A Tale of Two Cities: The Impact of Cross-Border Migration on Hong Kong's Housing Market

Yi Fan*, Maggie Rong Hu†, Xinwei Wan‡

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Abstract

In this era of globalization, cross-border migration brings capital flows and leads to accelerating demand for local housing resources. This paper examines the impact of the increase in mainland Chinese migrants between 2001 and 2017 on Hong Kong's housing market. We find that mainland Chinese buyers pay 4.4% more than locals for housing purchase. This price disparity is greater for larger units at central locations. Sellers enjoy 6.6% higher gross holding period return when they sell to mainland buyers. In the same building, more mainland buyers also lead to a housing price increase and higher gross return in the subsequent year. The "safe haven effect", or mainland buyer's confidence in China's currency and economy, explains over 34% of the price premium they pay, which dominates other channels, such as residential sorting and the weak bargaining power of mainland buyers.

Key words: migration, housing, safe haven effect, residential sorting, bargaining power
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*Department of Real Estate, National University of Singapore. Email: rstfyi@nus.edu.sg
†School of Hotel and Tourism Management and Department of Finance, The Chinese University of Hong Kong. Email: maggiehu@baf.cuhk.edu.hk
‡Department of Land Economy, The University of Cambridge. Email: xw357@cam.ac.uk

1 Introduction

Over the last few decades, the direction of migration flows has become more globalized and diverse (Abel & Sander, 2014; Czaika & De Haas, 2014). In the largest developing country, China, contemporary population mobility is experiencing a transition from mainly internal migration to increasingly more international migration, which constitutes a significant proportion of total global immigration (Mallee & Pieke, 2014; Nyri, 2011). Cross-border migration is accompanied by the cross-border capital flows, including investment in the real estate market. In the first quarter of 2019, the cross-border real estate transaction volume in Asia Pacific region hits the record-high of USD 45 billion (JLL, 2019). The driving force behind the growth is cross-border investment from China, which surged to an all-time high of USD 17 billion despite the trade war headwinds (CNBC, 2019).

Given the increasing global and regional complexity in recent years, such as the uncertainty of trade war, opinions are mixed regarding the relationship between the economic outlook for migration origins and the housing market in migration destination. One prominent example is mainland Chinese buyers in Hong Kong. Some reports predict that Hong Kong's property market will be weakened by China's slowdown (Shane, 2019). Other anecdotal news indicates that mainland buyers splash out on housing in Hong Kong as China's currency becomes weak (Li, 2016). This tendency of limiting exposure in the event of a downturn in one asset class and investing in alternative assets is commonly known as the "safe haven effect", although the majority of related empirical studies focus on financial assets (Baur & McDermott, 2010; Hood & Malik, 2013; Klingler & Lando, 2018; Ranaldo & Söderlind, 2010). Limited evidence has been found on the safe haven effect on real estate assets associated with immigration and foreign capital risk, especially in Asian cities (Badarinza & Ramadorai, 2018; Cvijanovic & Spaenjers, 2015).

It is widely acknowledged in the literature that cross-border migration has a significant influence on both social transformation and economic development in the destination country/region (Hatton & Williamson, 2005; Castles, 2010). While a large strand of economics literature focuses on the impact of immigration on the labor market (Dustmann & Glitz, 2005), how migration affects

the housing market in destinations has only emerged in recent years (Kerr & Kerr, 2011). Ambiguous evidence have been found on the effect of increasing migration on local housing prices (Saiz & Wachter, 2011; Gonzalez & Ortega, 2013; Sá, 2015; Accetturo *et al.*, 2014). Most of these studies on migration and housing markets use aggregated information at the city or neighborhood level (Chang, 2018). In addition, a large strand of this literature focuses on internal migration within countries rather than migration across borders (Mussa *et al.*, 2017; Wang *et al.*, 2017).

In this paper, we use cross-border migration from mainland China to Hong Kong as the institutional setting to investigate the effect of global migration on housing markets in the destination regions. We especially focus on exploring the connection between the economic outlook in origin countries of immigration and migrants' housing consumption in destination countries, through the impact of the safe haven effect. Hong Kong, because of its physical proximity, has widely been considered a migrants' society under the profound influence of mainland China. Over the last two centuries, Hong Kong has undergone several big waves of cross-border immigration from China. Only about 60% of Hong Kong's population was born locally, and many Hong Kong residents have family ties in China. This influence becomes even stronger with growing economic connections between mainland China and Hong Kong after the return of Hong Kong to China in 1997 (Shen, 2014). Currently, the Chinese government implements quota systems to control the entry of Chinese citizens to Hong Kong for purposes of travel, family visits, or residency. One of the major entry permits, the "One-way Permit", aims to help spouses and children born across the border in China reunite with their families in Hong Kong. By 2016, over 12% of Hong Kong's population originally migrated from China via this scheme (Ng & Ng, 2018). Cross-border migration from China has given rise to difficult social issues and the social exclusion of new migrants. Local residents attribute the increasing competition for jobs, houses, and welfare benefits to the arrival of newcomers (Vasu *et al.*, 2013).

Due to the scarcity of land, the housing market in Hong Kong is heavily affected by migration. Prices of residential housing estates in Hong Kong are widely acknowledged to be overvalued and unaffordable, after continuous escalation over recent decades (Carozzi *et al.*, 2018). Many in local

media attribute the unaffordable housing issue to the increasing demand from mainland Chinese buyers (SCMP, 2017), although only limited empirical evidence documents the impact of mainland home buyers in Hong Kong (Chang, 2018). The local government has therefore introduced a series of cooling measures in real estate markets from 2012 onward, including imposing additional stamp duties of up to 30% on nonlocal buyers and restricting the loan-to-value (LTV) limit for mortgage loans. These cooling measures were initially effective in 2012, but the housing price resumed its upward trend in 2016, indicating that migrant buyers are not deterred. Moreover, many working professionals from mainland China are eligible to become permanent residents in Hong Kong as of 2019, 7 years after introduction of the additional stamp duty policy. Housing demand from these high-earning young professionals is expected to grow in the near future (Liu, 2018).

In this paper, we use individual-level housing transaction data from EPRC Limited, which include all resale transaction records for Hong Kong from 2001 to 2017. Apart from providing comprehensive information on transaction details and housing features, this data set is unique because it provides the names of both buyers and sellers. This enables the identification of migrants by the spelling of their names, which significantly differ from local names. We also use this name information to identify multiple buyers and sellers to facilitate channel discussion. Combining this mass housing transaction data with data from the Hong Kong population census and by-census in 2006, 2011, and 2016, we examine the impact of mainland Chinese buyers on the housing market in Hong Kong at both the individual and neighborhood levels.

The baseline estimation shows that mainland Chinese buyers pay a 4.42% higher price, controlling for physical features of the flats. They pay an even higher price premium for units in central regions and with large floor areas. Transactions with mainland Chinese buyers are also associated with a 6.61% increase in the gross holding period return realized by sellers. We also apply time-lagged estimation at building level to examine the spillover impact of 1-year lagged mainland buyers on subsequent housing transactions. To address potential endogeneity, we follow the instrumental variable (IV) strategy proposed by Sá (2015) and Saiz & Wachter (2011). Specifically, we use the predicted proportion of incoming mainland buyers based on historical settlement patterns

as the instrumental variable for the actual proportion of incoming mainland buyers. We find that a 1-percentage-point increase in the lagged proportion of mainland buyers in the same building results in a 1.7% higher transaction price and a 3.7-percentage-point higher gross return in subsequent transactions. These results remain robust to excluding samples without prior transactions by mainland buyers, or using the lagged number of mainland buyers as the explanatory variable. The heterogeneity of the spillover impact is also observed across market segments. Specifically, the magnitude of the spillover effect is larger for units of larger size or at premium locations, which normally attract more interest from mainland Chinese buyers (Gopalan, 2018).

Further, we discuss the safe haven effect, as well as other channels, through which the buyer's immigration background impacts their transaction price. At a regional level, the safe haven effect is evident as the number of mainland Chinese buyers increases significantly with the depreciation of the Chinese yuan (CNY), or with increased uncertainty about China's economic policy. Given an increase of CNY/HKD exchange rate by 0.01, or 100 base points (bps), the proportion of mainland Chinese buyers in the following month increases, surprisingly, by around 20%, despite lower purchasing power with the depreciation of the CNY. While this safe haven effect can coexist with other channels, our horse racing analysis shows that it has the dominated impact, which explains around 34% of the price disparity between mainland and local buyers. At the neighborhood level, the residential sorting channel is also supported, as mainland buyers tend to agglomerate in estates with more early mainland residents, which implies that migrants are willing to pay a housing price premium to live in a culturally similar neighborhood. At an individual level, the channel of migrants' weak bargaining power—including asymmetric information from the buyer's perspective and statistical discrimination from the seller's perspective—is evident as well. Buyers with more prior transaction experience in the local market will enjoy a larger discount in housing price, but mainland buyers will need to accumulate more market experience to enjoy the same benefit local buyers do. Local sellers who have prior transactions with mainland Chinese will charge subsequent mainland buyers 1.78% more, but such price discrimination is not observed among other combinations of buyer's and seller's background.

The literature investigates the effect of migrant residents on the housing market (Kerr & Kerr, 2011; Saiz & Wachter, 2011; Gonzalez & Ortega, 2013; Sá, 2015; Accetturo *et al.*, 2014), though little work has been done to identify the direct impact of migrant buyers on the housing market. Thanks to the massive individual-level transaction data with detailed information on sellers and buyers, this paper contributes to the literature by providing evidence from specific market participants and forming estimations at close neighborhoods of building levels. It also aims to bridge the literature gap in exploring the channels through which migrant buyers can affect the housing market in destination regions. Our evidence of the safe haven effect in the housing market contributes to related literature on other financial assets (Baur & McDermott, 2010; Hood & Malik, 2013; Klingler & Lando, 2018; Ranaldo & Söderlind, 2010), while it also provides insights into the relationship between the economic outlook for migration origins and the housing market in migration destinations. Empirical results of this study shed light on the policy importance to reduce price discrimination towards migrants in the housing market as well.

The remainder of the paper is organized as follows. Section 2 introduces the institutional background of mainland Chinese migrants in Hong Kong and Hong Kong's housing market. Section 3 describes the data set, and Section 4 describes empirical specifications. Section 5 presents the main empirical results and Section 6 presents discussions of channels. Sections 7 concludes.

2 Institutional Background

2.1 Mainland Chinese Immigrants in Hong Kong

Hong Kong is often viewed as a Chinese immigrants' society, with only about 60% of Hong Kong's population born locally, and many Hong Kong residents have family ties in China. It has undergone several waves of cross-border migration. When Hong Kong became a British colony in 1842, it was essentially a small fishing village with a local population of no more than a few thousand. Since neither the Chinese government nor the British colonial government limited population mobility across the Chinese border, free migration from Mainland China, mainly from villages in South

China, occurred whenever there was political and social unrest in China. The first wave of refugees was caused by the Taiping uprising in the early 1850s. The second wave occurred during the 1911 Revolution. The third wave happened in 1938, when the Japanese attacked Guangdong. After the Second World War, the first big wave of immigration occurred, around the period during which the Communists took over China (Hopkins, 1971).

Currently, the Chinese government implements a permit-quota system to restrict the entry of Chinese citizens into Hong Kong, which follows the quota system introduced by the colonial government in May 1950. The Chinese government would decide on the number of entrants to be allowed to enter Hong Kong from China, and would vet and approve the applications for entry into Hong Kong. The Hong Kong government would accept all Chinese citizens who had been issued exit permits by the Chinese government for entry into Hong Kong for residence. However, in recognition of Hong Kong's population pressure, the Chinese government would restrict the number of people granted exit permits. With the exception of two brief periods of suspension in 1955 and 1956, this quota system has continued until today (Lam & Liu, 1998).

The number of mainland Chinese migrants coming to Hong Kong via the "One-way Permit" (OWP) scheme constitutes a major proportion of cross-border migration. This one-way permit scheme allows up to 150 mainlanders each day to move into the city and is aimed to allow spouses and children born across the border to reunite with their families in Hong Kong. About $41,000$ mainlanders moved to the city in the year ending June 30, 2018, according to Appendix Figure A1. Over the 12-month period before that, $55,700$ mainland Chinese moved to the city via the scheme between mid-2016 and mid-2017, for an 11-year high. According to the South China Morning Post (SCMP), total about $950,000$ mainlanders migrated to the city via the scheme as of the end of 2016, making up about 12.8% of Hong Kong's population (Ng & Ng, 2018).

In addition to the OWP, Chinese authorities can issue an unlimited number of "Two-way Permits" (TWP), which allow holders to enter Hong Kong for the purpose of visiting family or doing business, but require that they return to China after a designated period. However, the two-way permit system creates a loophole for illegal immigration, as there have been numerous over-stayers

over the years. For instance, in 1991 there were 22,566 mainlanders, 5% of whom were TWP holders who overstayed. Anecdotally, many of the female over-stayers hoped to give birth in Hong Kong so that their children would be Hong Kong residents. As a result, in May 1999 the Hong Kong Special Administrative Region (HKSAR) government requested a reinterpretation of certain provisions of the Hong Kong Basic Law from China's National People's Congress in order to prevent a flood of immigration from the mainland giving birth to children in Hong Kong.

In 2001, the Court of Final Appeal in Hong Kong affirmed that Chinese citizens born in Hong Kong enjoyed the right of abode, regardless of the Hong Kong immigration status of their parents. Motivated by this rule change, thousands of women from the mainland have come to Hong Kong to give birth because it entitles their babies to Hong Kong permanent residency, which confers the benefits of a free education in public schools and subsidized health care as part of Hong Kong's British-inspired welfare policies. The number of children born to non-Hong Kong permanent residents in Hong Kong hospitals increased almost 100 times from 2001 to 2006: The number of babies born to mainland mothers soared to $20,000$ in 2006 from less than $9,000$ in 2002.

The local government has introduced several polices to deter mainland mothers from coming to give birth. Starting on February 1st, 2007, pregnant women from the mainland must pay $5,000 for their hospital care before they are even allowed to enter Hong Kong. Under the new rules, immigration officers will be instructed to reject the entrance of any mainland woman who appears to be at least seven months pregnant and has not paid the fee. A stricter regulation was introduced at the end of 2012, whereby public hospitals are not allowed to accept pregnant women if both parents are not local residents.

Local Hong Kong residents often consider new migrants from China ignorant, rude, dirty, and greedy, and believe they are introducing evils from the mainland (Vasu *et al.*, 2013). Newcomers were also seen as aggravating the territory's social problems by increasing competition for jobs, housing, and welfare benefits. As Hong Kong's economic recession deepened, Hong Konger's negative perception of new arrivals further deteriorated. According to the Society for Community Organization (SoCO, 2014), 82% of new, adult, mainland immigrant respondents believe that they

are racially discriminated against by Hong Kongers, especially by the general public (88.9%), and are being denounced as "parasites" (78.5%).

This social exclusion of recent Chinese immigrants did not vanish with the return of Hong Kong to China. Paradoxically, the problem has become more severe under the HKSAR government which is both a Chinese and a local government (Law & Lee, 2006). Based on a survey by Shen (2014) in two cities, Hong Kong and Shenzhen, Hong Kong society is divided regarding interest in close cooperation and integration with Shenzhen. About 40% of Hong Kong residents do not support the close integration of Hong Kong and Shenzhen, which is revealed by their views on whether to allow Shenzhen residents to travel to Hong Kong more easily and frequently.

2.2 Hong Kong's Property Market: Price and Affordability

The prices of residential housing estates in Hong Kong have been rising continuously over the last few years (Figure 1), and the consensus is that present housing prices are not affordable. Hong Kong is now ranked as the world's most expensive city to live in, as the disparity between the median home price and the median household income continues to expand (Carozzi *et al.*, 2018). Hong Kong topped the list for the eighth year in a row, with home prices regarded as being "least affordable". The city's apartments cost 18.1 times gross annual median income, which is much higher than the 5.1 benchmark ratio for "severely unaffordable". Only under exceptional circumstances, such as the 1998 Asian financial crises and the 2003 respiratory syndrome outbreak, or SARS, has the Hong Kong housing market seen affordable levels. This extreme ratio is often attributed to the forces of supply and demand; however, it is also believed that the problem is due not to a lack of housing but to government control of land, which artificially inflates prices.

Hong Kong is also the world's most overvalued housing market, according to UBS Global Wealth Management in September 2018. Real estate markets have surpassed corresponding local inflation levels by a wide margin. The scarcity of land, high population density, and high property values are the key contributing factors. Land premium charges levied by the Hong Kong government make up 50% of the total cost of development projects. Nevertheless, the high value of

property has made land and property development in Hong Kong one of the world's most profitable businesses. Developers from mainland China purchase much of this land at extremely high prices, which drives many smaller, local developers out of business, and the resulting apartments are sold for record profits.

The HKSAR government has acknowledged this unaffordability problem. It stated in the 2018 Policy Address that "the housing problem is the most challenging, formidable and complex among all livelihood issues. It is also the very issue that our people most earnestly look to the current-term government to resolve with innovative solutions in a resolute manner." To meet these objectives, the Chief Executive of the HKSAR, Mrs. Carrie Lam, introduced new housing initiatives, such as making subsidized public housing sale-flats (SSFs) more affordable and increasing the supply of subsidized public housing units. Only local permanent residents are eligible to apply for these public housing units. For the private housing market, the government also announced initiatives to enhance more timely supply of new flats.

The government has also implemented a series of cooling measures to rein in property prices and provide more affordable housing, as listed in Figure 1. These measures have curbed bank lending by reducing the LTV ratio, increasing stamp duty levies, etc. However, the effectiveness of these cooling measures is unclear. Although the government can impose restrictions on home purchases to reach the goal of "Hong Kong property for Hong Kong residents", there is concern that it could come at the expense of the city's status as a free economy. It is also noteworthy that the HKSAR government largely relies on revenue generated by the land premium and property stamp duty, which means that the financial position of the government is strongly related to real estate market conditions. In financial year 2017/2018, the HKSAR government's revenue generated by the land premium and property stamp duty accounted for 26.6% and 15.4% of total annual income, respectively. The government's incentive to address the city's housing issues is therefore complicated by this revenue concern.

2.3 Influx of Mainland Property Investors into Hong Kong

As an international hub for finance and trade, Hong Kong attracts investments from all over the world, and especially mainland China, given the geographic proximity and close social ties between the two regions. Hong Kong and mainland China, especially the Pearl River Delta (PRD) in general, have formed a close regional production network since 1978. Political history, kinship, and business ties have facilitated close economic integration in the region (Grundy-Warr *et al.*, 1999). Implementation of the "one country, two systems" (OCTS) policy in Hong Kong after 1997 also distinguishes this region from other cross-border regions (Shen, 2004; Sparke *et al.*, 2004; Yeung & Shen, 2008).

Property investors from Hong Kong consider properties in mainland China for second-home investments. Hui & Yu (2009) find that attachment to the mainland, either through preexisting connections or familiarity, provides the context that motivates middle-aged Hong Kong residents and frequent cross-border trippers to prefer second homes in the mainland.

This kind of cross-border property investment can also go in the reverse direction, from mainland China to Hong Kong. Mainland Chinese investors consider the Hong Kong housing market to be an attractive location for long-term return and profit. For example, in September 2016, 250 homes were sold to nonresidents, the most in 14 months and 36% higher than the average for the previous 4 months (Bloomberg, 2016). While the revenue department does not give a breakdown of the nationality of nonresident buyers, analysts and developers say that Chinese mainlanders are the biggest buyers. "From the non-local pool, Chinese mainland buyers certainly played a starring role," said Ryan Lam, Hong Kong-based head of research at Shanghai Commercial Bank Ltd.

The performance of the housing market in China, as well as the exchange rate between CNY and Hong Kong dollars (HKD), also impact Chinese investors' interests in Hong Kong's real estate market. Because property markets in China, especially in tier-one cities such as Shenzhen, are getting overheated and offer limited growth (Figure 2), mainland Chinese investors are flocking to buy property overseas for higher yield and asset diversification. Given Hong Kong's pegged exchange rate to the US dollar as a hedge against the Chinese yuan, mainland property investors

are attracted the Hong Kong property market when forecasters predict a weakening performance of China's economy and Chinese currency. Figure 3a plots the change in the exchange rate of HKD to CNY and the number of mainland buyers in Hong Kong over years. An obvious positive correlation is observed ever since China introduced a more flexible floating currency policy in 2010. When the performance of the Chinese yuan is weak, more Chinese buyers choose to urgently purchase properties in Hong Kong despite the weaker purchasing power. Figure 3b plots China's economic policy uncertainty index from 2001 to 2017, as introduced by Baker *et al.* (2016). Similarly, it is observed that more mainland Chinese join Hong Kong's housing market when the uncertainty of China's economic policy is high.

To improve housing affordability for first-time local buyers, many of the cooling measures introduced by the HKSAR government from 2012 onward are intended to suppress demand from investors and nonresidents. Take the stamp duty as an example. In Hong Kong, all housing buyers must pay a stamp duty which is a small percentage of the property's price. Non-permanent residents (PR) purchasing a flat after October 2012 are subject to an additional 15% buyer's stamp duty (BSD). All home buyers for a second flat are subject to a double stamp duty (DSD), ranging from 1.5% to 8.5%. After Nov 2016, the DSD increased to 15% for all local home buyers purchasing a second flat and all nonlocal buyers, which means that the total stamp duty payable by migrant buyers is 30% of the housing price.

As shown in Figure 1, the market indeed cooled down significantly in 2012. Because of the additional stamp duty imposed on nonresident housing buyers, the percentage of migrant buyers in primary and secondary residential markets decreased from 3.9% in 2012 to 1.3% in 2017, according to statistics from the Inland Revenue Department (IRD). However, it regained its growth in 2016. In 2016 Q2, Chinese mainland buyers accounted for 16.3% of all purchases by value, the most since the 15% surcharge on outside buyers was imposed in 2012 Q4. Mainland buyers accounted for 31% of property purchases of homes worth at least HK$20 million (US$2.58 million) in 2016 Q2. These statistics imply that mainland buyers were undeterred by the extra taxes they faced when buying properties in Hong Kong.

Although the government's cooling measures impede mainland Chinese from entering Hong Kong's housing market, growing housing demand from Chinese migrants is expected in the near future. Going forward, it is estimated that around 21,000 working professionals from mainland China could become permanent residents in Hong Kong by 2019 (Liu, 2018). This number is likely to increase in future years as the Hong Kong government's visa program for mainland Chinese attracts more high-earning young professionals.

To prevent overheating of the property market, tighter restrictions may be imposed on nonlocal home buyers if necessary to rein in property prices, even as Hong Kong maintains its open-door policy for mainland Chinese migrants, as Chief Executive Carrie Lam stated in the July 2018 Policy Address. This paper attempts to fill the knowledge gap in this dimension of housing consumption, which involves two housing markets within the same nation that feature both remarkable similarities and conflicts due to fundamental structural differences.

3 Data

3.1 Transaction Records

The data on housing transaction records used in this study are from EPRC Limited. This data set has the special merit of providing the full names of both sellers and buyers (in the official romanized Chinese, or "Pinyin"), although the order of the Chinese characters is randomized for privacy considerations. Hong Kong, Mainland China, and Taiwan use distinctive spellings in Chinese Pinyin.[1] The spelling of an individual's official name is determined by the birth place and is normally unchanged upon later migration experience. Therefore, we are able to identify where buyers and sellers are originally from based on the spelling of their Chinese names. All Hong Kongers are denoted as locals and people from other origins are denoted as migrants. Majority of the migrant buyers are from mainland China. On average, migrant buyers constitute 5.5% of total buyers, and 3.67% of total buyers are from mainland China, which is more than two-thirds

[1] We refer to the official Chinese romanization schemes published by government agencies in mainland China, Hong Kong and Taiwan. A full list of the spelling used in our classification is available upon request.

of all migrant buyers. Since our main interest is the cross-border migration from China, we only include local and mainland Chinese home buyers in our main regression samples.[2] We also use the number of previous transactions under the same name as the measure for a buyer's experience in the housing market.

This data set also provides comprehensive information on housing characteristics and details of the transaction. Physical features of the housing unit include the address, district, housing type (e.g., single building, block in an estate, or village house), block number, floor level, unit number, gross unit size, number of bedrooms and living rooms, building age, and remaining lease years. The unit housing price per square foot (p.s.f.) is calculated by dividing the pretax final transaction price by the gross unit size. All prices are adjusted using the CPI for the month. The transaction date is considered to be the instrument date for entry in the Hong Kong Land Registry. For housing units with multiple transactions during our sample period from 2001 to 2017, the holding days between consecutive transactions are also calculated. The seller's gross return during the holding period is winsorized at the 1% and 99% levels.

Our main sample for regression analysis includes all private housing resale transactions between individuals in Hong Kong from 2001 to 2017. We apply the following criteria to screen the sample. Firstly, we exclude transactions with institutional buyers or sellers by screening the names. Secondly, some spellings exist in the official Pinyin schemes for both mainland China and Hong Kong, and we exclude ambiguous samples (0.7%) in which the buyer's origin cannot be identified. Further, transaction records with incomplete information on physical features or transaction details are also excluded. Lastly, we include only transactions made by and mainland Chinese buyers.

Compared with local buyers, migrant buyers tend to buy units with higher price and better physical quality. Table 1 presents summary statistics for housing units bought by mainland buyers and local buyers in our main sample. We find that mainland Chinese buy larger and newer units on higher floors, with more bedrooms, living rooms, and longer lease terms than local buyers. All of these differences are statistically significant at the 1% level. Figure 4 compares total transaction

[2]Including migrants other than mainland Chinese does not impact the conclusions of our baseline and spillover estimations.

price and price per square foot paid by buyers from different origins over years. It reveals that migrant buyers consistently pay both higher total price and price per square foot than local buyers. Mainland Chinese buyers initially pay less than other migrants in 2001, but gradually catch up over years and, as of 2017, pay 30% more in total price than other migrants. Appendix Table B2 further compares the summary statistics for units less than 500 sq. ft., between 500 and 800 sq. ft., or over 800 sq. ft. More mainland buyers (5.6%) purchase units over 800 sq. ft., and the average unit price for these properties is much higher than for smaller flats.

The number of mainland Chinese buyers over years shows correlation with cross-border socioeconomic events and macroeconomics. Figure 5 plots the change in percentage of mainland Chinese buyers from 2001 to 2017. It has increased from less than 1% in 2001 to over 8.5% in 2011, which corresponds to the closer across-border communication after the handover of Hong Kong to China. However, due to the tightened social and real estate policies aimed at mainland Chinese in 2012, the percentage of mainland buyers in Hong Kong started to drop drastically afterward until 2014.[3] It then gradually rises again, which can partially be attributed to weaker confidence in China's currency and economy (Figures 3a and 3b), stronger government control of mainland China's real estate market (especially in Shenzhen since 2016, as shown in Figure 2), and therefore stronger incentives for mainland investors to enter Hong Kong's housing market.

The number of mainland buyers is also closely correlated with aggregated housing price and transaction volume, and such correlation varies over time and across districts. Figure 5 shows a similar trend in percentage of mainland buyers and housing price over years. The Pearson correlation coefficient is 0.768 between percentage of mainland buyers and total price, and 0.817 between percentage of mainland buyers and price per sq. ft. A similar correlation is observed between percentage of mainland buyers and total transaction volume in the market (Table 6). Figure 7 compares the average growth rate of the housing price and the growth of mainland buyers in the 18 districts in Hong Kong over each 5-year period from 2002 to 2016. Positive correlations are observed in different time periods, while the correlation is especially strong during 2007-2011—

[3]Both the restriction on public hospitals' acceptance of mainland pregnant women and introduction of the buyer's stamp duty for migrants were announced in 2012 Q4.

namely, before the Hong Kong government tightened their social and real estate policies toward mainland Chinese in 2012.

Transactions in Hong Kong's housing market have been very active over the last decades. There are over 40,000 secondhand transactions per year during our study period, and 57.2% of the transactions are repeated sales. The average holding period between consecutive sales of one flat is about 4 years, and the gross holding period return of housing investment is 57.6%. When one housing unit is transacted, 23.3 prior transactions have taken place in the same building in the past 12 months. Mainland Chinese buyers account for 0.872 prior transactions (3.5%) in the same building. On average, each buyer has a history of 0.738 transactions in the local housing market.

3.2 Population Census

Migration experience and other demographic information on residents in each district are extracted from the Hong Kong population census and by-census in 2006, 2011, and 2016. These censuses are conducted from July to August in each census year. They cover 1% of the resident population and approximately 10% of residential quarters. There are 66,459 samples in 2006, 70,825 samples in 2011, and 71,075 samples in 2016. Based on their answers to the question that asks where they lived 5 years ago, we classify residents as recent migrants or not. They are tagged as migrants if their answer is not "Hong Kong". Otherwise, they are considered locals. Migrants who lived in China 5 years earlier are identified as recent migrants from mainland China. The classification is cross-checked with two questions that ask whether they have moved houses and where they moved from during the past 5 years. The results are consistent using these two methods of classification. Only samples with complete information on their migration experience and demographic characteristics are included in the main sample set. Appendix Table C1 presents summary statistics for our main sample from the census data.

As part of the 2016 population by-census, the government also published a thematic report on mainland residents who have resided in Hong Kong for less than 7 years, from which we extract information on the total population and population of recent migrants in each district over the years

2006, 2011, and 2016 (HKCSD, 2016). On average, the percentage of new mainland residents (who arrived within the prior 7 years) in Hong Kong is decreasing over years, but different districts display different patterns of migration from mainland China. Appendix Table B3 ranks the 18 districts by the percentage of new mainland residents in each census year. Districts ranked in the lower half in year 2006 (i.e., with fewer migrant residents) have generally risen in rank in latter years, and the trend becomes obvious after 2011. This implies that either more mainland migrants are moving into areas that traditionally for the locals, or locals are moving out of those areas. Before 2011, the district with the lowest percentage of new migrant residents is the Eastern District on Hong Kong Island, a traditionally residential district for middle-class locals. In 2016, however, the population of migrant residents in the Eastern District jumped by 7% compared with 2011, while the total population in that district decreased by 8%.

4 Empirical Strategy

The following model is used to evaluate the correlation between buyer's origin and housing price:

$$Y_{it} = \beta_1 MB_{it} + X_{it}^{'}\lambda + \phi_t + \rho_i + \epsilon_{it}, \tag{1}$$

where Y_{it} represents the set of dependent variables under investigation, including the unit price per sq. ft. and the annual holding period return the seller has realized for this transaction of unit i at time t. The variable of interest is MB_{it}, which is a dummy variable indicating whether the buyer is a migrant. It equals 1 if the buyer is classified a migrant and 0 if the buyer is considered local. The coefficient β_1 is therefore interpreted as the effect of buyer's background on transaction price or seller's investment return. X_{it} is a set of variables that control for the physical features of housing unit i at time t, including the gross area, number of bedrooms and living rooms, remaining lease years of land, building age, floor level, and type of building (single building, block in a residential estate, village house, etc.). In the model of annualized holding period return, we include an additional control for the initial purchase price per sq. ft. Year and quarter dummies (ϕ_t) capture

the time fixed effect, while ρ_i controls for district fixed effects. ϵ_{it} is the error term. Standard errors are clustered at district level.

We further investigate the causal effect of previous mainland Chinese buyers on the dynamics of the follow-on housing market. Unlike most previous analyses in the literature that aggregate the housing price at district level (Saiz, 2007; Saiz & Wachter, 2011; Gonzalez & Ortega, 2013; Sá, 2015), we conduct our analysis at the individual transaction level to capture the more granular and direct effect of migrant home buyers who move into the same building. This is because in cities with very high density such as Hong Kong, the majority of residential projects contain only a single building, as shown in Appendix Table B4, while the facilities and physical features across buildings vary largely. To achieve this, we follow the empirical strategy of Campbell *et al.* (2011), using lagged mainland buyers at building level as an explanatory variable:

$$Y_{it} = \beta_2 N_{i,t-1} + X_{it}^{'}\lambda + \phi_t + \rho_i + \epsilon_{it}. \tag{2}$$

Y_{it} is a set of transaction-specific dependent variables under investigation, including price per sq. ft., holding days since last transaction, and the annualized holding period return from selling the unit, while i and t denote housing unit and transaction time, respectively. $N_{i,t-1}$ is the measurement of migrant buyers in the neighborhood within a 1-year period before the transaction is settled. We use the number of migrant buyers, or the percentage of migrant buyers of all transactions, on the same floor, or within the same building as $N_{i,t-1}$ in separate models. β_2 is the estimated effect of previous migrant buyers in the neighborhood on subsequent housing transactions. As in the definition of Equation (1), X_{it} is a set of controls for the housing unit's physical quality, including gross area, number of bedrooms and living rooms, remaining lease years of land, building age, floor level and building type. In the model for annualized holding period return, we also control for the initial purchase price. ϕ_t is the time fixed effect and ρ_i is the district fixed effect. ϵ_{it} represents the error term. Standard errors are clustered at the district level.

The OLS estimates from Equation (2) may suffer from endogeneity, since unobserved factors are likely to affect the housing price and migration decision simultaneously. To address concern

about endogeneity from unobserved factors, we follow the IV strategy proposed by Sá (2015) and Saiz & Wachter (2011) to use a predicted number/proportion of mainland buyers as the instrumental variable for the actual influx of mainland buyers. Specifically, we use the historical settlement pattern of mainland Chinese buyers to construct a predicted proportion of mainland buyers in subsequent years. It is assumed that the influx of new migrants is highly correlated with their historical settlement patterns, but the historical settlement will only impact future changes in housing price through incoming migrant buyers. The predicted lagged number of mainland buyers is then calculated as

$$\widehat{N}_{i,t-1} = \frac{MBStock_{i,t-2}}{MBStock_{t-2}} \times MBFlow_{t-1}, \tag{3}$$

where $MBFlow_{t-1}$ is the total flow number of mainland buyers in Hong Kong in $t-1$ period. $MBStock_{i,t-2}$ is the total stock of mainland buyers in building i before time $t-1$. $MBStock_{t-2}$ is the total stock of mainland buyers in Hong Kong before time $t-1$. To allow for the construction of a reliable stock, we include only samples from 2011 to 2017 in IV estimations and use the prior transactions in the same building since 2001 as the stock. The predicted lagged number of mainland buyers, $\widehat{N}_{i,t-1}$, is then divided by the total number of buyers in building i over the same period to be the predicted proportion of mainland buyers.

5 Main Results

5.1 Baseline Estimates

Table 2 presents the impact of home buyers from mainland China on housing transactions in Hong Kong, estimated from Equation (1). Columns (1) and (2) display the effect on transaction price and annualized holding period return, respectively. Mainland buyers are estimated to pay 4.42% more per sq. ft. than local buyers. The estimate is statistically significant at the 1% level.[4] In addition, selling units to mainland buyers, compared with transactions with local buyers, is estimated to realize a higher annual return by 6.61 percentage points. The estimate is statistically significant

[4]Changing the level of clustering does not impact the results.

at a high 1% level of significance. This implies that migrant buyers from mainland China pay a premium in the housing market of Hong Kong, which benefits local sellers as well.

Figure 8 visualizes the estimated housing price premium paid by mainland Chinese buyers over the years between 2001 and 2017. The bars indicate the by-year estimate of Equation (1) with 95% confidence intervals. All estimates on housing premium are positive and statistically significant at the 5% level or less, except for years 2003 and 2004.[5] The magnitudes fluctuate before 2011 and start to decline until 2015, which is consistent with the declining trend in the number of transactions that mainland Chinese buyers were involved in over that period.[6]

The impact of mainland Chinese buyers on housing price shows heterogeneity in different market segments. Specifically, they pay a high price premium for units at central locations and with larger unit size, which normally attracts more interest from mainland Chinese buyers (Gopalan, 2018). Figure 9a plots the estimated effect of mainland buyers on housing price in the three major regions of Hong Kong, as well as the average unit price in these regions. It reveals that for units at a more premium location, which is evident by a higher average unit price in that region, mainland Chinese buyers will pay a larger price premium than local buyers. For example, on Hong Kong Island, where the city's Central Business District (CBD) is located, mainland buyers pay a 5.35% higher price than local buyers. Figure 9b plots the estimated effect of mainland buyers on housing price, for units with a size less than 500 sq. ft., between 500 to 800 sq. ft., and more than 800 sq. ft., respectively. For transactions of units larger than 800 sq. ft., in which over 5.6% of the buyers are from mainland China, these mainland buyers pay 7.1% more than local buyers.

[5]Due to the outbreak of SARS, Hong Kong's housing market experienced a recession from 2003 to 2004. The safe haven effect can explain the insignificant coefficient for mainland buyers during this period. Since mainland Chinese have low confidence in Hong Kong's housing market during a recession, fewer Chinese investors consider properties in Hong Kong as a hedge for domestic risk.

[6]Following the general literature on the aggregate impact of migrant residents on local housing markets (Gonzalez & Ortega, 2013; Sá, 2015; Saiz, 2007), we also investigate the correlation between housing price and aggregated population of migrant residents by including the district population of migrant residents from 2006 to 2016 in Equation (1). Results are presented in Appendix Table B5. Although individual mainland Chinese buyers constantly pay a higher price than local buyers, the association between mainland resident population and housing price at district level is on average negative in 2006 (Column (1)). The magnitude of the correlation shrinks in 2011 (Column (2)), and turns positive in 2016 (Column (3)). All estimates are statistically significant at a high 1% level. This pattern is consistent with our statement in Section 3 that in recent years, more mainland migrants are moving into more expensive residential areas, which are traditionally preferred by middle-class locals.

5.2 Spillover Impact of Lagged Migrant Buyers on Housing Price

While our baseline estimation reveals that mainland Chinese buyers purchase properties in Hong Kong at a higher price, it would be interesting to identify the impact of such price premium paid by mainland buyers on the subsequent housing market. Thus we turn to Equation (2) to estimate the causal impact of time-lagged mainland buyers in the same building on subsequent housing transactions, and we use the predicted number of mainland buyers based on historical settlements as the IV for the actual number of mainland buyers. We include only transactions from 2011 to 2017 as our main sample to allow a reliable stock period for predicting the distribution of new mainland buyers. Table 3 presents the IV estimation results.[7] In Columns (1) and (2), the outcome variable is the log of price, while in Columns (3) and (4) the outcome variable is the gross return. In Columns (1) and (3), we include all samples from 2011 to 2017. As a robustness check, we further exclude transactions without any prior mainland buyers in the previous year and report the estimation results in Columns (2) and (4). Appendix Table B7 reports the corresponding first-stage result of each IV estimation. As expected, the first-stage results reveal that the predicted proportion of mainland buyers based on historical settlement patterns are highly correlated with the actual proportion of mainland buyers. The F statistics of the first-stage estimations are between 59.84 and 162.42, which addressed the concern about a weak instrument. The results in Column (1) of Table 3 reveal that if the lagged proportion of migrant buyers in the same building increases by 1 percentage point, the subsequent transaction price will increase by 1.7%. Estimates in Column (3) indicate that a 1-percentage-point increase in the lagged percentage of mainland buyers will result in a higher annual holding period return of sellers by 3.7 percentage points. Both estimates are statistically significant at the 1% level. In addition, we check robustness by replacing the explanatory variable with the lagged number of mainland Chinese buyers, and obtain similar results (Appendix Table B8). This thus reveals that the influx of mainland buyers in the proximate neighborhood increases both housing prices and the return realized by sellers.

One potential concern is that transactions with no prior migrant buyers may bias the result.

[7] The OLS estimation result is supplemented in Appendix Table B6.

Excluding transactions with no prior mainland buyers, we estimate the impact of an additional 1-percentage-point increase in mainland buyers on housing price and gross return to be 0.77% and 1.35%, respectively, as presented in Columns (2) and (4) of Table 3. Both of these estimates are statistically significant at the 1% level. These results also imply that the spillover effect of lagged mainland buyers on subsequent housing transactions is nonlinear with increasing lagged mainland buyers. With a higher percentage of lagged mainland buyers in the same building, the magnitude of the spillover effect also tends to decrease.

Our empirical findings closely relate to a common puzzle in the literature: How does a small proportion of investors significantly impact the entire housing market (Deng *et al.*, 2019; Miller, 1977)? Some studies demonstrate the contagion effect of a small proportion of foreclosed properties on the entire market (Anenberg & Kung, 2014; Campbell *et al.*, 2011; Harding *et al.*, 2009). Piazzesi & Schneider (2009) propose a search model to demonstrate how a small fraction of optimistic investors can have a large effect on prices without buying a large share of the housing stock. We provide additional evidence that mainland Chinese buyers create an upward price momentum in Hong Kong's housing market. Although their percentage is only 3.7% in the entire buyer population, the momentum they create can be quite influential and drive up the market. Subsequently, a large and increasing fraction of local buyers believes that the time for buying a house is good, as the price will keep increasing, at least in the short to mid-term.

Heterogeneous Effect of Lagged Migrant Buyers on Housing Price Since mainland buyers are more inclined to purchase properties with better housing quality, we hypothesize that the influx of mainland Chinese buyers will have heterogeneous spillover effects on different market sectors, especially with stronger impact on the high-end market. Anecdotal evidence reports that premium location and large unit size are the two most critical housing features mainland Chinese buyers consider when they invest in Hong Kong's housing market (Gopalan, 2018).

We find that the impact of mainland Chinese buyers is stronger at premium housing locations. Specifically we estimate the heterogeneous effects of lagged mainland Chinese buyers on housing price across different regions in Hong Kong, and IV estimation results are reported in Panel A of

Table 4.[8] With an increase in the lagged proportion of mainland buyers by 1 percentage point, the estimated increase of housing price is 2.17%, 1.24%, and 1.27% in Hong Kong Island, Kowloon, and New Territories, as presented in Column (1)-(3), respectively. The first two estimates are statistically significant at the 1% level and the last estimate is statistically significant at the 5% level. The larger magnitude of the mainland buyers' impact on Hong Kong Island can be explained by its premium location. Hong Kong Island, where the city center and major business districts are located, has been commonly recognized as the most premium region in Hong Kong. The majority of Hong Kong's luxury residential properties are on Hong Kong Island, for which mainland Chinese are the major buyers, as reported by SCMP (2018). It also has the smallest supply of residential buildings, as shown in Appendix Table B4.

Our results also reveal that the spillover impact of mainland Chinese buyers is stronger for properties with larger size. We report IV estimation results by market sectors of unit size in Panel B of Table 4.[9] In Columns (1)-(3), we include the subsamples with unit size less than 500 sq. ft., between 500 to 800 sq. ft., or over 800 sq. ft., respectively. With an increase in the lagged proportion of mainland buyers by 1 percentage point, the corresponding estimates of the increase in housing price are 0.85%, 1.62%, and 1.89%, respectively. This demonstrates that the influx of mainland buyers has a stronger impact on the price of units over 800 sq. ft., which account for approximately the top 20% of properties in terms of unit size.

6 Channel Discussion

In this section, we discuss the channels for mainland Chinese buyers who pay a housing premium at regional, neighborhood and individual levels. We find that the safe haven effect at the regional level is the most important channel influencing this price premium, which dominates other channels such as residential sorting and bargaining power.

[8]The OLS estimation result is supplemented in Panel A of Appendix Table B9.
[9]The OLS estimation result is supplemented in Panel B of Appendix Table B9.

6.1 Regional Level: The Safe Haven Effect

At the regional level, buyers from mainland China are expected to be more willing and eager to invest in Hong Kong's housing market when they foresee a poorer investment return in the domestic property market, or a weaker domestic currency in the near future. This motivation is termed the "safe haven effect" (Badarinza & Ramadorai, 2018; Cvijanovic & Spaenjers, 2015), which means that investors limit their exposure to losses in one downturned market by retaining or increasing value in another market. We apply two identifications for the safe haven effect. The first is the CNY/HKD exchange rate. Specifically, given Hong Kong's pegged exchange rate to the US dollar as a hedge against the Chinese yuan, mainland Chinese property investors are attracted to the Hong Kong property market when they forecast a weakening performance for the Chinese currency. Since China only introduced a floating currency policy after 2006, we also apply the alternative identification, the Economic Policy Uncertainty (EPU) index introduced by Baker *et al.* (2016), to cover our whole study period from 2001 to 2017.

We examine the safe haven effect based on Equation (2), with the following modification:

$$Y_{it} = \beta S_{t-1} + X_{it}^{'}\lambda + \phi_t + \rho_i + \epsilon_{it}. \tag{4}$$

Instead of using lagged migrant buyers as an independent variable, we replace it with the lagged measures of safe haven effect, which are denoted as S_{t-1}. The first measure is the 1-month lagged exchange rate from HKD to CNY. Therefore, an increase in S_{t-1} means an appreciation of HKD and a depreciation of CNY. The second measure is the 1-month lagged EPU index. A higher EPU index indicates a higher level of uncertainty in China's economic performance and policy. Y_{it} is a set of the dependent variables under investigation, including a dummy variable indicating whether the buyer is a migrant, and a continuous variable equal to the log of the seller's holding days. Thus, β is the estimate of interest. As in Equation (2), X_{it} is the same set of controls for the housing unit's physical quality. ϕ_t is the time fixed effect and ρ_i is the district fixed effect. ϵ_{it} represents the error term.

Table 5 presents the logit estimation result of Equation (4) using the binary variable for migrant buyer as the dependent variable, and margins at the mean are reported. In Column (1), the lagged CNY/HKD exchange rate is included as the dependent variable, while the dependent variable is replaced by the lagged EPU index in Column (2). With an increase of 0.01, or 100 base points (bps), in the HKD/CNY exchange rate, the probability of a mainland buyer is raised by over 1.2 percentage points (Column (1)). This estimate is statistically significant at the 1% level. Given that mainland Chinese buyers constitute around 5.5% of total transactions during 2006 to 2017, this means that the 100 bps increase in the exchange rate will increase the number of mainland buyers by around 21.8% on average. Results in Column (2) reveal that when the EPU index of mainland China increases by 100 (equivalent to 0.9 standard deviation), the probability of a mainland buyer is increased by around 1 percentage point. This estimate is statistically significant at the 5% level.

In summary, our results indicate that when the performance of China's currency is weaker or China's economic uncertainty is higher, more Chinese buyers are entering Hong Kong's housing market as a hedge against risk. While the demand from mainland buyers becomes stronger, these mainland buyers are also more impatient in searching for comprehensive market information and negotiating for better prices. This, in turn, leads to the price disparity between local and mainland home buyers.[10]

6.2 Neighborhood Level: Residential Sorting

Following the assimilation theory of immigrants in the literature, we explore the influence of residential sorting on the mainland buyer's choice of residential location (Alba & Logan, 1992; Lieberson, 1963; Zunz, 1982). It is hypothesized that incoming mainland buyers prefer to live where earlier mainland Chinese agglomerate (Andersen, 2010, 2016; Borjas, 2002). As a result, mainland buyers are more willing to pay a price premium for housing units in those areas (Bajari & Kahn, 2005; Card *et al.*, 2008; Zhang & Zheng, 2015).

[10]The total wealth of mainland home buyers may also impact their home purchase prices, because wealthier buyers may spend less effort in bargaining. However, when the CNY/HKD exchange rate increases, the purchasing power of the wealthier mainland buyers are expected to decrease, which will result in less mainland buyers. Our empirical result thus implies that the safe haven effect also dominates this wealth effect.

Estimation of this channel follows Equation (2), but with the outcome variable changed to buyer status. Specifically, we investigate the effect of lagged proportion or lagged number of mainland buyers on the probability that the subsequent buyer is also a mainland Chinese. Our empirical specification is as follows:

$$MB_{it} = \beta N_{i,t-1} + X_{it}^{'}\lambda + \phi_t + \rho_i + \epsilon_{it}, \tag{5}$$

where MB_{it} is a dummy variable equal to 1 if the buyer of unit i at time t is a mainland Chinese and 0 otherwise. $N_{i,t-1}$ is the measurement of 1-year lagged mainland buyers in the same building. We use either the lagged number of migrant buyers or the lagged proportion of migrant buyers as $N_{i,t-1}$ in separate models. The coefficient β therefore indicates the effect of previous mainland buyers on the probability that the subsequent buyer is a migrant. X_{it} is the same set of controls for the housing unit's physical quality. ϕ_t is the time fixed effect and ρ_i is the district fixed effect. ϵ_{it} represents the error term.

Appendix Table B10 presents logit estimation results of Equation (5), with margins at the mean reported. Column (1) displays estimates using the lagged proportion of mainland buyers as explanatory variable, while in Column (2) we use the lagged number of mainland buyers. Results in Column (1) reveal that a 1-percentage-point increase in the lagged proportion of mainland buyers in the building will lead to an increase of 0.0006 in the probability that the subsequent buyer is a mainland Chinese. With one additional mainland buyer in the same building during the previous year, the probability that the subsequent buyer is also a mainland Chinese is estimated to rise by 0.0014 (Column (2)). Both estimates are statistically significant at the 1% level. These results thus support the existence of a residential sorting channel that, at least in part, drives the price disparity between local and mainland buyers.

6.3 Individual Level: Bargaining Power

Inferior bargaining power in the local housing market is the third possible channel to explain the price premium paid by migrant buyers. Here we mainly discuss a lack of market information from the perspective of buyers and statistical discrimination from the perspective of sellers, and we discuss the impact of alternative housing options from a policy perspective in Appendix C.

6.3.1 Asymmetric Information

Migrant buyers, as newcomers to the city, are expected to have less market information (Ling *et al.*, 2018), higher searching cost (Baryla & Ztanpano, 1995; Lambson *et al.*, 2004; Turnbull & Sirmans, 1993), and weaker local networks (Tu *et al.*, 2017). First-time migrant buyers may also face time constraints in their search for housing, while local buyers do not (Ihlanfeldt & Mayock, 2012). Therefore, migrant buyers normally possess less bargaining power that local buyers (Wilhelmsson, 2008; Zhou *et al.*, 2015).

Thanks to the abundant records of transactions over 17 years with detailed information on names, we are able to identify buyers with multiple transactions. The following empirical specification is modified from Equation (1) to test whether the asymmetric market experience induces the price difference:

$$\log(price_{it}) = BExp_{it}'\beta + X_{it}'\lambda + \phi_t + \rho_i + \epsilon_{it}. \tag{6}$$

Specifically, $BExp_{it}$ is a set of dummy variables representing the buyer's prior experience in the housing market before the buyer purchases unit i at time t. Specifically, we categorize the buyer's prior transaction times to be 0, 1, 2, or 3 or more times, and we use a binary variable to indicate each category. Using the subsamples of mainland and local buyers in separate models, we estimate the coefficients β, which represent the differentiated impact of transaction experiences on housing price. The same controls for physical features and fixed effects are included, as in Equation (1).

Appendix Table B11 presents OLS estimation results from Equation (6). Column (1) reports results with the subsamples of local buyers, and Column (2) reports results using subsamples of

mainland Chinese buyers. Compared with first-time local buyers, local buyers with 1, 2, or 3 or more prior transactions will purchase the unit at a discount of 1.51%, 2.19%, and 3.62% respectively (Column (1)). All estimates are statistically significant at the 1% level. However, for mainland Chinese buyers, having 1 or 2 prior transaction experiences in Hong Kong will not offer any price benefit in the subsequent purchase, as indicated by the statistically insignificant coefficient in Column (2). Only after mainland buyers have accumulated 3 or more prior transactions will they enjoy a 1.46% discount in the following transaction. This estimate is statistically significant at the 10% level. The results support our hypothesis that buyers with more knowledge of the local housing market will pay a lower price, but migrant buyers initially have limited local market knowledge and will need more market exposure to enjoy the benefit of market knowledge, as local buyers do.

6.3.2 Statistical Discrimination

Statistical discrimination from the seller's side is another possible explanation for the price disparity. Local sellers may consistently charge migrant buyers higher prices, possibly because they possess a biased belief in the migrant buyer's stronger willingness to pay or less knowledge of the market. An analogy is institutional sellers who impose different pricing strategies based on the consumer's background (Armstrong, 2006; Stole, 2003; Holmes, 1989). Specifically, firms recognize the various needs and willingness-to-pay of customers, and therefore charge them differently, either based on the time the customer makes the purchase (Möller & Watanabe, 2010; Stavins, 2001) or by customers' geographic segmentation (Bolton & Myers, 2003). Since recognizing the migrant buyer's needs is essential for implementing price discrimination (Fudenberg & Villas-Boas, 2006), a local seller's price discrimination toward migrants is hypothesized to become stronger if the local seller has previously transacted with migrant buyers.

With detailed information on the names of sellers and buyers, we identify sellers' past transaction times with mainland buyers. We then estimate the impact of prior transactions with mainland Chinese on subsequent selling price, out of all combinations of buyers and sellers with different

backgrounds. Following Equation (1), the empirical specification is modified as follows:

$$\log(price_{it}) = \beta SExp_{it} + X_{it}^{'}\lambda + \phi_t + \rho_i + \epsilon_{it}. \tag{7}$$

$SExp_{it}$ represents the seller's past transaction experience with mainland Chinese buyers before unit i is sold at time t. We use two measurements for $SExp_{it}$ in separate models. The first is a dummy variable equal to 1 if the seller has ever sold houses to migrants before and 0 otherwise. The second measurement is a continuous variable equal to seller's prior times of sales to migrants. The coefficient, β, is therefore of interest; it estimates the price premium sellers will charge if they have sold units to mainland buyers before.

Appendix Table B12 reports OLS estimation results from Equation (7). Panel A reports estimation results using the binary variable, "having prior sales to mainlanders", as the explanatory variable. Columns (1)-(2) include the subsamples with local sellers, and Columns (3)-(4) include the subsamples with mainland sellers. In Columns (1) and (3) we include only transactions by local buyers, and in Columns (2) and (4) only transactions by mainland buyers are included. It is shown that if local buyers have transacted once with mainland Chinese, they will sell the units at a 1.78% higher price in further transactions with mainland buyers (Column (2)). This estimate is statistically significant at the 10% level. As expected, such price discrimination is not imposed by local sellers on local buyers, nor imposed by mainland sellers. Panel B reports estimation results using a continuous measure of seller's experience with mainland buyers, and similar conclusions can be reached. With 1 additional prior transaction with mainland buyers, local buyers charge 1.56% more in subsequent sales to mainland buyers (Column (2)). This estimate is statistically significant at the 5% level. No such statistical discrimination is observed in other combinations of sellers and buyers. It is therefore evident that local sellers impose statistical price discrimination on mainland buyers. The more transactions they have done with migrants, the higher price they will charge the next migrant buyer.

The information channel and statistical-discrimination channel are not mutually exclusive; they can coexist and interact with each other to shape the overall pattern of housing premiums paid by

migrant buyers. There could also exist other mechanism, such as the alternative option channel, as described in Appendix C, to explain our results.

6.4 Horse Racing Analysis of the Channels

While our previous evidence reveals that both the safe haven effect at a regional level and other channels at the neighborhood or individual level explain the price premium paid by mainland Chinese home buyers in Hong Kong, it is of great interest to investigate whether the safe haven effect has a dominant impact. Therefore, we conduct a horse racing of the previously identified channels using the similar empirical specifications in Equations (4)-(7):

$$log(price)_{it} = Channel_{it}^{'}\alpha + X_{it}^{'}\lambda + \phi_t + \rho_i + \epsilon_{it}, \tag{8}$$

where $Channel_{it}$ is a set of standardized variables measuring the impact of the investigated channels. Specifically, we use the standardized 1-month lagged CNY/HKD exchange rate as the measure for the safe haven effect and the standardized 1-year lagged proportion of mainland buyers in building i as the measure for residential sorting. A continuous variable equal to the standardized buyer's prior transactions times is included as a measure for buyer's market information. Finally, we standardize the dummy variable, which indicates whether the seller is local as the measure for statistical discrimination. $log(price)_{it}$ is the log form of price for unit i transacted at time t. The estimate of α therefore represents the impact of each channel on average housing price. To specifically investigate each channel's impact on the price disparity between migrant and local buyers, we then interact $Channel_{it}$ with MB_{it}, which is a dummy variable indicating whether the buyer is a migrant. It equals to 1 if the buyer is classified as migrant, and is 0 the buyer is considered local.

$$log(price)_{it} = MB_{it} * Channel_{it}^{'}\delta + Channel_{it}^{'}\alpha + \beta MB_{it} + X_{it}^{'}\lambda + \phi_t + \rho_i + \epsilon_{it}. \tag{9}$$

Therefore, the coefficient of the interaction term (δ) indicates each channel's impact on migrants' purchase price premium. By comparing the magnitudes of δ, we can then identify whether the safe

haven effect dominates other channels. X_{it} is a set of variables controlling for the physical features of housing unit i at time t. In the model of gross return, we include additional controls for the initial purchase price and log holding days. ϕ_t is the year times quarter fixed effect. ρ_i is the district fixed effect, and ϵ_{it} is the error term. Standard errors are all clustered at the district level.

Table 6 reports estimation results of the horse racing analysis. Columns (1) and (2) report the estimation results of Equation (8), using the subsample of mainland buyers and local buyers, respectively. If the CNY/HKD exchange rate increases by 1 standard deviation (SD), the housing price for mainland and local buyers decreases by 8.75% (Column (1)) and 11.08% (Column (2)), respectively. This can be explained by the fact that an appreciation of Hong Kong dollars (i.e., an increase in the CNY/HKD exchange rate) is normally associated with higher interest rates and tightened monetary policy, which leads to high mortgage expenses and lower property prices. With an increase of 1 SD in the lagged proportion of mainland buyers, migrants' purchase price in the subsequent year increases by 1.89% (Column (1)) due to residential sorting. This impact of increasing demand spills over to local buyers, who will pay 1.12% higher price (Column (2)). Similar to previous findings, only local buyers statistically significantly benefit from their prior transaction experiences. With a 1-SD increase in the local buyer's prior transaction times, their subsequent purchase price will decrease by 0.96% (Column (2)). Meanwhile, local buyers only exercise price discrimination on mainland buyers, which is evident by the statistically significant coefficient of local sellers in Column (1) only.

What is more interesting is the impact of each channel on the price disparity between migrant and local buyers. Column (3) reports estimates of the coefficients (δ) for the interaction terms in Equation (9). If the CNY/HKD exchange rate increases by 1 SD, migrant buyers are estimated to pay a 1.51% higher price and the estimate is statistically significant at the 10% level.[11] The magnitude of this safe haven effect is larger than the impact of residential sorting (1.43%) and statistical discrimination (1.24%). In fact, the willingness of mainland buyers to pay a price premium because of safe haven concerns can be even larger than our estimate. This is because an increase in

[11]The result remains robust if we include additional controls for macroeconomic performance, including the quarterly GDP and unemployment rate for both China and Hong Kong.

the CNY/HKD exchange rate also indicates the lower relative purchasing power of Chinese buyers and more expensive property priced in Hong Kong dollars.

In summary, our result implies that when the economic performance in mainland China is weak, the desire to transfer assets across the border is the major reason mainland buyers are willing to purchase properties in Hong Kong at a higher price. Since mainland buyers are estimated to pay a price premium of 4.42% on average, our empirical evidence reveals that the safe haven effect, or specifically the mainland buyer's confidence in China's economy, can explain around 34.2% of this price disparity.

7 Conclusion

In this paper, we investigate the effect of cross-border migration on housing markets in destination regions and explore the channels that drive the price disparity between migrant and local home buyers. Using individual-level housing transaction records with detailed information on buyers' and sellers' names in Hong Kong between 2001 and 2017, we estimate the effect of immigration from mainland China on housing prices and property investment returns in Hong Kong. We explore possible channels at regional, neighborhood, and individual levels, and find that the safe haven effect at the regional level, or the mainland buyer's confidence in China's currency and economic policy, has the dominating impact.

By applying both correlation and time-lagged causality estimation with an IV identification strategy, we find that mainland Chinese buyers are associated with 4.4% higher housing prices, while the influx of mainland Chinese buyers results in increases in subsequent transaction prices and property investment returns at the close neighborhood level (i.e., in the same building). Such spillover effect is stronger for units with larger size or in premium locations, which mainland Chinese buyers are more interested in purchasing. Changes in macroeconomic factors—such as the exchange rate in mainland China and the uncertainty of China's economic policy—probably impose a safe haven effect on Hong Kong's housing market, which attracts more (impatient) mainland

Chinese buyers. This safe haven effect has a dominating impact in explaining the price premium paid by mainland buyers, which accounts for around 34% of the price disparity. Other channels include a residential sorting effect at the neighborhood level, which is likely to agglomerate migrant buyers to pay a higher premium in order to live in a neighborhood with a high proportion of migrants. At the individual level, asymmetric market information on the buyer's side and statistical discrimination on the seller's side may also contribute to the estimated effect of migrant buyers on the housing market.

Our investigation of the cross-border safe haven effect in this paper is salient for the heated debate regarding the relation between the economic outlook in migration origins and housing markets in migration destinations (Li, 2016; Shane, 2019). This study also fits into the literature that examines the effect of inner-country and international migration flows on housing prices at the city and neighborhood level (Accetturo *et al.*, 2014; Saiz, 2007; Saiz & Wachter, 2011; Gonzalez & Ortega, 2013; Sá, 2015). It provides further evidence at the individual transaction level, which adds to previous ambiguous results using aggregated prices. In addition, by combining data on macroeconomics and population mobility, this study also stands out as an analysis of cross-border migration from China, which is an important constituent of global migration. Given the increasing global and regional uncertainty and complexity in recent years, this study has strong practical implications. Moreover, our empirical results also shed light on the policy importance of reducing price discrimination toward migrants in housing markets. Future work will include detailed exploration of the differentiated effects of migration from different sending regions.

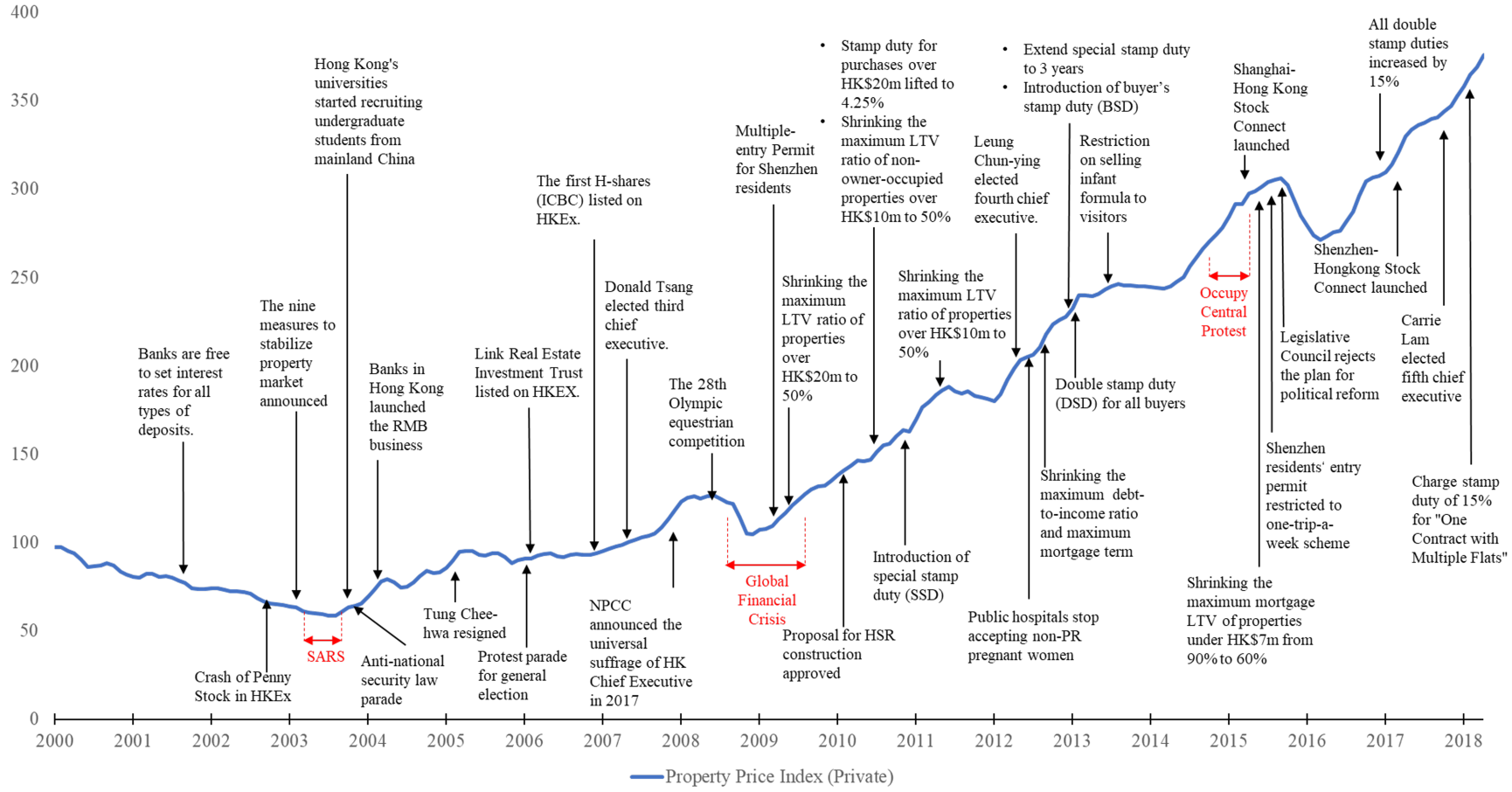


Figure 1: Socioeconomic Events and Housing Price in Hong Kong

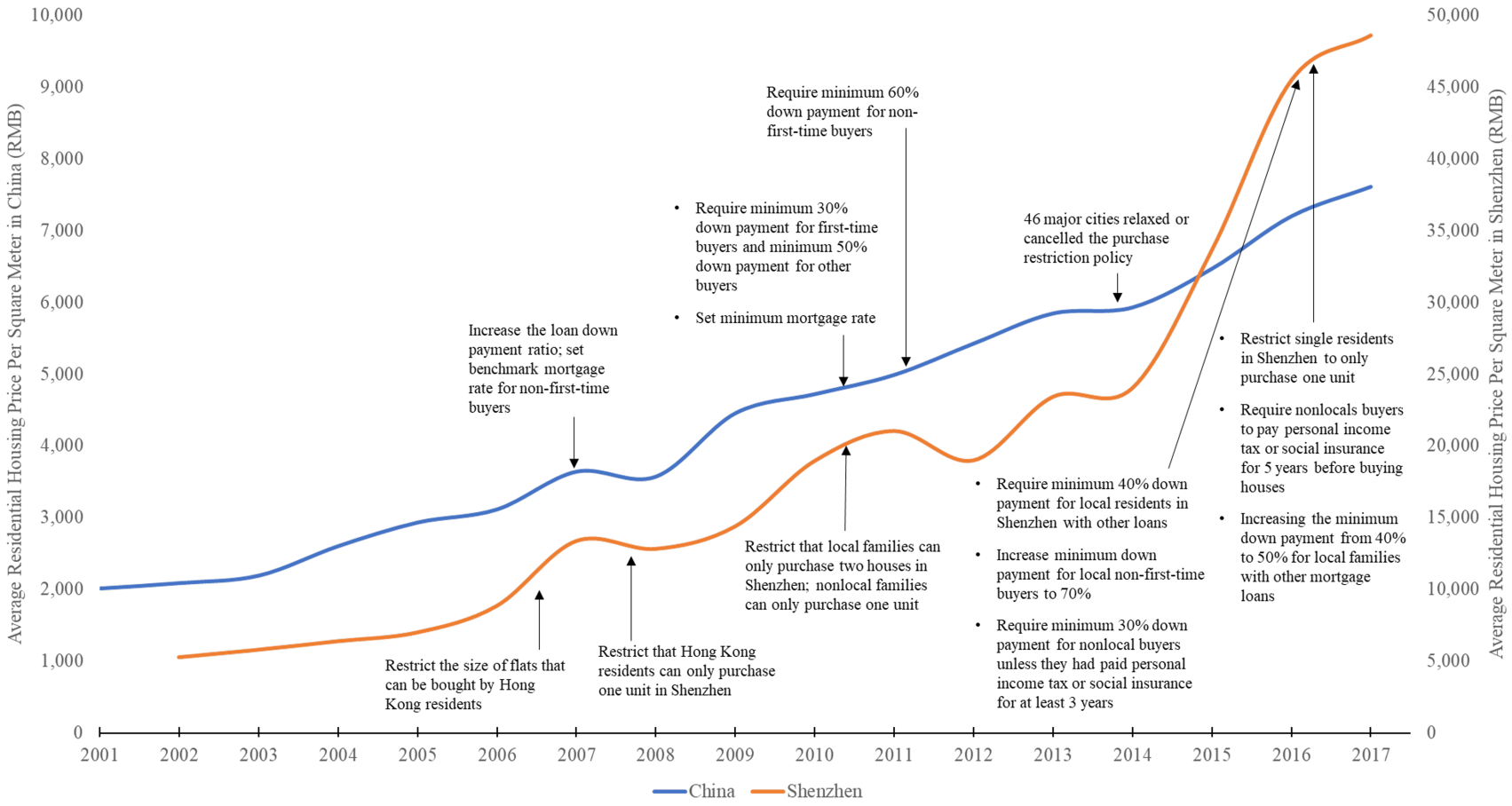
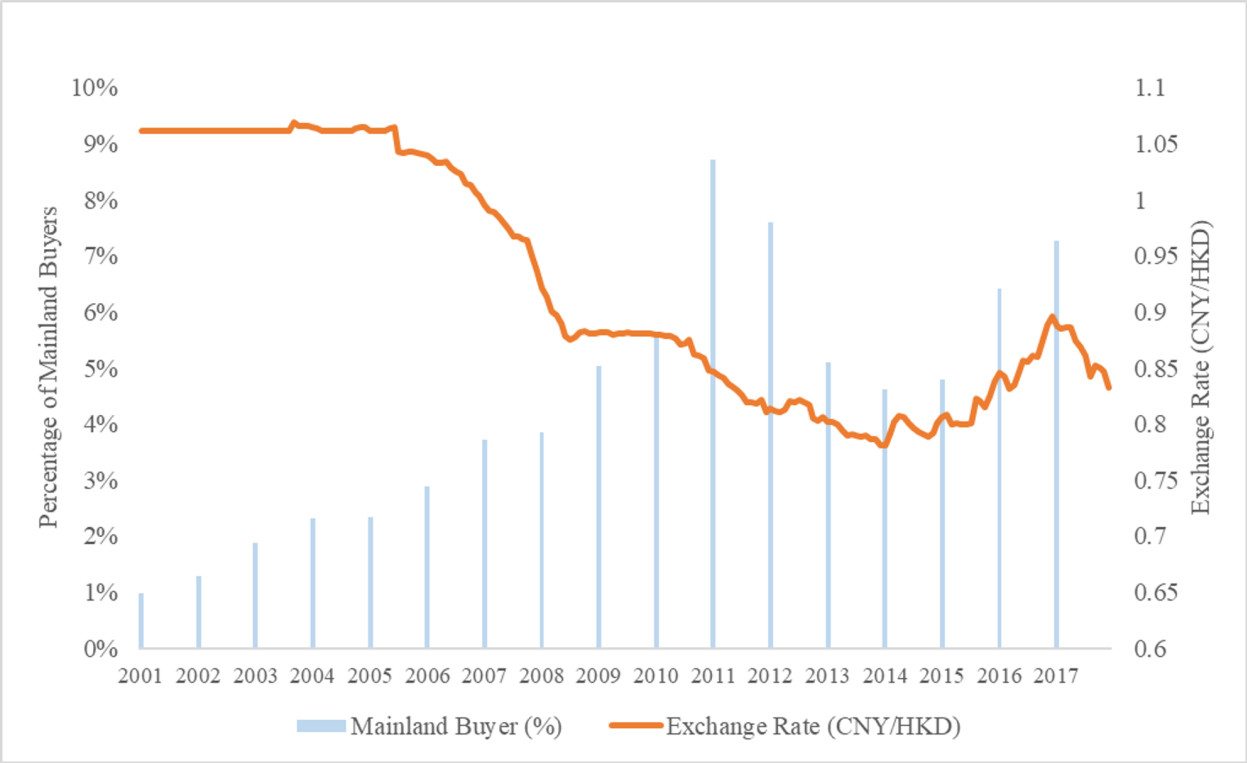
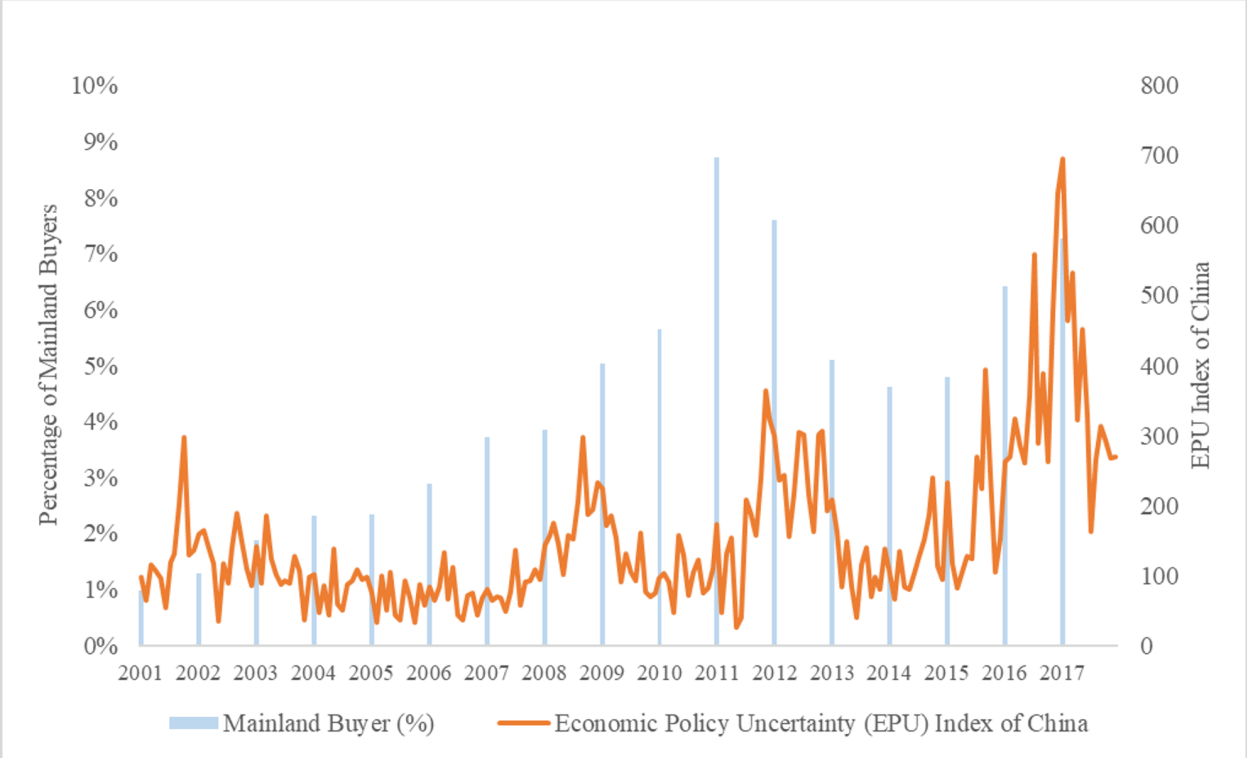


Figure 2: Housing Price and Housing Market Policies in China

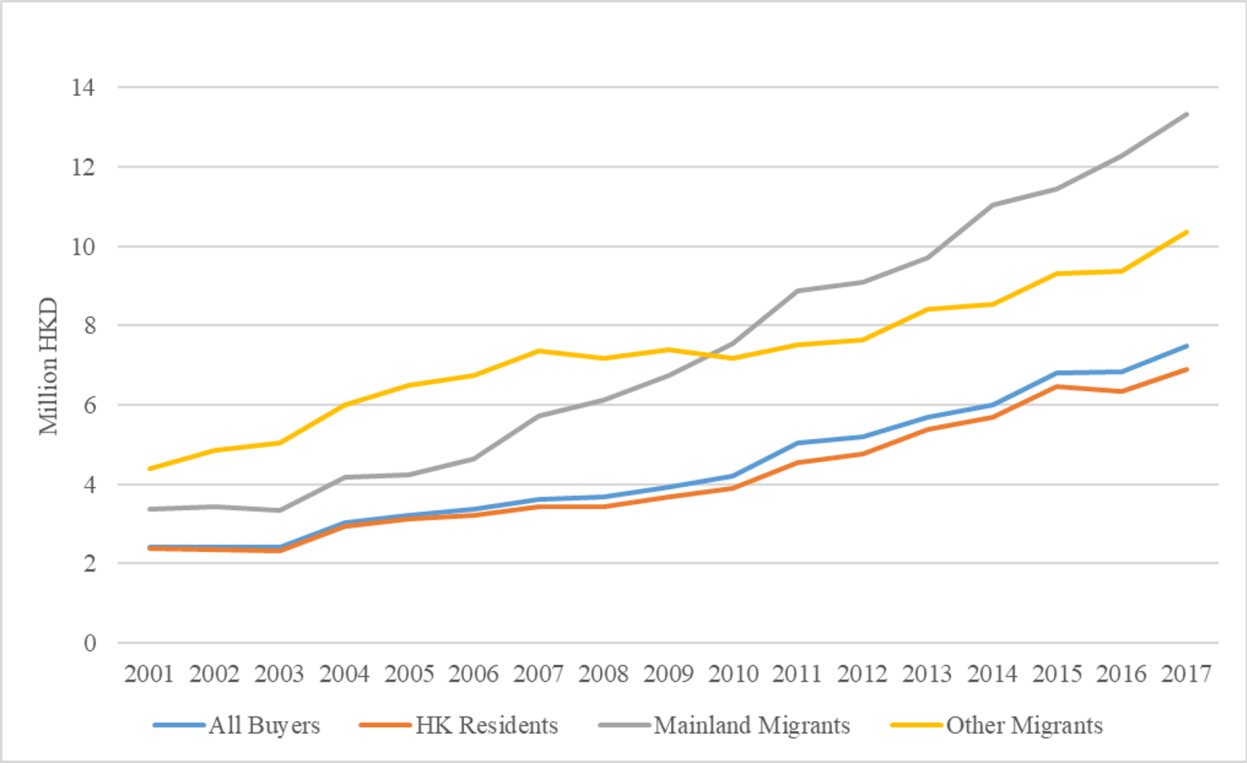


(a) CNY/HKD Exchange Rate

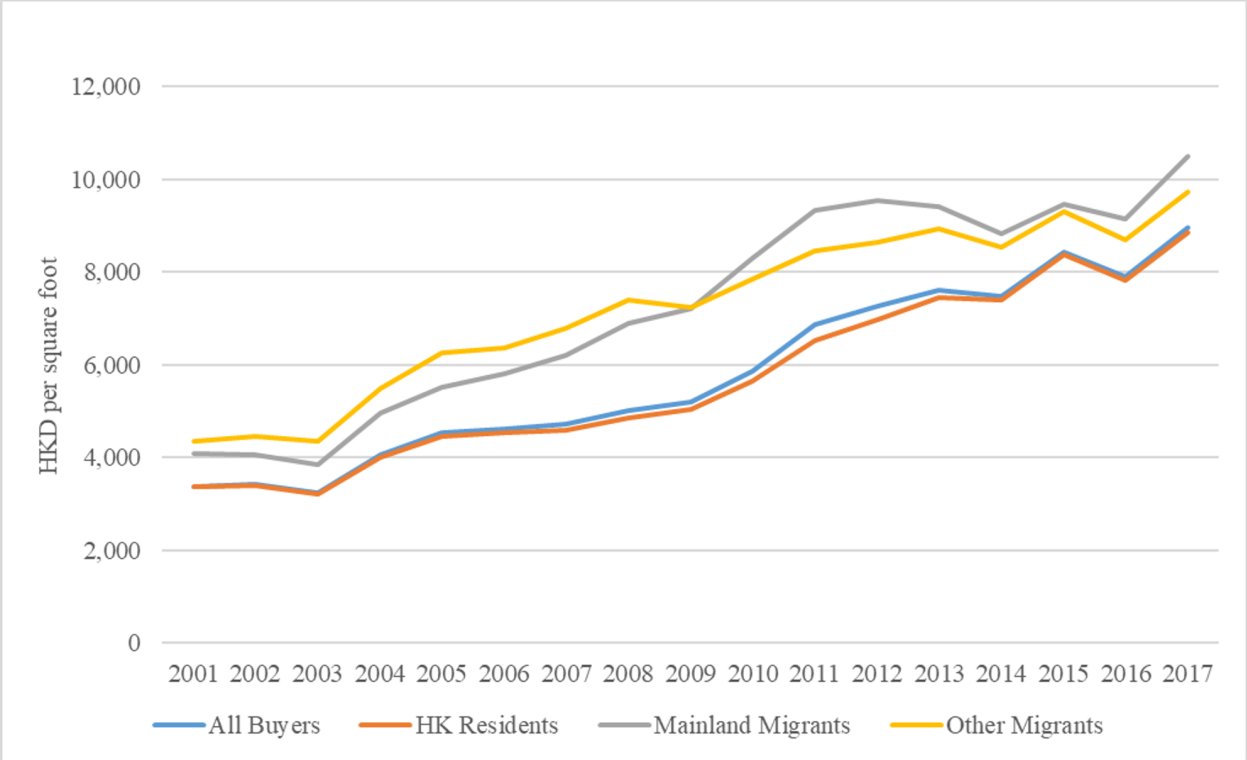


(b) Economic Policy Uncertainty (EPU) Index of China

Figure 3: Annual Percentage of Mainland Buyer and Macroeconomic Conditions in China



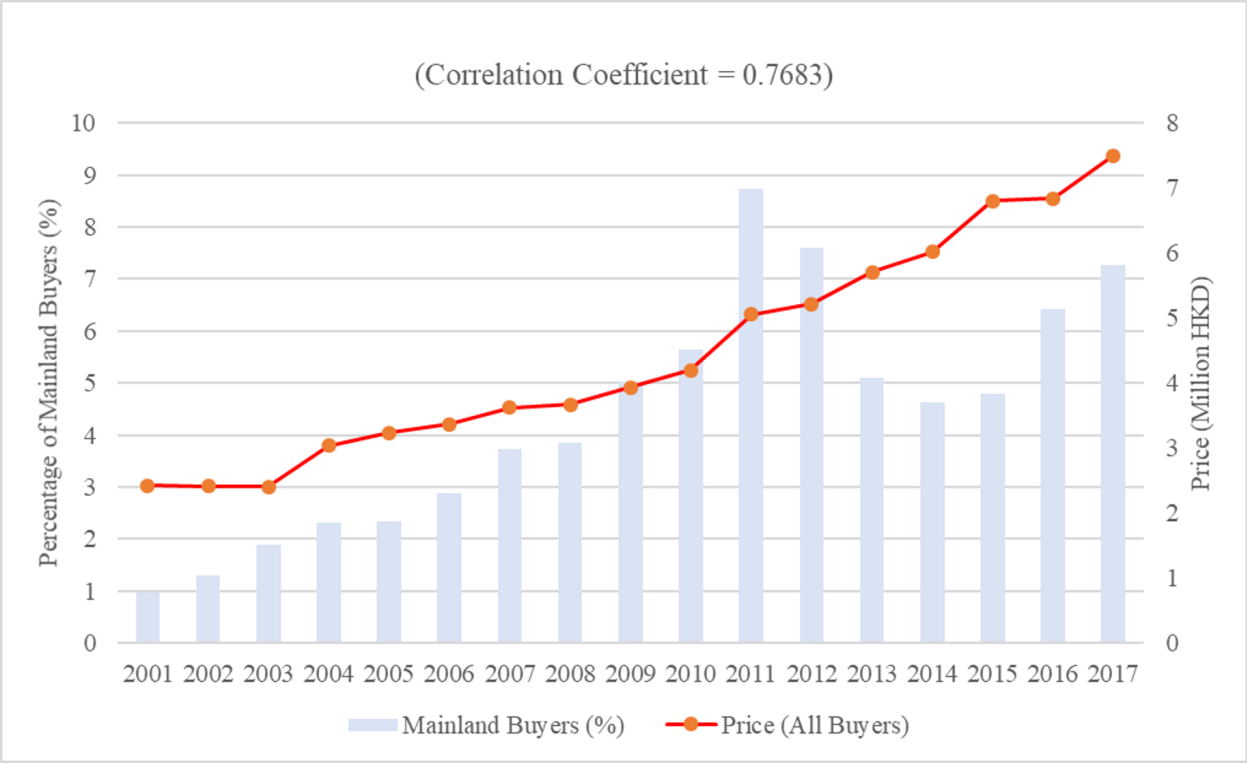
(a) Total Price



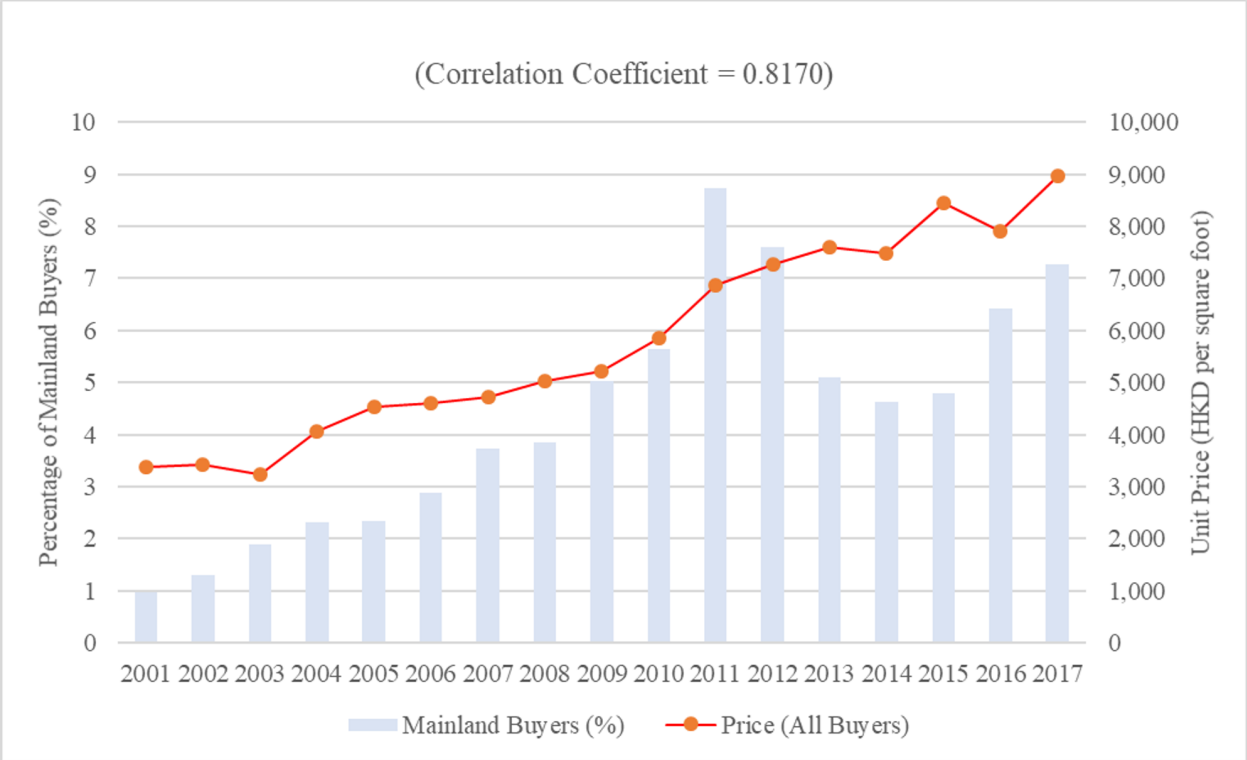
(b) Price Per Square Foot

Figure 4: Housing Price by Origin of Buyers

Note: Price adjusted by CPI of the month.



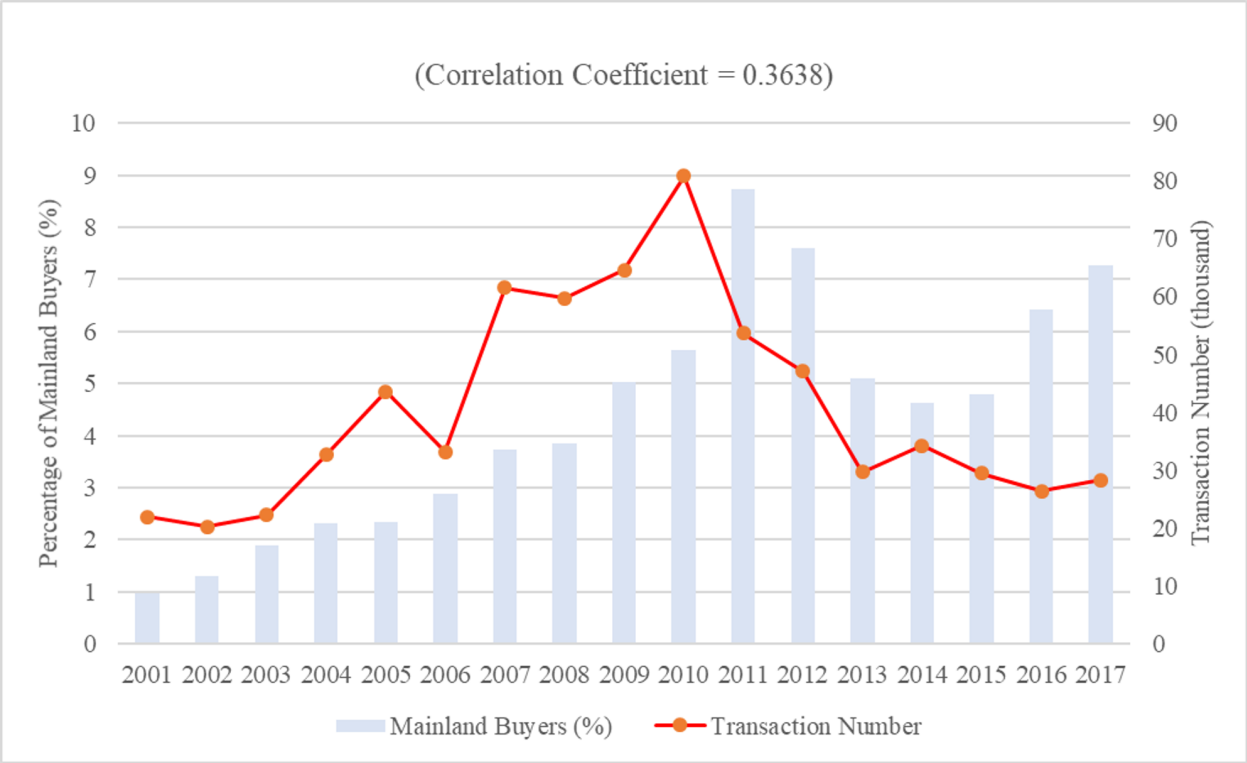
(a) Total Price



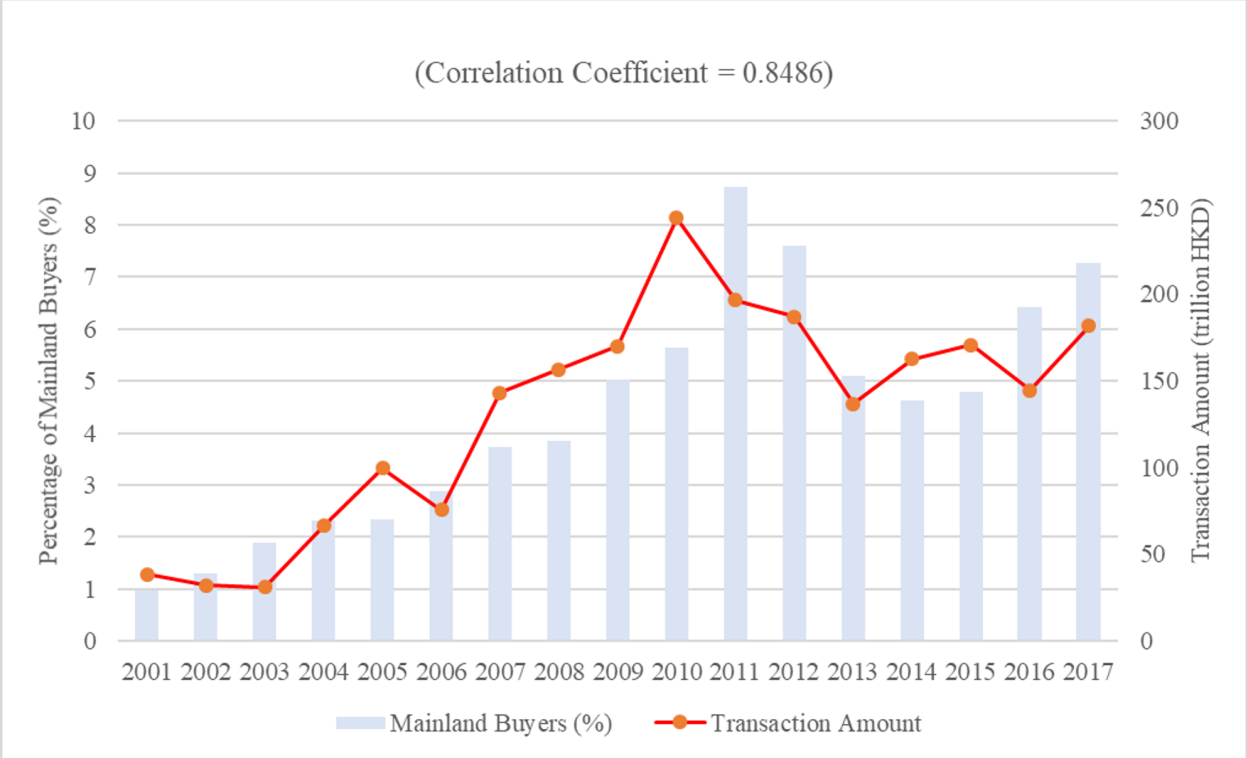
(b) Price Per Square Foot

Figure 5: Housing Price and Percentage of Mainland Buyers by Year

Note: Price adjusted by CPI of the month.



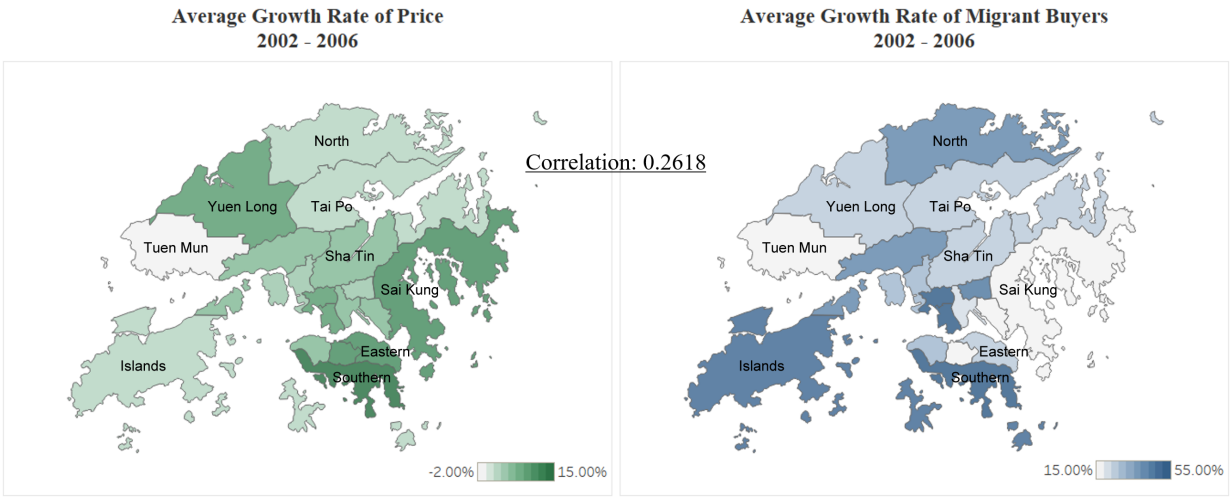
(a) Transaction Number



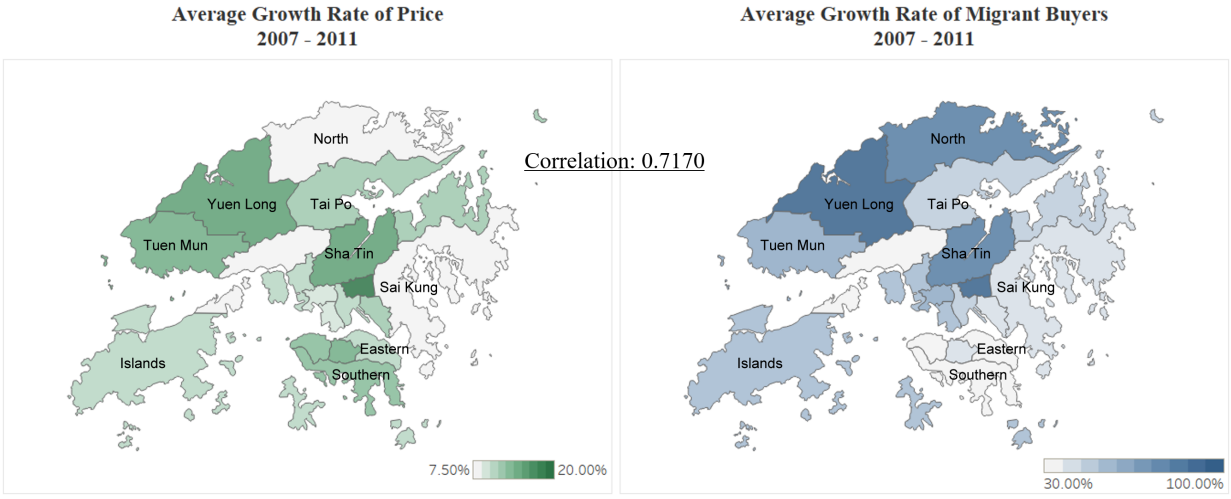
(b) Transaction Amount

Figure 6: Transaction Volume and Percentage of Mainland Buyers by Year

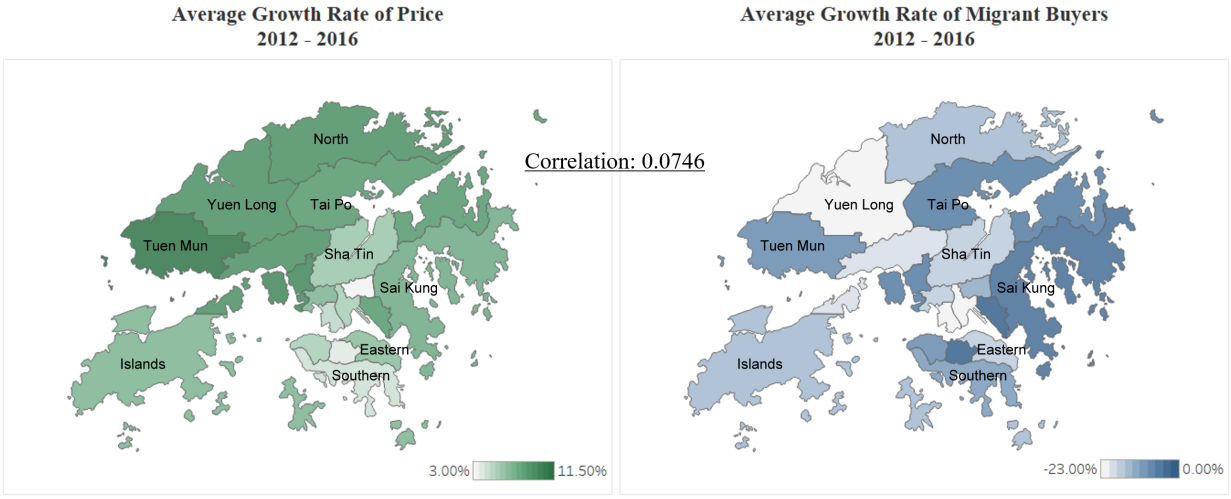
Note: Price adjusted by CPI of the month.



(a) 2002-2006



(b) 2007-2011



(c) 2012-2016

Figure 7: Correlation between Growth Rate of Price and Growth Rate of Mainland Buyers

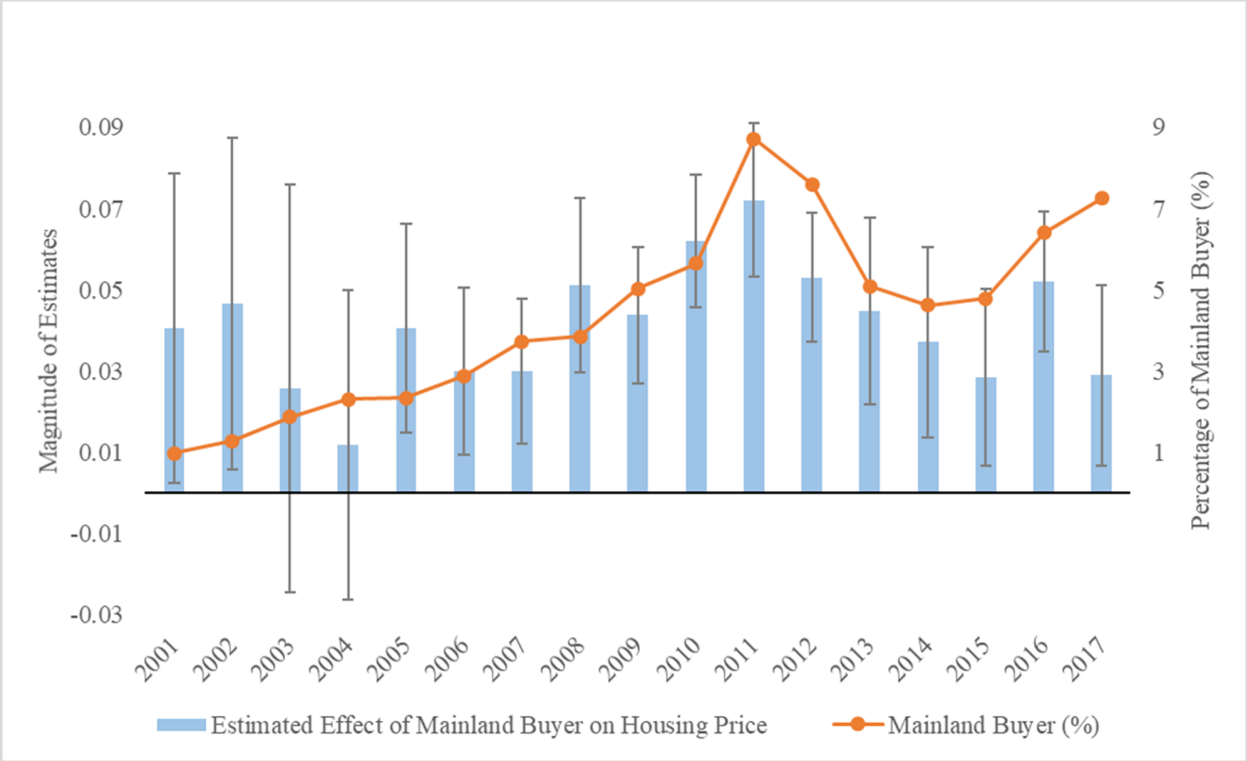
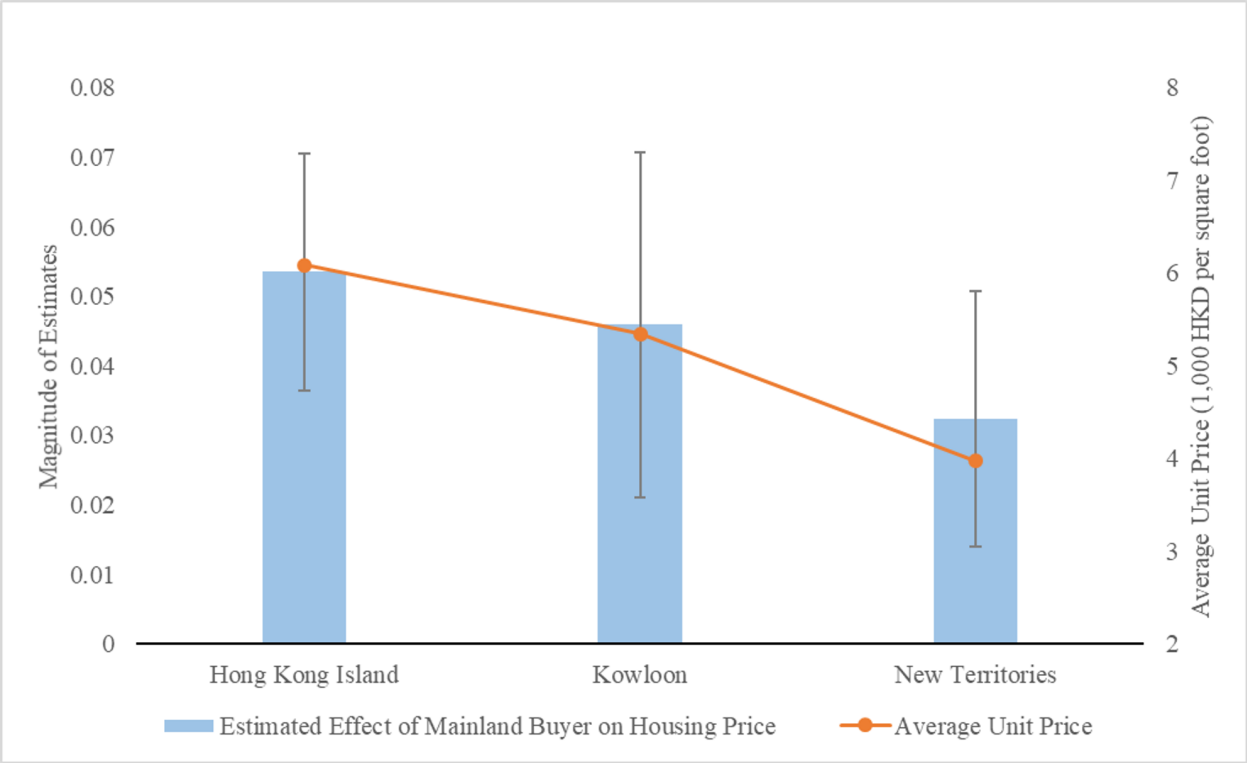
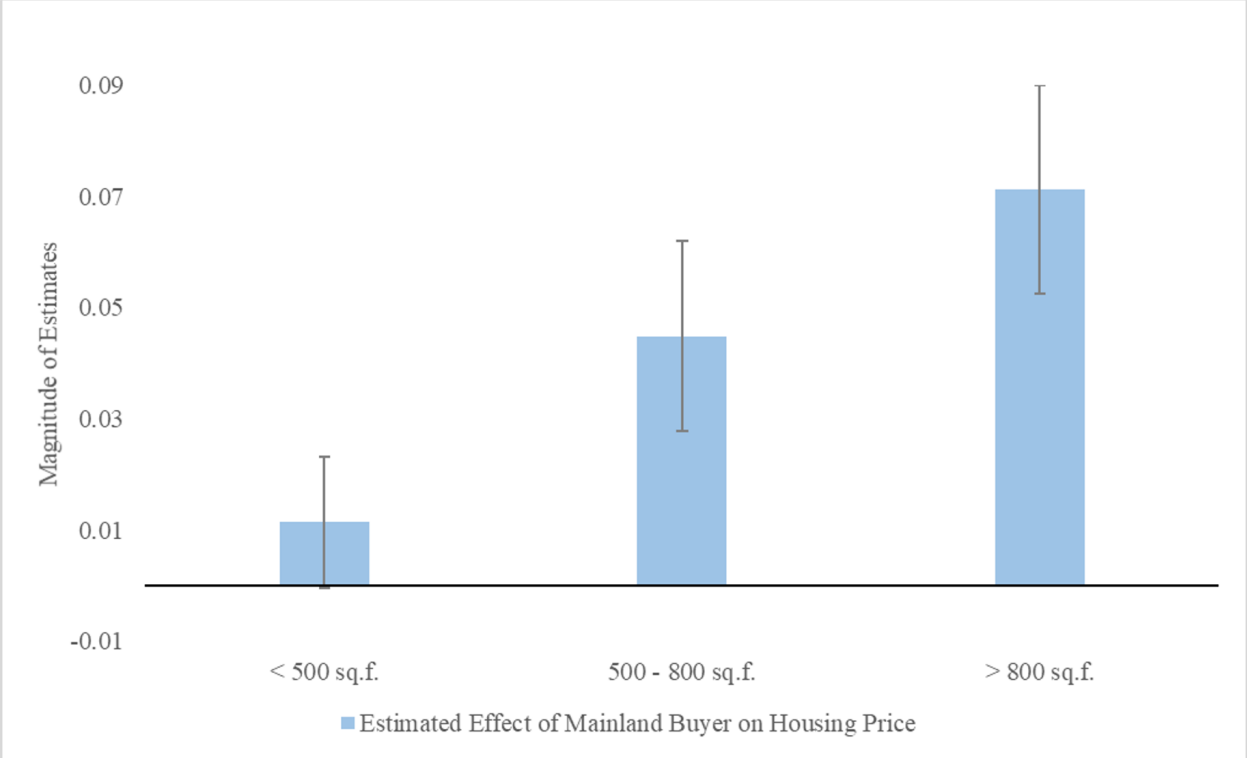


Figure 8: By-year Estimates of Mainland Buyers' Impact on Housing Price

Note: Standard errors clustered by districts. 95% confidence intervals are plotted with error bars.



(a) By Region



(b) By Unit Size

Figure 9: Heterogeneity in Mainland Buyers' Impact on Housing Price

Note: Standard errors clustered by districts. 95% confidence intervals are plotted with error bars.

Table 1: Summary Statistics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Local Buyer			Mainland Buyer			t-test	
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Difference (2)-(6)	Std. Err.
total price (million HKD)	651,896	3.142	2.831	25,326	5.001	5.170	-1.859***	0.033
unit price (thousand HKD p.s.f.)	651,896	4.584	2.671	25,326	6.227	3.511	-1.643***	0.022
gross area (hundred sq. ft.)	651,896	6.580	2.245	25,326	7.376	3.053	-0.796***	0.019
number of bedrooms	651,896	1.994	0.946	25,326	2.088	0.958	-0.095***	0.006
number of living rooms	651,896	1.601	0.716	25,326	1.669	0.678	-0.068***	0.004
remaining lease years	651,896	84.879	176.953	25,326	96.450	203.423	-11.572***	1.297
floor	651,896	18.438	11.993	25,326	20.285	13.884	-1.848***	0.089
building age	651,896	16.942	9.166	25,326	15.044	9.468	1.898***	0.061
building type	651,896	1.096	0.296	25,326	1.120	0.325	-0.024***	0.002
region	651,896	2.433	0.779	25,326	2.310	0.806	0.123***	0.005
district	651,896	42.830	18.011	25,326	40.117	18.010	2.713***	0.115
holding period (year)	368,116	3.981	2.964	18,349	4.068	2.903	-0.087***	0.022
gross holding period return	364,487	0.576	0.695	18,223	0.575	0.628	0.001	0.005
purchase year	651,896	2009	4.104	25,326	2011	3.601	-1.405***	0.026

Note: Building type in the transaction records is encoded as: 1 = block in estate; 2 = single building; 3 = village house. Region is encoded as: 1 = Hong Kong Island; 2 = Kowloon; 3 = New Territories. District is encoded following the classification from the data vendor.
*** p<0.01, ** p<0.05, * p<0.1

Table 2: Effect of Mainland Buyers on Housing Price and Return

	(1)	(2)
	2001 - 2017	
	log (price)	gross return
Mainland Buyer (Yes = 1)	0.0442***	0.0661***
	(0.0069)	(0.0101)
Unit Price of Purchase (1,000 HKD p.s.f.)		-0.2644***
		(0.0183)
log (Holding Days)		0.3450***
		(0.0213)
Gross Area (100 sq. ft.)	0.1355***	0.0183***
	(0.0046)	(0.0068)
Number of Rooms	0.0295***	-0.0251***
	(0.0055)	(0.0059)
log (Remain Lease Years)	0.0112	-0.0109
	(0.0173)	(0.0176)
log (Building Age)	-0.1728***	0.0003
	(0.0111)	(0.0184)
Floor	0.0030***	0.0029***
	(0.0004)	(0.0006)
Single Block (Yes = 1)	-0.1062***	-0.0866***
	(0.0239)	(0.0272)
Village House (Yes = 1)	-0.3624***	-0.3041***
	(0.0363)	(0.0806)
District Fixed Effect	Y	Y
Year * Quarter Fixed Effect	Y	Y
Observations	677,222	278,923
R-squared	0.836	0.643

Note: Column (1) includes full samples from 2001 to 2017. Column (2) includes repeated sales from 2001 to 2017, with holding period longer than 2 years. Standard errors clustered by district. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 3: Effect of Lagged Mainland Buyers on Housing Price: IV Estimation

	(1)	(2)	(3)	(4)
	2011 - 2017			
	all samples	$P_{i,t-1} > 0$	all samples	$P_{i,t-1} > 0$
	log (price)	log (price)	gross return	gross return
Lagged Proportion of Mainland Buyers	1.7046***	0.7706***	3.7054***	1.3494***
	(0.2225)	(0.1197)	(0.6237)	(0.2455)
Unit Price of Purchase (1,000 HKD p.s.f.)			-0.2547***	-0.2236***
			(0.0174)	(0.0201)
log (Holding Days)			0.5249***	0.4424***
			(0.0340)	(0.0343)
Property Features	Y	Y	Y	Y
District Fixed Effect	Y	Y	Y	Y
Year * Quarter Fixed Effect	Y	Y	Y	Y
First-stage F-Stats	59.84	162.42	104.45	145.38
Observations	240,094	95,318	152,023	61,560
R-squared	0.686	0.777	0.491	0.582

Note: The lag period is 1 year. Columns (1) and (3) include all samples from 2011 to 2017. Columns (2) and (4) exclude samples with no lagged mainland buyers in the same building. ($P_{i,t-1}$ denotes the 1-year lagged proportion of mainland buyers in building i.) Columns (3) and (4) exclude samples with holding period less than 2 years. Unreported control variables include unit size, number of rooms, log(remaining lease years), log(building age), floor and building type. Standard errors clustered by district. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Heterogeneous Effect of Lagged Mainland Buyers on Housing Price: IV Estimation

Panel A: Regions			
	(1)	(2)	(3)
		2011 - 2017	
	Hong Kong	Kowloon	New Territories
	log (price)	log (price)	log (price)
Lagged Proportion of Mainland Buyers	2.1700***	1.2382***	1.2759**
	(0.4880)	(0.1945)	(0.5674)
Property Features	Y	Y	Y
District Fixed Effect	Y	Y	Y
Year * Quarter Fixed Effect	Y	Y	Y
First-stage F-Statistics	34.01	42.65	25.98
Observations	37,901	49,671	152,522
R-squared	0.615	0.718	0.669

Panel B: Unit Size			
	(1)	(2)	(3)
		2011 - 2017	
	0-500 sq. ft.	500-800 sq. ft.	over 800 sq. ft.
	log (price)	log (price)	log (price)
Lagged Proportion of Mainland Buyers	0.8519**	1.6233***	1.8953***
	(0.4083)	(0.4072)	(0.3588)
Property Features	Y	Y	Y
District Fixed Effect	Y	Y	Y
Year * Quarter Fixed Effect	Y	Y	Y
First-stage F-Statistics	17.51	41.97	24.97
Observations	53,749	139,742	46,603
R-squared	0.653	0.556	0.598

Note: The lag period is 1 year. Unreported control variables include unit size, number of rooms, log(remaining lease years), log(building age), floor and building types. District and time fixed effects included. Standard errors clustered by district. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Channel of Safe Haven Effect

	(1)	(2)
	2006 - 2017	2001 - 2017
	Mainland Buyer (Yes = 1)	
	Logit	Logit
Lagged CNY/HKD Exchange Rate	0.1203***	
	(0.0223)	
Lagged EPU Index /100		0.0010**
		(0.0005)
Gross Area (100 sq. ft.)	0.0025***	0.0024***
	(0.0004)	(0.0003)
Number of Rooms	0.0006	0.0007
	(0.0006)	(0.0004)
log (Remain Lease Years)	-0.0037**	-0.0033**
	(0.0017)	(0.0014)
log (Building Age)	-0.0170***	-0.0123***
	(0.0030)	(0.0022)
Floor	-0.0000	-0.0000
	(0.0001)	(0.0001)
Single Block (Yes = 1)	0.0002	0.0009
	(0.0034)	(0.0024)
Village House (Yes = 1)	-0.0343***	-0.0233***
	(0.0006)	(0.0008)
District Fixed Effect	Y	Y
Year * Quarter Fixed Effect	Y	Y
Observations	538,505	677,222
Pseudo R-squared	0.068	0.077

Note: The lag period is 1 month. Column (1) includes only samples from 2006 onward, when China started to implement the floating exchange rate policy. Column (2) includes full samples from 2001 to 2017. Logit estimation of marginal effect at mean is reported. Standard errors clustered by district. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Horse Racing Analysis of Channels

	(1)	(2)	(3)
	Mainland Buyer	2006 - 2017 Local Buyer	Diff (Mainland - Local)
	log (price)	log (price)	log (price)
SD_lagged CNY/HKD exchange rate	-0.0875**	-0.1108***	0.0151*
	(0.0341)	(0.0135)	(0.0073)
SD_lagged proportion of mainland buyer	0.0189***	0.0112***	0.0143*
	(0.0057)	(0.0034)	(0.0068)
SD_buyer's prior transaction times	-0.0038	-0.0096***	-0.0022
	(0.0067)	(0.0019)	(0.0081)
SD_local seller	0.0095**	-0.0018	0.0124***
	(0.0037)	(0.0022)	(0.0025)
Property Features	Y	Y	Y
District Fixed Effect	Y	Y	Y
Year * Quarter Fixed Effect	Y	Y	Y
Observations	22,203	496,470	518,673
R-squared	0.874	0.827	0.831

Note: Lag period for the exchange rate is 1 month. Lag period for proportion of mainland buyers is 1 year. Lagged proportion of mainland buyers is calculated within the same building. Columns (1)-(2) include only mainland buyers and local buyers, respectively. Column (3) includes the full sample and reports the estimates of interactions between each channel and a standardized dummy for mainland buyer (δ in Equation (9)). These estimates, therefore, represent the difference in each channel's impact between mainland and local buyers. Unreported control variables include unit size, number of rooms, log(remaining lease years), log(building age), floor, and building type. Standard errors clustered by district. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix A: Supplementary Figures

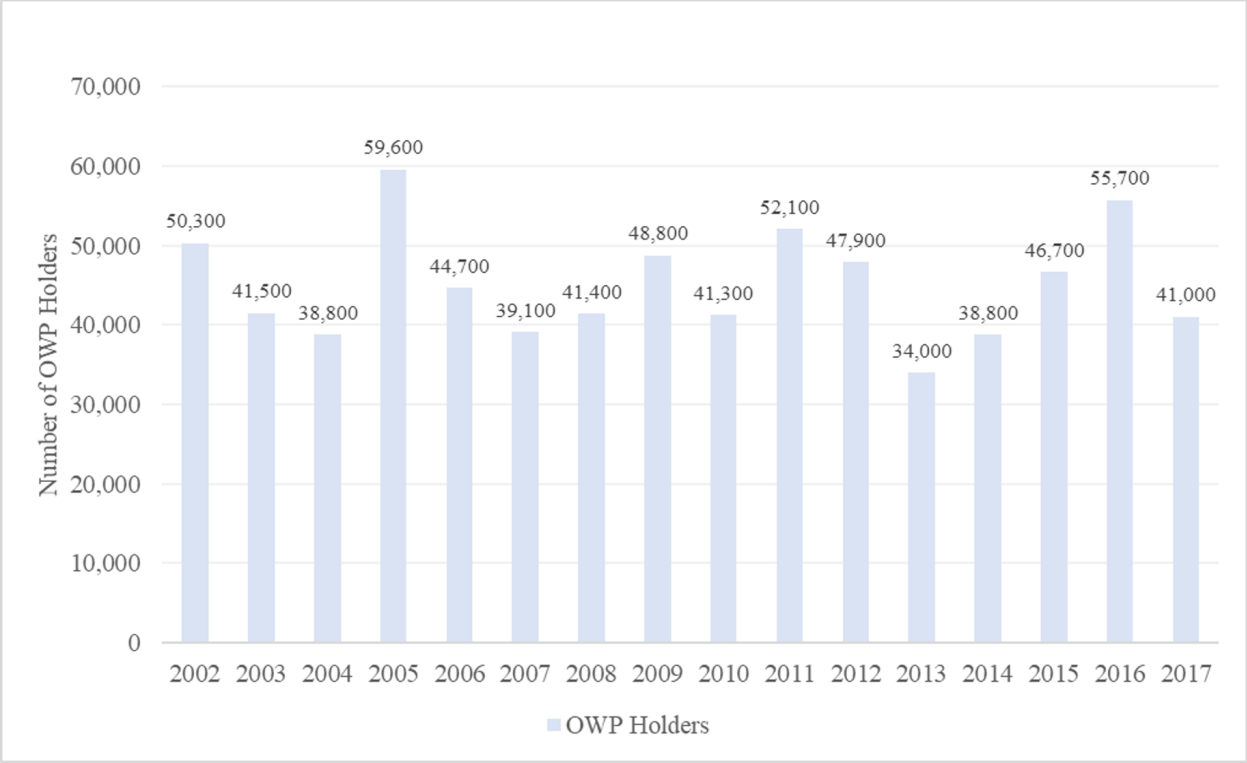


Figure A1: Number of One-way Permit (OWP) Holders Entering Hong Kong

Note: The time period used is from the middle of one year to the next. Statistics from the Census and Statistics Department (CSD) of Hong Kong.

Appendix B: Supplementary Tables

Table B1: Definition of Variables

Variable Name	Definition
Region	1 = Hong Kong Island; 2 = Kowloon; 3 = New Territories
District	District codes assigned by EPRC, including: 1 = Aberdeen/Ap Lei Chau; 2 = Causeway Bay; 3 = Central; 4 = Chai Wan; 5 = Happy Valley; 6 = Kennedy Town; 7 = Mid-level West; 8 = Mid-level Central; 9 = Mid-level East; 10 = North Point; 11 = North Point Hill; 12 = Peak; 13 = Pokfulam; 14 = Quarry Bay; 15 = Repulse Bay; 16 = Sai Ying Pun; 17 = Shau Kei Wan; 18 = Sheung Wan; 19 = Siu Sai Wan; 20 = Stanley; 21 = Tai Tam; 22 = Wan Chai; 23 = Wong Chuk Hang; 24 = Cheung Sha Wan; 25= Diamond Hill; 26 = Ho Man Tin; 27 = Hung Hom; 28 = Kai Tak; 29 = Kowloon Bay; 30 = Kowloon City; 31 = Kowloon Tong; 32 = Kwun Tong; 33 = Lai Chi Kok; 34 = Lam Tin; 35 = Mong Kok; 36 = Ngau Chi Wan; 37 = Ngau Tau Kok; 38 = San Po Kong; 39 = Sham Shui Po; 40 = Shek Kip Mei; 41 = Tai Kok Tsui; 42 = Tsim Sha Tsui; 43 = Tsz Wan Shan; 44 = Wang Tau Hom; 45 = Wong Tai Sin; 46 = Yau Ma Tei; 47 = Yau Tong; 48 = Fan Ling; 49 = Islands; 50 = Kwai Chung; 51 = Ma On Shan; 52 = Sai Kung; 53 = Sha Tin; 54 = Sheung Shui; 55 = Tai Po; 56 = Tseung Kwan O; 57 = Tsing Yi; 58 = Tsuen Wan; 59 = Tuen Mun; 60 = Yuen Long.
Building Type	1 = Estate Block; 2 = Single Building; 3= Village House
Total Price	Pretax settlement price adjusted by monthly CPI of Hong Kong, using October 2014 to September 2015 as the base period.
Unit Price	CPI-adjusted total price divided by the gross area of the unit.
Gross Holding Period Return	Percentage change in unit price since the last transaction. Winsorized at the 1% and 99% levels.

Table B2: Summary of Housing Features by Unit Size

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	0 - 500 sq. ft.			500 - 800 sq. ft.			over 800 sq. ft.		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
mainland buyer (Yes =1)	149,601	0.030	0.170	393,281	0.034	0.181	134,340	0.056	0.229
unit price (1,000 HKD p.s.f.)	149,601	4.436	2.548	393,281	4.420	2.458	134,340	5.538	3.397
gross area (100 sq. ft.)	149,601	4.290	0.537	393,281	6.306	0.800	134,340	10.081	2.412
number of bedrooms	149,601	1.447	0.856	393,281	1.952	0.846	134,340	2.743	0.841
number of living rooms	149,601	1.114	0.744	393,281	1.709	0.669	134,340	1.841	0.538
remaining lease years	149,601	100.760	205.243	393,281	77.623	160.818	134,340	90.615	191.525
floor	149,601	15.807	9.184	393,281	19.040	12.131	134,340	19.953	14.110
building age	149,601	22.810	7.226	393,281	15.900	8.931	134,340	13.100	8.795
building type	149,601	1.221	0.416	393,281	1.066	0.249	134,340	1.049	0.216
region	149,601	2.374	0.778	393,281	2.467	0.764	134,340	2.374	0.820
year	149,601	2009.297	3.993	393,281	2009.171	4.077	134,340	2009.147	4.234

Note: Building type in the transaction records is encoded as: 1 = block in estate; 2 = single building; 3 = village house. Region is encoded as: 1 = Hong Kong Island; 2 = Kowloon; 3 = New Territories.

Table B3: Ranking of Districts by Percentage of Recent Chinese Migrant Residents

District	Rank 2006	Rank 2011	Rank 2016	Change in Rank 2006 to 2016	Change in PMR 2006 to 2016
Sham Shui Po	1	1	1	0	-0.89%
Islands	2	13	18	-16	-4.10%
Yau Tsim Mong	3	4	2	1	-0.34%
Kwun Tong	4	2	5	-1	-1.67%
Yuen Long	5	9	8	-3	-2.26%
Kwai Tsing	6	7	7	-1	-1.69%
North	7	3	3	4	0.29%
Tuen Mun	8	11	11	-3	-1.08%
Wong Tai Sin	9	5	9	0	-0.90%
Kowloon City	10	8	6	4	-0.10%
Tsuen Wan	11	6	4	7	0.36%
Sai Kung	12	17	17	-5	-1.50%
Central and Western	13	10	14	-1	-0.89%
Sha Tin	14	12	12	2	-0.37%
Wan Chai	15	14	15	0	-0.62%
Southern	16	15	16	0	-0.91%
Tai Po	17	16	10	7	0.13%
Eastern	18	18	13	5	0.15%

Note: Recent Chinese migrant residents defined as migrants from mainland China who have resided in Hong Kong for less than 7 years.

Table B4: Distribution of Residential Building Types in Hong Kong

	All		Hong Kong Island		Kowloon		New Territories	
	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
Single Block	13,963	62.21	4,231	75.89	6,453	78.55	3,279	37.88
Estate	7,387	32.91	1,343	24.09	1,760	21.42	4,284	49.49
Village House	1,096	4.88	1	0.02	2	0.02	1,093	12.63
Total	22,446	100	5,575	100	8,215	100	8,656	100

Table B5: Effect of Mainland Residents on Housing Price

	(1) 2006	(2) 2011	(3) 2016
		log(price)	
Proportion of Mainland Residents	-0.0853***	-0.0487***	0.0137***
	(0.0025)	(0.0020)	(0.0027)
log (Total Population)	-0.0897***	-0.1091***	-0.0533***
	(0.0055)	(0.0037)	(0.0062)
Mainland Buyer (Yes = 1)	0.0452***	0.1064***	0.0626***
	(0.0125)	(0.0047)	(0.0086)
Property Features	Y	Y	Y
Quarter Fixed Effect	Y	Y	Y
District Fixed Effect	Y	Y	Y
Observations	32,597	52,600	26,021
R-squared	0.710	0.707	0.599

Note: Unreported control variables include unit size, number of rooms, remaining lease years, building age, floor, and building type. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table B6: Effect of Lagged Mainland Buyers on Housing Price: OLS Estimation

	(1)	(2)	(3)	(4)
	2011 - 2017			
	all samples	$P_{i,t-1} > 0$	all samples	$P_{i,t-1} > 0$
	log (price)	log (price)	gross return	gross return
Lagged Proportion of Mainland Buyers	0.1846***	0.1386***	0.2630***	0.2493***
	(0.0384)	(0.0460)	(0.0540)	(0.0660)
Unit Price of Purchase (1,000 HKD p.s.f.)			-0.2400***	-0.2191***
			(0.0172)	(0.0208)
log (Holding Days)			0.5415***	0.4490***
			(0.0342)	(0.0352)
Property Features	Y	Y	Y	Y
District Fixed Effect	Y	Y	Y	Y
Year * Quarter Fixed Effect	Y	Y	Y	Y
Observations	240,094	95,318	152,023	61,560
R-squared	0.743	0.788	0.627	0.603

Note: Lag period is 1 year. Columns (1) and (3) include all samples from 2011 to 2017. Columns (2) and (4) exclude samples with no lagged mainland buyers in the same building. ($P_{i,t-1}$ denotes the 1-year lagged proportion of mainland buyers in building i.) Columns (3) and (4) exclude samples with holding period less than 2 years. Unreported control variables include unit size, number of rooms, log(remaining lease years), log(building age), floor, and building types. Standard errors clustered by district. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table B7: Effect of Lagged Mainland Buyers on Housing Price: First-stage Results of IV Estimation

	(1)	(2)	(3)	(4)
		2011 - 2017		
	all samples	$P_{i,t-1} > 0$	all samples	$P_{i,t-1} > 0$
		Lagged Proportion of Mainland Buyers		
Predicted Lagged Proportion of Mainland Buyers	0.1019***	0.2538***	0.1000***	0.2647***
	(0.0132)	(0.0199)	(0.0098)	(0.0220)
Unit Price of Purchase (1,000 HKD p.s.f.)			0.0029***	0.0006
			(0.0008)	(0.0010)
log (Holding Days)			0.0028*	0.0013
			(0.0016)	(0.0024)
Property Features	Y	Y	Y	Y
District Fixed Effect	Y	Y	Y	Y
Year * Quarter Fixed Effect	Y	Y	Y	Y
First-stage F-statistics	59.84	162.42	104.45	145.38
Observations	240,094	95,318	152,023	61,560

Note: Lag period is 1 year. Columns (1) and (3) include all samples from 2011 to 2017. Columns (2) and (4) exclude samples with no lagged mainland buyers in the same building. ($P_{i,t-1}$ denotes the 1-year lagged proportion of mainland buyer in building i.) Columns (3) and (4) exclude samples with holding period less than 2 years. Unreported control variables include unit size, number of rooms, log(remaining lease years), log(building age), floor, and building types. Standard errors clustered by district. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table B8: Effect of Lagged Mainland Buyers on Housing Price: Robustness Check Using Lagged Number of Mainland Buyers

	(1)	(2)	(3)	(4)
	2011 -2017			
	log (price)	log (price)	gross return	gross return
	OLS	IV	OLS	IV
Lagged Number of Mainland Buyers	0.0058**	0.0406**	0.0145***	0.0310***
	(0.0023)	(0.0168)	(0.0036)	(0.0118)
Unit Price of Purchase (1,000 HKD p.s.f.)			-0.2341***	-0.2341***
			(0.0171)	(0.0170)
log (Holding Days)			0.5528***	0.5550***
			(0.0344)	(0.0347)
Property Features	Y	Y	Y	Y
District Fixed Effect	Y	Y	Y	Y
Year * Quarter Fixed Effect	Y	Y	Y	Y
First-stage F-Stats		27.30		114.83
Observations	244,327	244,327	154,666	154,666
R-squared	0.746	0.731	0.623	0.623

Note: Lag period is 1 year. In Columns (2) and (4), the predicted number of mainland buyers is applied as the IV. Unreported control variables include unit size, number of rooms, log(remaining lease years), log(building age), floor, and building type. Standard errors clustered by district. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table B9: Heterogeneous Effects of Lagged Mainland Buyers on Housing Price: OLS Estimation

Panel A: Regions			
	(1)	(2)	(3)
		2011 - 2017	
	Hong Kong	Kowloon	New Territories
	log (price)	log (price)	log (price)
Lagged Proportion of Mainland Buyer	0.1380***	0.1865***	0.1043*
	(0.0320)	(0.0600)	(0.0510)
Property Features	Y	Y	Y
District Fixed Effect	Y	Y	Y
Year * Quarter Fixed Effect	Y	Y	Y
Observations	37,901	49,671	152,522
R-squared	0.741	0.752	0.701

Panel B: Unit Size			
	(1)	(2)	(3)
		2011 - 2017	
	0-500 sq. ft.	500-800 sq. ft.	over 800 sq. ft.
	log (price)	log (price)	log (price)
Lagged Proportion of Mainland Buyer	0.0722***	0.1849***	0.1431***
	(0.0248)	(0.0493)	(0.0388)
Property Features	Y	Y	Y
District Fixed Effect	Y	Y	Y
Year & Quarter Fixed Effect	Y	Y	Y
Observations	53,749	139,742	46,603
R-squared	0.675	0.623	0.709

Note: Lag period is 1 year. Unreported control variables include unit size, number of rooms, log(remaining lease years), log(building age), floor, and building types. District and time fixed effects included. Standard errors clustered by district. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table B10: Residential Sorting Channel

	(1)	(2)
	Mainland Buyer (Yes = 1)	
	Logit	Logit
Lagged Proportion of Mainland Buyers	0.0572***	
	(0.0071)	
Lagged Number of Mainland Buyers		0.0014***
		(0.0001)
Gross Area (100 sq. ft.)	0.0022***	0.0025***
	(0.0003)	(0.0004)
Number of Rooms	0.0006	0.0007*
	(0.0004)	(0.0004)
log (Remain Lease Years)	-0.0030***	-0.0030**
	(0.0011)	(0.0012)
log (Building Age)	-0.0110***	-0.0086***
	(0.0011)	(0.0012)
Floor	-0.0000	-0.0000
	(0.0001)	(0.0001)
Single Block (Yes = 1)	0.0010	0.0017
	(0.0017)	(0.0019)
Village House (Yes = 1)	-0.0216***	-0.0223***
	(0.0063)	(0.0066)
District Fixed Effect	Y	Y
Year * Quarter Fixed Effect	Y	Y
Observations	667,595	677,222
Pseudo R-squared	0.080	0.079

Note: Lag period is 1 year. Logit estimation of marginal effect at the mean is reported. Unreported control variables include unit size, number of rooms, remaining lease years, building age, floor, and building type. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table B11: Asymmetric Information Channel

	(1) local buyer	(2) mainland buyer
	log (price)	
(base: first-time buyer)		
Buyer with 1 Prior Purchase (Yes = 1)	-0.0151***	0.0056
	(0.0011)	(0.0045)
Buyer with 2 Prior Purchases (Yes =1)	-0.0219***	-0.0112
	(0.0022)	(0.0073)
Buyer with 3 or More Prior Purchases (Yes =1)	-0.0362***	-0.0146*
	(0.0056)	(0.0083)
Property Features	Y	Y
Year * Quarter Fixed Effect	Y	Y
District Fixed Effect	Y	Y
Observations	651,896	25,326
R-squared	0.833	0.873

Note: Unreported control variables include unit size, number of rooms, remaining lease years, building age, floor, and building type. Standard errors clustered by district. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table B12: Statistical Discrimination Channel

Panel A: Use Binary Variable to Measure Seller's Prior Transaction Experience with Mainlanders				
	(1)	(2)	(3)	(4)
	local seller		mainland seller	
	local buyer	mainland buyer	local buyer	mainland buyer
	log (price)	log (price)	log (price)	log (price)
Seller with Prior Sales to Mainlanders (Yes = 1)	0.0068	0.0178*	-0.0072	-0.0522
	(0.0052)	(0.0100)	(0.0383)	(0.0392)
Property Features	Y	Y	Y	Y
District Fixed Effect	Y	Y	Y	Y
Year * Quarter Fixed Effect	Y	Y	Y	Y
Observations	611,815	22,257	16,392	2,119
R-squared	0.835	0.886	0.823	0.788
Panel B: Use Continuous Variable to Measure Seller's Prior Transaction Experience with Mainlanders				
	(1)	(2)	(3)	(4)
	local seller		mainland seller	
	local buyer	mainland buyer	local buyer	mainland buyer
	log (price)	log (price)	log (price)	log (price)
Seller's Prior Transactions with Mainlanders	0.0056	0.0156**	-0.0077	-0.0716
	(0.0037)	(0.0070)	(0.0300)	(0.0473)
Property Features	Y	Y	Y	Y
District Fixed Effect	Y	Y	Y	Y
Year * Quarter Fixed Effect	Y	Y	Y	Y
Observations	611,815	22,257	16,392	2,119
R-squared	0.835	0.886	0.822	0.788

Note: Unreported control variables include unit size, number of rooms, remaining lease years, building age, floor, and building type. Standard errors clustered by district. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Appendix C: Alternative Housing Options

The lack of alternative housing options for new migrants may also contribute to the price disparity in private markets. In Hong Kong, only permanent residents can apply for public housing, so migrants have fewer alternative options other than entering the private housing market. According to the population censuses in 2006, 2011, and 2016 (Panel B of Appendix Table C1), 46.4% of the population are living in public housing, either in public rental housing or in public housing sold using a government subsidy. Recent migrants are not eligible to apply for public housing, unless they have acquired permanent residency after residing in Hong Kong for more than 7 years, or they apply with their spouse, who is a permanent resident. Appendix Table C2 presents the percentage of migrant residents in public and private housing. Nine percent of the residents living in private housing are migrants, but this proportion is significantly lower (3%) in public housing. This difference is pervasive among both owners and renters.

Using the combined population census data, we examine the association between migration experience and alternative housing option with the following empirical specification:

$$PublicHousing_{int} = \beta MigrationExp_{it} + D_{it}^{'}\lambda + \phi_t + \rho_n + \epsilon_{int}, \tag{10}$$

where $PublicHousing_{int}$ is a dummy variable indicating whether person i lives in public housing of district n at census year t. $MigrationExp_{it}$ denotes the history of residences in Hong Kong that person i owns by census year t. Two measurements for this are included in separate models. The first is a dummy variable equal to 1 if the resident is a recent migrant arrived in Hong Kong within 5 years, and 0 if the person has resided for more than 5 years. The second measurement is a continuous variable equal to their actual residential years in Hong Kong. Therefore, the coefficient β estimates the effect that migration experience has on the resident's chance of living in public housing. D_{it} is a set of variables that control for resident's demographics, including gender, age, squared term of age, marital status, education level, personal monthly income, ethnicity, and nationality. ϕ_t and ρ_n are time and district fixed effects, respectively. ϵ_{int} is the error term.

Appendix Table C3 presents logit estimation results from Equation (10), and margins at the mean are reported. Columns (1) and (2) report the results using a dummy variable to indicate whether the person is a recent migrant. Columns (3) and (4) report the results using a continuous variable to measure the person's residential years in Hong Kong. Columns (1) and (3) present results containing all residents. Results in Column (1) show that, compared with natives or migrants who have resided for more years, recent migrants who have resided in Hong Kong for less than 5 years will have a lower possibility of living in public housing by 0.1. Results in Column (3) show that living in Hong Kong for 1 year longer will increase the person's possibility of living in public housing by 0.015. Not surprisingly, residents of Chinese ethnicity and with Hong Kong PR will have a higher possibility of living in public housing. Single residents with lower education and less personal income are also more representative in public housing. All these results are statistically significant at the 1% level and standard errors are clustered at the district level.

We further conduct robustness checks of these results. First, since recent migrants can pair up with their native spouses to apply for public housing, we also examine the results for household heads only, who are more likely to be the main applicant for public housing. These results are reported in Columns (2) and (4) of Table C3, using binary and continuous measurements for residential history, respectively. Estimates at the same significance level are observed for household heads, while the magnitudes of the estimates increase as expected. Second, concern about selection bias arises, since only 37.6% of the original records in the population censuses are included in our main regression sample. This is mainly due to incomplete information on individual monthly income. To address this concern, we exclude the control for personal income to include more samples from the census, and the results are reported in Appendix Table C4. This does not impact the conclusions drawn previously. Therefore, our empirical results confirm that recent migrants have fewer alternative housing options other than joining the private market.

Table C1: Summary Statistics of Population Census Data

	(1) obs.	(2) mean	(3) s.d.	(4) min	(5) max
Migration Experience and Demographics					
homeowner	105,284	0.292	0.455	0	1
recent migrant (less than 5 years)	105,269	0.074	0.262	0	1
residential years in Hong Kong	105,284	18.526	5.444	1	21
household head	105,284	0.470	0.499	0	1
education level	105,284	2.543	1.125	0	5
age	105,284	40.694	12.207	15	93
gender (male = 1, female = 0)	105,284	0.515	0.500	0	1
living in public housing	105,284	0.464	0.499	0	1
individual monthly income (HKD)	105,284	18,226	20,436	180	150,000
Chinese ethnicity	105,284	0.898	0.303	0	1
Hong Kong PR	105,284	0.605	0.489	0	1
ever married	105,284	0.658	0.475	0	1
Population in Districts					
population (2006)	18	370,791	146,788	134,223	591,794
population (2011)	18	378,676	149,913	136,186	609,093
population (2016)	18	389,649	150,666	148,797	632,600
percentage of mainland migrants (2006)	18	0.033	0.012	0.019	0.058
percentage of mainland migrants (2011)	18	0.025	0.010	0.015	0.051
percentage of mainland migrants (2016)	18	0.023	0.011	0.011	0.049

Note: Highest education level attended is encoded as follows: 0 = no schooling or preprimary; 1 = primary school or equivalent; 2 = secondary school or equivalent; 3 = associate degree or equivalent; 4 = bachelor's degree or equivalent; 5 = postgraduate degree or equivalent.

Table C2: Distribution of Migrants in Public and Private Housing

	Public Housing			Private Housing			Difference ((2)-(5))
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	t-test
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Migrant	100,293	0.0319	0.1757	100,519	0.0901	0.2864	-0.0583***
							(0.0011)
Migrant Owner	100,293	0.0011	0.0334	100,519	0.0070	0.0835	-0.0059***
							(0.0003)
Migrant Renter	100,293	0.0308	0.1727	100,519	0.0831	0.2761	-0.0523***
							(0.0010)

Note: Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table C3: Alternative Options Channel

	(1)	(2)	(3)	(4)
	all	household heads	all	household heads
	Living in Public Housing (Yes = 1)			
	logit	logit	logit	logit
Recent Migrant (in 5 years)	-0.1026***	-0.1471***		
	(0.0397)	(0.0886)		
Residential Years in HK			0.0015***	0.0041***
			(0.0022)	(0.0040)
Male	0.0329***	0.3364***	0.2130***	0.3194***
	(0.0168)	(0.0273)	(0.0169)	(0.0273)
Age	0.0032***	0.0125***	0.0036***	0.0127***
	(0.0047)	(0.0082)	(0.0046)	(0.0082)
Age Squared	-0.0000***	-0.0001***	-0.0000***	-0.0001***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Ever Married	-0.1137***	-0.0647***	-0.1147***	-0.0624***
	(0.0221)	(0.0356)	(0.0223)	(0.0356)
Education	-0.0682***	-0.0661***	-0.0690***	-0.0669***
	(0.0093)	(0.0140)	(0.0093)	(0.0140)
log (Personal Income)	-0.1128***	-0.1343***	-0.1129***	-0.1354***
	(0.0149)	(0.0218)	(0.0150)	(0.0219)
Chinese Ethnicity	0.2489***	0.0323**	0.2662***	0.0261*
	(0.0519)	(0.1045)	(0.0536)	(0.1043)
Hong Kong PR	0.0829***	0.1469***	0.0907***	0.1510***
	(0.0530)	(0.1117)	(0.0532)	(0.1141)
District Fixed Effect	Y	Y	Y	Y
Year Fixed Effect	Y	Y	Y	Y
Observations	104,587	49,128	104,587	49,128

Note: Logit estimation of marginal effect at the mean is reported. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table C4: Alternative Options Channel: Exclude Control for Personal Income

	(1)	(2)	(3)	(4)
	all	household heads	all	household heads
	Living in Public Housing (Yes = 1)			
	logit	logit	logit	logit
Recent Migrant (in 5 years)	-0.0815***	-0.1425***		
	(0.0273)	(0.0657)		
Residential Years in HK			0.0021***	0.0003
			(0.0002)	(0.0005)
Male	0.0118***	0.0196***	0.0098***	0.0197***
	(0.0111)	(0.0182)	(0.0109)	(0.0182)
Age	0.0101***	0.0065***	0.0114***	0.0071***
	(0.0015)	(0.0039)	(0.0015)	(0.0040)
Age Squared	-0.0001***	-0.0000***	-0.0001***	-0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Ever Married	-0.1452***	-0.0621***	-0.1528***	-0.0629***
	(0.0182)	(0.0292)	(0.0184)	(0.0292)
Education	-0.0872***	-0.1074***	-0.0867***	-0.1076***
	(0.0057)	(0.0096)	(0.0058)	(0.0095)
Chinese Ethnicity	0.1420***	0.0369***	0.1474***	0.0363***
	(0.0353)	(0.0801)	(0.0350)	(0.0785)
Hong Kong PR	0.0725***	0.1110***	0.0744***	0.1364***
	(0.0371)	(0.0825)	(0.0368)	(0.0823)
District Fixed Effect	Y	Y	Y	Y
Year Fixed Effect	Y	Y	Y	Y
Observations	199,639	82,022	205,574	82,028

Note: Control for subject's personal income excluded. Logit estimation of marginal effect at the mean is reported. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

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