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Valuation of Long-Term Property Rights under Political Uncertainty

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Valuation of Long-Term Property Rights under Political Uncertainty*

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Abstract

We empirically analyze 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. 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 the estimated discounts across long-term lease horizons, and implies that to extend their leases homeowners expect about 25% of penalty on ground rent after 2047. The discount is higher when people's confidence declines and where residents feel more uncertain of the city's future.

Keywords: Long-term contracting, Commitment, Housing, Land lease, Asset pricing, Reneging risk.
JEL Classification: G11, G12, G18, R30

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1. Introduction

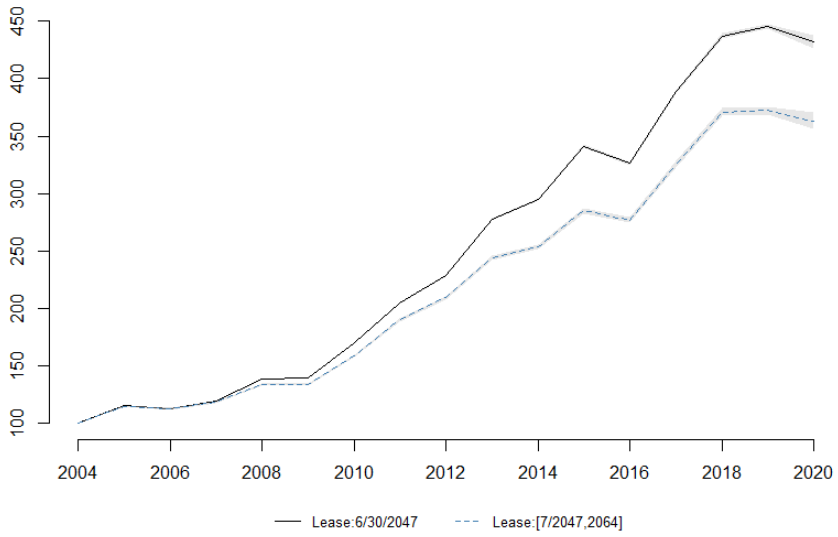
It has been widely recognized that political uncertainty plays a significant role in asset valuations as well as economic activity (for example, Pástor and Veronesi, 2013; Baker et al., 2016; Hassan et al., 2019). While most of the existing evidence on the connection between political uncertainty and 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 that are 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,[1] our setting offers several advantages to study this topic. 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 its ongoing 2019–20 social unrest. Second, all land in Hong Kong is leasehold, in which land tenure is granted to lessee by the government for a fixed term; this is subject to renewal/extension at the end of term 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. The main empirical challenge in exploring the relationship between political uncertainty and

[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).

Figure 1. 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 types of land leases in Hong Kong from 2004 to 2020. The first type of land lease expires on 6/30/2047, while the second type expires between 7/1/2047 and 12/31/2064. The 95% confidence intervals of price indices are indicated by the grey shaded area.

asset valuation 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 unprotected legally. The different treatment is rooted in the historical arrangements the "One Country, Two Systems" design which are all set to expire on July 1$^{\text{st}}$, 2047, giving rise to the largest political uncertainty regarding any lease renewal after that point.

Although our later analysis focuses on the level difference between the above-mentioned two housing assets, i.e., one with land leases expiring on June 30$^{\text{th}}$, 2047 and the other with leases expiring after that date, we show as important motivating evidence that home price trajectories of these two groups appear to diverge over time. Figure 1 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 had similar trends from 2004 to 2010, but have since become increasingly divergent. From 2004 to 2019, houses with land leases expiring after that date 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 June 30$^{\text{th}}$, 2047.

Our empirical analysis is guided by a theoretical asset pricing framework where we incorporate different land lease extension policies facing the political uncertainty after 2047 into housing valuation. The model assumes a "natural" housing rent as well as a ground rent mandated by the government for leasing the land, typically calculated as a percentage of the property's rateable (rental) value. The ground rent is subject to change, instead of being kept constant at 3% per today's practice, upon the next lease renewal in the future, affecting the house's value in present transaction. 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. Since the 50-year renewal 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, this fixed-term lease extension protection predicts that house prices should increase with their lease expiration years approaching 2047. As a result, 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 small or no discount relative to the control group.

We provide strong empirical support for our theoretical model using the property and land transactions in Hong Kong and hedonic regressions. Relative to the control group whose leases are set to expire on June 30$^{\text{th}}$, 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 with an estimated discount statistically insignificant from zero. 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.

We also find properties with colonial leases granted by the British Hong Kong governments are sold at significantly greater discount—about another 8%—than leases expiring in similar years but granted by the HKSAR. This suggests that property rights granted by the British colonial government are subject to another layer of political uncertainty. Homeowners assess a reneging risk in these legacy leases due to the expectation that the future government will be still under China's rule and thus more aligned with the HKSAR than the British colonial government.

We hence extend our baseline model by incorporating a reneging risk with lease extension penalty applied to the land lease contracts granted during the colonial era (i.e., before 1997). This full-blown model is calibrated/estimated, in that we search for the parameters that minimize the difference between the model-implied discounts and the empirical estimates, both relative to the control group. The resulting calibration implies that under the risk-adjusted measure, after the HKSAR ceases to exist in 2047 homeowners expect a 25% penalty as a fraction of the house rental value to renew their expired land leases; and British Hong Kong leases are expected to be reneged every 74 years with an additional penalty of 13% of the house value upon receiving a 50-year HKSAR-style renewal contract.

We further establish the link between the relative valuation discount embedded in land leases and the political uncertainty faced by Hong Kong. Interestingly, according to surveys that measured citywide sentiment, the estimated lease discount has appeared to increase over time since 2004 as people's confidence in Hong Kong's future has declined, reaching about 20% for leases expiring between 2047 and 2064 in recent years.

To provide plausible economic mechanisms, we construct two local political sentiment measures that are time-varying district-level characteristics that are unique to Hong Kong. The first measure is the percent of pro-democracy seats from district council elections, which captures the local residents' discontent due to fear and panic of losing a "high degree of autonomy" promised under the "One Country, Two Systems" design. 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 toward cultural influences from the mainland and their increasing fear of losing their own identity.

As expected, both local political sentiment 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 of pro-democracy seats as well as in the percentage of mainland migrants at the local district level is associated with an additional discount of 4.0 percentage points (or 27% increase in the base effect) and 9.4 percentage points (or 75%) for the treatment lease group. Both measures, which might well reflect both causes and consequences in a complicated political economy equilibrium in Hong Kong, yield a significant effect of sentiments in political uncertainty on the estimated price discount in the remote future.

Literature Review. In a related work, Giglio et al. (2015a) 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, which also includes another paper of theirs (Giglio et al., 2015b), which study the appropriate 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. (2015a), our paper differs in a significant way as we aim to identify the 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 were 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. (2015a). 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) as well as Grossman and Hart (1986) and Hart and Moore (1990). 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, in turn decreasing corporate investment. Several studies explore the relationship between term structure and long-run properties of risky assets (van Binsbergen et al., 2012; Pindyck, 2013; Barro, 2015). More generally, Hansen (2014) develops and applies methods for pricing the exposure to macroeconomic shocks over alternative investment horizons and investigates the implications of the pricing of long-term uncertainty.

Instead, we highlight the effect of political uncertainty in the context of Hong Kong on a major asset class on households' balance sheets. 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. Our angle is also novel in that we investigate the effect of political uncertainty on the decision-making of households who are believed to be not as sophisticated as institutional investors.

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, sample construction, summary statistics, and empirical design in Section 4. Our main baseline analysis is also presented in Section 4 while Section 5 presents additional results on reneging risk along with extended and calibrated model results. In Section 6, we explore 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 in the past several decades.

2.1. A Brief History of Hong Kong

We offer a brief introduction of Hong Kong and its relationship with China in this section, which lays the foundation for the concept of "One Country, Two Systems."

2.1.1. Before the 1997 Handover

The region of 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, the last dynasty in 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 they must lease the New Kowloon and New Territories to Britain for 99 years until June 30$^{\text{th}}$, 1997, which had become the legal basis of the handover, decades later, 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 and ended up with the Sino-British Joint Declaration (JD) signed on December 19$^{\text{th}}$, 1984 and ratified on May 27$^{\text{th}}$, 1985. The JD lays out 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 adopted by China's National People's Congress on April 4$^{\text{th}}$, 1990, and came into effect on July 1$^{\text{st}}$, 1997 to replace Hong Kong's colonial constitution of the Letters Patent and the Royal Instructions. The Basic Law, as the de facto constitution of the HKSAR, describes the relationship between the HKSAR and China, and how Hong Kong, as a highly-autonomous region of China, practises different legal and political systems. This reflects the principle of "One Country,

Two Systems," a topic we turn to in Section 2.2.

2.1.2. After the 1997 Handover

After the handover in July 1997, Hong Kong has experienced significant changes in all aspects of society, not only demographically and culturally, but also economically and politically. While the Basic Law guarantees a high degree of autonomy under Chinese sovereignty, it is not without controversy and debate. Concerns over the possibility of central government's interference in Hong Kong's affairs, especially civil and political rights, have been present since the handover and intensified over the years.

A major sticking point has been article 23 in the Basic Law, which requires Hong Kong to enact local national security laws that prohibit treason, secession, sedition, subversion against the central government, theft of state secrets and foreign organizations from conducting political activities in Hong Kong. In 2003, the Hong Kong government tabled the National Security Bill, which triggered a series of massive protests in the years that followed, most notably the 2014 Umbrella Revolution or Occupy Central movement, and the ongoing 2019–2020 social unrests.

After the 2004 Legislative Council (LegCo) election, political parties and politicians from different political ideologies joined hands to form two broad political alignments: the pro-establishment camp, which is perceived to be more supportive of the HKSAR and Chinese central government; and the pro-democracy camp or pan-democrats, 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). Many new political groups emerged from the Umbrella Revolution, labelled "localists," and called for "self-determination" or Hong Kong independence from Chinese rule as many of them considered "One Country, Two Systems" to have failed. Following the massive protest triggered by the extradition bill in 2019, the pro-democracy camp achieved its biggest victory in the history of Hong Kong in the 2019 Hong Kong local elections, gaining control of 17 of the 18 district councils and tripling their seats from around 124 to about 388.

2.2. "One Country, Two Systems"

"One Country, Two Systems" is a constitutional principle of the PRC describing the governance of Hong Kong and Macau since they became Special Administrative Regions of China in 1997 and

1999, respectively. As an unprecedented political experiment, it was formulated in the early 1980s by the then-leader Deng Xiaoping during negotiations with the United Kingdom over Hong Kong. He suggested that there would be only one China to maintain the sovereignty, but these regions could retain their own economic and administrative systems, while the rest of mainland China uses the "socialism with Chinese characteristics system." As the signature political arrangement of Hong Kong, the system has been implemented through the Basic Law, under which Hong Kong as a Special Administrative Region of China enjoys a high degree of autonomy and will retain its capitalist society, including legal and legislative systems, for at least 50 years, until July 1st, 2047.[2]

2.3. The Economy and Housing Market in Hong Kong

As China's economy surges to the second in the world by GDP, Hong Kong's economy has become increasingly more dependent on the mainland over the years, causing significant shift in business lives in Hong Kong. It is widely believed that the sky-high property prices fueled by mainland property investors have diminished the prospect that young adults might be able to afford their own homes in their lifetime. 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. The typical mortgage in Hong Kong has a 30-year term whose collateral value in underwriting the loans by a financial institution depends on the perpetuity and continuity of land ownership. The price the household pays to buy the property is a present value of expected net cash flows in the future, including those beyond the current land lease term. Thus the participants in housing market, both the households and financial institutions, are exposed to

[2]As stipulated by the Basic Law, while foreign affairs and defence remains the purview of the central government, Hong Kong is guaranteed a high degree of autonomy under Chinese rule. The Basic Law provides constitutional protection on various fundamental human rights and freedoms; for instance, Article 18 states that all national laws, except the Constitution, are not enforced in Hong Kong unless they are listed in Annex III. However, the same Article 18 of the Basic Law says that in events that endanger national security in Hong Kong the central government may issue an order applying the relevant national laws; and Article 23 requires Hong Kong to enact local national security laws that prohibit treason, secession, sedition, subversion against the central government, theft of state secrets and foreign organisations from conducting political activities in Hong Kong. In 2003, the HKSAR tabled the National Security Bill amid widespread social protests. In 2015, the proposed electoral reform failed to pass the LegCo, further deepening the mistrust that existed among different political parties. In June 2020, a partially equivalent law was enacted by the China's National People's Congress instead of the Hong Kong LegCo, and was added to Annex III.

the risk in property value due to the change in political uncertainty, making it uniquely suitable to study the effect of political uncertainty on asset price.

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. Demographia (2019) rates the housing in Hong Kong the most unaffordable among all 309 worldwide cities based on the ratio of median household income to median home price, known as price to income ratio. The Hong Kong price to income ratio stands at 20.8, which far exceeds 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.

2.4. Land Tenure System and Land Policy in Hong Kong

The real estate and property market plays an important role in the financial and economic stability in Hong Kong (Peng et al., 2001). Although almost all the lands in Hong Kong are owned by the British government during the colony era and now 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 versus fee simple prevalent in U.S. 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 chief executive's power to renew the renewable leases at its expiration date and extend the non-renewable leases. The HKSAR Lands Department sets the policy to be premised on the basic guiding principles of 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 the exactly the focus of our paper.

2.4.1. Leaseholds Granted Prior to 1984

Table 1 summarizes different types of land leases. The earliest land leases in Hong Kong dated back to 1843 with a period of 999 years, labeled as Type 1.[3] 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. From 1899 to 1985, the British government had widely implemented "75 + 75" year leases, with a single right of renewal ("+") for another 75 years period after the initial 75–year term. Exceptions include some 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 1. There are also non-renewable leases in New Kowloon and New Territories that expired on June 27$^{\text{th}}$, 1997, due to historical reasons (Type 4).

The government has had to make two decisions in renewing land leases. The first is recalculating the ground rent at renewal (e.g., 1974 for "75 + 75" leases auctioned from 1899); it was determined to be 3% of rateable value,[4] fixed throughout the lease period, and this practice has been in effect ever since. The second is whether to regrant or extend non-renewable leases upon their expiry (e.g., 1951 for the 75-year Kowloon leases auctioned from 1876). In 1946, the government announced that unless the land is needed for public purposes, it would offer regrants using the contemporary zone crown rental and assessing the full and fair market value of the land lease (excluding buildings). In the years that followed, the government also offered various concessions to bring down the land premium required for regrants.[5]

2.4.2. Leaseholds Granted or Regranted After 1984

The 1984 JD states that new leases could be granted during the transition period for terms expiring no later than June 30$^{\text{th}}$, 2047. Because of this, almost all the leases (Type 5 in Table 1) granted from the effective date of the JD (May 27$^{\text{th}}$, 1985) through June 30$^{\text{th}}$, 1997 are set to expire on June 30$^{\text{th}}$, 2047, so their terms range from 50 to 62 years.

[3]For example, the Consulate General of the United States, located at 26 Garden Road, Central, Hong Kong, sits on an 999-year lease. Although the original lease stated that it had a lease term of 75 years, renewable for 75 years in 1960, the Hong Kong government, later ratified by the HKSAR in 1999, extended the lease term to 999 years backdated to April 19, 1950.

[4]Rateable value is basically an estimate of the annual rent achievable for the property. Because the rents are fixed upon renewal, they decline in real terms due to inflation over the 75– or 95–year lease.

[5]In the two examples mentioned above, we observe their final expiration years in the data, 2049 for "75 + 75" leases auctioned from 1899, and 2026 for the 75-year Kowloon leases auctioned from 1876, making them similar in our setting. The only difference is that the latter is required to pay additional land premium at regrant and subject to stepwise rateable value.

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

The extended leases are subject to an annual ground rent of 3% of the property's rateable value, which will be adjusted in step with any changes in rateable value thereafter. Although the government may require the lessee to pay additional premium that reflects market appreciation of the land value when applying for lease renewal and extension, the actual practice is much more lenient and flexible. For example, according to lease modification transactions in 2012 that are publicly available on the Lands Department website, all 96 applications were granted, with only 29 of them requiring payment of an additional premium (6 applications were required to pay a nominal value of HKD 1,000).

The HKSAR also grant new land leases after the handover. This group of land leases, corresponding to Type 6 in Table 1, will expire 50 years after the initial land auction date. For example, those granted on July 1st, 1997 are set to expire on July 1st, 2047; and those on July 1st, 2000, are set to expire on July 1st, 2050, and so forth.

2.5. Political Uncertainty and Legitimacy of Leasehold Extensions Beyond 2047

Thus far, the HKSAR practices have been to i) extend the non-renewable leases without requiring an additional land premium instead requiring an annual ground rent of 3% of rateable value that is adjusted in step with its market value; and ii) set the ground rent for renewable leases at 3% of rateable value that is fixed throughout the term. This is aimed to provide as much clarity in the land tenure system and land policy and to minimize the possible disruption to the housing market. Despite the practice, several uncertainties of the renewal policy remain: (1) whether the government will renew land leases in the future; (2) if yes, whether the government will require additional land premium and/or increase the ground rent to above the current 3% rateable level fixed at renewal.

The policy uncertainty regarding the land lease renewal policy in Hong Kong, which lies at the center of the long-term property rights, has always existed, resulting in market confusion and valuation fluctuations in Hong Kong's housing market throughout its history. It is worth emphasizing, though, that the effect of policy uncertainty manifests only when it intertwines with changes in the

political uncertainty of Hong Kong itself. 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 renewed/extended by the HKSAR beyond its official expiration date (i.e., July 1st, 2047) a focal point.

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

The legitimacy of renewal extension beyond July 1st, 2047, made by the HKSAR, besides being respected by the new Hong Kong government in the post-HKSAR era, is an important assumption underpinning our analysis. We will come back to this point in Section 3.3 after presenting our theoretical framework in the next section.

3. A Pricing Model of Housing Asset with Political Uncertainty

The model in this section lays out the theoretical framework that connects political uncertainty with asset pricing and serves two goals for 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 for a long-term asset (i.e., a real estate property) with different renewal dates over its life horizon. In our model setup, we use renewal, extension, and regrants interchangeably. Section 3.3 then clarifies the underlying driving force of the relative discount in our model.

Second, the theoretical framework also allows us to further incorporate the "reneging risk" to capture the relative discount of British colonial leases and the HKSRA leases, a robust empirical pattern established later in Section 5.1.

Last, and perhaps the most important, today's price of a long-term asset depends on the entire stream of cash flows in the future in any typical asset pricing model. By establishing a link between the observed housing transaction prices and the (expected) future schedule of ground rent as well as

the 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 deep structural parameters from price discounts estimated from real transaction data. This is exactly what we do in Section 5 on model calibration.

3.1. Model Setup

Consider an infinite-horizon model of a housing asset that generates a "natural" rent (or 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 $\frac{1}{1-3\%}$. Assuming a constant discount rate r and that the rent grows at a constant rate g, we see that

$$\hat{R}_t = \frac{e^{gt}}{1-3\%}.$$

As explained in Section 2.4, homeowners build properties on land leased from the government and are required to pay a ground rent, set at 3% of the rateable—a relatively small number—as of now. Before the lease expires, a homeowner's net cashflow from the property can be expressed as

$$R_t = \hat{R}_t\,(1-3\%) = e^{gt}. \tag{1}$$

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 considered to be extended 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 and land premium (beyond 3% of the rateable).

In general, we define the extra ground rent as $f_s^{(\tau)}$,[6] imposed by the government on land leases upon renewal at a future time s by

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

[6]Here, $f_s^{(\tau)}$ captures both the additional ground rent (assuming that the rateable value always adjusts in step with market value.) and potential additional premium, paid by the government lessee (the 'owner') to the government in return for the right to hold and occupy the land for the term specified in the lease document. Government may charge additional ground rent by increasing the current 3% to a higher percentage. Land premium is an upfront 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 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 1$^{\text{st}}$, 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 renewal date L, the extra 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 cashflow is

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

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 renewal, i.e., for $s \in [t, L]$, there is no additional ground rent, and hence $R_s = e^{gs}$. We can then 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

For illustration, we set $t = 0$ in this subsection. For the sake of parsimony, given the penalty parameter $\gamma \in [0, 1]$, we consider the simple schedule of additional ground rent to be:

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

The predetermined time τ is right after the deadline of the current HKSAR land policy in which the government will extend the lease for another T years without charging any additional ground rent; recall the discussion in Section 2.4.2. In the context of our paper, the HKSAR has been extending the land leases for another 50 years ($T = 50$) for leases that are set to expire before June 30$^{\text{th}}$, 2047, without additional ground rent, but renewed ground rents may increase sharply for leases set to expire after July 1$^{\text{st}}$, 2047, right after the official end date of the HKSAR government. 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 expectation of the extra discount γ remains constant. 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 regranting the land every 50 years at 3% of the rateable as well as not requiring additional land premium; γ is the probability of the post-2047 Hong Kong government taking back the land completely (or charging a 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 extra ground rent and/or land premium 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 2 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 dashed red vertical line. In Figure 2 we also plot the cutoff years in blue dotted vertical lines for several boundaries of leasehold groups constructed 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 renewed right before τ and hence enjoy the normal ground rent of 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 underlying assumption 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 renewal/regrant policy after 2047, we assume that the renewal decision 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 land leases that expire right before 2047 face no discount in the next 50 years but those expiring right after do, driving the sharp downward jump in Figure 2 at $L = \tau$.

Exactly on this point, Section 2.5 explains the legitimacy of the HKSAR to extend 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 precedence of policy continuity is respected in the previous negotiations between the United Kingdom, China, and Hong Kong, and the policy announced on July 15$^{\text{th}}$, 1997, appeared to have implicit approval from the central government in Beijing. In other words, 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.

Even if these leases granted by HKSAR might not be fully honored in the case of a complete collapse of the "One Country, Two Systems" principle, the possibility of this dire political scenario does not invalidate our analysis. 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 should exist even under the most extreme scenario, reflects the guiding principle of "policy continuity" that is present in both Hong Kong's historical precedents after the JD as well as Beijing's practices in China's economic reform including its land policy.[7] Last, but not least,

[7]Historical precedents in Hong Kong came from the Land Leases annex (Annex III) in JD, which was signed amid periods of political uncertainty and market turbulence. The Annex guarantees that all leased lands granted by the

this underlying assumption is strongly supported by our empirical finding of a significant valuation discount regarding political uncertainty that is consistent with Figure 2, suggesting that it is widely expected that the central government in Beijing will honor the long-term property rights promised by the HKSAR.

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 data 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.

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 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 and 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.

British Hong Kong government which extend beyond June 30th, 1997, and all rights in relation to such leases, shall continue to be recognised 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 renewal fee to continue to use their residences after the shorter lease expires (Hsu, 2017).

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 the 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 longitudes and latitudes. The amenities include Mass Transit Railway (MTR), bus stop, hospitals, schools (K–12), universities, and the coastal line. 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 on to the land as a real option.

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 the 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, we require observations to have non-missing values in 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. Second, we exclude all the government housing projects based on a list of home ownership scheme courts in Hong Kong. Third, we exclude houses, townhomes, and non-arm's length transactions (e.g., deeds of gift, assignments, changes of name and sub-agreements). Fourth, we exclude 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 1998 to February 2020.

Table 2 Panel A reports the summary statistics of all the variables used in our analysis. First, the average sale price of the units is HKD 2,796,556 (logged value of 2.80 = 1.16) in total and HKD 5,534 (logged value = 8.62) per square feet. Using the exchange rate of 0.13 pegged 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 18 years. The building completion year is well populated from 1959 to 2018 with more than half of the transactions involving those built after 1993. Number of bedrooms and living rooms are both 2 on average. In our sample, most of the units have bay window, which reduces the gross living area. We also 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 2.4 based on their expiration years.

4.3.1. Control Lease Group

We first identify all the 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 2.4, 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 JD, which became effective on May 27th, 1985, all existing non-renewable leases that were going to expire before June 30th, 1997, were automatically extended to June 30th, 2047. These leases primarily cover land in New Kowloon and New Territories, shown as Type 4 in Table 1, and a small portion of such leases cover land in Hong Kong Island and Old Kowloon, shown as Type 2 in Table 1. We will come back to these leases later in Section 4.6. Second, any land auctioned between May 27th, 1985, and June 30th, 1997, i.e., after JD but before the handover, are set to expire on June 30th, 2047, shown as 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 1) will also expire in 2047, but only in the second half of the year according to the historical auction data.[8] Finally, any land auctioned by the newly established HKSAR between July 1–December 31st, 1997, will expire between July 1–December 31st, 2047,[9] which constitutes part of Type 6 in Table 1.

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, labeled as "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 2, we further decompose the pre-2047 leases into three groups: i.e., 2029–2033, 2034–2039, and 2040–2046 (Type 2 in Table 1).

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 the leases beyond 2047. These post-2047 leases are further decomposed into four groups (July 1st 2047–2049, 2050–2052, 2053–2064, and

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

[9] 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 includes the unique land lot number with land transaction price and date. There were twelve land lots auctioned between July 1–December 31st, 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 1st and December 31th, 2047. The other unmatched four land lots could have been developed as non-residential properties or could be held by developers as a real option. In Hong Kong, given the volatile housing market, it is common for developers to wait for a few years or even decades before developing the land into building properties.

2065–2097). According to our theory, the first post-2047 lease group 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 three groups (July 1st 2047–2049, 2050–2052, 2053–2064) together and call them the main treatment group.

The third group consists of those leases that are set to expire after 2097, so we call this group "distant" leases. There are two groups 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 3 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 3, 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 include all transactions with land leases expiring on 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 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 clustered at the estate and year-month level.

According to our theoretical framework in Section 3, the control group has the lowest exposure to ongoing political uncertainty, owing to the promised 50-year renewal 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 downward jump on $L = \tau$ in Figure 2.

The 50-year renewal 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 renewal 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 small or no discount relative to the control group.

4.5. Baseline Analysis

Hong Kong is comprised of three parts (Hong Kong Island, Kowloon, and New Territories) and divided into 18 districts with each represented by a district council. We control for district by year-month fixed effects in Eq. (9). Panel A and Panel B of Figure 4 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 New Territories and most districts in Kowloon.

Panel B of Table 2 presents the summary statistics based on 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 between the two lease groups, which are likely driven by their locations. We hence in Figure A.1 plot the residuals of the property attributes by the two lease groups, obtained from the regression of each hedonic characteristic on the district by year fixed effects. We find few 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 4 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$^{\text{th}}$, 2047, properties with leases expiring immediately after July 1$^{\text{st}}$, 2047, are sold at a 14.1% discount using unit price or 14.9% in terms of total price, both significant at 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, respectively, 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$^{\text{st}}$, 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 4, 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 years approach 2047 for pre-2047 or are further from 2047 for post-2047 lease groups. The broad empirical pattern matches that in Figure 2, 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 any 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 British Hong Kong colonial 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.[10]

Based on the baseline estimates in Column (4), we can calculate 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 at 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 GDP in Hong Kong 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

[10]For example, Pokfulam Gardens, a large development of six 28-story highrises, 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.

the lower property price.

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 20^th, 2047, are endogenously affected by political uncertainty regarding the future of "One Country, Two Systems" in Hong Kong? We leverage 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 groups: control a), whose leases were granted after JD; control b), whose leases were granted before JD and are located in Hong Kong Island and Old Kowloon; and finally, control c) whose leases were granted before JD and are located in New Kowloon and New Territories districts. Note, control a) corresponds to Type 5 land leases in Table 1 while control b) could be traced to Type 2 land leases and control c) constitutes Type 4 leases. They are 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; these market conditions might affect their transaction prices in these subgroups differently from those in the treatment groups. For example, it is quite possible that lands granted in the post-JD period were more likely to go to developers who had closer relationships with or have more confidence in mainland China compared to other periods.

Table 5 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 4.

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, and we address them in this section. 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 6, 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 4. 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).[11] 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 the 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.

5. Reneging Risk: Extending and Calibrating Model

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

[11]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 6 notes.

then extend our baseline model to capture this feature, which is calibrated 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 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.[12] 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 HKSAR, whose expiration years range from 2047 to 2064 in our data.[13] In Table 7, we further interact our treatment group, 2047–2064, with an indicator as to whether the lease was granted under HKSAR ($\geq$ July 1$^{\text{st}}$, 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 which is about 15 percentage points) in various specifications relative to those granted by British Hong Kong government. This is consistent with how market participants might perceive the Hong Kong government reneging on land leases issued by the British colonial government as at least a possibility.

5.2. Model Extension

Motivated by the above evidence, we extend our baseline model by incorporating a reneging risk applied to the land contracts issued during the colonial era (i.e., before the handover). The land

[12]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.

[13]We collect all land publicly auctioned by HKSAR and match them with property transactions by the land lot number in our data; we also collect all the buildings initiated by 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.

lease will be renewed to another 50-year lease either when the original lease expires; or when a reneging event (modeled as a Poisson shock) occurs. In both scenarios, the homeowner who is leasing land granted by the British colonial government will first be charged with an extra "penalty" $\delta > 0$ (i.e., additional land premium, calculated as a fraction of the house market value) and will then receive another new 50-year non-colonial lease contract with ground rent schedule given in Eq. (2).

We assume that this reneging shock is i.i.d. across all properties with British Hong Kong leases, and will emerge only after July 1$^{\text{st}}$, 2047 when the current HKSAR government ceases to exist. Recall that Footnote 7 mentions that Annex III in the JD guarantees that all leased lands granted by the British Hong Kong government shall be protected under the law of HKSAR; but HKSAR only exists through June 30$^{\text{th}}$, 2047, not even considering the anecdotal reports mentioned above. Our assumption keeps the parsimony while capturing the potentially heightened lease renege risk after July 1$^{\text{st}}$, 2047.

Suppose that the intensity of the reneging shock is λ, and the extra land premium faced by colonial leases is δ. Then when the lease expires in $L \geq \tau$, the value of a house with its underlying lease granted by the British colonial government, denoted by $P\left(L;\tau,Brit\right)$, can be calculated as

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

where $\mathcal{T}$ denotes the reneging event (Poisson arrival) with intensity $\lambda\mathbf{1}_{\{s\geq\tau\}}$, $L\wedge\mathcal{T}\equiv\min(L,\mathcal{T})$, and $P\left(L\wedge\mathcal{T}+50;HK\right)$ is a standardized Hong Kong land lease with a 50 year-term standing at the renewal date $L\wedge\mathcal{T}$ (which is subject to the same $f_s^{(\tau)}$ schedule) as given in Section 3.1.

Taking the simple schedule of $f_s^{(\tau)} = \gamma\mathbf{1}_{\{s\geq\tau\}}$ considered in Section 3.2, we derive the house value in Eq. (10) in closed-form as

$$P(L;\tau,Brit) = \frac{1}{\kappa} - \frac{(\gamma+\delta-\gamma\delta)e^{-\kappa\tau}}{\kappa(\kappa+\lambda)}(\lambda+\kappa e^{-(\kappa+\lambda)(L-\tau)}). \tag{11}$$

5.3. Calibration Method

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 the policy tools taken by the Hong Kong government. To do this, we carry out a simple calibration exercise based

on the asset pricing framework developed in this paper, which allows us to back out the underlying schedule of additional ground rent γ as well as the magnitude of reneging risk implied by the housing transaction data.

Given the estimated price discounts in Table 7 for different land lease groups relative to the control group, we perform a calibration exercise in which we attempt to find the model parameters that minimizes the difference between the model implied discounts and the estimates. We first set $\kappa = r - g = 1\%$ based on the mean of the difference between Hong Kong's 12-month HIBOR rate and rental price growth from 1998 to 2019.[14] Then, given the set of remaining parameters denoted by $\Theta \equiv \{\gamma, \lambda, \delta\}$, we first calculate $\beta_n(\Theta)$, which is the model-implied average discount for each leasehold group $n \in \{1, 2, ..., N\}$, as follows:

$$\beta_n(\Theta) = \frac{\sum_{L_i \in n} \{\ln P_{t_i}(L_i; \Theta) - \ln P_{t_i}(L = \tau; \Theta)\}}{\#\text{ of transactions in group } n}, \tag{12}$$

where i indexes each housing transaction in our data, L_i denotes its land lease expiration date, and t_i denotes its transaction date.[15] In other words, for transaction i in lease group n, $\ln P_{t_i}(L_i; \Theta) - \ln P_{t_i}(L = \tau; \Theta)$ is the model-implied price discount relative to the control lease group. As a result, $\beta_n(\Theta)$ is the average model-implied discount for all transactions in the leasehold group n, conditional on a set of parameters θ.

In sum, we pre-set the effective time discount rate $\kappa = r - g = 1\%$ based on its corresponding empirical moment that is external to the model, and search for three structural parameters that are internal to the model, i.e., $\hat{\Theta} = (\hat{\gamma}, \hat{\lambda}, \hat{\delta})$, that minimize the model's mean squared error (MSE) defined as follows:

$$\min_{\Theta} \frac{1}{N} \sum_{n=1}^{N} (\beta_n(\Theta) - \hat{\beta}_n)^2. \tag{13}$$

The MSE is over all twelve lease groups (leases groups granted by the British colonial government and the HKSAR government, with $N = 12$), where $\hat{\beta}_n$ is the empirically estimated discount for lease

[14] Hong Kong's 12-month HIBOR rate is from the website of Hong Kong Monetary Authority (www.hkma.gov.hk/eng). Annual growth of rental price is calculated using the average of five rental indices provided by Rating and Valuation Department of HKSAR (www.rvd.gov.hk/en/property_market_statistics/index.html).

[15] Since the EPRC only records the information about the lease expiration year, we simply assume L_i to be the last day (December 31$^{\text{st}}$) of the leasehold year. Of course, for the leasehold expiration year 2047, we set the leasehold date to be June 30$^{\text{th}}$, 2047 if it belongs to the control group. If not, we then set the leasehold expiration date to be December 31$^{\text{th}}$, 2047. Finally, to simplify the estimation, we also set the transaction date to be June 30$^{\text{th}}$ of the transaction year.

group n in Table 4.[16]

5.4. Calibration Results

Figure 5 plots the discounts of each lease group relative to the control group from the regression (light blue) and the model calibration (dark blue), respectively. The overall model fit is quite good and is shown as the close price discounts between model and regression for all lease groups except two small ones, i.e., 2040–2046 and 2098–2135, for which the model underpredicts and overpredicts the price discount, respectively.

What are the model parameters implied by the empirical estimates of land leases discounts, as a result of the optimization procedure in Eq. (13)? We find that $\hat{\gamma} = 25.117\%$, implying that after 2047 Hong Kong homeowners expect an about 25% of penalty in order to extend their land leases 2047. This seemingly large expected penalty in the remote future take into account all political uncertainty in the future (from the perspective of the first two decades of the 21$^{\text{st}}$ century), with the most imminent uncertainty being in mid-2047.

On the parameters for reneging risk in colonial leases, we find that the British Hong Kong leases are expected to be reneged every 74 years ($\hat{\lambda} = 1.342\%$); and Hong Kong homeowners need to pay a penalty of about $\hat{\delta} = 13.100\%$ of the house value upon receiving a 50-year HKSAR-style renewal contract in the modern era. Again, both parameters are under the risk-adjusted measure. Together, these two parameters imply that relative to an otherwise identical 50-year HKSAR contract, a hypothetical 50-year British Hong Kong lease is traded at an effective discount of 11.1% from today's viewpoint (or a discount of 13.4% if the lease term is 100 years).

6. Political Uncertainty and Price Discounts

In this section, we exploit sentiment measures at citywide, district, and individual levels and explore their relation 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.

[16] In some strict sense we estimate our model by following the M-estimation method (Huber, 1992).

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 often manifest 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 6 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 the net confidences had briefly recovered and been positive in 2017, they remain 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 renewal 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 7. Consistent with view that the discounts of 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) that 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 up 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 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 in each census year to all the transactions since the last census year (e.g., transactions in 2012 and later are matched with 2016 census variables). From each local election (1999, 2003, 2007, 2011, 2015, 2019), we match the percentage of pro-democracy seats for each district to all the transactions from two years before the election year through two years after (e.g., transactions in 2018–2020 are matched with 2019 pro-democracy seats).

Panel A of Table 8 reports the summary statistics of district characteristics based on the merged data. 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.[17]

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 percent 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."[18]

Panel (A) of Figure 8 shows that after suffering some defeats in 2007, 2011 and 2015 elections, the pro-democracy camp in conjunction with the 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 later.

6.2.2. Mainland Migrants

Figure 6 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.[19] There has been growing anxiety that Hong Kong will no longer belong to Hong Kongers as both

[17]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 the LegCo elections are held every four years, but the latter is held one year after the former (e.g., 2019 and 2020, respectively).

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

[19]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 frequently visited Hong Kong has increased exponentially, reaching over 40 million annual arrivals in 2013.

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 8 shows that the percent of mainland migrants was high across all districts in the early censuses, but has deceased 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 8 reports the correlations among the district characteristics, with most of them being statistically significant at the 1% level. For instance, education (proxied by the percent of college and higher degrees) is negatively correlated with age but positively correlated with income.

The two local sentiment measures, i.e., percent of pro-democracy seats and percent of mainland migrants, are positively correlated with each other (with $\rho = 0.34$), and both are positively correlated with median income and negatively with percent of homeowners. However, median age and education are (negatively) correlated with percent of mainland migrants only, but not with percent of pro-democracy seats. This suggests that mainland migrants tend to live in older and poorer communities with less educated residents and lower homeownership rate. 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 8. 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 powers in explaining 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 8, we follow the specification in Eq. (9) but include only the transactions in the control (June 30$^{\text{th}}$, 2047) and main treatment group (July 1$^{\text{st}}$ 2047–2064). In Column (1), the coefficient captures a significant discount of 13.3% in properties with leases expiring between July 1$^{\text{st}}$, 2047, and 2064, corresponding to the average discount among three lease groups (i.e., July 1$^{\text{st}}$, 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 -0.121 to -0.149, 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 percent of pro-democracy seats, suggesting that in addition to the -14.9% price discount, a one SD increase in pro-democracy seats in the local district (i.e., 18%) is associated with an additional discount of 4.0 percentage points (or 27% increase of base effect) for the treatment group. Similarly, results in Column (3) suggest that on top of the -12.6% average price discount, a one SD increase of mainland migrants in the local district (i.e., 6%) is associated with 9.4 percentage points (or 75%) 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 percentage of pro-democracy seats and percent 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 quantify a potential nonlinear effect of local sentiments. Column (5) shows that properties in the treatment group located in districts with

high proportion of pro-democracy seats see an additional 7.2 percentage points (60% of the base discount) of the price discount on top of 12% base discount already observed for properties in the treatment lease groups located in districts with lower percentage of pro-democracy seats. Hence the combined discount is 19.2% 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 10.2 percentage points (111% of the base discount) of the price discount on top of 9.2% base discount already observed for properties in the treatment lease groups located in the districts with lower percentage of mainland migrants.

Pane D reports the regression results where we treat leases granted by British Hong Kong and 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 but one of the triple interaction terms are statistically insignificant, suggesting no significant difference between the colonial and HKSAR leases in how local sentiments affect price discount.[20]

Taken together, these results confirm that the two series provide valid measures of local sentiment in political uncertainty and 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 7, respectively. Compared to the average effects reported in Table 8, the two panels in Figure 7 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

[20]The only significant estimate is on the triple interaction of HKSAR leases in the treatment group and the indicator for high percentage of mainland migrants, suggesting that an additional discount is placed in the transactions with HKSAR land leases in districts with many mainland migrants.

from Panel A of Figure 7. A significant price discount did not emerge in the districts with less sentiment until after 2005 when the citywide sentiments increased, and has been steadily worsening since 2005. The comparison suggests that estimated price discounts in 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 pan-democracy camp is to achieve universal suffrage for the elections of both 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 of 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.[21] Such anxiety stems partly from their eroding social position, but more importantly it is induced by mainland China's overwhelming political and economic dominance over HKSAR. As a result, in places where more mainland residents

[21]Some of the chief complaints include grocery shoppers, parallel businesses, and birth tourism. 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."

are present[22] 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 become more pessimistic about the future of "One Country, Two Systems."

6.4. The Effect of Mainlander Buyers

In the above analysis, we focus on local sentiment from the perspective of Hong Kongers using district-level data. We now explore the perspective of people from mainland China—especially those who have moved to Hong Kong—identified through the buyer and seller names in the transaction data.[23] Our premise is that mainlander buyers or sellers may have different "private" valuations regarding the political uncertainty embedded in the land lease. These individual private valuations should matter for the equilibrium transaction prices in the context of housing markets where over-the-counter bilateral bargaining is common.

Table A.1 reports the results from regressions on the interaction of the main treatment lease group and mainlander buyer dummies. Regardless of whether we control for the interaction of treatment group and district-level percentage of Chinese mainlanders, we find a significant and positive coefficient on the interaction of the treatment group and mainland buyer transactions, suggesting that relative to the significant price discount valued by non-mainlanders, similar transactions involving a mainlander buyer exhibit a slightly smaller political uncertainty price discount with a difference of 1.2–1.4 percentage points.

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.

[22]It is worth noting that Hong Kongers still account for 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.

[23]Mainlander buyers are identified if one of the well-known surnames from mainland China is matched for buyers following the algorithm developed in Fan et al. (2019). These well-known surnames from mainland China are distinctly different from those used by natives of Hong Kong or Taiwan.

We exploit an unique feature in the Hong Kong's housing market: land leases expiring on June 30^{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 the historical arrangements in the JD and the "One Country, Two Systems" design which are all set to expire in 2047, giving rise to the largest political uncertainty regarding any lease extension beyond that point.

We guide our reduced-form regressions by a pricing model of housing assets with future political uncertainty, which is to be resolved at a 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. Finally, citywide and local sentiments in political uncertainty provide plausible mechanisms through which housing prices fall with rising political uncertainty as residents feel more uncertain of Hong Kong's future.

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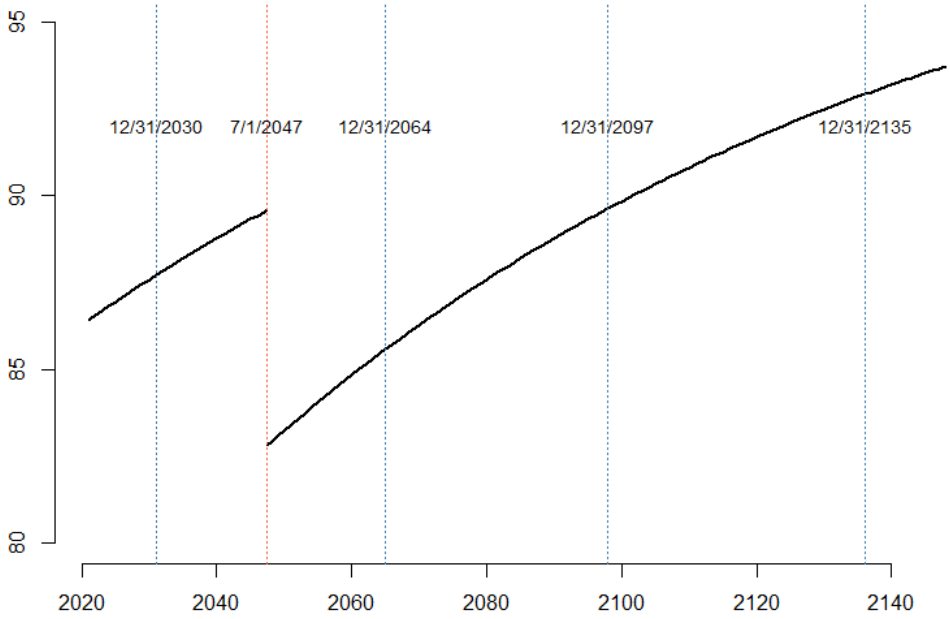
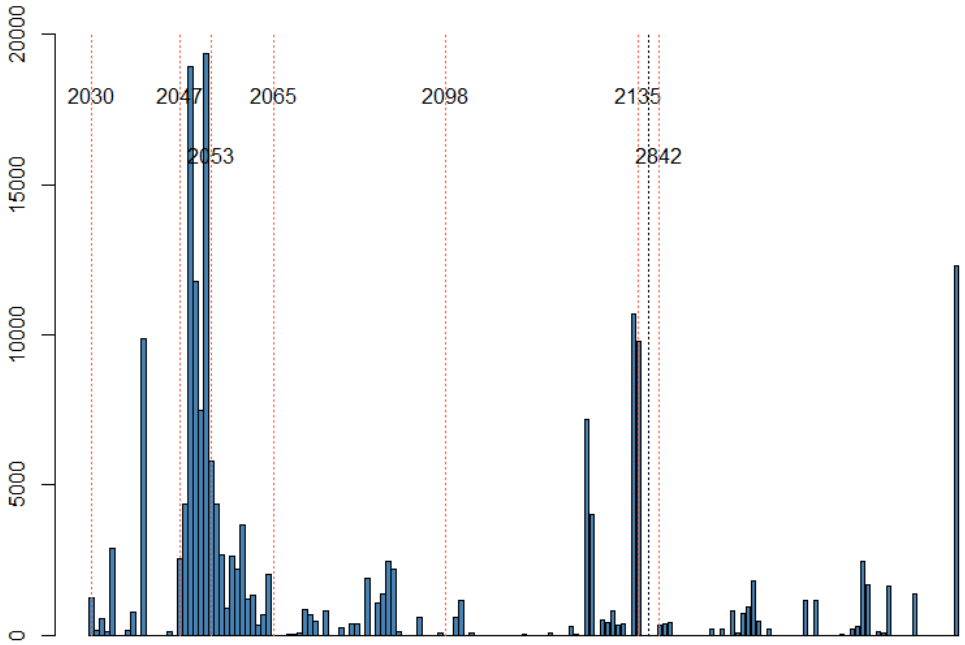
Figure 2. Model Implied Price Discounts with Constant Penalty Schedule



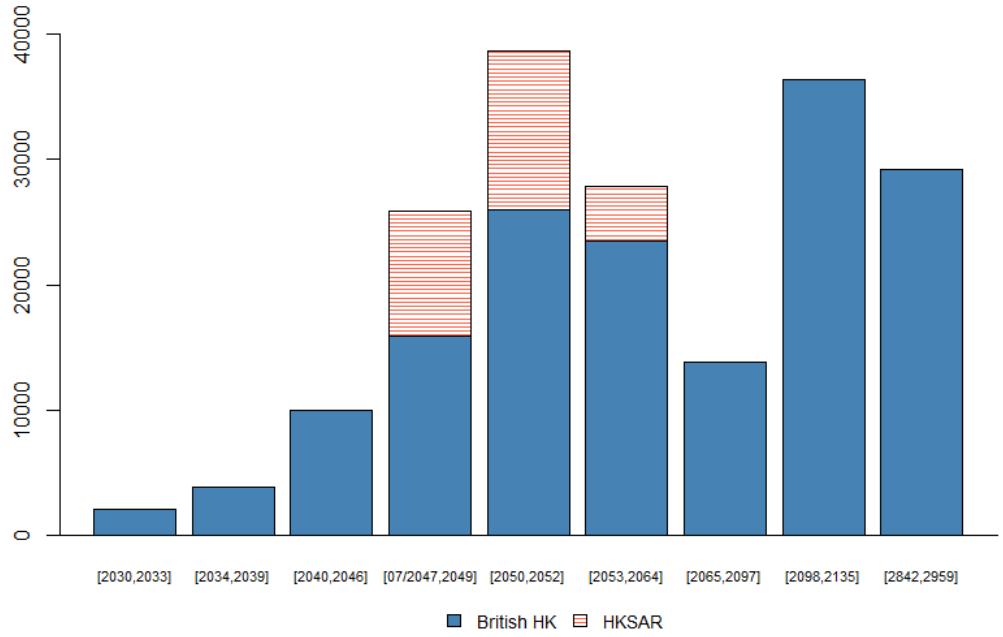
This figure plots the model implied house value as a function of lease expiration date L. The political uncertainty will be largely resolved on $\tau = 7/1/2047$, when a new Hong Kong government replaces the current HKSAR. Red vertical dashed line indicate leases expiring in $\tau = 7/1/2047$. Blue vertical 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 3. Distribution of Transactions by Lease Groups

Panel A: Number of Transactions By Leasehold Expiration Year



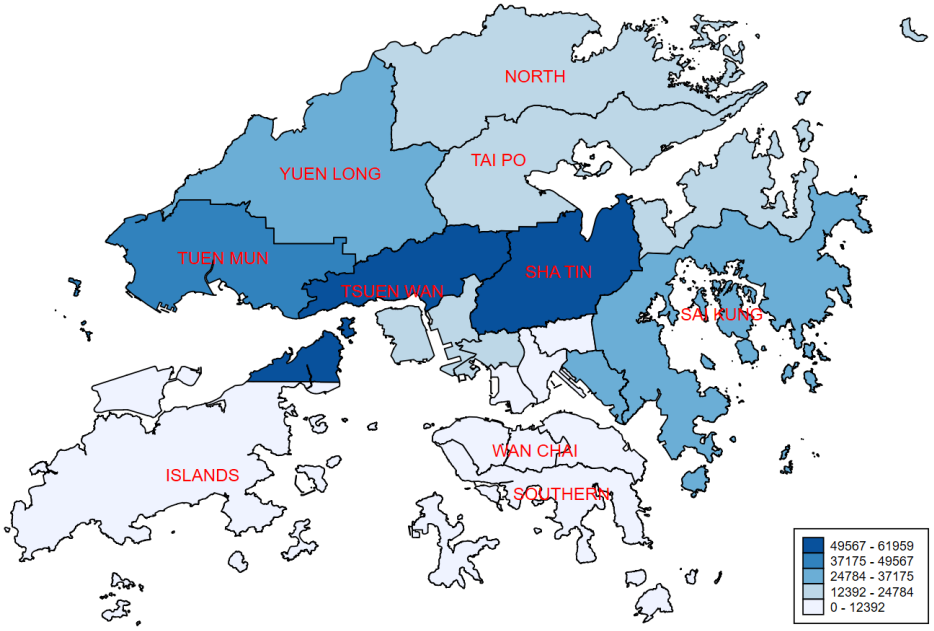
Panel B: Number of Transactions by Lease Group



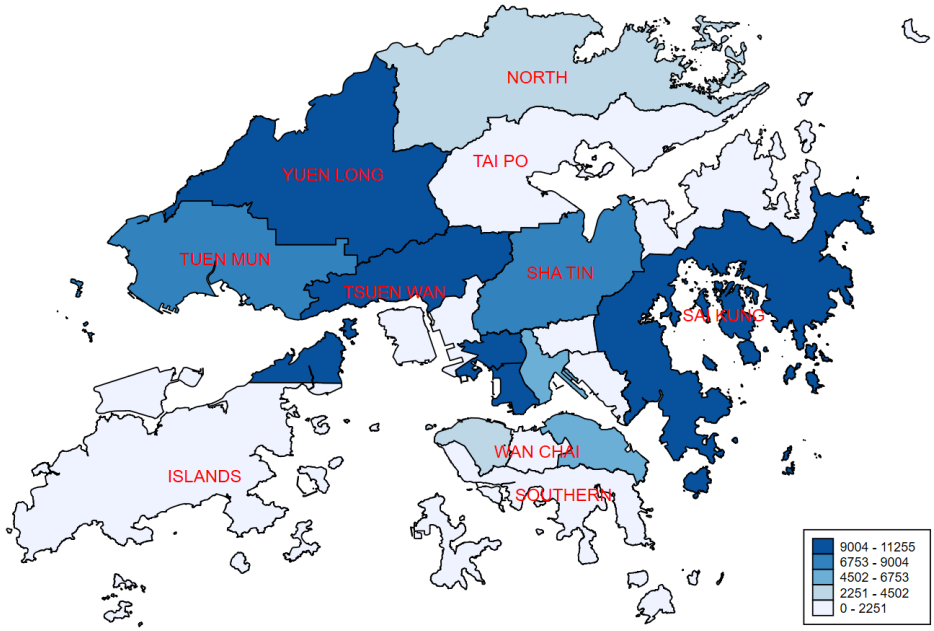
This figure plots the number of housing transactions by individual lease expiration year (except leases expiring on 6/30/2047). Panel A presents the number of transactions by lease expiration year from 2030 to 2135, and from 2842 to 2959. Panel B presents the number of transactions by lease groups and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

Figure 4. Geographic Distribution of Transactions and Leases

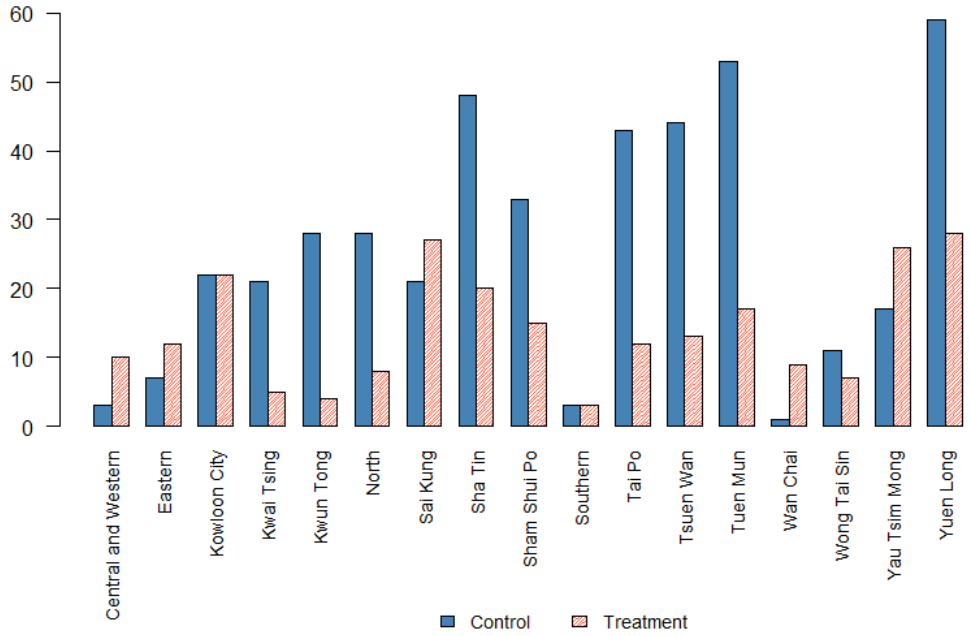
Panel A: Control Lease Group



Panel B: Main Treatment Lease Group



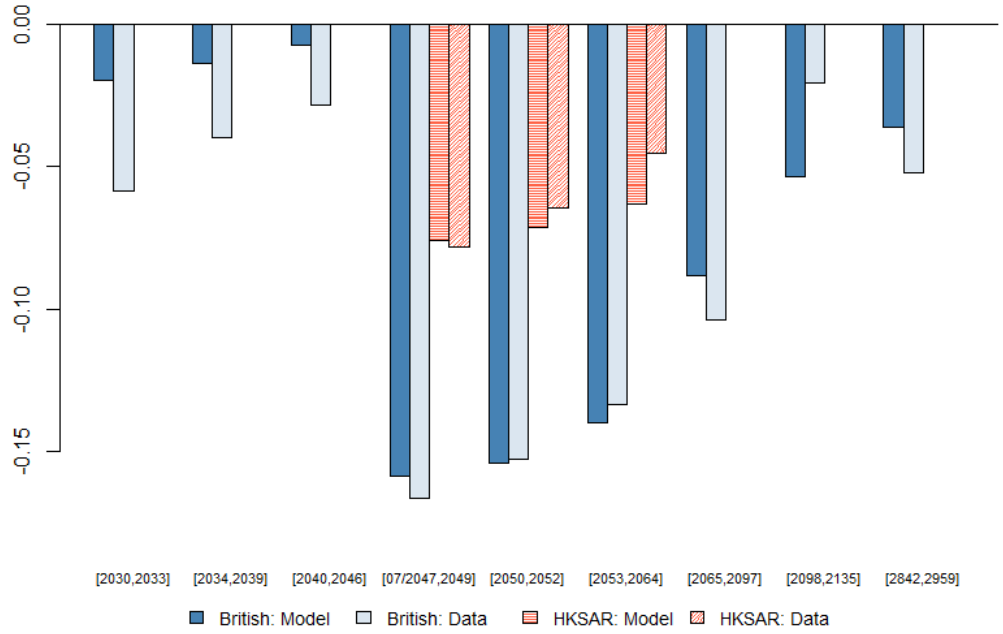
Panel C: Number of Leases



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.

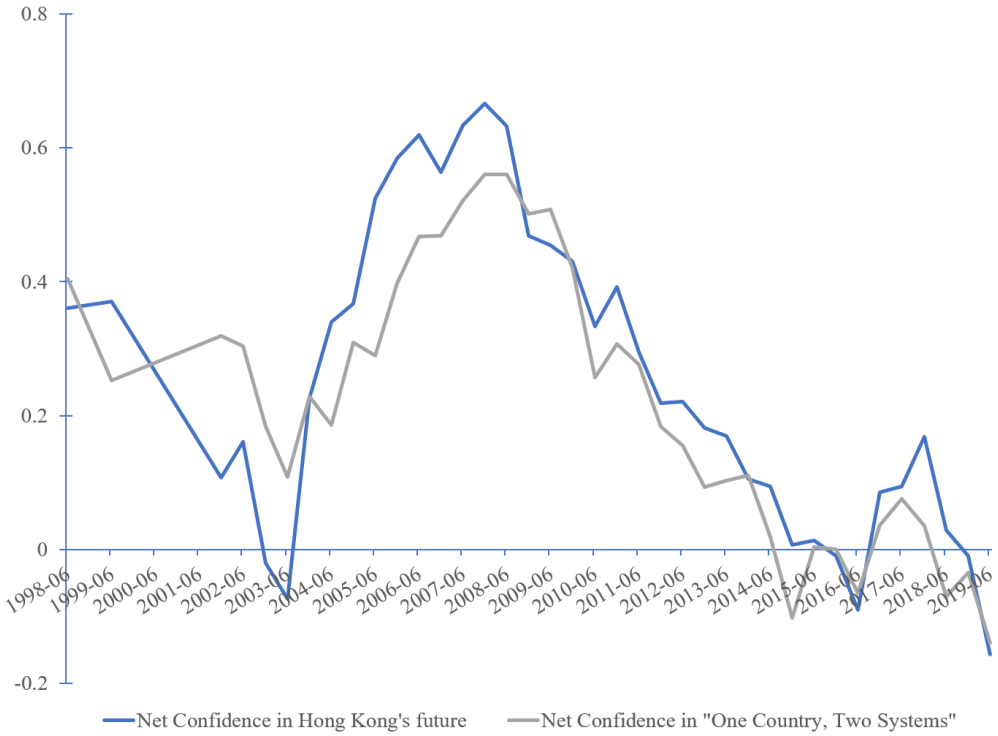
Figure 5. Model Calibration

Discounts from Model versus Data



This figure presents the model-implied discounts and discounts estimated from hedonic regressions (column (1) in Table 7 with additional control of turnover) across twelve lease groups (including British colonial and HKSAR ones). The resulting parameters from the calibration/estimation are $\kappa = r - g = 1\%$ (set by matching empirical moments outside the model) and $\lambda = 1.342\%$, $\delta = 13.001\%$, $\gamma = 25.117\%$ (optimally chosen to match the empirical moments inside the model).

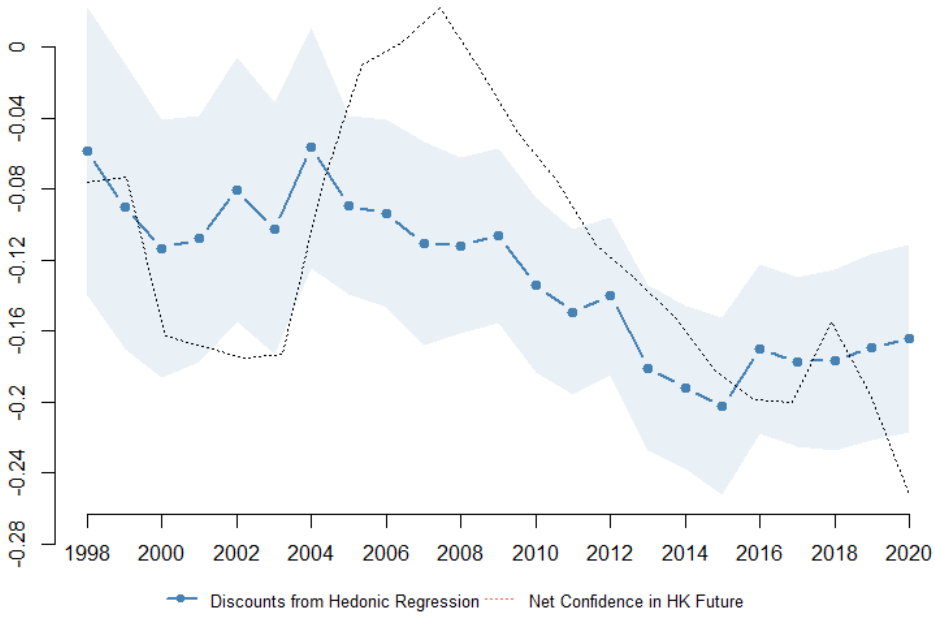
Figure 6. Citizen's Net Confidence from Surveys



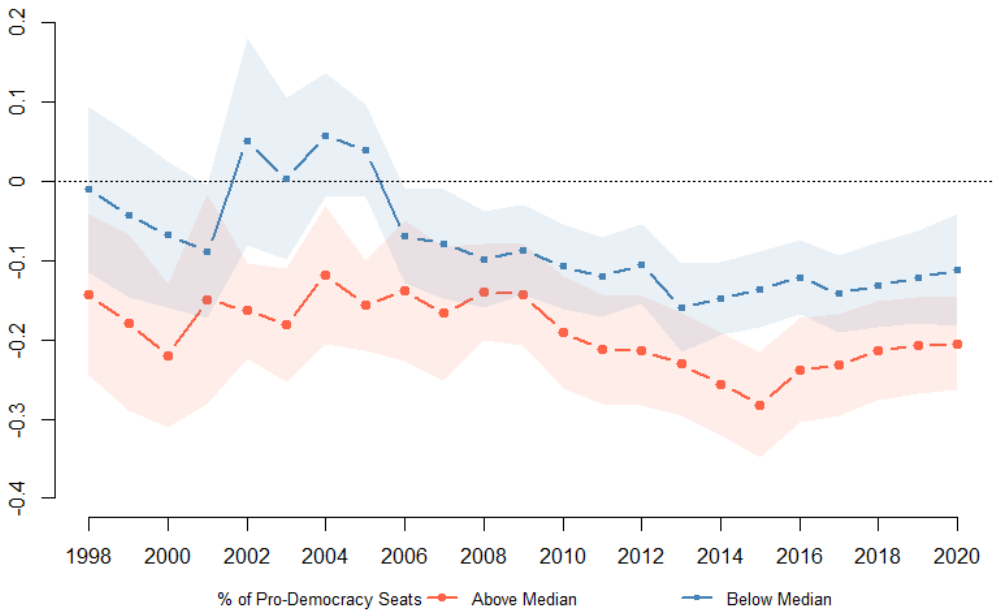
This figure plots two widely used measures of public sentiments toward political risk in Hong Kong over time from 1998 to 2020. The two sentiment measures, Net Confidence in Hong Kong's future and Net Confidence in "One Country, Two Systems", are provided by the public sentiment survey conducted by the Public Opinion Programme 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 7. Price Discount Over Time

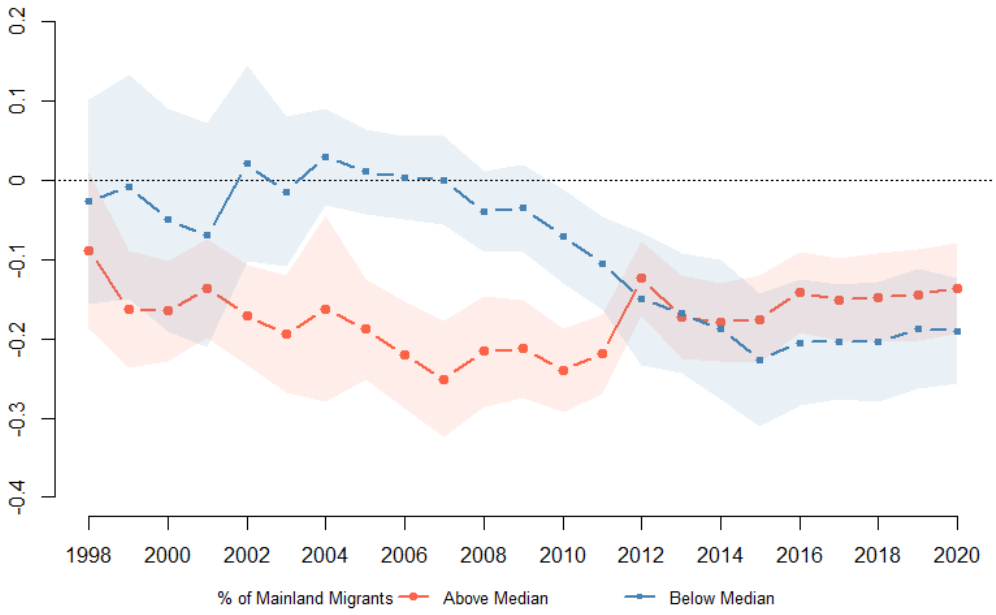
Panel A: Dynamic Estimates based on Entire Sample



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



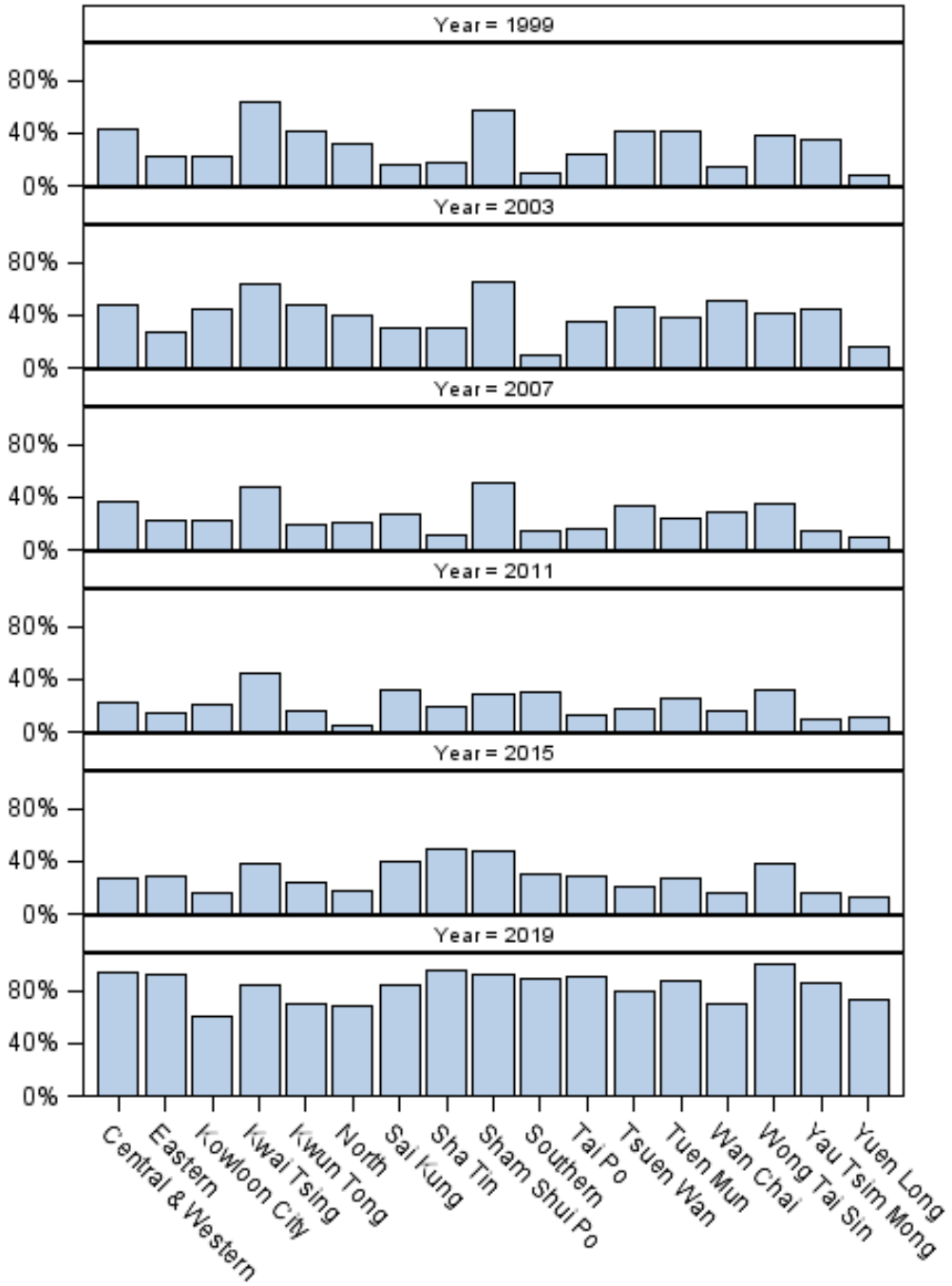
Panel C: Dynamic Estimates based on Districts with High Versus Low % of Mainland Migrants



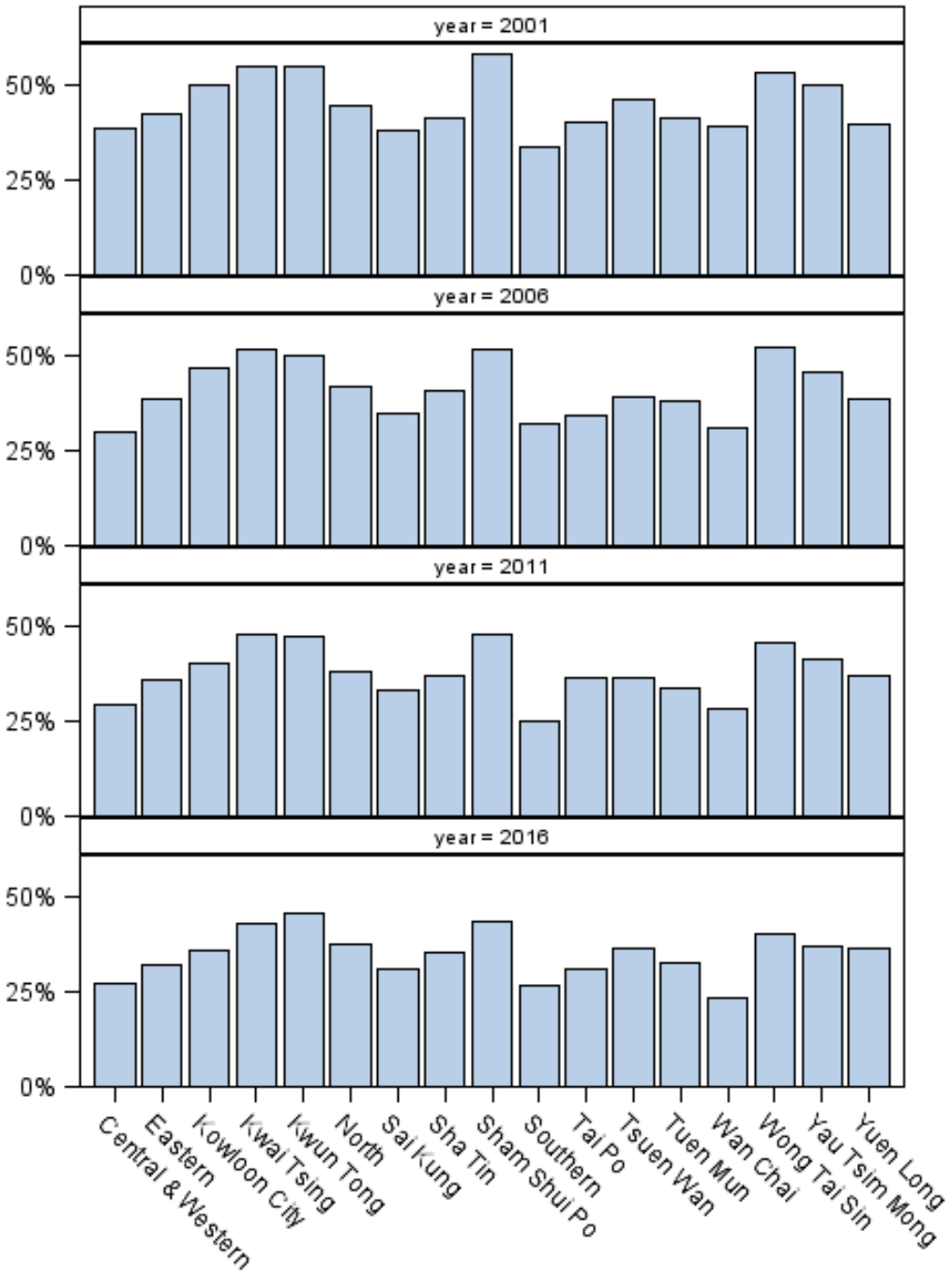
Panel A plots the price discounts over time for the main treatment group with lease expiring between [7/1/2047] and 2064. Panel B plots the price discounts over time for two groups: main treatment groups which have the percentage of Pro-Democracy Seats above median, main treatment groups which have the 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 8. 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 1: 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 in from 2842 to 2897). (2) 75 years lease (auctioned from 1843 to 1898, first regrant from 1918 to 1973 which will expire from 1993 to 2048). 99 years lease (rare, auctioned from 1843 to 1898, first regrant from 1942 to 1997 which will expire from 2041 to 2084. Note that if the first regrant happens after JD, the second regrant lease will expire on 6/30/2047 according to JD instead of another 99 years.) (3) 75+75 years lease (auctioned from 1899 to 1985, first renewed from 1974 to 2060 and expiring from 2049 to 2135); 99+99 years lease (rare, auctioned from 1899 to 1985, first renewed from 1998 to 2084 and expiring from 2097 to 2183).	(4) Nonrenewable lease expires on 6/27/1997 due to historical reason. According to Joint Declaration, these leases will be automatically renewed to 6/30/2047. Thus, they will expire on 6/30/2047 in our data.	
Transition (4/1/1985–6/30/1997)	(5) Non-renewable lease expires in 6/30/2047.		Split between UK & HKSAR
Post Handover ($\geq$ 7/1/1997)	(6) Non-renewable lease expires in (auction date + 50 years).		HKSAR

This table presents summary of different land leases in the history of Hong Kong. JD was signed on Dec 19, 1984 and went effective on May 27, 1985. However, according to our data, lease was set to 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 regranted for another 75 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 regranted once in 1972, then they will 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 99 years lease was sold in 1849 and got regranted 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.

Table 2: 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 for all the variables used in the analysis. Our sample contains all second-hand housing transactions of Estates in Hong Kong from 1998 to February, 2020 with the following restrictions: exclude transactions with missing date, total price, unit price, net living area size, building unique ID, lease expiration date, latitude or longitude, and floor number; exclude complexes that belong to public housing projects; exclude houses or townhouses; exclude 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, 2064]). 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 3: Distributions by Lease Group and Year

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

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

Table 4: 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% and 99% percentiles to remove outliers: log of unit price, log of 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 include a full set of property and building characteristics. Property characteristics includes the number of bedrooms (in categories, e.g., 1, 2, 3. Missing value is used as an extra category.), the number of living rooms (in categories, e.g., 0, 1, 2, 3. Missing value is used as an extra category.), bay window indicator (whether or not included in housing prices), bay window size (in 10 equally sized categories), the net size (in 10 equally sized categories), direction facing dummies, and floor group dummies (each floor group is formed by firstly classifying buildings to four groups, which are VeryLowRise (3 to 10 floors), LowRise (11 to 30 floors), MidRise (31 to 60 floors), HighRise (61 floors or higher). Secondly, for each building type, form a floor group every 5 floors. For example, group VeryLowRise1 includes floors below 5 in buildings belonging to VeryLowRise category.). Building characteristics includes 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). In each regression we include district by year-month fixed effects. Standard errors are clustered by estate and year-month. Columnss (1) and (5) presents the regression with controls above and trimmed sample. Columns (2) and (6) presents the regression with control interacted by year and trimmed sample. Columns (3) and (7) has the same setting with (1) and (5) except that the sample excludes observations with missing number of bedrooms and living rooms. Columns (4) and (8) has the same setting with (1) and (5) except that they had additional control of turnover.

Table 5: 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 baseline hedonic housing price regression results using the entire sample of housing transaction records in Hong Kong from 1998 to February, 2020. We separate control groups to three parts. The first part includes leases expiring on 6/30/2047 which were granted after JD, denoted by indicator I(lease = 6/30/2047 & After JD). The second part includes leases expiring on 6/30/2047 which were granted before 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 part, which serves the control group in this regression, includes leases expiring on 6/30/2047 which were granted before JD and located in New Kowloon and New Territories. The regression sample, controls and dependent variables of Columns (1) and (2) are the same with Column (1) in Table 4. The regression sample, controls and dependent variables of Columns (3) and (4) are the same with Column (4) in Table 4.

Table 6: 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 $\leq$ Lease $\leq$ 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 sample settings. The dependent variable of Columns (1) to (4) is the log of unit price, and the dependent variable of Columns (5) to (8) is the log total price. Columns (1) and (5) perform hedonic regression using the observations of control group and main treatment group in the sample of Columns (1) and (4) of Table 4. Columns (2) and (6) perform hedonic regression using the repeated sales sample, which include only properties that have been transacted at least twice. The regressions in Columns (3) and (7) use the PSM-matched sample. For each treated building, we find controlled buildings within 0.5 kilometers requiring they have the same facilities (swimming pool and club house). Using the transactions of the treated building and nearby controlled buildings, we calculate the propensity score by a probit regression of 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 by Hainmueller (2012).

Table 7: 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 leases issued by HKSAR. The sample includes the housing transaction records in Hong Kong from 1998 to February, 2020. The following four variables are trimmed at 1% and 99% percentiles to remove outliers: log of unit price, log of total price, net size, and building age. The dependent variable is log of unit price in Columns (1)-(3), whereas log of total price (in million HKD) is used as dependent variable in Columns (4)-(6). Control variables include a full set of property and building characteristics. Property characteristics includes the number of bedrooms (in categories, e.g., 1, 2, 3. Missing value is used as an extra category.), the number of living rooms (in categories, e.g., 0, 1, 2, 3. Missing value is used as an extra category.), bay window indicator (whether or not included in housing prices), bay window size (in 10 equally sized categories), the net size (in 10 equally sized categories), direction facing dummies, and floor group dummies (each floor group is formed by firstly classifying buildings to four groups, which are VeryLowRise (3 to 10 floors), LowRise (11 to 30 floors), MidRise (31 to 60 floors), HighRise (61 floors or higher). Secondly, for each building type, form a floor group every 5 floors. For example, group VeryLowRise1 includes floors below 5 in buildings belonging to VeryLowRise category.). Building characteristics includes 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). In each regression we include district by year-month fixed effects. Standard errors are clustered by estate and year-month. Columns (1) and (4) presents the regression with controls above and trimmed sample. Columns (2) and (5) presents the regression with control interacted by year and trimmed sample. Columns (3) and (6) has the same setting with (1) and (4) except that the sample excludes observations with missing number of bedrooms and living rooms.

Table 8: 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	0.3	0.18	0.04	0.04	0.1	0.26	0.7	0.92	1
% 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)	-0.133***	-0.149***	-0.126***	-0.121***	-0.120***	-0.092***
	[0.022]	[0.021]	[0.023]	[0.023]	[0.025]	[0.027]
× % of Pro-Democracy Seats		-0.040***		-0.041***		
		[0.013]		[0.013]		
× % of Mainland Migrants			-0.094***	-0.095***		
			[0.029]	[0.029]		
× I(High % Pro-Democracy Seats)					-0.072***	
					[0.023]	
× I(High % Mainland Migrants)						-0.102***
						[0.026]
× Median Age		-0.023	-0.040***	-0.018	-0.030*	-0.049***
		[0.017]	[0.015]	[0.017]	[0.017]	[0.015]
× Median Income		-0.007	-0.035	-0.034	-0.003	-0.044
		[0.030]	[0.032]	[0.031]	[0.029]	[0.032]
× % of College Above		0.018	0.037	0.041	0.014	0.048
		[0.031]	[0.031]	[0.031]	[0.030]	[0.031]
× % of Home Owners		0.021	-0.020	-0.027	0.026	0.010
		[0.025]	[0.029]	[0.028]	[0.025]	[0.026]
Property Attributes	Yes	Yes	Yes	Yes	Yes	Yes
District × Month FE	Yes	Yes	Yes	Yes	Yes	Yes
N	456,330	456,330	456,330	456,330	456,330	456,330
Adj R^2	0.9362	0.9372	0.9374	0.9378	0.9372	0.9375

Panel D: Adding Interaction with HKSAR Leases

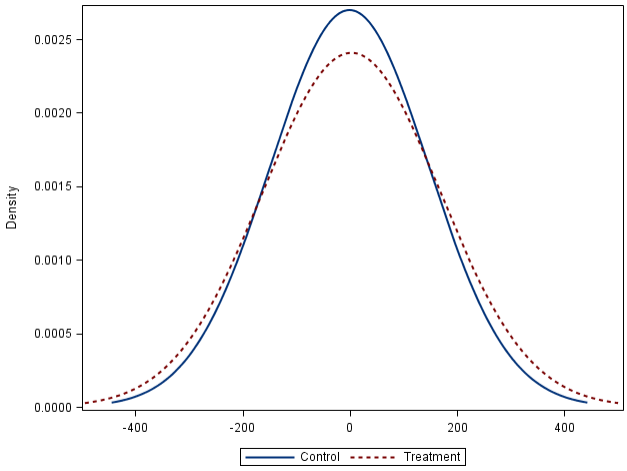
	(1)	(2)	(3)	(4)	(5)	(6)
Dep Var	Log (Unit Price)					
I(7/1/2047 ≤ Lease ≤ 2064)	-0.153***	-0.156***	-0.146***	-0.149***	-0.117***	-0.116***
	[0.022]	[0.021]	[0.021]	[0.021]	[0.024]	[0.028]
× % of Pro-Democracy Seats		-0.049***		-0.047***		
		[0.013]		[0.013]		
× % of Mainland Migrants			-0.060**	-0.054**		
			[0.024]	[0.024]		
× I(High % Pro-Democracy Seats)					-0.084***	
					[0.026]	
× I(High % Mainland Migrants)						-0.068**
						[0.028]
× HKSAR Leases	0.076***	0.071***	0.082***	0.077***	0.070***	0.117***
	[0.025]	[0.024]	[0.024]	[0.023]	[0.026]	[0.032]
× % of Pro-Democracy Seats		-0.001		0.010		
		[0.019]		[0.018]		
× % of Mainland Migrants			-0.042	-0.041		
			[0.029]	[0.030]		
× I(High % Pro-Democracy Seats)					0.001	
					[0.036]	
× I(High % Mainland Migrants)						-0.069*
						[0.040]
Property Attributes	Yes	Yes	Yes	Yes	Yes	Yes
District Month FE	Yes	Yes	Yes	Yes	Yes	Yes
N	456,330	456,330	456,330	456,330	456,330	456,330
Adj R^2	0.9367	0.9375	0.9374	0.9381	0.9373	0.9375

This table presents the district variation of price discounts for our main treatment lease group, which expires between 7/1/2047 and 12/31/2064. The sample includes the housing transaction records in Hong Kong from 1998 to February, 2020, and we only include transactions with leases expire between 6/30/2047 and 12/31/2064. The following four variables are trimmed at 1% and 99% percentiles to remove outliers: log of unit price, log of total price, net size, and building age. For each district, we calculate % 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. To facilitate the result interpretation in regressions, we standardize each district variable to mean 0 and standard deviation 1 by the district cross section at each voting or census year. Panel A shows the summary statistics of raw values using the merged sample. Panel B shows the correlation of standardized values using the merged sample. Panel C presents the hedonic housing price regression results on the effect of main treatment group (i.e., lease expiry date from 7/1/2047 to 12/31/2064), interacted with % of Pro-Democracy Seats, % of Mainland Migrants. The regression setting is the same with Column (1) in Table 4 with additional controls including the multiplication 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) equals to 1 if the variable is above the median of the district cross section, and 0 otherwise. Panel D presents the hedonic housing price regression results on how the effect of main treatment group (i.e., lease expiry date from 7/1/2047 to 12/31/2064), interacted with % of Pro-Democracy Seats, % of Mainland Migrants, differ by leases types, colonial leases or HKSAR leases. I(HKSAR Leases) equals to 1 if the leases were issued by HKSAR government after the handover. The regression setting is the same with Column (1) in Table 4 with additional controls including the multiplication of main treatment indicator and Median Age, Median Income, % of College Above, % of Home Owners.

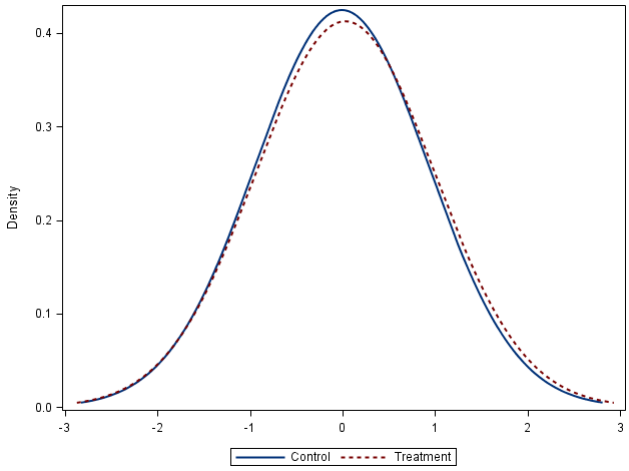
Appendix

Figure A.1. Distribution of Residuals

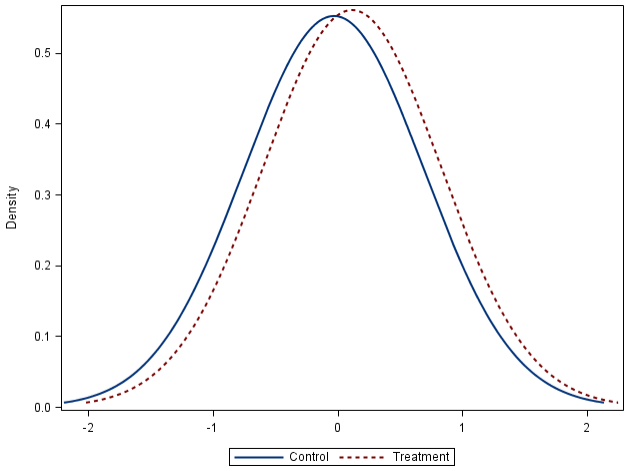
(A) Net Living Area



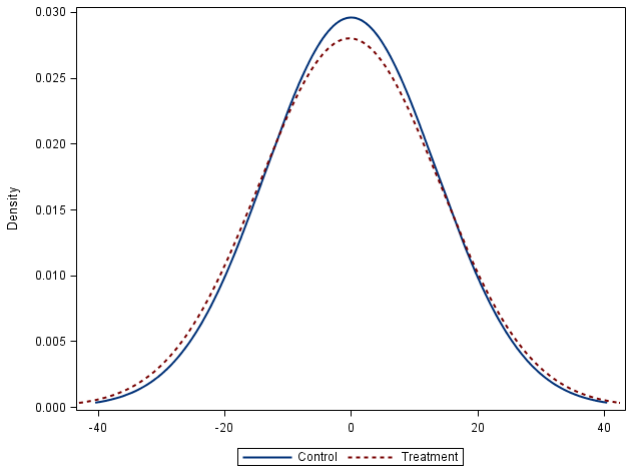
(B) No of Bedrooms



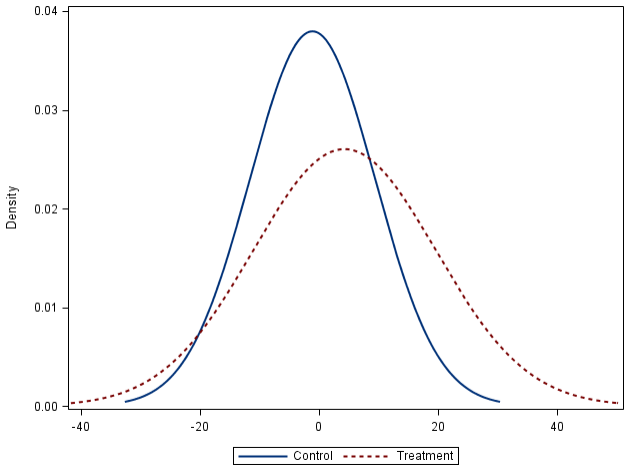
(C) No of Living Rooms



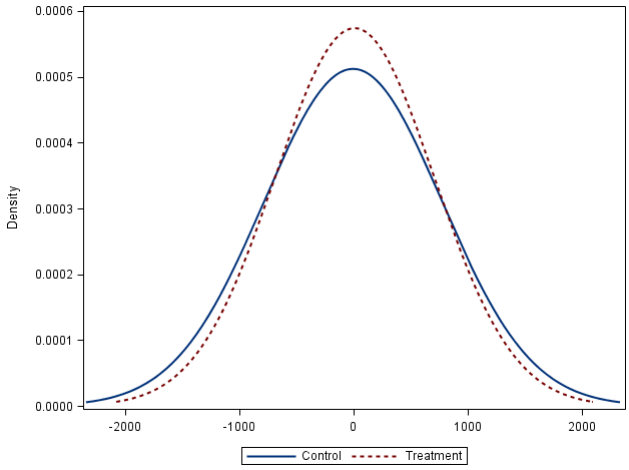
(D) Bay Window Size



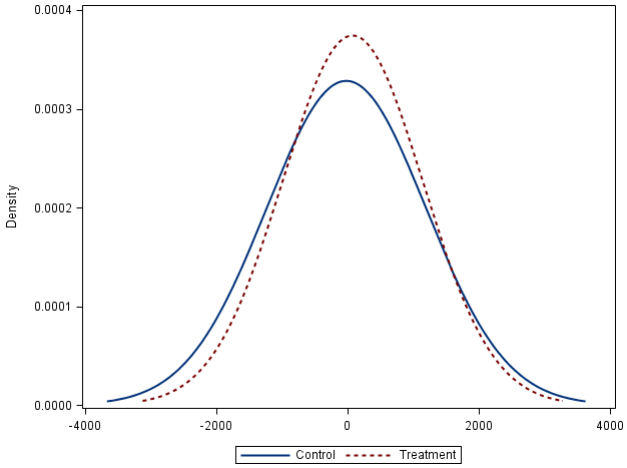
(E) Distance to MRT stations



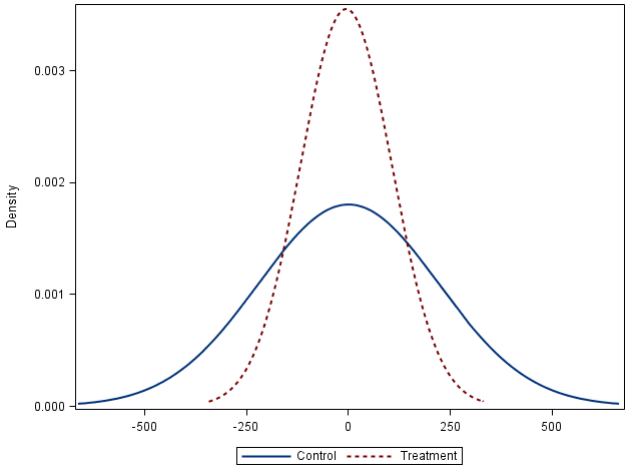
(F) Distance to Bus Stops



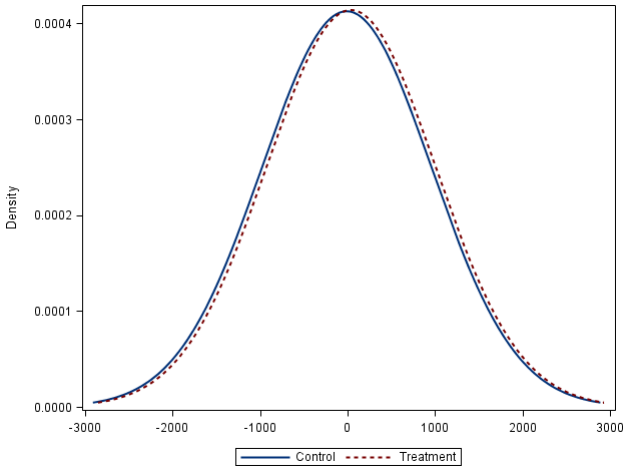
(G) Distance to School



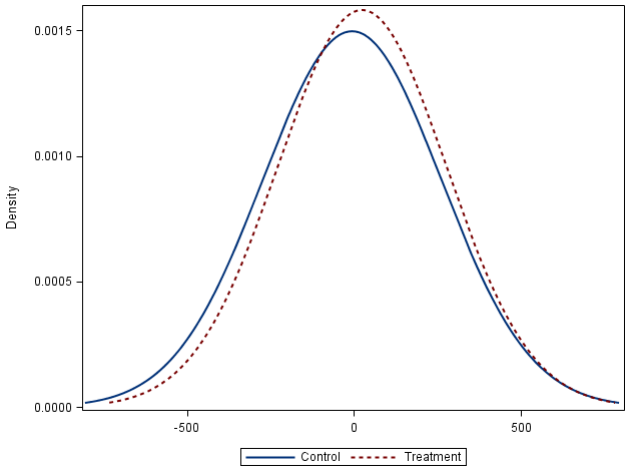
(H) Distance to University



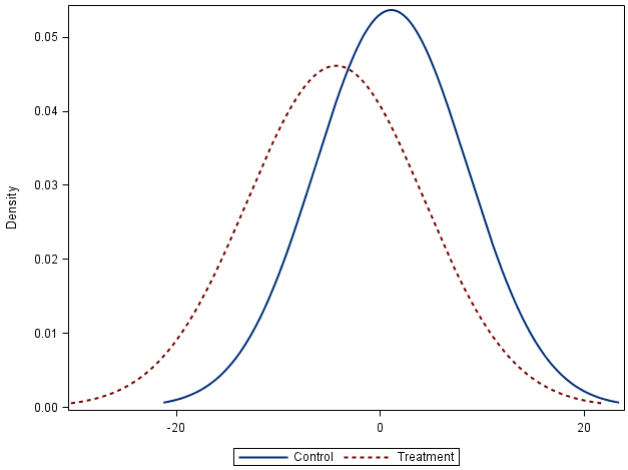
(I) Distance to Coastal Line



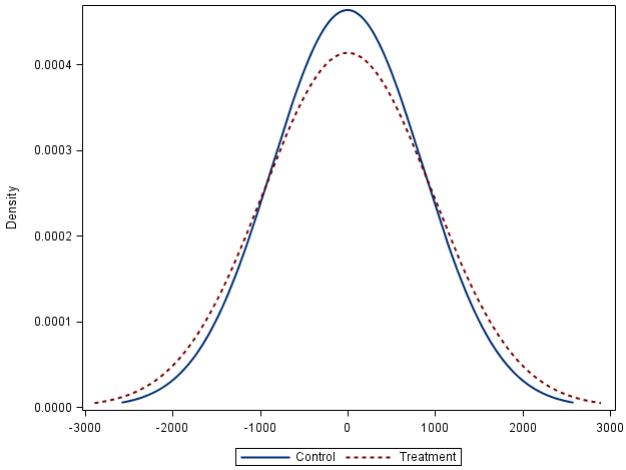
(J) Distance to Hospital



(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].

Table A.1: Mainlander Transactions and Price Discount

	(1)	(2)
Dep Var	Log (Unit Price)	
I(7/1/2047≤lease≤2064)	-0.133***	-0.090***
	[0.022]	[0.027]
× I(Mainland Buyer)	0.013**	0.013**
	[0.006]	[0.006]
× I(High % Mainland Migrants)		-0.104***
		[0.026]
× I (Mainland Buyer)		0.001
		[0.009]
I(Mainland Buyer)	0.003***	0.003*
	[0.001]	[0.002]
Property Attributes	Yes	Yes
Main Treatment District Attributes	Yes	Yes
District Month FE	Yes	Yes
N	456,330	456,330
Adj R^2	0.9361	0.9375

This table presents the 2 by 2 interaction effect of our main treatment lease group, which expires between 7/1/2047 and 12/31/2064, with the involvement of mainlander on the home sale price. The dependent variable is the log of unit price. The sample includes the housing transaction records in Hong Kong from 1998 to February 2020, and we only include transactions with leases expire between 6/30/2047 and 12/31/2064. The following four variables are trimmed at 1% and 99% percentiles to remove outliers: log of unit price, log of total price, net size, and building age. I(Mainland Buyer) equals to 1 if the assignee names are matched with a set of surnames unique for mainland migrants, which are distinctly different from those adopted by natives in Hong Kong and Taiwan, and 0 otherwise. I(High % of Mainland Migrants) equals to 1 if the variable is above the median of the district cross section, and 0 otherwise. The regression controls are the same with Column (1) in Table 4 with additional controls including the interaction term of main treatment indicator with Median Age, Median Income, % of College Above, % of Home Owners.