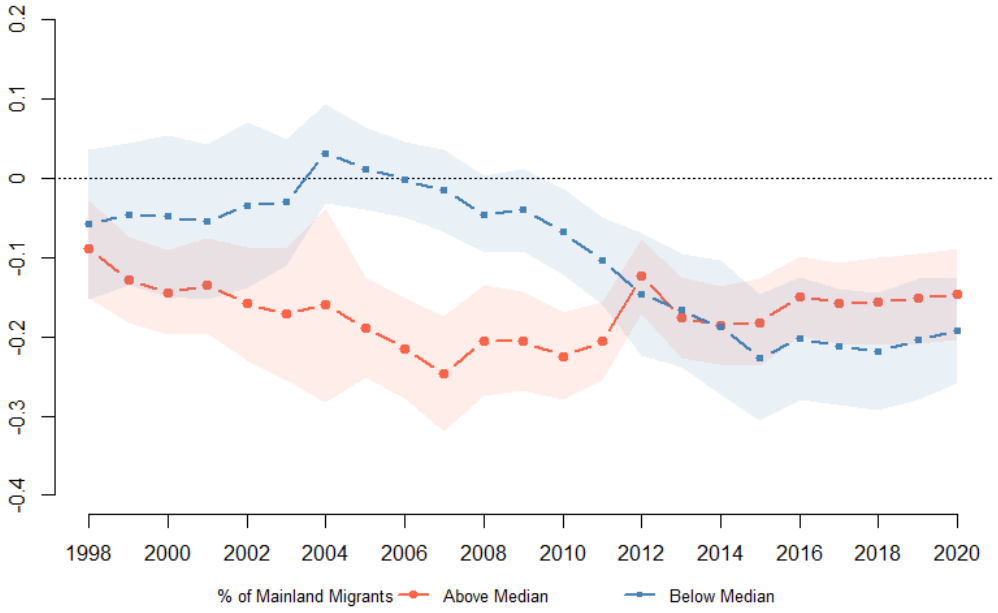
Figure VIII. Price Discount Over Time

Panel A: Dynamic Estimates based on Entire Sample

Panel B: Dynamic Estimates based on Districts with High Versus Low % of Pro-Democracy Seats



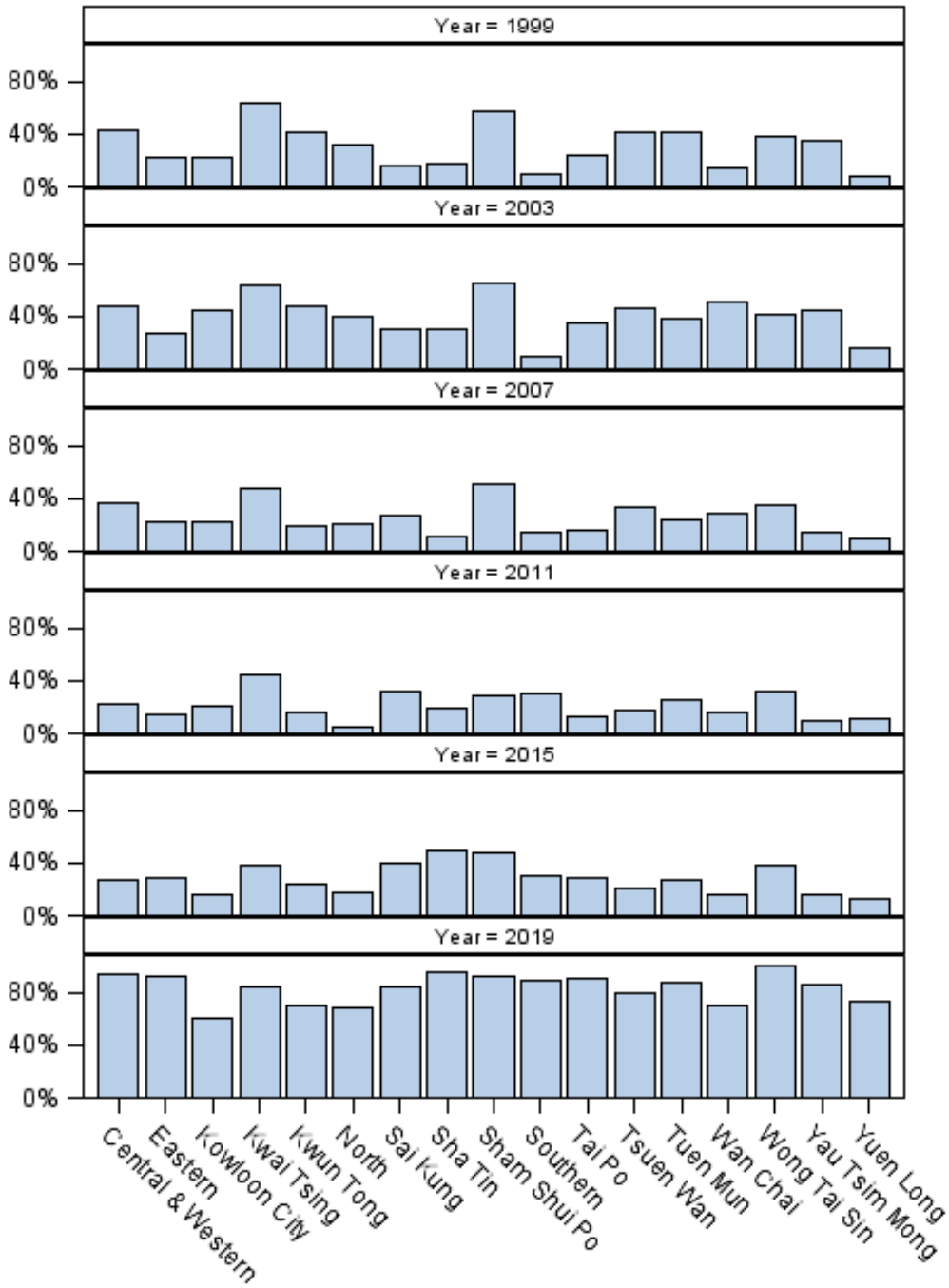
Panel C: Dynamic Estimates based on Districts with High Versus Low % of Mainland Migrants



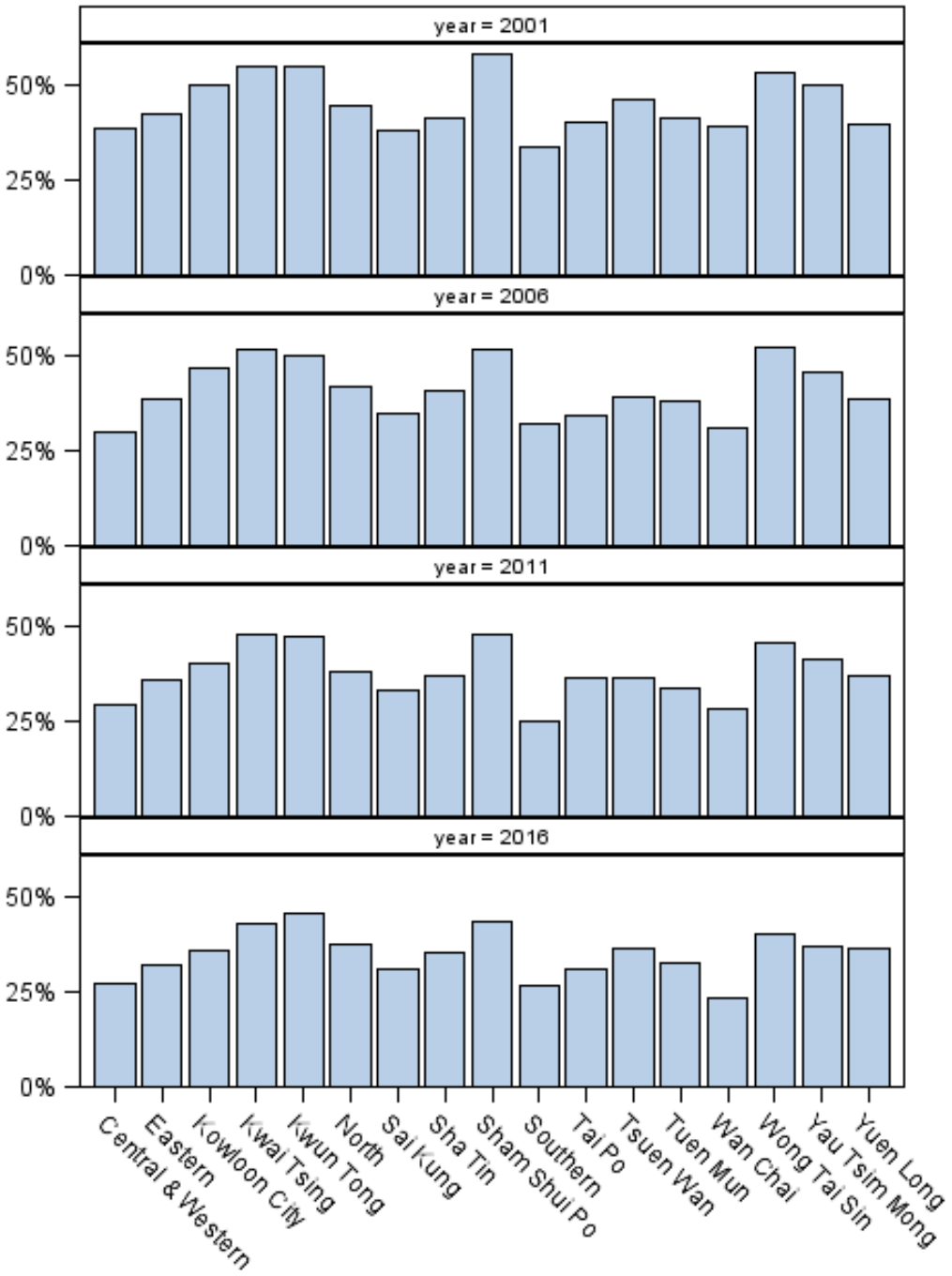
Panel A plots the price discounts over time for the main treatment group with lease expiring between [7/1/2047] and 2064. Panel B plots the price discounts over time for two groups: main treatment groups which have the percentage of Pro-Democracy Seats above median, main treatment groups which have the percentage of Pro-Democracy Seats below median. Panel C plots the price discounts over time for two groups: main treatment groups which have the percentage of Mainland Migrants above median, main treatment groups which have the percentage of Mainland Migrants below median.

Figure IX. 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.

TABLE I: Summary of Lease Types

Auction Date	Hong Kong Island & Old Kowloon	New Kowloon & New Territories	Land Proceeds
Before JD ($\leq$ 4/1/1985)	(1) 999 years lease (auctioned from 1843 to 1898 and expiring from 2842 to 2897). It pays nominal ground rent. (2) 75 years lease (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 that those extended after the JD and set to expire on 6/30/2047 are required to pay 3% of rateable as ground rent since the handover. (3) 75+75 years lease (auctioned from 1899 to 1985 and expiring from 2049 to 2135); 99+99 years lease (rare, auctioned from 1899 to 1985 and expiring from 2097 to 2183). "+" 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. It pays 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.	(4) Nonrenewable lease expiring on 6/27/1997 due to historical reasons. According to the JD, it will be automatically extended to 6/30/2047. It pays 3% of rateable as ground rent since 7/1/1997.	
Transition (4/1/1985–6/30/1997)	(5) Non-renewable lease expiring on 6/30/2047. It pays 3% of rateable as ground rent since 7/1/1997.		Split between UK & HKSAR
Post Handover ($\geq$ 7/1/1997)	(6) Non-renewable lease expiring in (auction date + 50 years). It pays 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 effective on May 27, 1985. However, according to our data, lease was 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. In our regression sample, the longest lease expires in 2959. Since 1899, 999 leases were sold as exceptions instead of regular land policy. For Type (2), when this type of leases ends, it 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 75 years lease was sold in 1897 and got extended once in 1972, then they will 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 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 they will expire in 2047 in our data. We do not find any 99–year lease 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 re-evaluated every year.

TABLE II: Summary Statistics

Panel A: Overall Sample

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
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
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
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
Turnover	551,790	0.079	0.043	0.000	0.006	0.024	0.072	0.156	0.209	0.517

Panel B: Split Samples

	Control Lease Group			Main Treatment Lease			Control -
Variable	N	Mean	SD	N	Mean	SD	Treatment
Log(Price)	363,923	0.89	0.62	92,407	1.40	0.63	-0.51***
Log(Unit Price)	363,923	8.51	0.53	92,407	8.95	0.51	-0.44***
Net Living Area Area	363,923	513.90	157.00	92,407	551.50	162.10	-37.67***
Floor	363,923	16.98	10.97	92,407	24.07	15.90	-7.08***
No of Bedrooms	363,923	2.06	0.98	92,407	2.06	0.98	0.00
No of Living Rooms	363,923	1.61	0.77	92,407	1.75	0.71	-0.14***
Bay Window Size	363,923	22.62	15.25	92,407	22.81	13.55	-0.19***
Building Age	363,923	16.44	8.41	92,407	9.46	8.02	6.98***
Building Completion Year	363,923	1991	7.31	92,407	2002	9	-11***
Distance To MRT	363,923	799	945	92,407	692	900	107***
Distance To Bus Stop	363,923	313	292	92,407	352	278	-39***
Distance To Hospital	363,923	1,689	1,382	92,407	1,549	1,181	140***
Distance To School	363,923	150	230	92,407	128	108	22***
Distance To University	363,923	4,010	2,539	92,407	3,349	2,365	661***
Distance To Coastal Line	363,923	1,608	1,742	92,407	1,254	1,634	354***
Turnover	363,923	0.079	0.043	92,407	0.082	0.050	-0.003***

Panel A 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 or longitude, and floor number; complexes that belong to public housing projects; houses or townhouses; transactions in Island district, which consists several islands that are not part of Kowloon peninsula or Hong Kong Island. Panel B presents number of observations, mean and standard deviation of property characteristics for the control group (lease = 6/30/2047) and main treatment group (lease $\in$ [7/1/2047, 12/31/2064]) separately. The last column presents the mean difference of these two groups and the t-test significance. Variables are defined as: Log(Price) is log of price in million HKD; Log(Unit Price) is log of unit price in HKD; Unit price is price divided by net size in square feet; Net Living Area Area is net size in square feet (We use net size instead of gross size since a large portion of gross size is missing in the sample since 2010); Building age is year of transaction minus building completion year; Bay Window Size is the size of bay window in square feet; Distance to MRT/Bus Stop/Hospital/School/University/Coastal line measures the closest distance of the property to the corresponding location in meters; turnover is calculated as the number of transactions over the number of units for each land (identified by land lot number) and transaction year. The number of units is proxied by the number of unique units in the entire transaction sample.

TABLE III: Distributions by Lease Group and Year

Lease Group	Sale Year				All Years
	1998-2005	2006-2010	2011-2015	2016-Feb 2020	
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 IV: Baseline Analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var	Log (Unit Price)				Log (Total Price)			
I(2030 ≤ Lease ≤ 2033)	-0.057	-0.054	-0.076	-0.071	-0.043	-0.043	-0.065	-0.058
	[0.043]	[0.045]	[0.046]	[0.045]	[0.046]	[0.046]	[0.050]	[0.049]
I(2034 ≤ Lease ≤ 2039)	-0.038	0.002	-0.022	-0.040	-0.042	0.001	-0.027	-0.044
	[0.039]	[0.038]	[0.036]	[0.038]	[0.042]	[0.041]	[0.040]	[0.042]
I(2040 ≤ Lease ≤ 2046)	-0.024	-0.009	-0.006	-0.022	-0.013	0.001	0.008	-0.011
	[0.057]	[0.056]	[0.057]	[0.058]	[0.060]	[0.058]	[0.060]	[0.060]
I(7/1/2047 ≤ Lease ≤ 2049)	-0.141***	-0.124***	-0.125***	-0.138***	-0.149***	-0.128***	-0.132***	-0.146***
	[0.028]	[0.026]	[0.029]	[0.029]	[0.029]	[0.027]	[0.030]	[0.030]
I(2050 ≤ Lease ≤ 2052)	-0.127***	-0.121***	-0.126***	-0.128***	-0.127***	-0.120***	-0.124***	-0.128***
	[0.028]	[0.027]	[0.028]	[0.028]	[0.030]	[0.028]	[0.030]	[0.030]
I(2053 ≤ Lease ≤ 2064)	-0.127***	-0.090***	-0.117***	-0.126***	-0.130***	-0.090***	-0.118***	-0.129***
	[0.032]	[0.028]	[0.034]	[0.032]	[0.033]	[0.029]	[0.035]	[0.033]
I(2065 ≤ Lease ≤ 2097)	-0.105***	-0.090***	-0.098***	-0.110***	-0.107**	-0.091**	-0.101**	-0.112***
	[0.035]	[0.033]	[0.036]	[0.034]	[0.043]	[0.040]	[0.044]	[0.042]
I(2098 ≤ Lease ≤ 2135)	-0.022	-0.014	-0.002	-0.023	-0.029	-0.019	-0.009	-0.030
	[0.039]	[0.035]	[0.039]	[0.038]	[0.040]	[0.036]	[0.041]	[0.040]
I(2842 ≤ Lease ≤ 2959)	-0.052	-0.034	-0.037	-0.054	-0.054	-0.034	-0.039	-0.057
	[0.035]	[0.034]	[0.037]	[0.035]	[0.038]	[0.036]	[0.040]	[0.038]
Turnover				0.170				0.103
				[0.113]				[0.120]
Property Attributes	Yes	No	Yes	Yes	Yes	No	Yes	Yes
Property Attributes × Year	No	Yes	No	No	No	Yes	No	No
District × Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	551,790	551,790	525,730	551,790	551,790	551,790	525,730	551,790
Adj R^2	0.9288	0.9405	0.9316	0.9289	0.9421	0.9509	0.9440	0.9421

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 following four variables are trimmed at 1% percentiles: unit price, total price, net size, and building age. The dependent variable is log of unit price in Columns (1)-(4), whereas log of total price (in million HKD) is used as dependent variable in Columns (5)-(8). Control variables in Columns (1) and (5) include a full set of property and building characteristics. Property characteristics includes the number of bedrooms (in categories, e.g., 1, 2, 3, and missing value.), the number of living rooms (in categories, e.g., 0, 1, 2, 3, and missing value.), bay window indicator (yes or no), bay window size (in 10 equally sized categories), the net size (in 10 equally sized categories), direction facing dummies, and floor group dummies (in four categories: 3 to 10, 11 to 30, 31 to 60, and 61 floors or higher). Building characteristics include age of the building (in 10 equally sized categories), building completion year (in 10 equally sized categories), swimming pool indicator, club house indicator, and distance to MRT/Bus Stop/Hospital/School/University/Coastal Line (each in 10 equally sized categories). We also control for district by year-month fixed effects. In Columns (2) and (6), we control for the interactions of property and building characteristics with year. In Columns (3) and (7), we exclude the observations with missing number of bedrooms and living rooms. Columns (4) and (8) include additional control of turnover. Standard errors are two-way clustered by estate and year-month. Asterisks denote significance levels (***=1%, **=5%, *=10%).

TABLE V: A More Exogenous Control Group

	(1)	(2)	(3)	(4)
Dep Var	Log (Unit Price)		Log (Total Price)	
I(2030 ≤ Lease ≤ 2033)	-0.064	-0.061	-0.052	-0.044
	[0.047]	[0.052]	[0.051]	[0.056]
I(2034 ≤ Lease ≤ 2039)	-0.033	-0.032	-0.038	-0.033
	[0.039]	[0.043]	[0.043]	[0.046]
I(2040 ≤ Lease ≤ 2046)	-0.004	-0.002	0.006	0.012
	[0.058]	[0.061]	[0.061]	[0.065]
I(Lease = 6/30/2047 & After JD)	0.025	0.025	0.024	0.025
	[0.019]	[0.019]	[0.020]	[0.020]
I(Lease = 6/30/2047 & Before JD and in HKL+KIL)		0.005		0.014
		[0.037]		[0.040]
I(7/1/2047 ≤ Lease ≤ 2049)	-0.134***	-0.132***	-0.141***	-0.137***
	[0.028]	[0.032]	[0.030]	[0.033]
I(2050 ≤ Lease ≤ 2052)	-0.123***	-0.122***	-0.123***	-0.120***
	[0.028]	[0.030]	[0.030]	[0.031]
I(2053 ≤ Lease ≤ 2064)	-0.124***	-0.122***	-0.126***	-0.122***
	[0.032]	[0.035]	[0.034]	[0.036]
I(2065 ≤ Lease ≤ 2097)	-0.106***	-0.104***	-0.108**	-0.102**
	[0.035]	[0.040]	[0.042]	[0.046]
I(2098 ≤ Lease ≤ 2135)	-0.018	-0.016	-0.025	-0.020
	[0.038]	[0.043]	[0.040]	[0.044]
I(2842 ≤ Lease ≤ 2959)	-0.052	-0.050	-0.054	-0.049
	[0.036]	[0.040]	[0.038]	[0.042]
Property Attributes	Yes	Yes	Yes	Yes
District × Month	Yes	Yes	Yes	Yes
N	551,790	551,790	551,790	551,790
Adj R^2	0.9289	0.9289	0.9422	0.9422

This table presents the hedonic regression results using the entire sample of housing transaction records in Hong Kong from 1998 to February, 2020. We separate the control group into three subgroups: the first set of leases, expiring on 6/30/2047, were granted after the JD, denoted by indicator I(lease = 6/30/2047 & After JD); the second set, expiring on 6/30/2047, was granted before the JD and located in Hong Kong Island and Old Kowloon, denoted by indicator I(lease = 6/30/2047 & Before JD and in (HKL,KIL)); the last set, expiring on 6/30/2047, was granted before the JD and located in New Kowloon and New Territories. The third subgroup is used as the control group. The specification in Columns (1) and (2) is the same as Column (1) in Table IV and that in Columns (3) and (4) is the same as Column (4) in Table IV. Standard errors are two-way clustered by estate and year-month. Asterisks denote significance levels (***=1%, **=5%, *=10%).

TABLE VI: Robustness Tests

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample	Overall	Repeated Sales	PSM-Matched	Entropy Balancing	Overall	Repeated Sales	PSM-Matched	Entropy Balancing
Dep Var	Log (Unite Price)				Log (Total Price)			
I(7/1/2047 ≤ Lease ≤ 2064)	-0.133***	-0.107***	-0.119***	-0.156***	-0.136***	-0.124***	-0.119***	-0.154***
	[0.022]	[0.021]	[0.021]	[0.023]	[0.023]	[0.023]	[0.022]	[0.025]
Property Attributes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District × Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	456,330	246,022	46,874	456,330	456,330	246,022	46,874	456,330
Adj R^2	0.9362	0.9387	0.9511	0.9258	0.94	0.9484	0.9595	0.9467

This table presents the hedonic regression results of our main treatment lease group [7/1/2047, 2064] using different samples. The dependent variable is the log of unit price in Columns (1) to (4) and the log of total price in Columns (5) to (8). Columns (1) and (5) perform hedonic regression using the observations of control group and main treatment group based on the sample used in Columns (1) and (4) of Table IV. Columns (2) and (6) are based on the repeated sales sample which include only properties that have been transacted at least twice. Columns (3) and (7) are based on the PSM-matched sample which is constructed by finding controlled buildings within 0.5 kilometers requiring they have the same facilities (swimming pool and club house) for each treated building. Using the transactions in the treated building and nearby controlled buildings, we calculate the propensity score using Probit regression of the treatment dummy on property characteristics including number of bedrooms, living rooms, living area size, bay window size, floor number, and building completion year. We match each treated observation with a controlled observation with the same year of transaction and the closest propensity score (1:1 nearest-neighbor matching). Columns (4) and (8) perform the weighted regression using the entropy reweighting scheme (Hainmueller, 2012). We also control for district by year-month fixed effects in all regressions. Standard errors are two-way clustered by estate and year-month. Asterisks denote significance levels (***=1%, **=5%, *=10%).

TABLE VII: Placebo Test

	(1)	(2)	(3)	(4)
Dep Var	Log (Unit Rent)	Log (Total Rent)	Log (Unit Price)	Log (Total Price)
I(2030 $\leq$ Lease $\leq$ 2046)	-0.052*	-0.042	-0.050	-0.044
	[0.029]	[0.030]	[0.042]	[0.044]
I(7/1/2047 $\leq$ Lease $\leq$ 2049)	-0.009	0.000	-0.184***	-0.186***
	[0.022]	[0.025]	[0.030]	[0.031]
I(2050 $\leq$ Lease $\leq$ 2052)	-0.017	-0.009	-0.184***	-0.181***
	[0.018]	[0.020]	[0.033]	[0.033]
I(2053 $\leq$ Lease $\leq$ 2064)	0.018	0.031	-0.100**	-0.102**
	[0.023]	[0.024]	[0.036]	[0.037]
I(2065 $\leq$ Lease $\leq$ 2135)	-0.041*	-0.055*	-0.008	-0.010
	[0.022]	[0.026]	[0.038]	[0.038]
I(2842 $\leq$ Lease $\leq$ 2959)	-0.023	-0.057*	0.028	0.029
	[0.030]	[0.031]	[0.042]	[0.043]
Property Attributes	Yes	Yes	Yes	Yes
District $\times$ Month FE	Yes	Yes	Yes	Yes
N	9,171	9,171	18,029	18,029
Adj R^2	0.8042	0.9170	0.7217	0.8678

This table presents the hedonic regression result using a sample of housing rental or sales transaction records from November, 2018 to February, 2020. The rental sample is obtained from the website of Centaline Property, one of the largest real estate agencies, and the transaction sample is matched with the rental sample during the same period. The dependent variables are the log of unit and total rents in in Columns (1) and (2), respectively and the log of unit and total price in in Columns (3) and (4), respectively. The specifications in Columns (3) and (4) are the same as Column (1) in Table IV. Since similar variables are not available for the rental sample, we use the estate-level average (if numeric variable) or mode (if category variable) to replace those variables in Columns (1) and (2). We control for district by year-month fixed effects in all the regressions. Standard errors are two-way clustered by estate and year-month. Asterisks denote significance levels (***=1%, **=5%, *=10%).

TABLE VIII: Leases Granted by the British Hong Kong versus HKSAR

	(1)	(2)	(3)	(4)	(5)	(6)
Dep Var	Log (Unit Price)			Log (Total Price)		
I(2030 ≤ Lease ≤ 2033)	-0.042	-0.043	-0.062	-0.028	-0.032	-0.051
	[0.043]	[0.044]	[0.046]	[0.046]	[0.045]	[0.050]
I(2034 ≤ Lease ≤ 2039)	-0.039	0.001	-0.021	-0.042	0.001	-0.027
	[0.038]	[0.038]	[0.037]	[0.042]	[0.041]	[0.041]
I(2040 ≤ Lease ≤ 2046)	-0.030	-0.015	-0.012	-0.019	-0.005	0.003
	[0.058]	[0.057]	[0.059]	[0.060]	[0.059]	[0.061]
I(7/1/2047 ≤ Lease ≤ 2049)	-0.168***	-0.148***	-0.150***	-0.176***	-0.152***	-0.158***
	[0.029]	[0.026]	[0.030]	[0.030]	[0.027]	[0.031]
I(2050 ≤ Lease ≤ 2052)	-0.150***	-0.141***	-0.147***	-0.151***	-0.141***	-0.146***
	[0.030]	[0.028]	[0.030]	[0.032]	[0.029]	[0.032]
I(2053 ≤ Lease ≤ 2064)	-0.135***	-0.097***	-0.125***	-0.138***	-0.097***	-0.126***
	[0.032]	[0.027]	[0.033]	[0.033]	[0.028]	[0.035]
I(2065 ≤ Lease ≤ 2097)	-0.099***	-0.085***	-0.092***	-0.101**	-0.086**	-0.095**
	[0.035]	[0.033]	[0.036]	[0.043]	[0.040]	[0.044]
I(2098 ≤ Lease ≤ 2135)	-0.020	-0.012	0.000	-0.027	-0.018	-0.007
	[0.038]	[0.035]	[0.039]	[0.040]	[0.037]	[0.041]
I(2842 ≤ Lease ≤ 2959)	-0.049	-0.032	-0.034	-0.051	-0.032	-0.036
	[0.035]	[0.034]	[0.037]	[0.038]	[0.036]	[0.040]
I(7/1/2047 ≤ Lease ≤ 2064)	0.085***	0.074***	0.073***	0.088***	0.075***	0.074***
× I(HKSAR Leases)	[0.027]	[0.025]	[0.027]	[0.028]	[0.026]	[0.028]
Property Attributes	Yes	No	Yes	Yes	No	Yes
Property Attributes × Year	No	Yes	No	No	Yes	No
District × Month FE	Yes	Yes	Yes	Yes	Yes	Yes
N	551,790	551,790	525,730	551,790	551,790	525,730
Adj R^2	0.9294	0.9409	0.9321	0.9425	0.9511	0.9443

This table presents the baseline hedonic housing price regression results with an additional dummy for the leases granted by the HKSAR. The sample includes the housing transactions in Hong Kong from 1998 to February, 2020. The following four variables are trimmed at 1% percentiles: unit price, total price, net size, and building age. The dependent variable is the log of unit price in Columns (1)-(3) and the log of total price in Columns (4)-(6). Columns (1) and (4) have the same controls as Column (1) in Table IV. In Columns (2) and (5), we control for the interactions of property and building characteristics with year. Columns (3) and (6) are similar to Columns (1) and (4), respectively, except that observations with missing number of bedrooms and living rooms are excluded. Standard errors are two-way clustered by estate and year-month. Asterisks denote significance levels (***=1%, **=5%, *=10%).

TABLE IX: Model Estimations

	(1)	(2)	(3)	(4)	(5)	(6)
	Base	Extension	Base: Alternative κ			
Gross Rental Yield	2.00%	2.00%	1.00%	3.00%	4.00%	5.00%
κ	1.44%	1.44%	0.72%	2.16%	2.88%	3.60%
λ^{Pre}	0.000	0.000	0.000	0.000	0.000	0.003
	[0.004]	[0.019]	[0.003]	[0.004]	[0.003]	[0.003]
λ^{Post}	0.017***	0.020***	0.015***	0.020***	0.024***	0.024***
	[0.003]	[0.003]	[0.002]	[0.004]	[0.005]	[0.005]
δ^{Pre}_{HK}		0.028***				
		[0.056]				
δ^{Pre}	0.069***	0.090***	0.045***	0.097***	0.131***	0.154***
	[0.008]	[0.033]	[0.005]	[0.011]	[0.015]	[0.018]
δ^{Post}	0.212***	0.225***	0.130***	0.317***	0.463***	0.718***
	[0.021]	[0.110]	[0.012]	[0.027]	[0.031]	[0.053]
γ	0.203***	0.246***	0.267***	0.206***	0.234***	0.283***
	[0.008]	[0.207]	[0.008]	[0.0084]	[0.010]	[0.012]
N	551,790	551,790	551,790	551,790	551,790	551,790

This table reports the 2-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 κ equals to $1-28\% = 0.72$ multiplying the corresponding Gross Rental Yield. Standard errors are reported in [ ]. Asterisks denote significance levels (***=1%, **=5%, *=10%).

TABLE X: Political Uncertainty by Building Age Group

	(1)	(2)	(3)	(4)
	Log (Unit Price)		Log (Total Price)	
Dep Var	Age $\leq$ 5	Age $\geq$ 6	Age $\leq$ 5	Age $\geq$ 6
I(2030 $\leq$ lease $\leq$ 2046)	-0.088**	-0.041	-0.087*	-0.036
	[0.042]	[0.032]	[0.047]	[0.034]
I(7/1/2047 $\leq$ lease $\leq$ 2049)	-0.145***	-0.173***	-0.153***	-0.181***
	[0.035]	[0.030]	[0.037]	[0.031]
I(2050 $\leq$ lease $\leq$ 2052)	-0.123***	-0.160***	-0.123***	-0.161***
	[0.034]	[0.032]	[0.035]	[0.034]
I(2053 $\leq$ lease $\leq$ 2064)	-0.111***	-0.140***	-0.115***	-0.142***
	[0.041]	[0.031]	[0.043]	[0.032]
I(lease $\geq$ 2065)	-0.073	-0.052	-0.077	-0.056
	[0.051]	[0.032]	[0.058]	[0.034]
I(7/1/2047 $\leq$ lease $\leq$ 2064) $\times$ I (HKSAR leases)	0.081**	0.093***	0.085***	0.093***
	[0.032]	[0.028]	[0.033]	[0.029]
Property Attributes	Yes		Yes	
District $\times$ Month FE	Yes		Yes	
N	551,790		551,790	
Adj R^2	0.9293		0.9425	

This table estimates price discounts for our treatment lease groups and colonial leases by different building age groups. The sample includes the housing transactions in Hong Kong from 1998 to February, 2020. The following four variables are trimmed at 1% percentiles: unit price, total price, net size, and building age. The dependent variable is the log of unit price in Columns (1)-(2) and the log of total price in Columns (3)-(4). Columns (1) and (3) present the analysis of price discount based on the subsample in which buildings are less than 6 years old at the time of sale, and Columns (2) and (4) present the analysis based on the subsample in which buildings are more than 5 years old at the time of sale. All the controls are the same as Column (1) in Table VIII. I(HKSAR leases) equals to 1 if the leases were auctioned by the HKSAR government on and after July 1^{st}, 1997 and 0 otherwise. Standard errors are two-way clustered by estate and year-month. Asterisks denote significance levels (***=1%, **=5%, *=10%).

TABLE XI: 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: Main Lease Groups Interacted with District Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)
Dep Var	Log (Unit Price)					
I($7/1/2047 \leq lease \leq 2064$)	-0.132***	-0.146***	-0.131***	-0.127***	-0.112***	-0.090***
	[0.021]	[0.020]	[0.021]	[0.021]	[0.023]	[0.025]
× % of Pro-Democracy Seats		-0.052***		-0.049***		
		[0.012]		[0.012]		
× % of Mainland Migrants			-0.082***	-0.077***		
			[0.024]	[0.024]		
× I(High % Pro-Democracy Seats)					-0.086***	
					[0.021]	
× I(High % Mainland Migrants)						-0.106***
						[0.025]
× Median Age		-0.014	-0.039***	-0.016	-0.023	-0.047***
		[0.015]	[0.014]	[0.014]	[0.015]	[0.014]
×Median Income		-0.012	-0.044	-0.036	-0.010	-0.054*
		[0.028]	[0.031]	[0.029]	[0.028]	[0.031]
× % of College Above		0.017	0.029	0.032	0.013	0.046
		[0.031]	[0.030]	[0.030]	[0.030]	[0.031]
× % of Home Owners		0.028	0.004	-0.005	0.035	0.021
		[0.024]	[0.027]	[0.025]	[0.024]	[0.024]
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
Adj R^2	0.9288	0.9301	0.9300	0.9305	0.9300	0.9301

Panel D: Adding Interaction with HKSAR Leases

	(1)	(2)	(3)	(4)	(5)	(6)
Dep Var	Log (Unit Price)					
I(7/1/2047 $\leq$ *lease* $\leq$ 2064)	-0.153***	-0.156***	-0.145***	-0.148***	-0.114***	-0.113***
	[0.022]	[0.021]	[0.021]	[0.021]	[0.024]	[0.028]
× % of Pro-Democracy Seats		-0.057***		-0.054***		
		[0.013]		[0.013]		
× % of Mainland Migrants			-0.064***	-0.057***		
			[0.022]	[0.022]		
× I(High % Pro-Democracy Seats)					-0.093***	
					[0.026]	
× I(High % Mainland Migrants)						-0.073**
						[0.028]
× HKSAR Leases	0.084***	0.077***	0.085***	0.078***	0.077***	0.106***
	[0.026]	[0.024]	[0.027]	[0.026]	[0.026]	[0.036]
× % of Pro-Democracy Seats		-0.001		0.004		
		[0.019]		[0.020]		
× % of Mainland Migrants			-0.016	-0.014		
			[0.038]	[0.038]		
× I(High % Pro-Democracy Seats)					-0.002	
					[0.037]	
× I(High % Mainland Migrants)						-0.042
						[0.043]
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
Adj R^2	0.9294	0.9304	0.9301	0.9309	0.9301	0.9300

This table presents the district-level variation of price discounts for our main treatment lease group, which includes the leases expiring between 7/1/2047 and 12/31/2064. The sample includes the housing transactions in Hong Kong from 1998 to February, 2020 matched with the district variables. We calculate the % of Pro-Democracy Seats using district voting data in 1999, 2003, 2007, 2011, 2015, 2019. We merged this variable with property transaction data by matching voting year to transaction years within [voting year-1, voting year+2]. Other district variables are calculated using Census survey data in 2001, 2006, 2011, 2016. % of Mainland Migrants is the percentage of households with heads born in Mainland. Median Age is the median age of survey participant. Median Income is the median income of survey participants who are employed. % of College Degree or Above is the percentage of survey participants with bachelor's degree or higher among those who are older than 25 years. % of Home Owners is the percentage of household who own their homes. We merged census district variables with property transaction data by matching census year and transaction year within [transaction year-4, transaction year]. For transaction data from 2017 to 2020, we merge them with census data in 2016. For ease of interpretation, we standardize the district variables to mean 0 and standard deviation 1. Panel A reports the summary statistics of raw values. Panel B reports the correlations of standardized values. Panel C presents the hedonic regression results on the effect of main treatment group interacted with % of Pro-Democracy Seats and % of Mainland Migrants, respectively. The dependent variable is the log of unit price. The regression setting is the same as Column (1) in Table IV with additional controls including the interaction of main treatment indicator and Median Age, Median Income, % of College Above, % of Home Owners. I(High % of Pro-Democracy Seats) equals to 1 if the variable is above the median of the district cross section, and 0 otherwise. I(High % of Mainland Migrants) is defined using the same logic. Panel D presents similar analysis as Panel C with additional interaction terms of the HKSAR leases dummy with % of Pro-Democracy Seats and % of Mainland Migrants, respectively. Standard errors are two-way clustered by estate and year-month. Asterisks denote significance levels (***=1%, **=5%, *=10%).

TABLE XII: Mainlander Transactions and Price Discount

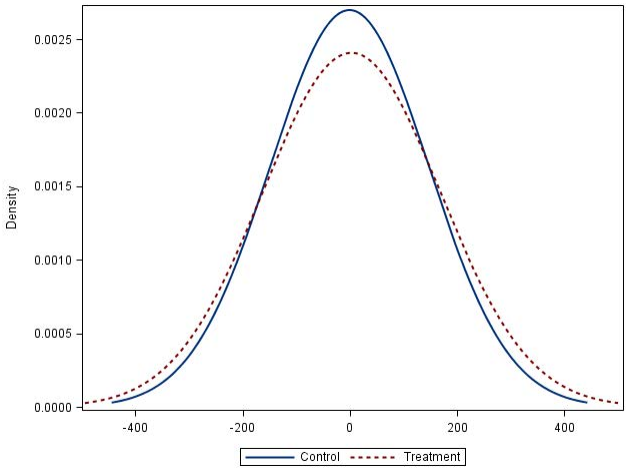
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep Var	Log (Unit Price)							
I(7/1/2047 $\leq$ *lease* $\leq$ 2064)		-0.117***		-0.116***		-0.117***	-0.072***	-0.116***
		[0.021]		[0.021]		[0.021]	[0.023]	[0.020]
× I(Mainland Buyer)		0.011						
		[0.008]						
× I(Mainland Seller)				-0.016**				
				[0.008]				
× I(Mainland Buyer) × I(Local Seller)						0.014*	-0.016	0.014*
						[0.008]	[0.019]	[0.008]
× I(Mainland Buyer) × I(Mainland Seller)						0.002	-0.010	0.004
						[0.012]	[0.036]	[0.012]
× I(Local Buyer) × I(Mainland Seller)						-0.016**	0.023	-0.015**
						[0.008]	[0.024]	[0.007]
I (Mainland Buyer)	0.019***	0.015***						
	[0.003]	[0.003]						
I (Mainland Seller)			-0.002	0.002				
			[0.003]	[0.003]				
I(Mainland Buyer) × I(Local Seller)					0.021***	0.016***	0.001	0.020***
					[0.003]	[0.003]	[0.005]	[0.004]
I(Mainland Buyer) × I(Mainland Seller)					-0.013**	-0.015*	-0.009	-0.015*
					[0.006]	[0.008]	[0.020]	[0.008]
I(Local Buyer) × I(Mainland Seller)					0.000	0.004*	0.003	0.004
					[0.003]	[0.003]	[0.005]	[0.003]
Property Attributes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District × Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Start	1998	1998	1998	2008	1998	1998	1998	2007
End	2020	2020	2007	2020	2020	2020	2006	2020
N	457,575	457,575	457,575	457,575	457,575	457,575	145,759	311,816
Adj R^2	0.9322	0.9343	0.9321	0.9342	0.9322	0.9343	0.8379	0.9238

This table presents the pricing difference of mainland buyers and mainland sellers. The sample includes the housing transaction records in Hong Kong from 1998 to February, 2020. The following four variables are trimmed at 1% percentiles: unit price, total price, net size, and building age. Only transactions with mainland or Hong Kong buyers/sellers are included. The dependent variable is the log of unit price. I(Mainland Buyer) equals to 1 if the assignee name is identified as mainlanders, and 0 if the assignee name is identified as Hong Kong locals. I(Mainland Seller) equals to 1 if the assignor name is identified as mainlanders, and 0 if the assignor is identified as Hong Kong locals. I(Local Seller) equals to 1 if the assignor name is identified as Hong Kong locals, and 0 if the assignor name is identified as mainlanders. The regression controls are the same with Column (1) in Table IV with additional controls including the interaction term of main treatment indicator with Median Age, Median Income, % of College Above, % of Home Owners as defined in Table XI. Standard errors are two-way clustered by estate and year-month. Asterisks denote significance levels (***=1%, **=5%, *=10%).

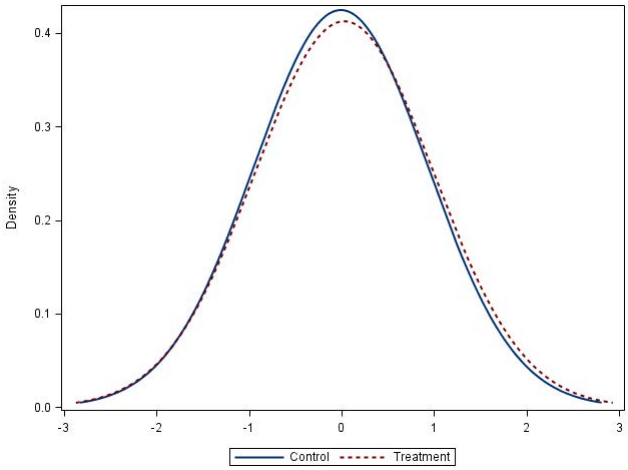
Appendix

Figure A.1. Distribution of Residuals

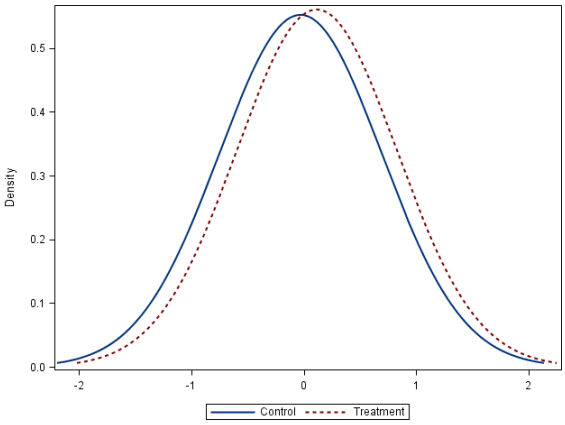
(A) Net Living Area



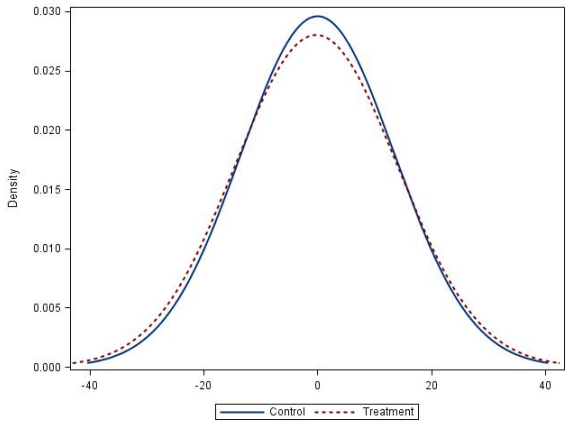
(B) No of Bedrooms



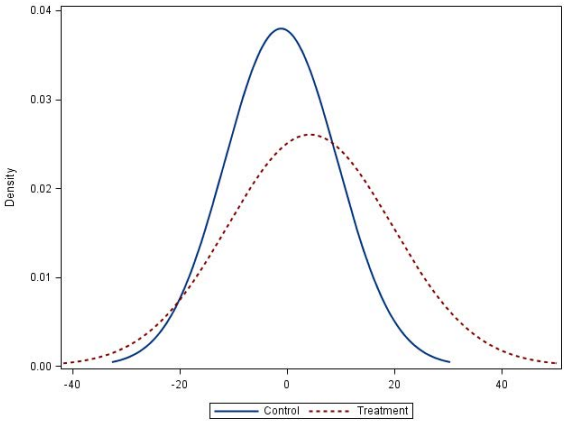
(C) No of Living Rooms



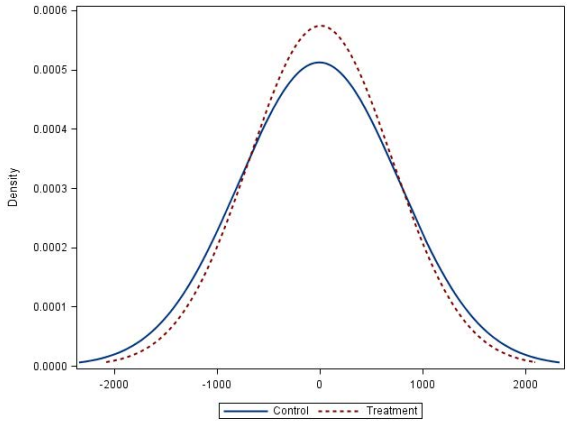
(D) Bay Window Size



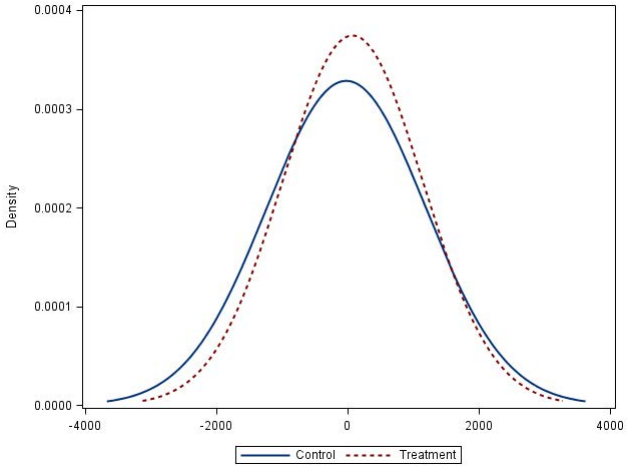
(E) Distance to MRT stations



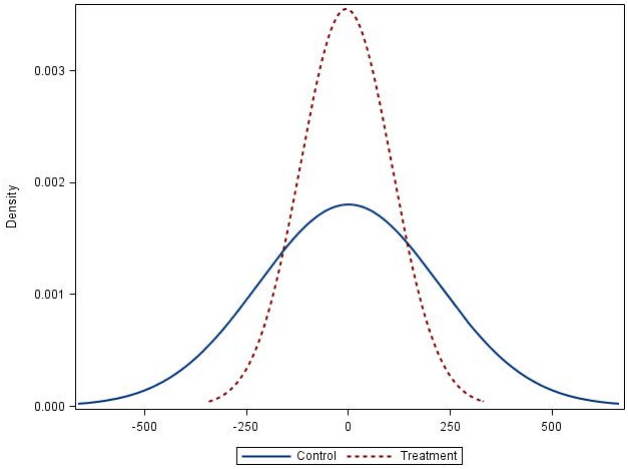
(F) Distance to Bus Stops



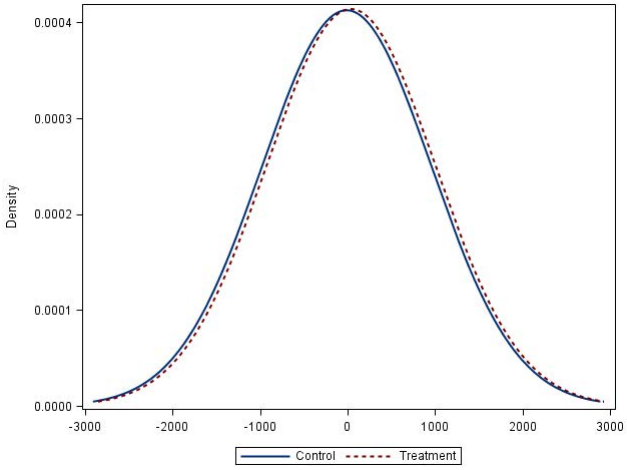
(G) Distance to School



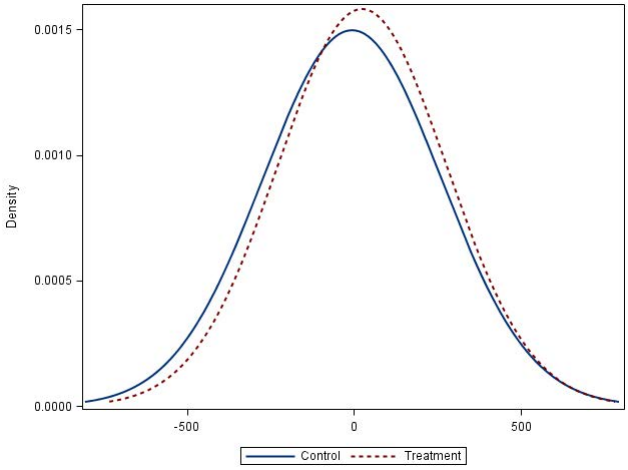
(H) Distance to University



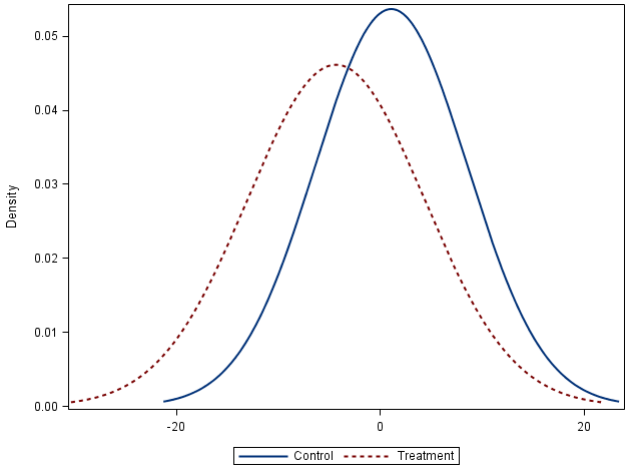
(I) Distance to Coastal Line



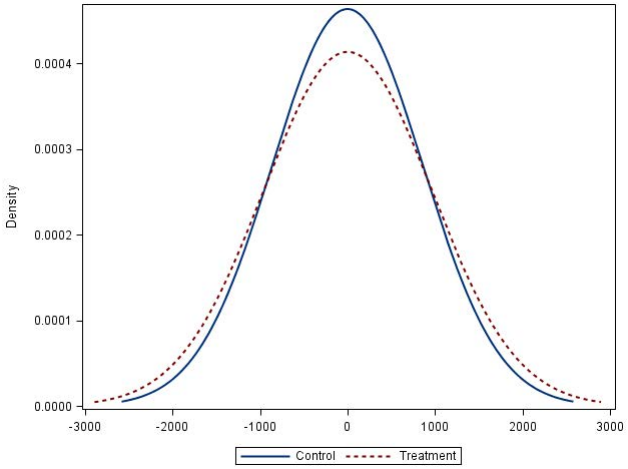
(J) Distance to Hospital



(K) Building Age



(L) Turnover



This figure plots the residuals from regressing each property characteristic on the district fixed effects for our control lease group [6/30/2047] and main treatment group [7/1/2047, 2064].

A. Appendix

A.1. Valuation of Colonial Leases with Nominal Ground Rent

In Section 3.1 the net cash flow $R_s = e^{gs}$ is under the setting of current baseline ground rent, with 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:

$$P(L;\tau,Brit) = \mathbb{E}\left[\int_0^{L\wedge\mathcal{T}} (C_1 e^{-\kappa s} - C_2)ds + e^{-\kappa(L\wedge\mathcal{T})}\cdot(1-\delta^{pre}\mathbf{1}_{s<\tau} - \delta^{post}\mathbf{1}_{s\geq\tau})\cdot P(L\wedge\mathcal{T}+50;HK)\right]. \tag{12}$$

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 ω is the percentage of repairing costs and taxes in the gross rent. Here, 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.