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Private space, shared space and private housing prices in Hong Kong: An exploratory study

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Abstract

This exploratory study examines the relationship between internal space, shared space and private housing prices. Housing floor area is an ambiguous concept in Hong Kong because it covers a possible exaggeration of the amount of ‘private space’ exclusively enjoyed by the owner and an unidentifiable portion of ‘public space’ shared with other owners within the development. Using hedonic pricing models, this study has found that different distributions between private and shared space command different values from the housing buyers. Shared communal space generally exerts a downward pressure on housing prices. The buyers are willing to pay more for the private space and some desirable forms of communal space. A higher willingness-to-pay for the desirable attributes such as clubhouse indicates that the Hong Kong people are increasingly concerned about the quality of living space in the built environment. This study suggests a need of further research into the exact measurement and the different forms of housing space rather than simply taking the stated floor space figures for granted.

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Introduction

This study explores how the different nature of living space affects housing prices. In Hong Kong, buildable space is limited due to topographic constraints and government planning policy. These limitations have led to a high-density and compact design solution for housing as well as the other urban developments (Zaman, Lau, & So, 2000). Hong Kong is one of the most densely populated areas in the world, with an overall population density of over 6350 persons/km\textsuperscript{2} where Kwan Tong District had about 52,123 persons/km\textsuperscript{2} (Census and Statistics Department, 2007) and 194,178 domestic households in 2006 (Census and Statistics Department, 2006). Urban space is at a premium. As a result, there are always arguments in favour of and against compact urban form. Such a development model is often praised for its efficient utilization of precious urban land because a large number of residents can share the common space and facilities within mass housing estates. However, a high concentration of residents also results in a very congested environment. Some past studies
claim that compactness may induce adverse effects under reduced domestic living space (Brotchie, 1992; Forster, 1994; Stretton, 1996) and poorer access to green space (Brechny, 1992; Knight, 1996; Stretton, 1994).

Home buyers are willing to pay for desired attributes such as more floor area, access to park, access to facilities, and nice view. But they are also forced to pay for common space and facilities that have to be shared with other households.

With limited buildable land, high-density development is one of the viable solutions in providing affordable housing to Hong Kong population (Fig. 1). In Hong Kong, all land is leasehold. The Hong Kong government exerts control on private development through land sales and planning control mechanisms. Private housing land is sold to developers through auctions and tenders. The land price is the highest cost component in private housing development. Hence, private developers try to maximize their profits by maximizing the saleable area. The extremely high population results in a majority of the residents living in higher-density housing development. In general, these multi-storey housing blocks are associated with smaller dwelling units for the mass population whereas the lower-density housing development can afford to have comparatively larger and spacious units for the higher-income households (Chan, Tang, & Wong, 2002).

Hong Kong housing is mainly classified into two categories: public housing and private housing. More than half of the housing units (55.3%) are produced by private housing sector (Census and Statistics Department, 2007). Public housing blocks have been built using the standard block designs. The most frequently used standard block designs are: (1) the New Cruciform [for Home Ownership Scheme (HOS)]; (2) the Harmony One (for rental housing); and (3) the Concord (for HOS) (Fig. 2). Another block design is developed with

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1 The New Cruciform design was introduced in 1984 and the first blocks were completed in 1987. This block design has been mainly used for the purposely designed Home Ownership Scheme (HOS) courts. Cruciform design is like a cross with four arms extending from a central core containing lifts, services and stairs. There are 10 flats on each floor. The Harmony One design was introduced in 1989 and used only for rental housing blocks. The floor layout of Harmony One is similar to Cruciform with four arms extending from a central core. The numbers of flats on each floor vary from 16 to 20. The Concord design was introduced in 1995 for HOS courts. The Concord design, compared with the New Cruciform design, is more modern in terms of standards and finishes. A typical Concord block is a block with eight flats on each floor.
private developers under the Private Sector Participation Scheme (PSPS), with a higher efficiency ratio (ER) (Audit Commission, 2001). Households of all these block designs have to share a common area. Hong Kong private housing development is also remarkable with similar building layout of public housing. A typical building layout comprises a large number of housing units clustered around a cruciform core sharing a common area by the households. This central core contains lifts, services and stairs (Fig. 3).

Key issues and questions

In Hong Kong, there are no standards on the minimum amount of living space per capita, which is left to be determined by the market forces. Liu, Wu, and Lee (1999) estimated that the average “saleable area” of private housing in Hong Kong was about 15.6 m²/person, which was much lower than the minimum space standard of 21.34 m²/person in the UK and the minimum floor area of 18 m²/person in Japan. Furthermore, the “saleable area” concept in Hong Kong includes a portion of common area or mechanical plant room that is not used for the exclusive use of the flat owners. Hence, the private space for the exclusive enjoyment of the flat owner is further reduced (Chan et al., 2002).

With the outbreak of the severe acute respiratory syndrome² (SARS) in 2003 (Lee, 2006), Hong Kong Special Administrative Region (HKSAR) Government has started to realize that high housing density (including the public housing and private housing developments) might create congestion and was conducive to the spread of chronic diseases. New policy measures and incentives have been adopted by the government to

²In one 33-storey apartment building, more than 300 people were infected by the SARS in 2003. The authorities stated that it happened due to the worn-down plumbing in the complex caused an infected patient’s virus-tainted waste to spread to other residents’ apartments.
encourage private developers to expand the communal space and green features within housing development with a view to reducing congestion and enhancing the quality of living space. The effects of these new initiatives are yet to be determined.

However, the HKSAR Government is also facing many complaints from home buyers about some “perplexing” practices by the Hong Kong developers with regard to the calculation of floor space (Liu, 2007). There has been a long-term confusion about the exact measurements of ‘gross floor area’ (GFA) and ‘saleable area’ of a housing unit. Some developers cite GFA, which the Government defines to include all roofed areas, the area within the walls, the thickness of walls and apportion of common areas such as corridors, staircases, lift lobbies and the ground floor areas. Others interpret ‘saleable area’ to include also a share of external facilities such as gardens and car parks. The Government exempts some areas from the GFA calculation in order to encourage developers to build better public facilities and more spacious design for the housing developments. In fact, developers have to pay a very small amount for the construction cost for these exempt areas as compared with a huge amount for the land premium. This unclear measurement is mainly because the developers are including unidentifiable portion of floor area into the GFA calculation for the purpose of flat sale. Moreover, the final “saleable” GFA approved by the Buildings Department is always more than the GFA stated in the land lease documents. It is mainly because some floor areas, for example, plant rooms,
are exempted from the GFA calculation, but some of the developers will include these exempted floor area into the GFA for the flat selling purpose. For example, a low-density housing development in Tai Po Kau was found to have a saleable area stated in the sale brochure exceeding about 10% (1233 ft²) of the accountable GFA under the land lease (Asia Television Ltd., 2000). It is difficult to have a clear picture about the actual size of the internal floor space of the housing units simply by judging from the GFA figures provided by the developers and subsequently registered with the Land Registry.

This study argues that different distribution of housing space will command different values from the housing buyers. Our key argument is that, notwithstanding the confusion in measuring housing flat size in Hong Kong, home buyers are not myopic in relying entirely on the GFA figures which are stated by the developers and registered in the Land Registry. In the secondary housing market, the buyers have the opportunity to inspect the flats and determine whether the “stated” floor space measurements are reasonable or not. There are two major types of measurement. The first one is GFA which has been fully elaborated above. The second one is net floor area (NFA) which is commonly conceived of as a measure of private internal space, net of the shared portion of external space included in the respective GFA, of a particular housing unit. Although this is a common understanding, there is no statutory and standardized definition of NFA. Therefore, there is still a possibility that the NFA may also be inaccurate. However, this study argues that, despite its possible imprecision, the NFA figure is likely to act as a better reference to home buyers than the GFA figure. It is natural to expect that, in a residential purchase decision, home buyers will put emphasis on the amount of internal space within the housing unit. The NFA figure is supposed to provide a better proxy of the internal space exclusively enjoyed by the buyers. When a prospective buyer inspects a housing unit, he can make a judgment about whether the stated NFA figure is indeed a reasonable measure of the internal space he is paying for.

The objective of this study is to determine the relationship between the different forms of housing space and the relative willingness-to-pay for housing prices. Based upon the above arguments, this study will examine the following hypotheses. First, a buyer is willing to pay more for a higher amount of internal space that he can exclusively enjoy. This implies that the NFA is expected to be more accountable for the housing price than the GFA. The higher is the amount of internal space, the higher will be the housing price, ceteris paribus. Second, a buyer is expected to be less willing to pay for the shared space. In other words, shared space is expected to exert a downward pressure on the housing price. The higher is the amount of shared space, the lower will be the housing price, ceteris paribus. Third, shared space may exist in different forms and a buyer is expected to be willing to pay for some ‘desirable’ shared space. For example, clubhouse is a kind of shared space which is desirable to the households within a housing development. Thus, a positive relationship between ‘desirable’ shared space and housing price is expected.

Previous studies of living space and housing price

Quality living space offers benefits to our communities. Such benefits can be classified into different categories: social, economic, environmental, physiological and psychological. Many of these benefits are difficult to be quantified. From an environmental perspective, green space provides shade, moderates local air temperature, and filters air pollutants and noise (Dwyer, McPherson, Schroeder, & Rowntree, 1992). From a social perspective, green space serves as linkages within neighbourhoods and develops closer community ties. Parks and green spaces provide recreation space for communities and offer numerous psychological and physiological benefits (Godbey, Roy, Payne, & Orsenga-Smith, 1998; Parsons, Tassinary, Ulrich, Hebl, & Grossman, 1998; Ulrich, 1981; Ulrich & Addoms, 1981).

Provision of parks and green spaces become critical in regional planning and housing development especially when the people have raised their concerns about the quality of life. The ability to place values quantitatively on the benefits generated by green spaces is becoming essential to the urban planners and developers. One of the methods to measure the economic benefits of green space to communities is to measure their impacts on the surrounding property prices. This approach assumes that the benefits (in terms of positive and negative externalities) of green space proximity are capitalized into property prices. Home buyers are willing to pay premiums for locations offering easy physical access to green spaces and the benefits they provide.
Hedonic price modeling can be applied to estimate the impacts of green spaces on property prices. There is a huge body of literature studying the impacts of parks on property prices and many studies have found statistically significant positive relationship between existence of or proximity to green spaces and property values (Bolitzer & Netusil, 2000; Hammer, Coughlin, & Horn, 1974; Hobden, Laughton, & Morgan, 2004; Lutzenhiser & Netusil, 2001; Willis & Garrod, 1992, 1993). In contrast, a study (Cromption & Nicholls, 2005) has found that green spaces have no significant impacts on the surrounding property prices. In this study, hedonic price modeling is applied to study the impacts of four large parks in Bastrop County, Texas, on the surrounding properties prices. The findings revealed that these green spaces have no significant impacts on the prices of surrounding property located in the rural county.

There are a few studies exploring the relationship between different attributes and housing prices in the context of Hong Kong. Hui and Ho (2003) have examined the impact of land-use planning system on housing prices by using hedonic pricing method and found that the planning system has a significant impact on the housing market in Hong Kong. So, Tse, and Ganesan (1997) have studied the role of accessibility of transport in determining the private housing price in Hong Kong. Tse and Love (2000) have found that the residential property values are higher for estate-type housing properties, and lower for dwelling units with a cemetery view.

By using hedonic pricing method, Mok, Chan, and Cho (1995) have examined three main categories of attributes one of which includes the GFA of each housing unit. They admit that “the living space and the number of rooms are more relevant structural variables, but unfortunately such data are not available” (Mok et al., 1995, p. 43). This is a major deficiency. In Hong Kong, the land premium is directly related to the maximum GFA allowed to be developed on a piece of land. The current laws do not distinguish between the two components of the GFA: living space and shared common space. Furthermore, the “saleable” GFA of each housing unit is determined by the developers and may not directly reflect the actual amount of exclusive space in each unit. Therefore, the net size, i.e. the NFA, is applied in this research in order to explore how the distribution of different kinds of space affects the prices of the housing units.

**Study methodology and data**

Hedonic price modelling is applied in this study. It is a technique which studies the demand side of housing with the assumption that a property is sold as a package of inherent attributes (Rosen, 1974). It is assumed that the market is under pure and perfect competition. House prices for dwelling units are determined by the consumers’ evaluations of a bundle of attributes. In fact, hedonic prices are the implicit values for the characteristics of the housing unit. The hedonic price model was first employed by Griliches in the studying of fixed assets in 1971. This technique was widely used in housing studies exploring the effect of different attributes on housing prices such as: accessibility to work, school and facilities; socio-economic characteristics of neighbourhood; environmental externalities; and racial discrimination, and so on.

The data employed in this research were obtained from the EPRC Limited which has established a database recording all the property transaction data registered with the Land Registry of the HKSAR Government since 1991. The EPRC Limited provides online access to this database for the subscribed users. It is an authoritative database because it has secured a market share of over 95% for such services. It is obvious that transport accessibility has a significant influence on housing prices. In the Hong Kong context, proximity to Mass Transit Railway (MTR) station is known to create a premium on housing price. In order to control the effect of location-related variables, this study has assembled property transaction records from the mass housing projects located within the ‘captured zones’ of a 500 m radius (around 15 min walking distance) from the nearest MTR Station on Hong Kong Island. A total sample of 528 transaction records has been randomly taken from the actual property transaction records during the second quarter of 2005. This was considered as a relatively stable market after the outbreak of SARS. The selection of data helps control the undue influence of accessibility advantage and market sentiment on housing prices and enables the analysis to focus more specifically on the effect of space distribution of housing unit.

**Table 1** shows the descriptive statistics of the data and explains the key variables included in this analysis. In the first analysis, the NFA and the GFA are applied in two separate models: MODEL_NET (using NFA as independent variable) and MODEL_GROSS (using GFA as independent variable). In Hong Kong, housing...
unit is sold in terms of the gross price per square foot (selling price divided by the GFA). However, it is argued that house buyers are more sensitive to NFA rather than GFA. We hypothesize that home buyers are more willing to pay for a housing unit with a higher NFA, ceteris paribus. When they buy the housing units, they will perceive NFA as one of their preferences but not the GFA, as most developers only provide data on GFA and some calculations of the GFA are ambiguous. Therefore, in the first analysis, GFA and NFA are applied as independent variable, respectively, in two separate models (MODEL_NET and MODEL_GROSS) with the same combination of other variables. This shows the impacts made by GFA and NFA separately on the housing price. By comparing these two models, we are able to compare the coefficients of GFA and NFA, and to determine whether internal space is a better estimator of housing prices. In the subsequent analysis, we will examine how different attributes of floor area provision may affect housing prices. These attributes include the different levels of total shared space, the amount of ‘desirable’ shared space such as clubhouse and the possible exaggeration of internal floor space.

Table 1
Descriptive statistics and definition of variables

| Variables          | N  | Minimum | Maximum | Mean     | Std. deviation |
|--------------------|----|---------|---------|----------|----------------|
| G_P                | 528| 3165    | 6794    | 5160.01  | 527.565        |
| NET_SIZE           | 528| 374     | 669     | 534.93   | 69.985         |
| GROSS_SIZE         | 528| 474     | 752     | 630.38   | 77.218         |
| AGE                | 528| 2       | 229     | 139.12   | 58.106         |
| FLOOR              | 528| 1       | 48      | 14.87    | 8.641          |
| NOR_VIEW           | 528| 0       | 1       | 0.16     | 0.368          |
| GD_VIEW            | 528| 0       | 1       | 0.72     | 0.450          |
| EX_VIEW            | 528| 0       | 1       | 0.04     | 0.191          |
| CLUB               | 528| 0       | 1       | 0.29     | 0.452          |
| LAND_IND           | 528| 0       | 1       | 0.20     | 0.402          |
| LAND_PARK          | 528| 0       | 1       | 0.28     | 0.450          |
| DIS_FLY            | 528| 20      | 1100    | 498.22   | 298.893        |

Category | Variable | Definition | Expected sign |
Dependent | G_P (selling price) | Transaction price per sq. ft. gross of the subject property | |
Structural/property physical features | NET_SIZE (NFA) | Private, internal area of the subject property (net size in square foot) | + |
(Applied in MODEL_NET) | GROSS_SIZE (GFA) | Gross floor area of the subject property (gross size in square foot) | + |
(Applied in MODEL_GROSS) | AGE (age of building in month) | Building age at the time of transactions | – |
| FLOOR | The actual floor level of the subject property | + |
| NOR_VIEW (normal view) | 1 if the unit is having a normal view; 0 otherwise | + |
| GD_VIEW (good view) | 1 if the unit is having a good view; 0 otherwise | + |
| EX_VIEW (excellent view) | 1 if the unit is having an excellent view; 0 otherwise | + |
Neighbourhood | CLUB (availability of clubhouse within housing estate) | 1 if there is a club house; 0 otherwise | + |
Environmental | LAND_IND (industrial land use within a radius of 200 m) | 1 if industrial land use located within a radius of 200 m of the housing unit; 0 if otherwise | – |
| LAND_PARK (availability of park or green space within a radius of 200 m) | 1 if there is park or green space located within a radius of 200 m of the housing unit; 0 if otherwise | + |
| DIS_FLY (distance to the nearest flyover) | The distance of the unit to the nearest flyover within a radius of 200 m | – |
Housing attributes other than the measurement of floor area were collected through site observations and surveys and their definitions are shown in Table 1. The housing attributes are mainly classified into three categories: physical, neighbourhood, and environmental. The numerically measurable attributes which are quantitative in nature, such as size, age, floor, and distance. Dummy variables are applied in the analysis. The dummy variable method is used to deal with the qualitative variables. In this analysis, a particular condition was classified as either “available” or “not available”, coded with “1” for available and “0” otherwise. Desirable attributes include access to park and clubhouse. Undesirable attributes include whether industrial land use exists within a radius of 200 m of the subject housing unit. A binary variable of value “1” is coded for existing and “0” otherwise.

View is considered as one of the openness features and influences the quality of the living environment. Therefore, in this research, instead of defining a dummy variable of possessing sea view, three dummies are applied in this analysis. There are four categories of view: (1) poor view; (2) normal view; (3) good view; and (4) excellent view. In order to avoid dummy variable trap, three dummy variables of view are applied in the models: (1) NOR_VIEW (normal view—coded with “1” if the unit is possessing building view, inner street view, school view and podium view; “0” otherwise); (2) GD_VIEW (good view—coded with “1” if the unit is possessing garden view, mountain view, and swimming pool view); (3) EX_VIEW (excellent view—coded with “1” if the unit is possessing sea view). The poor view (unit possessing industrial building, old building, and elevated road) is kept as the control group.

In the first analysis, we estimate the models MODEL_NET and MODEL_GROSS using the ordinary least-squares technique (OLS) in the following equations:

MODEL_NET

\[
\ln(G_P) = \beta_0 + \beta_1 \ln(\text{NET_SIZE}) + \beta_2 \ln(\text{AGE}) + \beta_3 \ln(\text{FLOOR}) + \beta_4 \text{NOR_VIEW} \\
+ \beta_5 \text{GD_VIEW} + \beta_6 \text{EX_VIEW} + \beta_7 \text{CLUB} + \beta_8 \text{LAND_IND} \\
+ \beta_9 \text{LAND_PARK} + \beta_{10} \ln(\text{DIS_FLY}) + u, \tag{1}
\]

MODEL_GROSS

\[
\ln(G_P) = \beta_0 + \beta_1 \ln(\text{GROSS_SIZE}) + \beta_2 \ln(\text{AGE}) + \beta_3 \ln(\text{FLOOR}) + \beta_4 \text{NOR_VIEW} \\
+ \beta_5 \text{GD_VIEW} + \beta_6 \text{EX_VIEW} + \beta_7 \text{CLUB} + \beta_8 \text{LAND_IND} + \beta_9 \text{LAND_PARK} \\
+ \beta_{10} \ln(\text{DIS_FLY}) + u. \tag{2}
\]

**Study findings and discussions**

The results of MODEL_NET and MODEL_GROSS are presented in Table 2. In both MODEL_NET and MODEL_GROSS, the adjusted \( R^2 \) are around 0.61, which means that the models explain approximately 61 percent of the variation of the housing price. However, the adjusted \( R^2 \) of MODEL_NET is slightly higher than the one of MODEL_GROSS. The explanatory power is higher by using NET_SIZE compared to GROSS_SIZE in the analysis with the same set of independent variables.

In MODEL_NET and MODEL_GROSS, a natural logarithmic transformation is applied to the quantitative variables such as house prices, size, age, floor level of the housing units, and also the distance to the nearest flyover. Thus, the associated estimators of these quantitative variables represent their corresponding price elasticities. In the MODEL_NET, 1 percent increase in the NFA will lead to 0.1 percent increase in housing price. In the MODEL_GROSS, 1 percent increase in the GFA will lead to less than 0.1 percent increase in property price. The findings showed that, the coefficient of \( \ln(\text{NET_SIZE}) \) is higher than \( \ln(\text{GROSS_SIZE}) \), *ceteris paribus*. This confirms our hypothesis that home buyers can better perceive the actual useable size they own.

The industry experts stated that it is difficult for potential home buyers to compare the unit price of flats among different housing developments recently because different developers apply different methods to calculate the saleable area. To ensure consistency, the Hong Kong Institute of Surveyors (HKIS) has reviewed and revised the existing code of measuring practice. The HKIS proposed revising its current “Code of
Measuring Practice of Saleable Area” so that the saleable area\(^3\) of a unit would be measured in two parts, namely saleable area (Type A) and saleable area (Type B). Type A would refer to the saleable area which is roofed of full headroom and is available for full normal occupation. Type B, however, would refer to areas of cockloft (of clear headroom less than 2 m); bay window, yard/terrace/garden/flat roof/car park; car parking space; and plant room. The HKIS also proposed clarifying that during measurement of saleable area, features such as pipe duct, mouldings, architectural fins and air-conditioning platforms not be included (Chung, 2007; LEGCO, 2007). Alnwick Chan Chi-Hing, an executive director at Knight Frank, said: “The new practice has clarified the definition of saleable area. It could help potential buyers to calculate flat prices based on the same level, allowing them to finally compare apples to apples” (Liu, 2007).

In addition to the floor area variables, the signs of all other coefficients are as expected (Table 2). View is considered as one of the openness features. Home buyers are expected to pay a higher value to the housing unit possessing a nice view. For the attribute of view, all three variables are significant, especially EX\(_\text{VIEW}\) and GD\(_\text{VIEW}\), pose a substantial positive impact on the housing price. In Eq. (1), the values of \(b\) measure different effects, for example, the values of \(b_3\) and \(b_7\) represent the marginal effects of FLOOR and CLUB, respectively. Since the estimates coefficients are not comparable in numerical terms, the standardized regression is estimated in order to compare the numerical value of one regressed coefficient with that of another. The \(b\) coefficients are unit free and are directly comparable to each other. Clubhouse is considered as one of the components of the communal space and quality living space. The effect of CLUB is remarkable and the \(b\) coefficient is the highest (Table 2 above), which indicates the home buyers are willing to pay for the availability of club house. The result indicates that the home buyers are willing to pay for a higher quality of life and environmental attributes play an important role in the buying decision for a housing unit.

In this research, the availability of a public park within a radius of 200 m, is considered as a natural feature, one of the desired environmental features and external quality living space. The \(b\) coefficient is the second highest in both in MODEL\(_\text{NET}\) and MODEL\(_\text{GROSS}\). The coefficient associated with the LAND\(_\text{PARK}\)

\(^3\)The saleable area of a unit comprises the floor area exclusively allocated to that unit including balconies and other similar features but excluding common areas such as staircases, lift shafts, lobbies and communal toilets. It shall be the area contained within the enclosing walls of the unit measured up to the exterior face of an external wall or the center line of a separating wall between adjoining units, as the case may be. Enclosing walls separating a unit from a lightwell, a lift shaft or any similar vertical shaft, or a common area, shall be deemed an external wall and its full thickness shall be included. All internal partitions and columns within the unit shall be included (LEGCO, 2007).
is highly positive significant indicates that the availability of park has a strong positive influence on property price. As expected, home buyers have a higher willingness-to-pay more for the housing units with access to park. Especially in the case of urban areas, the amount of green space available within the neighbourhoods is very limited and perceived as a scarce natural feature.

FLOOR has an expected positive impact on the housing price. The higher is the floor level, the higher will be the selling price of the housing unit, ceteris paribus. FLOOR is believed to work as an environmental feature that higher floor can mitigate air and noise pollution. Moreover, higher floor generally have a better air ventilation and sunlight. These can improve living environment and in result improving our health.

A more flexible functional form is considered by performing Box–Cox transformation (Box & Cox, 1964) and variable Y is defined as $Y = (y^{l-1})/l$ if $l \neq 0$; $Y = \log(y)$ if $l = 0$. Box–Cox transformation is a power transformation in such a way as to make it continuous with the parameter $l$ at $l = 0$. $l$ is the transformation parameter and to be determined by the maximum likelihood estimation (MLE) method. Box–Cox transformation can be applied to make the linear model more appropriate to the data and attempt to impose linearity, reduce skewness or stabilize the residual variance.

In this study, all continuous variables in MODEL_NET are transformed according to the Box–Cox transformation. The result of the Box–Cox Model is presented in Table 3. The results of the MODEL_NET and the transformed model are similar. The signs of all variables are as expected, and the adjusted $R^2$ is a bit improved than the MODEL_NET. But the NOR_VIEW is only significant at 0.1 level in the transformed model. We can conclude that the transformed model is similar to the log-linear model and this suggests that a log-linear specification would provide a reasonably close approximation to the best fitting non-linear model.

Table 4 presents the results of four additional models using different divisions of floor space. In these four models, LN_PUBSPACE is created as a new independent variable. It measures the amount of shared space assigned to each housing unit and is simply the difference between its GFA and NFA in natural logarithmic form. In addition, the provision of clubhouse is not treated as a dummy variable. An interaction variable, CLUB_PUBSPACE, is created to gauge the impact of ‘desirable’ shared space. In other words, these models seek to distinguish between normal shared space (e.g. corridors, plant rooms) and ‘desirable’ shared space (e.g. clubhouse). It rests on our hypothesis that buyers are less willing to pay for the former than the latter space.

Findings of Models I and II match our expectations. Shared space is found to exert a negative influence on housing prices. But if the housing unit involves a clubhouse, shared space is found to exert a positive effect on housing prices. This indicates that home buyers are more willing to pay for a larger amount of shared space (and accept a higher GFA or accept a lower NFA), if a clubhouse exists within the development. Comparing

| Table 3 |
|---|
| Results of the MODEL_NET and the transformed model |
| | MODEL_NET (log-linear model) | Box–Cox transformed model ($\lambda = 0.2$) |
| | Estimate | Std. $\beta$ | Estimate | Std. $\beta$ |
| NET_SIZE | 0.1010947*** | 0.132912 | 0.1463618*** | 0.121575 |
| AGE | −0.031547*** | −0.26334 | −0.089402*** | −0.27099 |
| FLOOR | 0.0359895*** | 0.275597 | 0.1362057*** | 0.288696 |
| NOR_VIEW | 0.0439354** | 0.15373 | 0.2180533 | 0.13904 |
| GD_VIEW | 0.0711471*** | 0.304238 | 0.3688501*** | 0.287434 |
| EX_VIEW | 0.1240772*** | 0.225513 | 0.6556647*** | 0.217167 |
| CLUB | 0.1397516*** | 0.601242 | 0.7596372*** | 0.595568 |
| LAND_IND | −0.014832 | −0.05676 | −0.107053 | −0.07466 |
| LAND_PARK | 0.1099547*** | 0.471151 | 0.5826695*** | 0.454989 |
| DIS_FLYOVER | −0.025143*** | −0.20331 | −0.049206*** | −0.22307 |
| Dependent variable | G_P | G_P |
| $N$ | 528 | 528 |
| Adjusted $R^2$ | 0.614039 | 0.627003 |

Note: ** and *** indicates coefficient estimates that are statistically significant at the 0.05 and 0.01 levels of significance.
the coefficients of Models I and II shows that, while the GFA has a higher positive price elasticity than the NFA, nonetheless it is also associated with a higher negative price elasticity of the shared space. This reflects that the amount of shared space of the housing units will exert a stronger negative influence on housing prices, when the GFA rather than the NFA is used as a price estimator.

Models III and IV present the results of a sensitive analysis. It is possible that the NFA is an exaggerated figure. In Model III, the NFA figure of the property data is reduced by 5% when the housing unit does not have a clubhouse. This essentially assumes that buyers will perceive a small exaggeration of the NFA when no clubhouse exists. In Model IV, housing units with an NFA larger than 501 ft² are reduced by 5%. This assumes that it is easier to cheat home buyers for larger units than smaller units. The results indicate that coefficients of some independent variables are highly sensitive to these alternations. In Model III, the negative price elasticity of shared space expands further, whereas in Model IV, the positive price elasticity of internal space increases considerably. These results indicate that home buyers are highly sensitive to the distribution of gross floor space of the housing units.

Conclusions and implications

Using estimates from hedonic price equations, this study explores how the different attributes of housing space affect private housing prices. Many factors have an influence on housing prices. Floor area of the housing unit is one of these factors. It is normally expected that the larger is the amount of floor area, the higher will be the housing price. In the high-density building environment of Hong Kong, the measurement of floor area of a housing unit is complicated by the inclusion of an unidentified amount of shared space. Therefore, housing buyer in Hong Kong faces with at least two different categories of housing space in a purchase decision: internal space that is exclusively enjoyed by the purchaser and shared space that is an undivided part to be used jointly with other residents within the same building or housing development. The situation is further perplexed because there has been no standardized and statutory measurement of these two categories of housing space.

This study argues that, notwithstanding such confusion, housing buyers are able to detect what they are paying for from inspecting the housing units in the secondary market. This will ultimately be reflected in the housing prices. It is argued that the home buyer has a higher willingness-to-pay for the exclusive private space,
represented by the net floor area, than the GFA of the property which includes an ‘unknown’ scale of communal space provided by the developer. The price elasticity of NFA is higher than that of the GFA. The analysis also confirms that there is a negative relationship between the amount of shared space and housing prices. In other words, the higher is the amount of shared space, the lower will be the housing price, ceteris paribus. However, it is also found that the housing purchasers are able to distinguish between different forms of shared space and can accept to pay for some desirable ones such as clubhouse. They are found to be highly sensitive to the division of gross housing space.

The strong and positive impacts of park and clubhouse have made clear that these attributes are evaluated by home buyers as the basic elements of good quality of living space. In order to achieve quality living space comprehensively, there is a need to make a distinction between: (1) internal private living space, and (2) external public space which include common space (corridors, stairs, lift lobbies), public space (communal facilities), and green space (parks/podium gardens/landscaped areas). However, when these facilities are added into the housing projects, they may have an effect of expanding the GFAs considerably rather than the net floor areas. As this study shows, the home buyers should be made aware of how much floor space of these facilities are distributed ‘numerically’ into each of the living units. They are also highly sensitive to this space distribution. It is therefore important for the government to further promote and enforce the accuracy, transparency and consistency in floor area information especially in relation to the measurement of NFA in property sales brochures provided by the developers.

Definitely, there is also a need for further studies of how the different components of space influence the housing market. To better explain the variations in housing price, it may not be good enough simply to rely on the “stated” floor space figures recorded in the Land Registry. Considerations should be given to measure the different types of floor area directly from the floor plans of the housing units using a consistent standard of measurement (e.g. Chan et al., 2002). Furthermore, future research shall consider not only the quantity, but also the quality of the spaces.

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