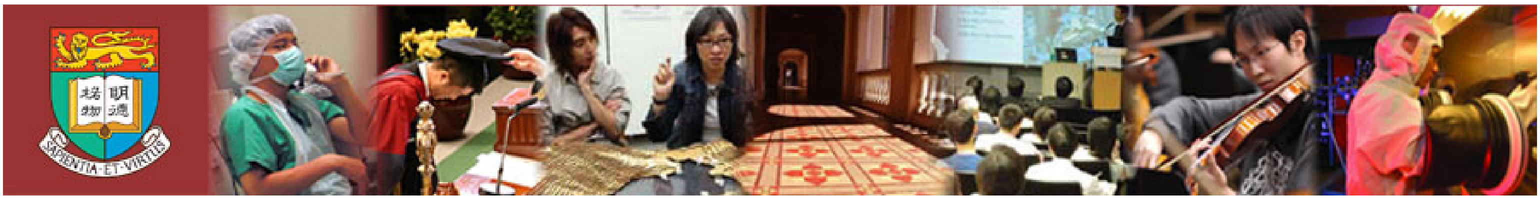

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Estimating Optimal Site Area for Planned Residential Development in Hong Kong

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Abstract:

This study provides an empirical assessment of the optimal site area for planned high-density housing development in Hong Kong. Conventional hedonic pricing methods are not used because they cannot separate the price effects of site area caused by its amenity value and by market power. We obtain our estimate from a unique data set containing the choice of household applicants for the housing units in 128 public housing estates in Hong Kong between 1990 and 1998. An inverted U-shaped relationship between site area and popularity of the estate is revealed. We conclude that the land areas of most public housing estates in Hong Kong are sub-optimal. The optimal housing site area that gives the highest amenity value is estimated at about 24,770 sq.m. This serves as a sound quantitative benchmark for the government in its future disposal of public as well as private housing land.

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Abbreviated title: *Optimal Housing Site*

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Estimating Optimal Site Area for Planned Residential Development in Hong Kong

I. Introduction

Consider a town planner with a large piece of land to be developed. Should he allocate the whole block of land to one single developer? Or should he divide the land into smaller plots for different developers? If the piece of land is to be divided, what is the optimal size of each development site? Planning practitioners routinely confront questions like these. In this paper, we attempt to shed some light on these questions using empirical evidence from Hong Kong.

To accommodate some 6.8 million people within a territory of less than 1,100 square kilometers, housing in Hong Kong primarily takes the form of high-rise building structures. A typical household occupies a self-contained apartment unit within a building and shares the use of elevators and other common facilities. The Hong Kong government is the monopoly supplier of land. All private housing land is leasehold and is sold to housing developers by competitive means through auctions and tenders. After obtaining the land titles, the developers are responsible for the planning, layout design, and construction of the housing development subject to relevant government regulations. However, the total area of each housing development site is essentially a bureaucratic decision. In the fiscal year 1997-1998, for example, 19 plots of housing sites were sold through public land sales. The size of these housing sites varies enormously, with a range from 88 sq.m. to 91,265 sq.m. Depending on the size of the site, each development may contain one to many multi-storey building blocks.

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Town planners are generally in favor of comprehensive planning (Cullingworth & Nadin, 1997; Fainstein & Campbell, 1996).[1] This idea is reflected, for instance, in the concept of "planned unit developments" (PUDs) in the United States (Tomioka & Tomioka, 1984). Professional planners consider that comprehensive development by a single agent has the advantages of providing greater design flexibility, better neighborhood environment, exclusive open space, and community facilities for the residents. Such planned development basically internalizes the externalities in land use (Fischel, 1994). Prospective homebuyers are attracted not only to these distinctive physical features, but also to the possible higher value appreciation of these housing units than in traditional subdivision type of housing development (Arendt, 1996).

Comprehensive development often requires a larger land area.[2] Pushed to the extreme, the concept of comprehensive development would suggest that it is always optimal to allocate the whole piece of land to a single developer. However, just as there are limits to scale economies in the theory of the firm, there are limits to the gains from comprehensive development. Beyond a certain site size, diseconomies of scale from large housing development emerge. Such diseconomies arise principally from coordination and project management problems. The economies and diseconomies of scale in residential housing development ultimately are reflected in the overall quality, or "amenity value," of housing. A better-planned housing development produces a higher amenity value to its residents. If economies of scale dominate when the site area is small while diseconomies of scale dominate when site area is large, we

[1] An early version of the U.S. Standard State Zoning Enabling Act included the following note: "A comprehensive plan: sound planning implies a comprehensive plan. The zoning should be applied to the whole municipality at once. Piecemeal zoning is dangerous, because it treats the same kind of property differently in the same community." (Bair, 1984:120, fn.1)

[2] Land area requirements for planned unit developments vary from place to place. A minimum site area is normally specified under the planning law (Levy, 1997:131). For instance, San Francisco City Zoning Ordinance for planned unit developments required the land parcel to comprise an area of at least 3 acres (about 12,000 sq.m.). In Lincoln of Massachusetts, the minimum size of the land tract for Open Space Residential Development was 25 acres (about 101,000 sq.m.) (Tomioka & Tomioka, 1984:154). In New York, large scale planned unit developments may extend up to 100 acres (about 405,000 sq.m.) or more (So, 1979:455).

expect the amenity value of housing to bear an inverted U-shaped relationship with the size of the development site. The theory of production identifies the optimal firm size as one that minimizes the average cost of production. In this paper, we identify the optimal site area as one that maximizes the amenity value of the housing development.

The amenity value of housing affects the housing prices. In previous studies, lot size is an attribute in explaining property values. Larger land lots are found to be proportionally more expensive (Tabuchi, 1996). The value of a land lot is found to depend both on its absolute size and on its size relative to the average lot size in its close neighborhood (Asabere & Colwell, 1985). Optimal lot size and configuration are clearly important considerations from the property developer's perspective in maximizing profits from the development, both in the presence (Colwell & Scheu, 1989; Colwell & Scheu, 1998) and in the absence of planning constraints (Cannaday & Colwell, 1990; Edelson, 1975).

Past research on site size tends to focus mainly on the impacts of *minimum* lot size zoning on property values and on urban sprawl (see Pogodzinski & Sass (1991) for a summary review). Different model specifications, assumptions and case study areas have, however, led to mixed findings. Some indicate that minimum lot size restrictions would lead to rising property prices and, in some instances, to metropolitan expansion (e.g., Abelson, 1997; Bucovetsky, 1984; Fischel, 1996; Henderson, 1985; Moss, 1977; Pasha, 1995; Pasha, 1996; Pollakowski & Wachter, 1990). Thorson (1997) also argues that increasing minimum lot size restrictions can decrease new housing construction in the long run, and thus potentially lead to a higher housing price. In contrast, others argue that the property value effects are ambiguous (Grieson & White, 1981; White, 1975). Ohls, Weisberg, & White (1974) indicate that the effect of minimum lot size on overall land value cannot be determined *a priori,* but they assert that the authorities would, in practice, tend to increase land supply and thus lower the costs of single-family properties. Jud's (1980) empirical findings confirm that minimum lot zoning has a negative impact on residential values.

Most of these studies are, however, not directly applicable to the case of Hong Kong. Urban housing lot in Hong Kong refers to the whole development site, not a single-family housing plot as in the North American setting. Our concern is thus about the area of the entire development, rather than the size of its individual subdivision units. This empirical study seeks to derive the optimal site area for planned housing development in Hong Kong using data collected on the preferences of public housing applicants. Following this introduction, the remainder of the paper is divided into four sections. Section II discusses why the conventional method of examining the lot size effects on property prices cannot give an answer to our case, and explains our alternative approach to estimating the optimal size of housing site in Hong Kong. Section III gives our statistical model and Section IV discusses our empirical findings. The final Section V provides our conclusions and discusses the policy implications.

II. Methodology

If both economies and diseconomies of scale are present in the development of residential housing sites, we expect there is an optimal site size that strikes the right balance between the two opposing factors. Housing located in excessively small or overly large sites will be relatively unattractive to homebuyers. Tiny sites are unattractive because they lack the space to provide the ancillary facilities, such as car parks, for the residents. Furthermore, in a compact city like Hong Kong, they result in unsightly, tall pencil-like building blocks in contiguous sites, causing undesirable overlooking with each other. However, huge housing developments are equally unattractive due to monotony and lack of exclusivity. A housing development that is designed for the average taste may end up pleasing no one. Overcrowding of residents in the use of the communal facilities can reduce the sense of tranquillity and the amenity value of the housing development (Lai, 1993). How can these different considerations be quantitatively measured?

The overall quality, or amenity value, of housing is reflected in housing prices. If the total site area of a housing development affects the amenity value of housing, then property values are systematically related to site area. A hedonic study of housing prices that includes site area as one of the attributes will help reveal whether homebuyers prefer to live in large or small housing developments. Such a hedonic analysis of private housing, however, suffers from at least two problems.

First, the total area of a site may be systematically related to development cost. High prices in a small housing development, for example, may reflect diseconomies in construction costs rather than consumers' preference for small sites. This is the classic identification problem pointed out by (Rosen, 1974).

Second, site area may also be systematically related to the degree of competition in a housing market. Suppose consumers have strong locational preferences, so that the relevant housing market is confined to a relatively small geographical area. If land is auctioned in large lots, the effective number of competing property developers within a geographical area will be small. To the extent that fewer competitors translate into higher prices, a positive relationship between housing prices and total site area need not reflect consumers' preference for large sites. In other words, site area may affect property prices by its effect on amenity value and by its effect on market power. These confounding effects are difficult to isolate.

We sidestep these problems by exploiting a unique data set provided by the Hong Kong Housing Authority (hereafter referred to as Housing Authority) on the applications for publicly subsidized sale flats in Hong Kong. Established as a statutory organization since 1973, the Housing Authority is now the largest landlord in Hong Kong. It acts as the government's agent in implementing the public housing program and currently provides accommodation for over half of the local population. It is responsible for planning, developing, allocating and managing public sector housing, which includes both subsidized rental and sale units. The government provides land and financing to the Housing Authority on concessionary terms to meet the public housing production targets. With the various forms of government subsidies, the housing rents and prices of these public housing units are much lower than full market values. Households have to meet certain demographic characteristics, income limits and resale restrictions before they are eligible to apply for these public housing units. Table 1 shows some basic facts about public versus private housing in Hong Kong.

Table 1 Housing characteristics in Hong Kong, 1998

	Public Permanent Housing	Private Permanent Housing	All Permanent Housing
Number of Dwellings ('000)	948	1056	2004
Population Share (%)(1)	50.3	47.7	98.0
Average Household Size (persons)	3.5	3.1	-
Home Ownership Rate (%)(2)	29	72	52

Data source: Hong Kong Housing Authority, *Housing in Figures*, 1998 edition.

Notes:
(1) These figures exclude population in temporary housing.
(2) The figures are provisional estimates in the Fiscal Year 1998/1999 of the government.

Our estimate of optimal housing site area is based on the preferences indicated by the applicants for the publicly subsidized sale units. All these units were sold at a discount from the full market value. The majority of them came from the Home Ownership Scheme, but a few units belonged to other subsidized sale housing programs such as the Private Sector Participation Scheme administered by the Housing Authority. For all these programs, the Housing Authority periodically conducts an allocation exercise (referred to as a "phase") of its housing stock. Flats from several different housing estates are made available for application in each phase, and applicants are requested to indicate their preferred choice of up to four estates. Successful applicants are drawn by random lottery, and their final selection of flats does not depend on the preferences stated on their application forms.

We assume that the preferences stated on the application forms are the applicants' true preferences. Since these priority orderings have no effect on the actual allocation of flats, there is no strategic motive for the applicants to misrepresent their preferences in order to improve their chances of success. Given our assumption, the popularity of an estate (i.e., the number of times an estate is cited as a preferred choice in the application forms) is directly related to factors that enhance the value of housing. For example, if a larger site area of the estate increases the amenity value of a housing unit, larger estate will be more popular. The subsequent analysis confirms that more desirable housing sites (e.g., those in urban areas) tend to be more popular. This increases our confidence that the stated preferences are not arbitrary, even though they do not directly affect housing choice.

The pricing of these sale flats is determined in terms of a discount on the market value of comparable private housing units. At its call for applications, the Housing Authority publicly announces the rates of housing price discount. Development costs do not figure in this calculation. Housing costs and hence the degree of public subsidies vary in accordance with the different types of public housing, rather than the size of the estates (Chiu, 1997; Yu, 1997). Thus, even if there are economies or diseconomies in construction costs associated with large sites, they are not reflected in prices and hence have no effect on the popularity of a public housing estate. The relationship between site size and popularity primarily reveals the demand factor rather than the supply factor. Using the popularity of these public sale housing estates instead of private housing prices as the dependent variable of analysis therefore avoids the identification problem in hedonic pricing studies.

Furthermore the purpose of the Housing Authority is not to maximize profits, but to subsidize homebuyers. Even if larger development sites do reduce the degree of competition, we do not expect the Housing Authority to wield its market power by raising prices in larger estates. The confounding effects of amenity value and market power are therefore isolated. If there is a relationship between site size and the popularity of subsidized housing sale estates, such a relationship reflects the amenity value effect rather than the market power effect.

III. Statistical Model

We have been provided with data on the preferences for the subsidized sale housing estates indicated by the applicants for the period 1990 to 1998. Similar data for earlier periods are not available in the Housing Authority. Let Y_i be the number of times that estate i is cited as a preferred choice by applicants in a certain phase of allocation. Because the total number of public housing applicants varies greatly across different phases, we normalize this variable by calculating the popularity share, $y_i = Y_i / \sum_j Y_j$, where the summation is taken over all the housing estates that are available *within the same phase*.

We model popularity share as a function of total site area and other variables. The unit of observation is a public housing estate in a given phase of allocation. In particular, we let

$$y_i = f(x_i) + z_i \beta + e_i.$$

In this model, z_i represents a vector of variables that are expected to affect popularity share, and β is the corresponding vector of coefficients to be estimated. These variables include the average price per sq.m. of floor area (in constant 1998 dollars), the percentage discount from market value, the number of flats from the estate available for allocation in a given phase (as a fraction of the total number of flats available in that phase), dummy variables for location, and dummy variables for allocation phase. By introducing the phase dummy variables, any phase-specific factor that affects popularity share is controlled.

The main variable of interest is x_i, the total area of the estate. Since *a priori* reasoning cannot determine the relationship between site size and popularity share, we let this relationship be represented by a sufficiently flexible function, represented by $f(x_i)$, and use the data to determine the best fit. Empirically, this is implemented by estimating a polynomial of degree 5, and successively removing the higher-order terms that are statistically insignificant. If the resulting function is increasing in x_i, one would conclude that larger sites increase amenity value. If $f(x_i)$ is decreasing, one would conclude that larger sites reduce amenity value. If the function first increases and then decreases, the optimal site size is identified by the point at which $f(x_i)$ reaches its peak.

Finally, note that the popularity shares of different housing estates in the same phase may be correlated with each other. Since the independence assumption fails for the error term e_i, standard errors from ordinary least squares regressions are wrong. Based on the procedures developed by White (1982), our statistical analysis will use robust standard errors that allow for correlation of error terms within a phase.

IV. Empirical Data and Findings

Table 2 displays the summary statistics of the variables used in the analysis. The data set contains information on 130 housing estates over 24 phases of housing allocation. The site area variable refers to the total area of the development site. In some cases, two or more housing estates may share the same site. Records of these housing estates will be considered as separate observations.

Table 2. Summary statistics of all variables in the model

Variable	*Mean*	*Std. Dev.*	*Min*	*Max*
Popularity share (%)	17.043	9.589	1	55
Site area (,000 sq.m.)	20.244	15.975	2.724	87.800
Real price (HK$,000/sq.m.)	19.261	5.392	9.322	35.393
Discount (%)	41.923	6.379	30	50
Share of flats (%)	17.692	10.631	1.812	56.279
Hong Kong Island	0.177	0.383	0	1
Kowloon	0.262	0.441	0	1
New Territories with rail	0.177	0.383	0	1
New Territories without rail	0.385	0.488	0	1

It is possible to obtain more disaggregated data on the preferences of different categories of applicants. However, Table 3 shows that their preferences are highly similar, as indicated by a high degree of cross correlation in the popularity shares of different housing estates for different groups of applicants. For this reason, our analysis focuses only on the popularity share computed from *all applicants* of the Scheme.

Table 3. Correlation among the choice of different categories of applicants

	priority 1	*priority 2*	*green*	*white*	*non-white*	*total*
priority 1	1					
priority 2	0.7852	1				
green form	0.7106	0.8431	1			
white form	0.6084	0.7328	0.7981	1		
non-white form	0.6241	0.7124	0.7973	0.9184	1	
total	0.6456	0.7534	0.8411	0.8661	0.8451	1

Before estimating the statistical model, it is useful to take a look at the main variables of interest, popularity share and site area. In Figure 1, we show a scatter plot of these two variables. We have also added a smoothing spline to the plot to aid the visualization (Hastie & Tibshirani, 1990). One can see that popularity share is loosely related to site area. An increase in site area tends to raise popularity initially and lower it beyond a certain size. There are two obvious outliers in the data set. Tin Shing Court (Phase I and Phase II) has a total site area of about 87,800 sq.m., which exceeds the next largest development site by 65 percent. Since these two outliers will have a large leverage on the parametric estimation of the functional form of $f(x_i)$, they are dropped from most of the subsequent analysis.

Figure 1.

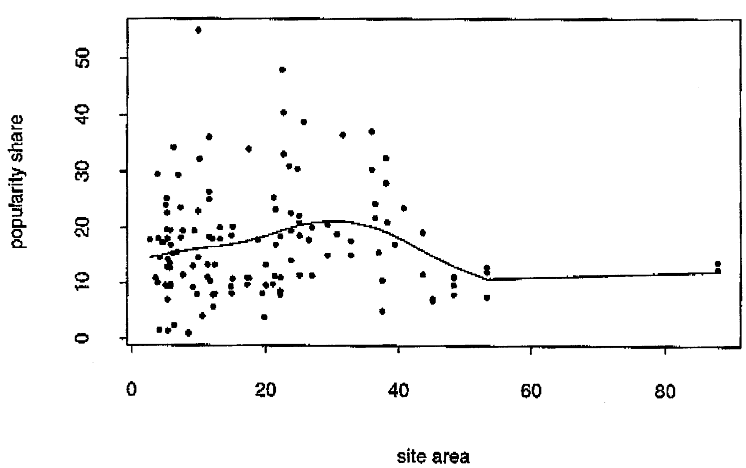

Table 4 shows the estimation results of our statistical model. In column (1), we specify $f(x_i)$ as a polynomial of degree 5. The hypothesis that $\alpha_5 = \alpha_4 = \alpha_3 = 0$ is not rejected ($p = 0.344$), but the hypothesis that $\alpha_5 = \alpha_4 = \alpha_3 = \alpha_2 = 0$ is rejected ($p = 0.017$). We therefore conclude that $f(x_i)$ can be approximated by a quadratic function. In column (2), we re-estimate the model by removing terms higher than the third order. This equation shows that both α_1 and α_2 are statistically significant. The implied shape of the relationship between site area and popularity share is an inverted U-shape.

If $f(x_i) = \alpha_1 x_i + \alpha_2 x_i^2$ and if α_2 is negative, this function reaches a peak at the point where $f'(x_i) = \alpha_1 + 2\ \alpha_2\ x_i = 0$. Thus, the optimal site size can be estimated by $x_i^* = -\ \alpha_1 / 2\alpha_2$. This expression is a non-linear function of the coefficient estimates, and standard errors can be obtained by the delta method (Greene, 1997). Using the estimates obtained from column (2), the optimal site size is calculated to be about 24,770 sq.m., with a 95 percent confidence interval of (20,690, 28,860) sq.m. Of the 128 housing estates, 25 estates have site areas that fall within the 95 percent confidence interval of the optimal size, 74 estates have site areas that are below the lower limit, and 29 estates have areas that exceed the upper limit.

Table 4. Estimation results

	(1)	(2)
Site (a1)	0.6025	0.6623
	0.1790	2.4920
$Site^2$ (a2)	0.0027	-0.0134
	0.0080	-2.9080
$Site^3$ (a3)	-0.0018	
	-0.1160	
$Site^4$ (a4)	6.1900E-05	
	0.2050	
$Site^5$ (a5)	-6.5900E-07	
	-0.2980	
Real price	0.3622	0.4580
	1.1850	1.6250
Discount	0.7903	0.8942
	1.0480	1.2320
Share of flats	0.2510	0.2601
	2.7200	2.8600
Hong Kong Island	7.7246	7.0794
	2.2290	2.2190
Kowloon	12.3044	10.8984
	5.3030	5.5740
New Territories with rail	7.8840	7.1840
	3.5330	3.4450
New Territories without rail	omitted	omitted
phase dummy variables	yes	yes
R^2	0.4793	0.4655
N	128	128

The effects of the other variables in the model are not difficult to understand. From Table 4, it can be seen that more expensive estates are *more* popular. This is hardly surprising. All these subsidized sale flats are sold at a substantial discount of their market value. Buying a more expensive unit therefore implies getting a bigger subsidy in dollar terms. The percentage discount from market value also has a positive effect on popularity, although the effects of both price and discount are not statistically significant at conventional levels. Naturally, the applicants are more likely to indicate a choice for housing estates which have more flats available for allocation and which are located in the urban areas or along railway lines. The coefficients on the "share of flats" variable and on the locational dummy variables are highly significant. The fact that these variables have the expected effects on popularity share increases our confidence that the dependent variable is measuring the housing applicants' true preferences.

The statistical models in Table 4 are estimated with dummy variables for allocation phase. For economy of space, the coefficients for these variables are not reported, but they are jointly significant at the one percent level.

Table 5 shows a number of variations of the basic model we have estimated to test the robustness of our results. In column (1), the model is estimated with the outliers (Tin Shing Court Phase I and Phase II) included in the sample. Compared to column (2) of Table 4, the coefficients on the site area variables retain the same signs, indicating an inverted U-shaped relationship between site area and popularity share. Notice, however, that the magnitudes of these coefficients change dramatically, confirming that these two outlier observations have an unduly large effect on the model estimates (Belsley, Kuh, & Welsch, 1980).

In column (2) of Table 5, we use popularity (Y_i) instead of popularity share (y_i) as the dependent variable. Most of the results are qualitatively the same as those reported in column (2) of Table 4. The implied optimal site size estimated from this model is about 25,800 sq.m., very close to the estimate of 24,770 sq.m. obtained earlier.

The relationship between site size and popularity share may be different in urban areas (Hong Kong Island and Kowloon) than in the non-metropolitan New Territories. To test whether this is the case, we introduce interaction terms between the size variables and a dummy variable for urban areas. Column (3) of Table 5 displays the results (the dependent variable is popularity share). These interaction terms are jointly insignificant, with a p-value of 0.236. Using this interaction model, the implied optimal site area for urban areas is 22,680 sq.m. and that for the non-metropolitan districts in the New Territories is 27,470 sq.m. The difference between these two estimates, however, is not statistically significant (p = 0.314).

If any reduction in the amenity value of housing resulting from sub-optimal site size is compensated by a reduction in the real price of flats or by an increase in discount, then the popularity of an estate will not fall even if site size is sub-optimal. For our methodology to work, quality differences resulting from variations in site size must not be incorporated into the Housing Authority's pricing policies. We have checked that this is indeed the case. When we estimate a regression using the real price as the dependent variable, the coefficients on size and its square are jointly insignificant, with a p-value of 0.877 (the other independent variables in this regression are dummy variables for location and for allocation phase). A similar regression using percentage discount from market value as the dependent variable indicates that site size is unrelated to discount (p = 0.225). We also re-estimate our basic model by excluding price and discount from the set of independent variables. The resulting model coefficients shown in column (4) of Table 5 are quite similar to the original model coefficients shown in column (2) of Table 4. The optimal site size implied by column (4) is about 25,710 sq.m., again very close to the original estimate of 24,770 sq.m.

Table 5. Estimation results (with different model specifications)

	(1)	(2)	(3)	(4)
site (a1)	0.123	371.509	5583781	0.705
	0.908	1.826	1.706	2.616
$site^2$ (a2)	-0.002	-7.199	-0.010	-0.014
	-1.029	-2.082	-1.867	-2.903
urban*site			0.186	
			0.296	
urban*($site^2$)			-0.006	
			-0.572	
real price	0.399	385.080	0.414	
	1.523	2.373	1.381	
discount	0.746	940.709	0.813	
	1.024	2.151	1.047	
share of flats	0.285		0.258	0.239
	3.158		2.778	2.917
number of flats		2.595		
		2.789		
Hong Kong Island	7.212	3640.846	7.257	9.841
	2.303	1.580	1.060	2.593
Kowloon	11.025	5835.521	11.370	13.387
	4.546	4.193	1.941	5.053
New Territories with rail	7.973	5075.404	7.841	7.644
	3.459	2.738	3.577	3.334
New Territories without rail	Omitted	omitted	omitted	omitted
phase dummy variables	Yes	yes	yes	yes
R^2	0.4167	0.6107	0.4734	0.4441
N	130	128	128	128

V. Conclusions and Policy Implications

This paper provides an empirical assessment of the optimal site area of planned high-density housing development in Hong Kong. We argue that both tiny and excessively large housing estates are undesirable from the perspective of the households. In the private housing market, market concentration produced by large development sites may cause housing units within larger housing estates to command higher prices, although this does not necessarily imply greater amenity value for such units. Conventional hedonic pricing technique cannot identify the optimal site area, because it cannot distinguish whether its effect on housing price is caused by amenity value or by market power. In this paper, we propose to get around this problem by using a data set containing the choice of applicants for publicly subsidized sale housing units in Hong Kong. After controlling other variables, our estimation does show an inverted U-shaped relationship between site area and popularity of the housing estates among applicants. We conclude that the optimal housing site area is about 24,770 sq.m., with a 95 percent confidence interval between 20,690 sq.m. and 28,860 sq.m. Only about 20 percent of the surveyed estates fall within this interval. We have tried out different specifications and variations of our model but the estimation results have not substantially departed from our initial estimates.

Identification of optimal site area of public housing estates has obvious relevance for the planning of public housing developments. Although the size of a development site is often constrained by topographical factors, planners do have a choice in determining the scale of the housing development. Planners are generally in favor of comprehensively planned development (Knox, 1991). However, our study shows that comprehensive development does not always produce housing that people prefer: larger is not necessarily better. More importantly, this study yields a *quantitative* estimate of an optimal site area of 25,000 sq.m. that may serve as a useful benchmark for planning considerations.

Our findings also have relevance for the planning and development of *private* housing land. Two caveats have to be borne in mind, however. First, this study is based on the preferences of public housing applicants, who may not be as well off as private housing homebuyers. To the extent that tastes for large versus small housing estates differ systematically by income class, the optimal site size for private housing development may be different from the estimate obtained in this study. For example, private housing estates often include better ancillary facilities than do public housing. In this case, the optimal private lot size may be larger than our estimate. Second, in the private housing market, the size of the development site may affect the degree of competition in the localized property market, as well as the amenity value of the housing estate. To the extent that larger sites reduces market competition by reducing the number of competing housing developments in a localized area, the optimal site size for private developments should be less than our estimate of 25,000 sq.m.

To elaborate on this second point, consider the effects of land use planning policies on competition in the property market. It is argued that in the United States zoning leads to a local monopolistic supply of land and housing, thus increasing land and housing prices above competitive equilibrium levels (e.g., Ohls, Weisberg, & White, 1974; Bramley, Bartlett, & Lambert, 1995; Carroll, 1988; Peiser, 1990). Inter-urban differences in housing prices due to varying zoning restrictions could be as high as fifty percent (Hamilton, 1978). Similarly, Thorson (1996) argues that local communities with stronger monopoly power tend to have higher housing prices than do fragmented neighborhoods. In Hong Kong, as the monopoly supplier of new housing land, the government has been criticized for selling too many large housing sites during the property booms in the early 1990s (Hong Kong Consumer Council, 1996).[3] It is argued that these sites meet the planning objectives for comprehensive

[3] Between 1993 and 1995, 45 housing sites were sold by the government. Over half of them comprised a land area of 5,000 sq.m. and 17 of them over 10,000 sq.m. The Consumer Council stated that there was a strong barrier to entry by smaller developers as most of these large sites were purchased by the dominant developers (Hong Kong

development but their scales deter the participation of smaller developers.[4] This policy is said to help further sustain the dominance of the larger developers, as the property industry in Hong Kong is regarded as a *de facto* oligopoly[5] (Dodwell, 1999; Enright, Scott, & Dodwell, 1997). Suggestions were made to reduce the size of government auctioned land with a view to stimulating competition (Hong Kong Consumer Council, 1996; Hong Kong Government, 1994). It is by no means clear that large development lots necessarily reduce competition. For example, resale housing units may be good substitutes for new housing units so that the property market may remain highly competitive even though the market for new housing units is dominated by a few large developers (Carleton & Gertler, 1989). In any case, even if market power is a valid concern, dividing the land into very small plots is not costless because the quality of a housing development bears an inverted U-shaped relationship with its size. There is a trade-off between achieving greater amenity value and promoting more intense competition.[6]

Dividing new housing land into "manageable size" may promote competition in the housing market. Amalgamating diverse plots of land into a "comprehensive development site" may improve the amenity value of the housing development. The fundamental question is, *How much land area should an optimal site take up?* At present, decisions are based upon intuitive judgement taking into account physical conditions, urban design, road layouts of the subject site, and so on. There is no systematic approach to answering the question. Our estimation here has contributed to offer a tentative answer in informing professional practices. Obviously, some adjustments have to be made when we apply the answer to private housing land development. Nonetheless, as our estimated optimal site area gives the highest amenity value

Consumer Council, 1996:2-8 and Annex 4).

[4] In the US, high capital outlays and long payback for planned unit developments are also expected to drive out smaller and independent developers (Tomioka & Tomioka, 1984:166).

[5] Seven developers supplied 70 percent of all the new housing units. Fifty-five percent came from four developers and one developer consistently produced 25 percent of the market share during 1991 and 1994 (Hong Kong Consumer Council, 1996).

[6] See Williamson (1968) for a parallel discussion in the context of the theory of the firm.

of housing, we believe it serves as a reasonable first benchmark for the government to consider in its future disposal of urban housing land.

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