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Information Asymmetry with Heterogeneous Buyers and Sellers in the Housing Market

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Abstract

This study examines how heterogeneous traders on both sides of transactions behave in the housing market under information asymmetry. Two types of buyers, namely, informed and uninformed buyers, correspond to local and non-local buyers in the empirical tests. Non-local housing buyers in Hong Kong pay a 2.8% premium over local buyers in the second-hand market for housing units with similar observable attributes. We distinguish real estate developers from sellers in the second-hand market. The former has an incentive and ability to reduce information asymmetry by providing a quality guarantee on the building structure and signaling with brand name, none of which can be fulfilled by sellers in the second-hand market. Empirical results show that developers' efforts to reduce information asymmetry allow them to fetch a higher price than sellers in the second-hand market, holding property characteristics constant. Such efforts are particularly valued by uninformed buyers as non-local buyers prefer to purchase in the first-hand market rather than in the second-hand market, especially when the problem of information asymmetry is serious.

Keywords Information asymmetry · Housing price · Non-local buyer · Developer

JEL Classification D83 · R2 · R3

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Introduction

The significance of information asymmetry in shaping market behavior has been well developed since Akerlof's (1970) seminal paper. With information asymmetry, low quality goods (lemons) drive out high quality goods (peaches). This prediction is largely refuted by empirical observations because it ignores the possibility of the emergence of various institutions in reducing information asymmetry (Bond, 1982; Genesove, 1993; Janssen & Roy, 2002; Enger et al., 2009). Potential gains from trades, especially for expensive products, are sufficiently high, which induces market participants to counteract the negative impacts of information asymmetry. One prominent example is the use of experts (Alchian, 1977; Chau & Lennon, 2011). When the cost of using experts to ascertain the product quality is lower than the loss in the potential gain from trade, markets for goods with asymmetric information will not collapse as described by Akerlof (1970) and both lemons and peaches will be transacted. This study conjectures that even in the absence of experts, markets for lemons and peaches can still co-exist due to (1) variations in the cost of reducing information asymmetry among buyers (assuming that a buyer is the information disadvantaged party); and/or (2) variations in sellers' efforts to reduce information asymmetry.

As information asymmetry deters mutually beneficial transactions, sellers and buyers have the incentive to reduce such asymmetry. If the seller knows more about the quality of a product than the buyer, then the buyer will try to collect information to assess the quality of the product. When the cost of obtaining such information is prohibitively high, it reduces to the situation described by Akerlof (1970): buyers will value the product at the lowest possible quality and thus only lemons will be transacted. However, prospective buyers are not equally uninformed due to differences in their costs of obtaining product quality information and their ability to process the information. Buyers with low cost of reducing information asymmetry (the informed buyer) are likely to pay less for a product of the same quality than buyers with high cost of reducing information asymmetry (the uninformed buyer). On the supply side, sellers can provide product warranty (Nanda & Ross, 2012) or signal the quality of their product by investing in establishing brand name or goodwill in the case of repeat business (Tadelis, 1999; Mueller & Supina, 2002). They can charge a higher price to compensate their effort to reduce information asymmetry. Compared with informed buyers, uninformed buyers are more willing to pay for the seller's effort to reduce information asymmetry.

We apply the analysis presented above to explain the behavior of local and non-local buyers, respectively the informed and uninformed buyers, and their interactions with the two types of sellers in the housing market. In general, housing markets are characterized by information asymmetry due to substantial property heterogeneity and infrequent transactions (Eerola & Lyytikäinen, 2015). Compared with local housing buyers, non-local buyers are generally less informed and have higher search cost due to the geographic distance (Lambson et al., 2004; Ling et al., 2018; Liu et al., 2015; Turnbull & Sirmans, 1993; Ihlanfeldt & Mayock, 2012). As a result, they will end with paying a premium over local buyers for identical properties. However, information asymmetry becomes less of an issue if non-local buyers trade with sellers who are willing to signal the quality of their products like real estate developers.

Given that real estate development is usually a repeat business for them, developers are more likely to reduce information asymmetry about the quality of their products than sellers in the second-hand market who are generally doing a one-time business. Consequently, non-local buyers are more willing to pay a premium to buy from the developer than to search in the second-hand market.

Specifically, our study develops hypotheses to test (1) the price differentials between local and non-local buyers, (2) the price differentials between developers and second-hand sellers, and (3) the matching pattern between buyers and sellers in the presence of information asymmetry. The Hong Kong's housing market provides a natural laboratory for testing our hypotheses with two main features. First, the first-hand housing market in Hong Kong is dominated by several large real estate developers[1] and they have successfully established goodwill to signal the quality of their products. Moreover, all developers are required to provide home buyers warranty during the defect liability period. They are distinguished from sellers in the second-hand market who cannot fulfil any of the above conditions. Second, Hong Kong's housing market has faced an important inflow of non-local buyers over the years. Since 2003, several policies (e.g., the investment immigration policy and the individual visit scheme) have been implemented to attract non-local immigrants by investing in real estate. The government realized the pressure of a considerable amount of non-local housing buyers only until the end of 2012. The Buyer Stamp Duty, which requires an extra 15% stamp duty for non-local buyers, was imposed to suppress the inflationary influence of non-local buyers in the Hong Kong housing market.

The empirical tests rely on comprehensive data on housing transactions in Hong Kong spanning the period of 1993 to 2015. The data contain detailed information on housing units and their locational characteristics and households' characteristics. By utilizing various specifications, we obtained the following findings. First, non-local buyers pay a 2.8% premium over local buyers in the second-hand market, holding property features constant. Two strategies are used to reduce the influence of unobservable property characteristics on the estimated non-local buyer premium. On the one hand, propensity-score matching procedure is applied to similar properties for transactions involving local and non-local buyers. On the other hand, we consider the local and non-local differences in sales outcomes in accordance with Liu et al. (2015). If non-local buyers pay a higher price because of information asymmetry, then their exit price will not be higher than that of local sellers.

Second, the developer premium (DP) remains positive. DP is defined as the difference in the price of a housing unit in the first-hand market that is above that of the same unit in the second-hand market after adjusting for differences in age and carrying cost (in the case of sales before completion). DP is small with less information asymmetry as indicated by the high contribution of land value to property value (high land leverage ratio) as found in Wong et al. (2012) or a developer with a good reputation. According to Chau et al. (2007), developers' reputations are capitalized into forward property prices to resolve the potential quality problem. Our findings show

[1] Over 70% of the market share of the Hong Kong residential market is held by five large developers (Wong et al., 2018).

that developers' reputation reduces information asymmetry even when their housing units are later transacted in the second-hand market.

Third, non-local buyers are more likely to buy from developers than from sellers in the second-hand market. This inclination is low when the information asymmetry problem is less serious due to a high land leverage ratio or built by a reputable developer. Meanwhile, non-local buyers also pay a higher price (i.e., 1.6%) than local buyers do in the first-hand market considering that the quality guarantee provided by the developer is more valuable to them than local buyers. When housing units are overpriced by developers due to inaccurate information on pricing, non-local buyers are more likely to buy, therefore crowding out local buyers with a premium.

The documented evidence in this study contributes to the literature mainly in two ways. First, the study complements our understanding of the role of information asymmetry in shaping the behaviors of buyers and sellers. While a large and important theoretical literature on the importance of information asymmetry exists (e.g., Guerrieri et al., 2010; Chari et al., 2014), empirical studies testing its direct effects are relatively few. The empirical relevance of information asymmetry has mostly been studied with the assumption that buyers are equally uninformed and/or sellers are identical (e.g., Hendel & Lizzeri, 2002; Wong et al., 2012). Relaxing these assumptions can explain different behaviors of buyers and sellers in the presence of information asymmetry and pricing difference has been the main focus in the existing literature (Chinco & Mayer, 2014; Ihlanfeldt & Mayock, 2012; Levitt & Syverson, 2008; Turnbull & Sirmans, 1993; Garmaise & Moskowitz, 2004; Kurlat & Stroebel, 2015) are two exceptions to investigate beyond the price effect. Garmaise and Moskowitz (2004) compared informed and uninformed buyers in property selection. They predicted a highly localized real estate market as uninformed non-local agents limit their trades with local agents. Kurlat and Stroebel (2015) examined how the composition of informed agents influence the future housing dynamics. In this study, we combine the existing studies to consider both the pricing effect and the property selection when there are two types of sellers (i.e., developers and second-hand sellers) and two types of buyers (i.e., informed and uninformed). By explaining how non-local buyers address their information concerns by choosing from whom to buy and what to pay, this study provides complementary evidence to the existing literature.

Second, our findings complement the literature on the influence of non-local buyers. In line with the well-established literature addressing the non-local effects, we found a price premium paid by non-local buyers. Apart from our information asymmetry account, which is also documented in Neo et al. (2008), Liu et al. (2015), and Zhou et al. (2015), several other explanations exist for the price premium including unobservable selection bias (Ling et al., 2018), anchoring (Lambson et al., 2004; Ihlanfeldt & Mayock, 2012), and investor clienteles (Wiley, 2012). However, to the best of our knowledge, given the fact that non-local buyers paying a premium has been well-documented, relatively few studies devote attention to the influence of non-local buyers on the local real estate market. This case is particularly a paradox because the presence of non-local buyers in the real estate market has become a major concern for many regions in the world. The existing empirical evidence is limited to a positive effect of non-local buyers on the average local property prices (e.g.,

Jinjarak & Sheffrin, 2011; Akbari & Aydede, 2012; Chao & Eden, 2015; Badarinza & Ramadorai, 2018). A notable exception is Giannoni et al. (2017) who argue that the existence of the non-local buyer premium is a driving force behind the local buyer eviction phenomenon. They built a stylized static search and bargaining model, which shows that no seller will be willing to deal with local buyers if the non-local buyer premium exceeds a given threshold. Combined with their theoretical proofs, our empirical evidence on non-local buyers' inclination to trade with developers at a price premium raises a practical concern for the local buyer eviction phenomenon in the first-hand housing market. This concern is less practical in the second-hand market where non-local buyers voluntarily limit their participation due to information disadvantage.

The rest of the paper is organized as follows. Section 2 explains testable hypotheses in Hong Kong's housing market. Section 3 presents our data and empirical models. Section 4 presents the results of the study. The last section concludes the paper.

Testable Hypotheses in Hong Kong's Housing Market

In Hong Kong's housing market, information asymmetry is primarily related to the quality of a building's structure. Sellers are not responsible for any structural quality problem after signing the sales agreement. Given that most housing units in Hong Kong are predominately high-rise apartment units, their quality is also affected by the adjacent units and the parts of the buildings co-owned by all unit owners. Real estate agents can alleviate the structural information asymmetry problem. However, this case is less likely because in Hong Kong, real estate agents are appointed for facilitating matching buyers and sellers but not for ascertaining the quality of properties[2]. Buyers in general only have access to superficial quality information, and latent defects cannot be easily discovered by visual inspection. Many important land attributes (i.e., land use restrictions, neighbourhood facilities, views, and accessibility), on the other hand, can be easily identified by buyers through government websites and site inspections.

As some attributes are more transparent than others, information asymmetry about the housing quality exists as a matter of degree. Wong et al. (2012) showed that the degree of information asymmetry in Hong Kong's real estate market varies across locations. As a result of high transaction cost, information asymmetry deters beneficial trades between buyers and sellers. Within the same market, products with less asymmetric information are likely to be transacted first. Wong et al. (2012) suggested that housing units in expensive locations are more actively transacted because much of the housing value in these locations are attributable to locational characteristics, which are easily observable by buyers and sellers.

[2] Hiring a real estate agent cannot significantly improve the situation for two more reasons. First, real estate agents represent both the seller and the buyer in Hong Kong. Second, in the single-family home market, employing a building surveyor or house inspector before transaction is very common. However, this case is not possible for multi-storey apartment/condominium units because assessing the quality of the unit requires access to places other than the unit owned by a seller.

One underlying assumption of Wong et al. (2012) is that buyers and sellers are homogeneous and affected by information asymmetry to the same degree. They also ignored buyer's and seller's incentives to reduce information asymmetry and capture the dissipation of potential gains from trade. We extend the work of Wong et al. (2012) by relaxing the assumption of homogenous buyers and sellers and consider their effort in reducing information asymmetry.

Heterogeneous Buyers

We first relax the assumption of homogenous buyers and focus on how buyers with different costs of reducing information asymmetry behave. For simplicity, we suppose that two types of buyers are involved: informed and uninformed buyers. The distributions of their valuation of the same product are the same. However, the search cost and information cost on the quality of the product are higher for the uninformed than for the informed buyers. A high search cost implies that finding a seller with the lowest reservation price for the expected quality takes longer time or requires more resources for the uninformed buyer. The chance of finding a seller with the lowest reservation price is supposed to increase with search effort and time, but the increase is smaller for the uninformed buyer. Therefore, with the same search effort and time, an uninformed buyer is, on average, more likely to find a seller with higher reservation price than an informed buyer. A high information cost for the uninformed buyer means that reducing information asymmetry by spending resources to collect information is very costly. Under this condition, the uninformed buyer may simply use the information collected by the informed buyer by outbidding the informed buyer during negotiation. Stigler (1961) suggested that high information cost is a reason why the same product can be transacted at different prices. In any case, the uninformed buyer is likely to end up paying a high price for the same product under information asymmetry.

This analysis is applied to the second-hand housing market of Hong Kong where the seller knows more about the quality of the building structure than the buyer. We follow the literature (Lambson et al., 2004; Ling et al., 2018; Liu et al., 2015; Turnbull & Sirmans, 1993; Ihlanfeldt & Mayock, 2012) to distinguish uninformed from informed buyers based on their location of residence. Non-local buyers are buyers who live outside Hong Kong. Given their distance from Hong Kong, their information and search costs about the local housing market are generally higher than those of local buyers. This situation should result in non-local buyers paying a higher price than what local buyers will pay for the same housing unit, which becomes our first testable hypothesis:

Hypothesis 1 A non-local buyer pays more, on average, than a local buyer for a housing unit with the same observable attributes in the second-hand housing market, *ceteris paribus*.

Heterogeneous Sellers

When sellers are heterogeneous, some sellers, typical high-quality goods sellers, may spend resources to reduce information asymmetry so that they can benefit from more trades. Sellers can reduce information asymmetry in many ways. A commonly observed solution is warranty. Many sellers provide maintenance services during a specific period so that buyers do not need to worry about the unobserved attributes of a product. In Hong Kong's housing market, developers have the obligation to fix any defect or substandard work discovered by the owner during the defect liability period, which is normally 12 months after completion of the unit. Notably, the principle of privity of contract limits developers' contractual liability for housing defects to first-hand buyers (Chau & Lennon, 2011). In the second-hand market, the seller will not provide such quality guarantee. Therefore, information asymmetry about the quality of building structure is less of an issue in the first-hand market than in the second-hand market.

Given that reduced information asymmetry is beneficial to buyers, competition among buyers will bid up the price of first-hand properties. Therefore, developers' efforts in providing quality warranty will be rewarded by the market with a developer premium (DP). This case leads to the second hypothesis:

Hypothesis 2 Developers sell at a price premium over sellers in the second-hand market, *ceteris paribus*.

DP is a result of the developers' efforts to reduce information asymmetry that is valued by the buyer. The premium should be high when the information asymmetry problem is serious. This leads to the following hypothesis:

Hypothesis 3 DP increases with the degree of information asymmetry, *ceteris paribus*.

The degree of information asymmetry problem varies with the attributes of the housing unit and developer's reputation. We propose the following two sub-hypotheses that relate to each of these causes of variation in information asymmetry:

Hypothesis 3a DP is small for housing units with high land leverage ratio, *ceteris paribus*.

Hypothesis 3b DP is small for housing units developed by reputable developers, *ceteris paribus*.

We derive Hypothesis 3a from Wong et al.'s (2012) method of measuring the degree of information asymmetry in a housing unit by the land leverage ratio or the share of housing value attributable to land, which is determined by its location. As the locational attribute of the housing unit can be easily observed by the potential buyer, very little information asymmetry for the part of the housing value is attributable to its location. The quality of building structure, especially for multi-story buildings,

is the main source of information asymmetry. Thus, housing units with a high land leverage ratio present less information asymmetry problem. With a low degree of information asymmetry, buyers will value developers' efforts to reduce information asymmetry less, which can give rise to a low DP.

Hypothesis 3b stems from the fact that some developers are more reputable than others. Unlike sellers in the second-hand market, developers are in a repeat business in a developed market, such as Hong Kong. Reputable developers will not risk their reputation by building units with substandard workmanship and materials, which only sustain during the defect liability period. The economic loss of damaging their reputation is much higher than savings from constructing low-quality housing units because buyers rely on the quality of products produced by the developer in the past as an indicator of present or future quality (Shapiro, 1983). This finding is in sharp contrast to sellers in the second-hand market who are performing one-time businesses. Therefore, housing units sold by more reputable developers are likely to suffer less from information asymmetry, which should last in the second-hand market (Chau et al., 2007). With less information asymmetry problem in the first- and second-hand markets, DP is likely to be small.

Heterogeneous Buyers and Sellers

As the cost of reducing information asymmetry is higher for uninformed buyers, they will value the seller's effort in reducing information asymmetry more than the informed buyer does. This situation implies that uninformed buyers are more likely to buy from sellers who can provide warranty or more reputable sellers, even at a higher price. The flipside of the coin is that informed buyers are more likely to shop around for bargain buys and are more willing to take risk on product quality than uninformed buyers. For example, car experts prefer to shop for good-quality cars in the second-hand market, whereas lay buyers rather pay more to buy from reputable retailers in the first-hand market.

Home buyers self-select into buying from developers or second-hand sellers. As non-local buyers' search and information costs are high, they should value developers' effort to reduce information asymmetry more than the local buyers do. Given the choice, a risk-averse non-local buyer will rather pay a DP to buy a housing unit with more certainty in quality than to take the risk of buying a lemon in the second-hand market. This leads to our fourth hypothesis:

Hypothesis 4 A non-local buyer is more likely to buy a housing unit in the first-hand market than in the second-hand market, *ceteris paribus*.

A non-local buyer's preference to buy from developers over sellers in the second-hand market (developer preference) is a result of the substantial cost to reduce information asymmetry. If no information asymmetry about housing quality exists, then a non-local buyer will be indifferent to the types of sellers. If information asymmetry is serious, then a non-local buyer will prefer to pay the developer to solve the information asymmetry problem. This developer preference of a non-local buyer should

increase with the degree of information asymmetry. Thus, we have the following hypothesis:

Hypothesis 5 A non-local buyer's tendency to buy from a developer over a seller in the second-hand market will increase with the degree of information asymmetry, *ceteris paribus*.

Similar with Hypothesis 3, we propose the following two sub-hypotheses that relate to each of the two causes of variation in information asymmetry[3]:

Hypothesis 5a A non-local buyer's tendency to buy from a developer rather than a seller in the second-hand market is lower for housing units with higher land leverage ratio, *ceteris paribus*.

Hypothesis 5b A non-local buyer's tendency to buy from a developer rather than a seller in the second-hand market is lower for housing units developed by more reputable developers, *ceteris paribus*.

Data and Empirical Tests

Our empirical tests rely on a housing transaction dataset from EPRC Ltd. The EPRC database reports unit transaction price and date, detailed address, saleable floor area, floor level, and names of sellers and buyers. Other major price-influencing attributes are obtained from the Buildings Department and Rating and Valuation Department of Hong Kong, the Hong Kong Green Building Council, and Google Maps. With the limited information on the market participant, we follow Chang and Li (2018) to identify whether a home buyer (seller) is non-local based on the name. The names of local participants are recorded based on the old Cantonese Romanization system, whereas those of market participants from Mainland China are recorded based on the Mandarin Pinyin system[4]. The names in the two systems are very different and can easily be identified. However, given the fact that the number of Mainland residents working and living in Hong Kong like locals increases, simply relying on the name to identify a buyer/seller outside Hong Kong may underestimate the effects of information asymmetry. The number of Mainland buyers is calculated, and the results are shown in Fig. 1. The sharp fall in the proportion of Mainland buyers from 2013 corresponds to the imposition of an extra buyer stamp duty on non-local buyers.

The dataset consists of 620,927 housing transactions of condominium flats between 1993 and 2015 in Hong Kong. Approximately half of the records are sec-

[3] The rationales for Hypothesis 5a and 5b are similar to those of Hypothesis 3a and 3b and thus will not be repeated here.

[4] Only a few combination alphabets in the Cantonese Romanization system also exist in the Pinyin system, but the name always consists of two to four Chinese characters. Thus, the alphabet combinations of all Chinese characters in the full name are unlikely the same in Pinyin and Cantonese Romanization systems.

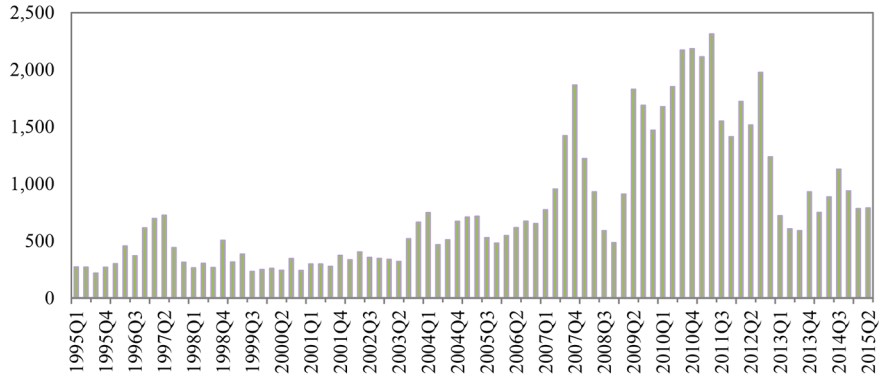

Fig. 1 No. of buyers from Mainland China in the housing market of Hong Kong (1995Q1-2015Q2) The number is compiled based on raw data from EPRC

ond-hand market transactions from the estates built between 1995 and 2015. Given that non-local buyers in the housing market of Hong Kong are predominately Mainland Chinese, we treat them as the non-local representative in this study. Table 1 provides the definition of the variables used in this study, and sample means and standard deviations for the variables are reported in Table 2. The first column of Table 2 displays the full sample stratified by the types of seller: panel A reports the sales in the first-hand market and panel B in the second-hand market. We further stratify the two sub-samples by the types of buyer: columns 2 and 3 of Table 2 display the sales closed by Mainland buyers and local buyers, respectively.

By comparing the two panels in Table 2, we find a slightly larger percent of Mainland buyers in the second-hand market (i.e., 3.6%) than in the first-hand market (i.e., 4.0%), which is not in line with Hypothesis 4. One possible reason is the characteristic differences between properties purchased by Mainland and local buyers. On average, Mainland buyers purchase properties with more up-market attributes, such as higher floor levels, larger floor plan, green labels, and convenient or expensive locations. To remove the influence of property differences, we apply a propensity-score matching (PSM) procedure[5] to select housing transactions by local and Mainland buyers who are mostly similar in terms of observable characteristics. After matching, 23,796 first-hand sales and 23,102 s-hand sales are evenly distributed between local and Mainland buyers. Summary statistics for the matched samples are presented in the last column of Table 2. As a result of the matching procedure, property differences between the two groups of buyers are substantially reduced. The models below will be tested using the matched sample.

Baseline Hedonic Price Model

To test our hypotheses, we start with the following baseline model using second-hand housing transactions:

[5] Details of the propensity-score matching process will be provided upon request.

Table 1 Variable definitions

Variables	Descriptions
Dependent variables	
ln(SP)	Natural log of housing transaction price
ln(AP)	Natural log of housing transaction price adjusted for carrying cost
Independent variables	
Structural attributes:	
Age	Age of the housing unit (in years)
Age^2	Age squared
Area	Saleable floor area of a unit (in square feet)
$Area^2$	Saleable floor area squared
Floor	Floor level
$Floor^2$	Floor level squared
Swim	Dummy variable which equals 1 if swimming pool is available within the estate and 0 otherwise
Size	Number of units within an estate
Beam	Dummy variable which equals 1 if the development is labelled as green building and 0 otherwise
Neighborhood attributes:	
Sea	Dummy variable which equals 1 if the unit has a sea view and 0 otherwise
Park	Dummy variable which equals 1 if the unit has a park view and 0 otherwise
Mountain	Dummy variable which equals 1 if the unit has a mountain view and 0 otherwise
Distance	Distance from the estate to the nearby MTR station (in km)
$Distance^2$	Square of the distance to the nearby MTR station
Location attributes:	
D_j	A vector of district dummies that equals 1 if property is in district j and 0 otherwise
LVA	Average deflated unit sale price by district derived from the coefficients of sub-districts in a hedonic regression
Participants attributes:	
REP	Dummy variable which equals 1 if the housing estate is developed by a blue-chip developer and 0 otherwise
MAB	Dummy variable which equals 1 if the unit is bought by Mainland Chinese and 0 otherwise
MAS	Dummy variable which equals 1 if the unit is sold by Mainland Chinese and 0 otherwise
Others:	
T_t	A vector of monthly time dummies which equals 1 if a unit is transacted at time t and 0 otherwise
DS	Dummy variable which equals 1 if a unit is sold by the developer and 0 otherwise
Supply	Quarterly housing supply measured by the number of units with consent to commence work

Table 2 Summary statistics

Panel A. Sample in the first-hand market

Variable	Full Sample (Obs. 334,951)		Mainland (Obs.11,898)		Local: pre-match (Obs. 323, 053)		Local: post-match (Obs. 11,898)	
			Mean	S.D.	Mean	S.D.	Mean	S.D.
AP(HK$Mn)	4.84	4.23	8.08	5.99	4.73	4.10	7.63	5.80
Age	0.47	1.29	0.76	1.86	0.46	1.26	0.75	2.00
Floor	22.36	15.05	24.73	16.17	22.27	15.00	24.26	15.86
Area	665.70	290.25	737.70	312.82	663.10	289.05	721.90	319.54
Swim	0.71	0.45	0.71	0.45	0.71	0.45	0.71	0.45
Beam	0.10	0.30	0.21	0.41	0.10	0.30	0.20	0.40
Size	2181	2001	2110	2134	2183	1996	2114	2154
Sea	0.21	0.41	0.22	0.42	0.21	0.41	0.21	0.41
Park	0.06	0.24	0.07	0.26	0.06	0.24	0.07	0.25
Mountain	0.22	0.41	0.21	0.41	0.212	0.4	0.21	0.41
Distance	0.90	1.04	0.75	0.85	0.90	1.05	0.77	0.86
REP	0.79	0.41	0.77	0.42	0.79	0.41	0.79	0.41
LVA	0.80	0.24	0.84	0.25	0.79	0.24	0.84	0.25

Panel B. Sample in the second-hand market

	Full Sample (Obs. 285,976)		Mainland buyers (Obs. 11,551)		Local: pre-match (Obs. 274,425)		Local: post-match (Obs. 11,551)	
AP(HK$Mn)	4.43	3.69	6.27	5.21	4.35	3.59	6.00	4.91
Age	6.42	4.44	6.84	4.10	6.40	4.45	6.98	4.37
Floor	21.75	14.85	23.97	15.69	21.65	14.81	23.75	15.71
Area	620.70	261.19	650.70	277.47	619.40	260.40	646.10	278.28
Swim	0.72	0.45	0.73	0.44	0.72	0.45	0.73	0.446
Beam	0.07	0.25	0.09	0.28	0.06	0.25	0.08	0.277
Size	2267	1982	2293	1913	2266	1985	2304	1950
Sea	0.19	0.39	0.27	0.44	0.19	0.39	0.26	0.44
Park	0.06	0.24	0.07	0.25	0.06	0.24	0.07	0.25
Mountain	0.21	0.41	0.19	0.39	0.21	0.41	0.18	0.39
Distance	0.97	1.11	0.85	0.98	0.97	1.12	0.85	0.98
REP	0.79	0.41	0.82	0.38	0.79	0.41	0.82	0.38
LVA	0.79	0.24	0.86	0.27	0.79	0.24	0.86	0.27
MAS	0.01	0.10	0.05	0.21	0.02	0.14	0.03	0.18

$$LnSP = \alpha_0 + \alpha_1 X + \sum \alpha_{2j} D_j + \sum \alpha_{3t} T_t + \varepsilon, \tag{1}$$

where SP represents sales price; X is a vector of housing attributes and their square terms; $\sum D_j$ is a vector of 56 dummies used to capture all district-specific effects, which are shared by transacted properties within district j; $\sum T_t$ indicates a vector of monthly time dummies; ε is the idiosyncratic term; and α_{mn} (m=0, 1, 2, 3; n=j, t) are coefficients to be estimated.

Estimation of The non-local Buyer Premium

We estimate the following model to test whether non-local buyers pay more than local buyers in the second-hand market:

$$\ln(SP) = \alpha_0 + \alpha_1 X + \sum \alpha_{2j} D_j + \sum \alpha_{3t} T_t + \alpha_4 MAB + \alpha_5 MAS + \alpha_6 MAB \times MAS + \varepsilon, \quad (2)$$

where *MAB* (*MAS*) is a dummy variable, which equals 1 if the buyer (seller) is based in Mainland China and 0 otherwise.

Hypothesis 1 implies that $\alpha_4 > 0$. However, this result can be due to the anchoring bias. The anchoring bias mainly comes from buyers using prices in their home market as a reference when purchasing properties elsewhere (Chinloy et al., 2014). This result may lead to overpayment in case the buyer is from a more expensive real estate market. However, this is not a concern of our study as property prices in Mainland China are generally lower than those in Hong Kong even in its most developed cities (see Appendix Fig. 1).

We may have omitted some important variables that are different between housing units purchased by Mainland and local buyers. Mainland buyers with high travelling costs may have a great demand for high-quality units that are not easy to be observed and thus a positive coefficient for *MAB* (Ling et al., 2018). Our PSM strategy is one way to handle this problem. In addition, we include the Mainland seller dummy to test whether Mainland sellers are selling units at a higher price. If the omitted variable bias exists even after the PSM procedure, then Mainland buyers are expected to purchase at a higher price and sell at a higher price than locals (Liu et al., 2015). However, if Mainland buyers are truly less informed and consequently pay a higher price, then their exit price will not be higher. A non-positive coefficient for *MAS* (α_5) will lend further credit to our information asymmetry argument. We also interact *MAB* with *MAS* to test the potential difference if Mainland buyers trade with Mainland sellers.

Testing the Developer Premium (DP)

We estimate another hedonic price model with first- and second-hand market transactions to test if developers' effort in providing quality warranty is rewarded with a higher selling price or DP. The model is set as follows:

$$\ln(AP) = \gamma_0 + \gamma_1 X + \sum \gamma_{2j} D_j + \sum \gamma_{3t} T_t + \gamma_4 DS + \varepsilon, \quad (3)$$

where *AP* is the sales price or price adjusted for carrying cost if it is a presale[6] and *DS* is a dummy variable that equals 1 if the seller is a developer and 0 otherwise. Hypothesis 2 implies that $\gamma_4 > 0$.

Next, we estimate Eq. (4) to test whether DP varies with land leverage (*LVA*) (Hypothesis 3a) and developer's reputation (*REP*) (Hypothesis 3b):

$$\ln(AP) = \gamma_0 + \gamma_1 X + \sum \gamma_{2j} D_j + \sum \gamma_{3t} T_t + \gamma_4 DS + \gamma_5 DS \times LVA + \gamma_6 REP + \gamma_7 DS \times REP + \gamma_8 MAB + \gamma_9 DS \times MAB + \gamma_{10} DS \times Supply + \varepsilon, \quad (4)$$

[6] As majority of our first-hand sales are presales, we adjusted the presale prices for carrying cost using the method presented by Chau et al. (2003).

where *LVA* is the average deflated unit sale price by district derived from the coefficients of sub-districts in a hedonic regression as in Wong et al. (2012); *REP* is a dummy variable which equals 1 given the developer is a constituent company of the Hang Seng Index (Hong Kong stock market index) and 0 otherwise; and *Supply* is the number of units with consent to commence construction lagged by one quarter.

As noted above, Mainland buyers are predicted to pay a premium in the second-hand market. They should as well overpay in the first-hand market considering the greater value they put on the developer's effort to reduce information asymmetry. Developers are likely to list their properties at a price that is too high or too low due to the lack of information for accurate pricing. When the housing units are overpriced, local buyers are likely to be crowded out by Mainland buyers. That is, Mainland buyers are more likely to overpay even if first-hand transaction prices are set by developers rather than a result of negotiation. We interact *MAB* with *DS* to test if Mainland buyers pay a high DP. The interaction term between *DS* and *Supply* controls the variations in the number of new housing supply.

Non-local Buyer's Preference

Finally, we estimate the following logit regression model to test if non-local buyers have a greater preference for units with less information asymmetry as predicted by Hypotheses 4 and 5:

$$Logit\{MAB=1\}=\beta_0+\beta_1 X+\sum\beta_{2j}D_j+\sum\beta_{3t}T_t+\beta_4 REP+\beta_5 MAS+\beta_6 DS+\beta_7 DS\times LVA+\beta_8 DS\times REP+\varepsilon \quad (5)$$

Results

Table 3 presents the results of estimating Eqs. (1) and (2) using the post-matched sample with second-hand transactions. Sub-district and time dummies are control variables and their coefficients are suppressed for brevity. The signs of all coefficients in the baseline model are as expected and very significant ($p<1\%$). These coefficients remain stable after the trader attributes are added in Eq. (2).

In Eq. (2), the coefficient of *MAB* is positive and significant ($p<1\%$) as predicted by Hypothesis 1. On average, Mainland buyers pay 2.8% more than local buyers when trading with local sellers. The estimated non-local buyer premium is only half of that found by Lambson et al. (2004) in the U.S. apartment market. This might be a positive result of the PSM procedure which was not applied by Lambson et al. (2004),[7] or the underestimation of the non-local buyer premium due to our strategy of identifying non-local buyers. The estimated coefficient on *MAS* is negative but insignificant, suggesting that Mainland sellers do not sell at a higher price than local sellers. This result provides a strong check on an intuitive explanation for price differences. Higher purchase prices combined with significantly lower sale prices do not support the notion that Mainland buyers selecting higher-quality properties

[7] The estimated purchase price premium using the pre-matched second-hand sample is 4.2%.

Table 3 Regression results for Eqs. (1) and (2)

	Equation (1)		Equation (2)	
	Coef.	t-Stat.	Coef.	t-Stat.
C	13.770^{***}	59.7	13.770^{***}	59.9
Age	-0.017^{***}	-16.0	-0.017^{***}	-16.3
Age^2	$3.2\times10^{-4***}$	5.1	$3.3\times10^{-4***}$	5.3
Floor	0.004^{***}	14.0	0.004^{***}	13.9
Floor^2	$-2.3\times10^{-5***}$	-5.1	$-2.3\times10^{-5***}$	-5.1
Area	0.002^{***}	186.7	0.002^{***}	187.2
Area^2	$-4.7\text{Ex}10^{-7***}$	-78.3	$-4.7\text{Ex}10^{-7***}$	-78.4
Swim	0.053^{***}	15.8	0.053^{***}	15.9
Beam	0.130^{***}	22.0	0.130^{***}	21.9
Size	$-3.4\times10^{-6***}$	-3.4	$-3.2\times10^{-6***}$	-3.2
Sea	0.070^{***}	20.1	0.070^{***}	20.2
Park	0.020^{***}	3.7	0.020^{***}	3.7
Mountain	0.013^{***}	3.1	0.013^{***}	3.1
Distance	-0.107^{***}	-17.3	-0.107^{***}	-17.4
Distance^2	0.018^{***}	13.9	0.018^{***}	14.0
MAB			0.028^{***}	11.0
MAS			-0.013	-1.3
MAB×MAS			-0.051^{***}	-3.9
District dummies (ΣD_i)	Suppressed		Suppressed	
Time dummies (ΣT_t)	Suppressed		Suppressed	
No. of observations	23,102		23,102	
Adjusted R^2	0.924		0.925	

The dependent variable is *ln(SP)*. Equations (1) and (2) use post-matched second-hand transactions. *MAB* and *MAS* are used to test Hypothesis 1. ΣD_i and ΣT_t are missed for brevity

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively

cause the price premium they pay. In addition, compared with local buyers, Mainland buyers achieve a 2.3% discount when trading with Mainland sellers. Mainland sellers' information disadvantage possibly remains at the time of sale or some of these transactions are connected. We invite further research with more data and detailed transaction information to test the robustness of this result as only a few of such cases are included in our sample (see the last row of Table 2).

Nevertheless, the use of PSM and the inclusion of the seller type can only address the influence of unobservables partially. Local and non-local buyers may still be different in their purposes of buying and adequacy of cash. For example, Mainland buyers may treat the Hong Kong property market as a safe place to "park" their cash or to diversify portfolio, while local buyers tend to treat it as a place to live. These differences, if not captured, may lead to an overestimation of the price premium due to information asymmetry. Given no additional information on traders, we try to minimize the difference between local and non-local buyers based on the feature of the purchased property. First, we distinguish between buyers of small-size units (SFA < 700 sq.ft.) and luxury units (SFA > 1,000 sq.ft.). Local and non-local buyers targeting similar size properties are likely to enjoy equivalent wealth and purchase for similar purposes. Second, we consider the additional buyer's stamp duty (BSD) which was imposed exclusively on non-local residents purchasing properties in Hong

Table 4 Robustness tests for Eq. (2)

	Equation (2) Subsample: Area < 700 sq.ft		Equation (2) Subsample: Area > 1,000	
Panel A	Coef.	t-Stat.	Coef.	t-Stat.
C	1.340***	114.8	1.417***	60.8
MAB	0.021***	7.8	0.042***	4.5
MAS	-0.008	-0.8	-0.015	-0.4
MAB×*MAS*	-0.034**	-2.5	-0.109**	-2.5
Property attributes	Suppressed		Suppressed	
District dummies (ΣD_i)	Suppressed		Suppressed	
Time dummies (ΣT_t)	Suppressed		Suppressed	
No. of observations	15,964		2,322	
Adjusted R^2	0.897		0.839	
	Equation (2) Subsample: Sale Year Before BSD		Equation (2) Subsample: Sale Year After BSD	
Panel B	Coef.	t-Stat.	Coef.	t-Stat.
C	1.387***	77.1	1.470***	323.3
MAB	0.031***	11.6	0.018**	2.5
MAS	-0.020*	-1.6	0.015	0.8
MAB×*MAS*	-0.020	-1.3	-0.110***	-4.4
Property attributes	Suppressed		Suppressed	
District dummies (ΣD_i)	Suppressed		Suppressed	
Time dummies (ΣT_t)	Suppressed		Suppressed	
No. of observations	19,308		3,794	
Adjusted R^2	0.933		0.864	

The dependent variable is *ln(SP)*. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively

Kong after October 2012. Due to the heavy tax burden, we suppose that non-local buyers after the BSD may have different purposes of purchase than non-local buyer before the BSD. We repeat Eq. (2) based on the above two features and results are reported in the two panels of Table 4. The results show consistently positive non-local buyer premium in different categories of buyers, despite some variations in the magnitude.

Table 5 presents the results of estimating Eqs. (3) and (4) using post-matched first- and second-hand transactions. The estimated coefficients for housing attributes are consistent in sign and significance with those using second-hand transactions in Table 3. The estimated coefficient on *DS* is positive and significant in Eq. (3) as predicted by Hypothesis 2. Developers fetch a 9.6% price premium over second-hand sellers. Property differences may also contribute to the DP. The most significant difference between a first-hand property and second-hand property should be the age of the property. Table 2 shows that the average age in the post-matched first-hand sample is 0.75 year, whereas that in the post-matched second-hand sample is approximately 6.9 years. Although we have controlled for age in the estimate, a multicollinearity issue might still exist. Therefore, we repeat Eq. (3) by using the subsample with second-hand transactions of newly built properties (i.e., *Age* < 3 years). The results are reported in column (2) of Table 5. With the age limit, DP even increases by 1%.

Table 5 Regression results for Eqs. (3) and (4)

	Equation (3)		Equation (3) Subsample: Age < 3		Equation (4) Subsample: Age < 3	
	Coef.	t-Stat.	Coef.	t-Stat.	Coef.	t-Stat.
C	14.21***	70.4	14.28***	70.4	14.27***	248.1
Age	-0.012***	-14.1	-0.043***	-7.9	-0.042***	-7.9
Age^2	9.6×10^{-5}***	2.97	1.7×10^{-4}***	8.1	1.7×10^{-4}***	8.1
Floor	0.004***	21.1	0.003***	14.1	0.003***	14.1
Floor^2	-2.4×10^{-5}***	-7.1	-1.5×10^{-5}***	-3.8	-1.5×10^{-5}***	-3.8
Area	0.002***	277.6	0.002***	214.9	0.002***	214.9
Area^2	-3.9×10^{-7}***	-112.9	-3.6×10^{-7}***	-83.3	-3.6×10^{-7}***	-83.3
Swim	0.039***	14.0	0.005	1.6	0.005	1.6
Beam	0.104***	31.6	0.103***	26.5	0.103***	26.5
Size	-6.9×10^{-6}***	-11.7	-1.8×10^{-5}***	-20.9	-1.8×10^{-5}***	-20.9
Sea	0.067***	26.6	0.072***	21.9	0.073***	21.9
Park	0.035***	9.2	0.061***	12.3	0.059***	12.3
Mountain	0.015***	5.2	0.002	0.6	0.002	0.6
Distance	-0.143***	-32.5	-0.200***	-31.5	-0.201***	-31.5
Distance^2	0.026***	28.4	0.042***	29.1	0.042***	29.1
DS	0.096***	13.9	0.106***	7.5	0.265***	7.5
DS × *LVA*					-0.065***	-5.2
REP					0.030***	3.9
DS × *REP*					-0.030***	-3.8
MAB					0.034***	6.2
DS×*MAB*					-0.018***	-3.0
DS × *Supply*					-0.009**	-2.2
District dummies (ΣD_i)	Suppressed		Suppressed		Suppressed	
Time dummies (ΣT_t)	Suppressed		Suppressed		Suppressed	
No. of observations	46,898		26,878		26,878	
Adj-R^2	0.923		0.934		0.935	

The dependent variable is *ln(AP)*. Equations (3) and (4) use post-matched first- and second-hand transactions. *DS* is used to test Hypothesis 2. *DS*×*LVA* and *DS*×*REP* are used to test Hypotheses 3a & b. MAB and *DS*×*MAB* are used to test Hypothesis 1 and Hypothesis 4. ΣD_i and ΣT_t are missed for brevity.

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Yet, the difference between first-hand and second-hand properties is more than physical quality. For example, it is much harder to negotiate on price with developers than with sellers of second-hand properties. The negotiation power may either increase or decrease DP depending on the relative bargaining power of the buyer and the seller in the second-hand market. Therefore, we should be cautious to attribute the above estimated DP exclusively to developers' effort of reducing information asymmetry.

The two interaction tests provide some assurance of the link between the estimated DP and information asymmetry. In Eq. (4), we interact *DS* with other variables to test how other factors affect DP. The negative and significant coefficient of *DS*×*LVA* in column (3) of Table 5 shows that DP is lower when the housing estate is located in more expensive (higher land leverage) locations, which is consistent with Hypothesis 3a. Similarly, the estimated coefficient on the interaction term of *DS*×*REP* is negative and significant as predicted by Hypothesis 3b. The estimated coefficient on *REP* is

Table 6 Logit regression results for Eq. (5)

	Equation (5)			
	Coef.	z-Stat.	Coef.	z-Stat.
C	10.510	0.1	10.510	0.1
Age	0.021**	2.1	0.021**	2.2
Age^2	-0.003***	-4.3	-0.003***	-4.2
Floor	-0.003	-1.4	-0.003	-1.4
Floor^2	1.1×10^{-5}	0.3	1.1×10^{-5}	0.3
Area	6.0×10^{-4}***	5.6	5.9×10^{-4}***	5.6
Area^2	-2.7×10^{-7}***	-5.5	-2.7×10^{-7}***	-5.4
Swim	-0.034	-1.3	-0.034	-1.3
Beam	0.040	1.1	0.043	1.2
Size	-2.2×10^{-5}***	-3.0	-2.2×10^{-5}***	-3.0
Sea	-0.028	-1.0	-0.028	-1.1
Park	0.071	1.6	0.066	1.6
Mountain	-0.097***	-3.2	-0.097***	-3.2
Distance	0.102**	2.2	0.097**	2.0
Distance^2	-0.020**	-2.0	-0.019*	-1.9
REP	0.020	0.7	0.026	0.7
MAS	0.355***	5.1	0.354***	5.1
DS	0.157***	4.8	0.320***	3.6
DS× LVA			-0.173**	-2.3
DS × REP			-0.011	-0.3
District dummies (ΣD_i)	Suppressed		Suppressed	
Time dummies (ΣT_t)	Suppressed		Suppressed	
No. of observations	46,898		46,898	
Akaike Inf. Crit.	63,707		63,706	
Log likelihood	-31,756		-31,753	

Equation (5) are binary logit models utilizing both first- and second-hand transactions. The dependent variable is *MAB*, equal to 1 if the buyer is from Mainland China and 0 otherwise. *DS* is used to test Hypothesis 4. *DS×LVA* and *DS×REP* are used to test Hypotheses 5a & b, respectively.

***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

positive and significant, which lends further credit to the argument that developer's reputation is useful in reducing information asymmetry in the second-hand market without quality guarantee. Overall, developers' reputation is rewarded with a 3% premium in the second-hand market, which does not exist in the first-hand market. This finding raises a practical concern over the developers' motivation to maintain a good reputation after the defect liability period. Finally, similar with the results in Eq. (3), Mainland buyers pay a premium (i.e., 1.6%) in the second-hand market, which is slightly larger than that in Eq. (3) without the age limit and much smaller than in the first-hand market.

The results of estimating the logit models are shown in Table 6. Majority of the housing characteristics are well matched through the PSM procedure and show no significant effect or weak effect in the logit models. The results in column (1) confirm that Mainland buyers prefer to buy from developers than from second-hand market sellers (Hypothesis 4). However, as shown in column (2) of Table 6, the difference in the preferences to buy in the first- and second-hand markets is smaller in more

expensive locations (Hypothesis 5b). We also expect this difference to be significantly smaller if the housing unit is developed by a reputable developer as predicted by Hypothesis 5a. However, only weak evidence is obtained because the interactive term between *DS* and *REP* is negative but insignificant ($p > 10\%$). In addition, Mainland buyers prefer to trade with Mainland sellers. One explanation is that there exists less information asymmetry for Mainland buyers trading with Mainland sellers. Further research may answer this question with more abundant transactions between Mainland buyers and Mainland sellers.

Conclusion

This study examines the importance of information asymmetry in the housing market. We have developed five testable hypotheses on how heterogeneous buyers and sellers behave in the presence of information asymmetry when experts are not used to reduce information asymmetry. The results tested with Hong Kong data are largely in line with the predictions of our hypotheses. We find that non-local buyers, driven by their high costs of reducing information asymmetry, tend to purchase in the first-hand housing market; otherwise, they end up paying a higher price than local buyers in the second-hand market for similar housing units. Moreover, sellers in the first-hand market can fetch a high price for their effort to reduce information asymmetry, especially when the problem of information asymmetry is serious. Admittedly, the non-local buyer premium and the developer premium estimated in this study may not be entirely attributed to information asymmetry. Future studies could address it with better quality of data which includes detailed buyer and seller information.

Overall, the evidence documented in this study complement the existing literature on non-local buyers in two ways. First, it extends our understanding of how non-local buyers address their information concerns in the local real estate market by choosing from whom to buy and what to pay. Second, it sheds light on the influence of non-local buyers. Despite the fact that the presence of non-local buyers has become a major concern for many cities, regions, or countries in the world, the influence of non-local buyers has received little attention. Our findings put forward a practical concern for the local buyer eviction phenomenon as documented by Giannoni et al. (2017). In submarkets with less information asymmetry, non-local buyers are likely to crowd out local buyers with their willingness to overpay. This possibility is applicable to other cities around the world such as Vancouver, London, and Sydney, which have been experiencing similar influxes of non-local buyers into their housing market.

Appendix

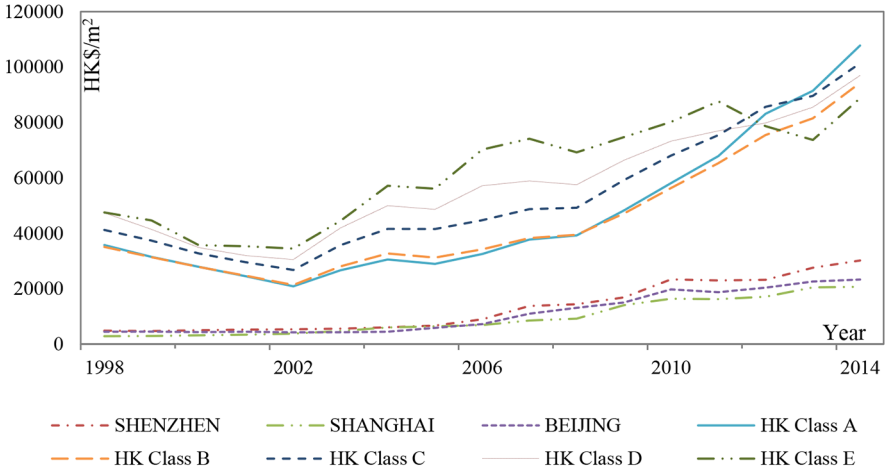

Fig. A1 Housing prices of main cities in Mainland China and Hong Kong. Raw data from National Bureau of Statistics of China and Rating and Valuation Department of Hong Kong; the average private housing prices of Hong Kong only refer to New Territories which is relatively cheaper than the other two districts (Hong Kong Island and Kowloon); housing units in Hong Kong are divided by reference to floor area into five groups: Class A (saleable area less than 40 sq.m), Class B (saleable area of 40 sq.m to 69.9 sq.m), Class C (saleable area of 70 sq.m to 99.9 sq.m), Class D (saleable area of 100 sq.m to 159.9 sq.m), and Class E (saleable area of 160 sq.m or above).

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