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Love thy neighbor: Income distribution and housing preferences

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ABSTRACT

Do homeowners prefer living in an area with a more equal distribution of income? We answer this question by estimating a semi-parametric hedonic pricing model for about 90,000 housing units transacted in Hong Kong between 2005 and 2006. We first identify a hedonic price function by locally regressing the rental price of the housing unit on its intrinsic and neighborhood characteristics, one of which is the Gini coefficient for household income of the constituency area. We then combine the estimates with a log utility function to obtain the heterogeneous preference parameters. Finally, we estimate the joint distribution of the preference parameters and demographics. We find that most homeowners have a strong distaste for inequality in their neighborhood, and the distaste increases with income and goes down with education level. Counterfactual experiments show that reallocating public rental housing by half can increase the welfare of homeowners by about HK$8,000 on average per year, an amount which is equivalent to increasing the housing unit by 20 square feet or reducing the age of the unit by 5 years.

1. Introduction

"How seldom we weigh our neighbor in the same balance with ourselves"

Of the Imitation of Christ, Thomas à Kempis (1418).

Do homeowners have a preference for living among neighbors with a similar income level? Common sense suggests that homeowners prefer income equality in the neighborhood. There is the alleged snobbery of the rich towards the poor and the reciprocal jealousy of the poor towards the rich. Recent neural science research has also shown that humans have social preferences to reduce inequality in outcome distributions (see Tricomi et al., 2010). According to one sociological research by Gans (1961), "People with higher incomes and more education may feel that they or their children are being harmed by living among less advantaged neighbors. The latter are likely to feel equally negative about the 'airs' being put on by the former. . .". In this paper we give a quantitative answer to the question by studying approximately 90,000 transactions in the Hong Kong housing market in 2005 and 2006.

There is a concern that we may be mixing up the distaste for inequality with other unpleasant outcomes induced by inequality. For example, the poor may find it hard to find a shop that caters for his needs in a rich neighborhood; also, the rich may be concerned about the higher crime rate in a poor neighborhood. Our identifying assumption is that these unpleasant outcomes are likely to affect a *district* larger than a *local neighborhood* (the size of both will be defined later). We are then able to control for district fixed effects in order to identify the distaste for inequality in a local neighborhood.

We first describe the data and explain why two unique features of the Hong Kong housing market are important for our purpose. First, Hong Kong is a densely populated

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area that magnifies the impact of neighbors (e.g., frequent face-to-face interactions in the elevator). Second, the public housing policy in Hong Kong has created substantial income inequality within local neighborhoods. Using a 3-step semi-parametric hedonic pricing technique, we obtain the willingness to pay and preference parameters for the characteristics of the housing unit and also the neighborhood characteristics. In particular, we look at the preference for income inequality and see how the preference changes with the demographics. Finally, we conduct a counterfactual experiment by reallocating half of the poorest public housing residents in all constituency areas in Hong Kong, and look at the welfare implications.

To address the concern that the neighborhood income inequality may be correlated with some omitted variable that are correlated with house price, we take advantage of an exogenous policy change. On May 15, 2004, the Hong Kong SAR government made an unexpected announcement to turn a hitherto idle apartment complex into public rental housing. The expectation of an influx of relatively poor neighbors caused a drop in the housing transaction prices in that neighborhood. We compare the housing prices in this neighborhood and several control groups and find that the effect of income inequality induced by this policy change is in line with the estimates in our semi-parametric hedonic regression.

Our paper is related to the large literature of the neighborhood effects on house price, and our paper contributes to the literature by identifying a new neighborhood effect, i.e., income inequality in the local neighborhood. Empirical studies on the neighborhood effect can be roughly divided into several categories. First, Boyle and Kiel (2001) review the evidence on the impact of environmental goods, such as air quality, on consumers' willingness to pay for housing. A recent paper by Rossi-Hansberg et al. (2010) looks at the concentrated residential urban revitalization programs in Richmond, VA. A few disadvantaged neighborhoods (the impact area) are supported by the federal government to renovate, but the neighborhood of the impact area also benefits from the program due to the neighborhood effects. The authors find that there is an increase in the land value of the neighborhood, and the effect decreases with the distance from the impact area. Using the American Housing Survey for 1985 and 1989, Ioannides (2002) finds that whether the neighbors (the 10 nearest housing units) of an individual have house maintenance substantially affects the individual's maintenance decision. That is, living in a dilapidated neighborhood discourages an individual to improve her housing unit, while the individual has a higher incentive to renovate when the neighbors' housing units look much better. There are studies on the impact of school quality on house price. For example, Bayer et al. (2007) find that households are willing to pay less than 1% more in house price when the average performance of the local schools is higher by 5%. Social status of the neighbors also matters. Ioannides and Zabel (2003) find a large elasticity of housing demand with respect to neighbors' permanent income. Our paper is closest to a recent study by Ioannides et al. (2008). The authors find that homeowners prefer to live with neighbors with similar characteristics. Finally, Kiel et al. (2008) show that different levels of neighborhood effects, from a large area to the very local neighborhood, all have an impact on house price. We contribute to the literature by identifying one particular local characteristic (income inequality) of the neighborhood. The large variations of income distribution within each district in Hong Kong allow us to identify such effect, and our results may have useful implications on public housing policy.

2. Why the Hong Kong housing market?

Hong Kong is famous for being a densely populated city. According to the World Population Prospects,[1] the estimated population density in Hong Kong is 6433 people per squared kilometer for the year 2010, in contrast with 33 people in the United States, 225 people in the United Kingdom and 336 people in Japan. Of course, Hong Kong is less populated than major cities in the US like Manhattan, New York (25,850 people).[2] But since Hong Kong is characterized by high-rises and being mountainous, some of the residential areas we study are highly populated. For example, a medium-quality high-rise of 40 floors usually have more than 10 housing units on each floor, and residents are forced into having frequent interactions with neighbors (in the elevator, or even hearing a conversation from next door). As a result, Hong Kong is a more suitable case for identifying a distaste for income inequality than other cities or regions studied in the literature.

As our interest is the preference for income inequality in the neighborhood and the potential benefit of removing inequality, we need to study residential areas with significant variations of income distribution. The public housing policy in Hong Kong has contributed to the substantial income inequality in different areas of Hong Kong.

In 1953, a fire in Shek Kip Mei destroyed thousands of shanty homes. Since then, the government of Hong Kong began to construct homes for the poor. A significant portion of people in Hong Kong are inhabiting in public housing. According to 2006 census, 3.4 million people, out of 6.9 million, lived in public housing provided by the Hong Kong government. This is the greatest government intervention in a city renowned for its free-market principle.

There are three main types of public housing in Hong Kong.[3] The first type is public rental housing estates which are the most numerous type of public housing. As of 2006, 2.1 million people lived in public rental housing estates. Applicants' income and total net assets value cannot exceed certain limits, which vary between families, the elderly and individual applicants. For instance, the monthly income and total net asset limit for a two-person household are HK$11,660 and HK$252,000.

The second type is the Home Ownership Scheme (HOS) estates. These are subsidized-sale public housing estates for low-income residents. As of 2006, 1.2 million people

[1] See http://esa.un.org/unpp/ for details.

[2] See http://www.census.gov/population/www/censusdata/density.html for details.

[3] The following description is based on the information from the Hong Kong Housing Authority and the Housing Department http://www.housingauthority.gov.hk/en.

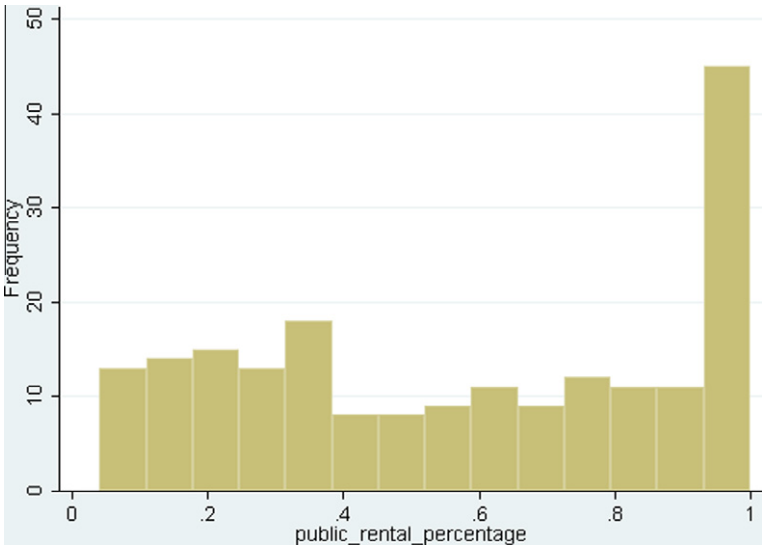


Fig. 1. Percentage of public rental housing across constituency areas (excluding constituency areas without any public rental housing).

lived in these estates. The income and asset limits are higher than that of the public rental housing estates. The monthly income and total net asset limit for a two-person household are HK$23,000 and HK$660,000.

The third type is the Sandwich Class Housing Scheme estates. They were built for sale to the "sandwich class", which are the lower-middle and middle-income residents not eligible for other public housing but have difficulties affording private housing. The flats are sold at prices slightly below market value (usually 70%), but with quality comparable to some middle-class private housing. The supply of these estates are limited. Only 48,106 people lived in these Sandwich Class Housing Scheme estates in 2006.

The Census data only allows us to separately identify the demographics of the public rental housing estates and the rest. Also, since the housing units of both the Home Ownership Scheme estates and Sandwich Class Housing Scheme estates are transacted in private second hand market, and the income of the residents are significantly higher than those living in public rental housing estates, we count these residents as living in private housing. Thus, in the analysis below, we focus to analyze on how public rental housing estates affect Gini and welfare of homeowners in different constituency areas.[4]

One distinct feature in the Hong Kong housing market is that public housing inhabited by lower-income group and private housing inhabited by higher-income group can coexist in the same local neighborhood (or the same constituency area, which is to be defined later). While about half of the constituency areas (186 out of 380) do not have any public rental housing estates, Fig. 1 shows that the percentage of public rental housing units in a constituency area varies evenly across the rest of the constituency areas.

A related literature looks at the relationship between the provision of public goods and ethnic/income fragmentation in the US (see Alesina et al., 1999 and Fernandez et al., 1996). For example, public spending may increase in an area with more serious ethnic conflicts. Under such environment it is hard to disentangle between the preference for equality and the government's reaction to inequality. In Hong Kong, given the small size and a majority of citizens of Chinese descent, provision of public goods is weakly, if at all, related to income or ethnicity. Such an environment allows a clean identification of the preference of equality.

3. Data description

In this paper, we use housing transaction data provided by the Economic Property Research Center (EPRC) for 2005–06 as our main source of data.[5,6] We then supplement this data with the 2006 Hong Kong Census data, which is available on the internet.[7]

3.1. The EPRC data

The EPRC data contains many aspects of each transaction, including prices, gross and net area, address, floor, age, number of bedrooms and living rooms, and so forth.[8]

[4] We have also calculated two other commonly used measures of income inequality, the Hoover index and the Theil index, and we find that they are highly correlated with the Gini coefficient.

[5] We include data in 2005 to have a larger sample size, since it is reasonable to assume that the demographics did not change much between 2005 and 2006. Nevertheless, the results from using only the 2006 data are similar and available upon request. We do not have access to data beyond 2007.

[6] For studies on the Hong Kong housing market using the same dataset, see Leung et al. (2002, 2006).

[7] Interested readers can go to http://www.censtatd.gov.hk/home/index.jsp.

[8] All prices hereafter are denominated in Hong Kong dollars, in 2006 value. We account for possible inflation/deflation of house price between 2005 and 2006 by adding a year dummy in our analysis. Nevertheless, the adjustment is unimportant as the CPI inflation over the two years is less than 0.1%.

Table 1
Sample selection in the homes transaction data.

Reasons for exclusion	Year 2005		Year 2006	
	# Dropped	# Remain	# Dropped	# Remain
Initial sample	N.A.	173,445	N.A.	184,486
Missing floor	4097	169,348	3613	180,873
Missing gross area	45,072	124,276	53,017	127,856
Missing net area	14,249	110,027	15,429	112,427
Missing bedroom	26,587	83,440	27,691	84,736
Missing living room	31	83,409	24	84,712
Price = 0	1731	81,678	2,021	82,691
Price outliers	1621	80,057	1652	81039
Not matched with constituency areas	33,790	46,267	38,216	42,823

Table 2
Summary Statistics for Hong Kong Homes Transacted in 2005–06.

	Year 2005	Year 2006
Price ($HK Million)	2.46 (1.81)	2.51 (2.02)
Floor	18.63 (12.77)	18.31 (12.29)
Gross area (sq. ft.)	713.61 (248.34)	722.07 (263.45)
Net area (sq. ft.)	561.94 (207.10)	572.86 (224.54)
Bedrooms	2.38 (0.55)	2.40 (0.56)
Living rooms	1.87 (0.33)	1.86 (0.34)
Age of structure	12.42 (7.85)	14.07 (7.76)
Swimming pool	0.80 (0.40)	0.78 (0.41)
Club house	0.54 (0.50)	0.52 (0.50)
Std. Dev. in parenthesis.	$N = 46,267$	$N = 42,823$

Let us compare the EPRC data with the more conventional micro data from the US Census of Population and Housing. On the one hand, the US Census data provide more detailed homeowners' demographic and financial information than our data. We can only use the average demographic information of people living in private housing in various constituency areas as proxy. On the other hand, the home price data from the US Census is self-reported and is top-coded at US$875,000. In addition, home prices are partitioned into only 23 mutually exclusive categories. Also, the US Census data only provide limited information on the home's characteristics such as the number of rooms and age of the structure.

Initially, there are 357,931 observations in the EPRC data. We drop observations with missing characteristics like prices, floor, area, etc. We then select the observations with addresses that be matched with the list of the estates and buildings in each constituency area.[9] We then merge them with the Census data which have the demographic statistics for each constituency area. This leaves us with 89,090 observations.[10] Table 1 describes the sample selection process.

Table 2 summarizes the characteristics of the transacted housing units between 2005 and 2006. The transaction prices and the transacted housing units are reasonably similar across the two years, which can serve as a justification for treating the two years as the same market for the following analysis.

[9] The lists are provided by the Electoral Affair Commission. Please go to http://www.eac.gov.hk/en_txt/distco/2003dc_boundary_description.htm.

[10] Please refer to the Appendix for the summary statistics of the initial sample and the sample without missing variables, and also for a discussion on the rationale behind the sample selection procedure.

Table 3
Summary statistics of constituency areas.

	Mean	Std. Dev.	Min.	Max.
Population	17,148.22	4,465.66	5158	46,447
Median age	39.72	3.23	26	50
Median household (monthly) income	10,769.88	2,959.966	7000	25,000
Average household size	3.00	0.32	2.3	4
% Post secondary education	22.25	12.69	5	64.9
Gini	0.45	0.06	0.22	0.60
% Public rental housing	0.30	0.37	0	1
$N = 380$				

3.2. Census data

In the EPRC dataset housing units are grouped into 49 *districts*. But the Census data, collected every five years, are available at a more refined level of 380 *constituency areas*. To combine the two datasets, we match each housing unit in the EPRC dataset to a constituency area.

For purpose of elections in the District Council, the government divides Hong Kong into 380 constituency area.[11] The 2006 Census data includes various demographic, social, educational, economic and household information of each of the 380 constituency areas. Table 3 summarizes the demographic information of the constituency areas. The average population in a constituency area is 17,148. All of the variables reported in Table 3 have reasonable variation across constituency areas. As shown in Table 3, the Gini coefficient across constituency areas vary a lot from 0.22 to 0.6, average at 0.45.

4. A hedonic price model

In this section, we build a model of housing demand for households in Hong Kong between 2005 and 2006. A home $j = 1, \ldots, J$ is a bundle of three types of characteristics: physical attributes, neighborhood attributes and attributes observed by consumers but not by econometricians. The physical characteristics include floor, net gross ratio, gross area, bay window, age of structure, the presence of a swimming pool. The neighborhood characteristics are (1) the percentage of households living in public housing and (2) the Gini coefficient in the constituency area. These two groups of attributes are grouped as $\mathbf{x}_j$. The unobserved attribute is modeled as a scalar ξ_j.

Prices of houses are determined by the interaction of buyers and sellers in the equilibrium. The price function $\mathbf{p}$ maps housing characteristics $(\mathbf{x}, \xi)$ into their equilibrium prices:

[11] The District Council is responsible for advising the government on issues like public facilities and community activities in the district. Qualified voters can vote in their own constituency area, and the candidate with the largest number of votes in each area wins and enters the District Council. As a result there are 380 elected members in the Council, along with some other appointed members. For more details, see http://www.elections.gov.hk/elections/dc2003/english/.

$$p_j = \mathbf{p}(\mathbf{x}_j, \xi_j) \tag{1}$$

Households take prices as given and solve the following static utility maximization problem:

$$u_{ij} = \max_j u_i(\mathbf{x}_j, \xi_j, c) \quad \text{Subject to : } p_j + c \leqslant y_i \tag{2}$$

where c is a composite commodity, with a price normalized to \$1 (pre-tax).

Suppose the characteristic k is continuous and that j^* is household i 's optimal choice. The first-order condition of Eq. (2) says that the marginal rate of substitution between product characteristics k and the composite commodity must equal to the implicit price:

$$\frac{\frac{\partial u_i(\mathbf{x}_{j^*}, \xi_{j^*}, y_i - p_{j^*})}{\partial x_{j,k}}}{\frac{\partial u_i(\mathbf{x}_{j^*}, \xi_{j^*}, y_i - p_{j^*})}{\partial c}} = \frac{\partial \mathbf{p}(\mathbf{x}_{j^*}, \xi_{j^*})}{\partial x_{j,k}} \tag{3}$$

As noted by Bajari and Benkard (2005b) and Bajari and Kahn (2008), a single cross section observed in this data is not enough to recover a household's utility function globally. We follow the literature on random coefficient discrete choice models to specify household's utility to be:

$$u_{ij} = \beta_i'[\log(\mathbf{x}_j); \log(\xi_j)] \tag{4}$$

We allow for a rich specification of heterogeneity in tastes as we allow the marginal valuation of the characteristics to be household specific, since β_i are household specific. Also, utility in Eq. (4) is a log-linear function of the product characteristics. The log specification allows product characteristics to have diminishing marginal utility.

Most of the previous studies on differentiated product assume β_i to have a parametric distribution. In particular, they are independently and normally distributed.[12] We do not impose any parametric distribution on β_i and will estimate the distribution of new homeowners' tastes semi-parametrically.

In this paper, we are interested to see how distaste against income inequalities of households with different demographic characteristics differ. We thus model the joint distribution of the random utility coefficients, β_i, and demographics.[13] As discussed in Bajari and Kahn (2008), the lack of micro level data on household level characteristics requires an assumption of linearity between tastes and demographics.

5. Estimation

Our estimation approach involves three steps. The first two steps are similar to those used in Bajari and Benkard (2005a); the last step is similar to Bajari and Kahn (2008). In the first step, we estimate the hedonic price function **p** using a flexible local linear regression method described in Fan and Gijbels (1996) and applied in Bajari and Kahn (2005) and Bajari and Kahn (2008). Second, we "back out" the random utility coefficients for each household by applying first order conditions for optimality. Finally, we recover the joint distribution of random utility coefficients and household demographics. Since we only have access to demographics aggregated at the level of constituency areas, we follow Bajari and Kahn (2008) to estimate household-level preferences with this aggregated data.

5.1. First step: estimating the hedonic price function

We follow Fan and Gijbels (1996) and use local linear methods to estimate the hedonic flexibly. For a particular home j^*, we assume the hedonic price function **p** is locally linear and satisfies:

$$p_j = \alpha_{0,j^*} + \sum_k \alpha_{k,j^*}(x_{j,k} - x_{j^*,k}) + \xi_j \tag{5}$$

We only assume the hedonic in Eq. (5) is locally linear, not globally linear as in a linear regression model. The coefficients $\alpha_{\cdot,j^*}$ have a subscript j^* to emphasize that they are specific to (x_{j^*}, ξ_{j^*}).

For any $j^*, 1 \leqslant j^* \leqslant J$, we follow Fan and Gijbels (1996) to use weighted least squares to estimate α_{j^*}

$$\alpha_{j^*} = \arg\min_{\alpha} (\vec{\mathbf{p}} - \mathbf{X}\alpha)' \mathbf{W} (\vec{\mathbf{p}} - \mathbf{X}\alpha) \tag{6}$$

$$\mathbf{p} = [\text{RPRICE}_j], \mathbf{X} = [\mathbf{x}_j], \mathbf{W} = diag\{K_h(\mathbf{x}_j - \mathbf{x}_{j^*})\} \tag{7}$$

In Eqs. (6) and (7), $\vec{\mathbf{p}}$ is the vector of the owner's equivalent rent for all homes $j = 1, \ldots, J$, $\mathbf{X}$ is a vector of regressors which correspond to the observed product characteristics and $\mathbf{W}$ is a matrix of kernel weights.

The kernel weights in $\mathbf{W}$ are a function of the distance between home j^* and j. The local linear regression assigns more weights to observation near j^*. As discussed in Fan and Gijbels (1996), local linear methods have the same asymptotic variance and a lower asymptotic bias than the Nadaraya–Watson estimator, whereas the Gasser–Mueller estimator has the same asymptotic bias and a higher asymptotic variance than local linear methods. We chose the following normal kernel function with a bandwidth of 3[14]:

$$K(z) = \prod_k N(z_k/\hat{\sigma}^2) \tag{8}$$

$$K_h(z) == K(z/h)/h \tag{9}$$

In Eq. (8), K is a product of standard normal density and $\hat{\sigma}^2$ is the standard sample deviation of characteristic k.

In the first step, we run a linear regression on the characteristics of the housing unit. The physical characteristics include floor, net gross ratio, gross area, bay window, age of structure, the presence of a swimming pool. The neighborhood characteristics are the percentage of households living in public housing and the Gini coefficient in the constituency area.[15] To control for unobserved attributes that may be correlated with the characteristics, we also include

[12] See Berry et al. (1995), Petrin (2002), Nevo (2000), and Rossi et al. (2005).

[13] Section 6 provides more discussion on the set up.

[14] Fan and Gijbels (1996) discuss several methods for choosing bandwidth. However, due to the large number of covariates, we follow Bajari and Benkard (2005b) to choose the bandwidth equal to 3.

[15] Adding an interaction term between the two variables or constituency-level average income as one of the neighborhood characteristics does not change the results much. Please refer to Tables A.2 and A.3 in the Appendix.

district fixed effect in the regression.[16] Each of the 49 districts in our sample has 140,000 people on average.[17] The district fixed effects absorb important attributes such as distance from work, air quality, crime rate and local school quality that can be correlated with the percentage of public housing or income inequality.[18] We then subtract the district fixed effects from the owner's equivalent rent and estimate the local linear regressions described above.

The treatment for binary variables (e.g., the presence of a swimming pool) is different. Suppose the household i chooses a house j^*. Define $\hat{\mathbf{x}}_j$ as the observed characteristics of house j^* except one of the binary variable x is set to 1, and $\bar{\mathbf{x}}_j$ as the same characteristics with the binary variable set to 0. The implicit price for the binary characteristic x is then $\mathbf{p}(\hat{\mathbf{x}}_j, \xi_j) - \mathbf{p}(\bar{\mathbf{x}}_j, \xi_j)$, and if household i chooses $x = 1$ then $\beta_{i,x} > \mathbf{p}(\hat{\mathbf{x}}_j, \xi_j) - \mathbf{p}(\bar{\mathbf{x}}_j, \xi_j)$ and $\beta_{i,x} < \mathbf{p}(\hat{\mathbf{x}}_j, \xi_j) - \mathbf{p}(\bar{\mathbf{x}}_j, \xi_j)$ otherwise. That is, $\beta_{i,x}$ is not identified.

5.2. Second step: "Backing Out" the random utility coefficients

Due to the log utility function (4), we can calculate the random utility coefficients easily. Let $\hat{\alpha}_{j^*,k}$ be the estimated coefficients from the local linear regression for variable x_{j^*}. The coefficients are the implicit prices faced by household i, who chooses x_{j^*}, in the market, and hence $\hat{\alpha}_{j^*,k}$ is the estimated implicit price $\frac{\partial \mathbf{p}(\mathbf{x}_{j^*}, \xi_{j^*})}{\partial x_{j,k}}$. The random coefficients for this household i is calculated as:

$$\hat{\beta}_{i,k} = \hat{\alpha}_{j^*,k} x_{j^*,k} \tag{10}$$

That is, we obtain a random coefficient for every characteristic k and for every household i.

5.3. Third step: finding the joint distribution of preferences and demographics

We model the relationship between preferences and demographics using a linear model. Denoting $d_{i,s}$ as the demographic characteristic $s = 1, \ldots, S$ of household i, we can estimate:

$$\hat{\beta}_{i,k} = \theta_{0,k} + \theta_{k,1} d_{i,1} + \cdots + \theta_{k,S} d_{i,S} + \eta_{i,k} \tag{11}$$

Unfortunately, we do not have observations on the household's characteristics $d_{i,s}$. Instead, we observe the average characteristics of households in each constituency area $d_{t,s}$ for $t = 1, \ldots, T$. We follow Bajari and Kahn (2008) and estimate (11) with the group-mean method. We divide the $i = 1, \ldots, I$ households into G groups each of size $n = I/G$, and write (11) as:

$$\bar{\beta}_{g,k} = \theta_{0,k} + \theta_{k,1} \bar{d}_{g,1} + \cdots + \theta_{k,S} \bar{d}_{g,S} + \bar{\eta}_{g,k} \tag{12}$$

That is, we regress the mean preference parameter in each group on the mean demographic characteristics of each group. We do not observe these group means either, but we can approximate it by:

$$\bar{d}_{g,s} \simeq \frac{1}{n} \sum_{i \in g} \sum_{t} d_{t,s} \times 1\{t(i) = t\} \tag{13}$$

The approximation would be close if T and n are large. First, we draw without replacement and group the households into G groups each with n members. Next, we calculate the group average preference $\bar{\beta}_{g,k}$and average demographics $\bar{d}_{g,s}$ by (13). Third, with the G observations on $\bar{\beta}_{g,k}$ and the G observations on each $\bar{d}_{g,s}$, we can estimate $\theta_{0,k}, \ldots, \theta_{k,S}$ for each preference parameter k by OLS.

In Bajari and Kahn (2008) only one draw is made and the OLS standard errors are used for inference. To account for the uncertainty induced by using group means instead of household-level demographic characteristics, we draw with replacement and estimate (12) for 1000 times. Instead of using the OLS standard errors, we take the standard deviation of the 1000 sets of $\theta_{0,k}, \ldots, \theta_{k,S}$ estimates to build our confidence intervals.

6. Results and discussion

6.1. Hedonic pricing estimates

In Table 4, we show the hedonic prices for various housing attributes from the first step estimation. Since we use a semi-parametric regression technique, we display the distribution of the hedonic prices. Most of the average hedonic prices have signs and magnitudes consistent with economic intuition. One floor higher is priced at HK$675.1 per year. Homeowners would pay, on average, HK$382.1 per year for each extra square foot in gross area and HK$1274.3 per year for each percent increase in the net gross ratio.[19] That is, holding the gross area constant, the homeowner would prefer increasing the net area. Of the community characteristics, homeowners prefer a homogenous neighborhood. Home price drops, on average, by HK$7,317 when the Gini coefficient increases by 0.1. In other words, homeowners, on average, are willing to exchange 19 square feet of gross area (about half the size of a typical bathroom in Hong Kong) for a decrease in the Gini coefficient in the local neighborhood by 0.1. Local income inequality is a statistically and economically important factor to an average homeowner. In addition, the price of each

[16] To control for macro-economic fluctuations, we also add month–year fixed effects. Since the results are very similar, we only report the results without these month–year fixed effects.

[17] Given that Hong Kong is not a large city and that Hong Kong has close to 7 million people during the sample period, the population size is actually not that big. Hong Kong has a land mass of 426 square miles, and only 25% of that is developed due to the mountainous terrain. Each district has an average area of less than 9 square miles (again, most of which is not developed), which is a reasonably small area for us to consider as a neighborhood.

[18] After kindergarten, children in Hong Kong are required to attend 6 years of primary school education, followed by 7 years of secondary school education (only the first three years are required, and recently it is reduced to 6 years total). For both levels of education, preference of entering a certain school is given to families who reside in the same region (for a list of the schools in each region put together by a certain real estate agency, see http://www.midlandmap.hk/map/schoolnet.jsp). For secondary schools, they are grouped into 18 regions. For primary schools, they are grouped into 37 regions. Clearly, the more refined district fixed effects can capture the neighborhood effect of school quality.

[19] The net area is defined as the area that a resident actually occupies, whereas the gross area is the sum of the net area and "public area" like lobby, corridor and other recreational facilities.

Table 4
Summary of implicit hedonic prices.

Variable	Mean	Std. Dev.	25%	50%	75%
Constant	1385.5	95,885.4	−59,069.1	−14,094.1	37,535.9
Floor	675.1	62.6	642.2	661.7	691.4
Net gross ratio (%)	1274.3	219.4	1167.4	1253.6	1365.7
Gross area (sq. ft.)	382.1	12.0	375.3	380.5	386.2
Bay window (sq. ft.)	−290.2	95.7	−317.8	−294.9	−265.6
Age of structure	−1603.6	146.3	−1682.7	−1639.2	−1570.6
Const. area Gini	−73,166.5	32,404.9	−84,151.0	−69,586.5	−57,862.5
Const. area % public housing	−45,505.7	6,781.4	−48,533.5	−46,541.0	−44,296.8

Table 5
Consumer willingness to pay for housing attributes.

Variable	Mean	25%	50%	75%
Floor	1197.1	542.5	1049.2	1670.6
Net gross ratio (%)	9524.0	8644.6	9337.4	10302.2
Gross area (sq. ft.)	26347.8	19685.8	24120.0	29959.6
Bay window (sq. ft.)	−599.3	−903.3	−658.4	−225.2
Age of structure	−2075.4	−2994.7	−2049.2	−1023.0
Const. area Gini	−3203.6	−3704.7	−3015.0	−2500.5
Const. area % public housing	−205.1	0.0	0.0	0.0

Units are in HK dollars per year.

1% decrease in the people living in public housing is HK$455. Home price can drop with more public housing in the constituency area for many reasons: more crime, more traffic or higher population density.[20] Whatever the reason, the presence of this characteristic in the hedonic price function makes sure that the Gini coefficient variable is not measuring any unpleasant effects of public housing, but purely reflecting local income distribution.

6.2. Preferences estimates

In the second step, we use the hedonic price estimates, and homeowners' optimal consumption of various housing attributes, to recover homeowners' marginal valuation for various housing attributes. In Table 5, we present the distribution of estimates of willingness to pay for a 10% increase in consumption of various attributes. In particular, suppose household i's current consumption of attribute k is x_k, the willingness to pay for an extra 10% for attribute k is:

$$WTP_{i,k} = \beta_{i,k}(\log(1.1x_k) - \log(x_k)) = \beta_{i,k}\log(1.1) \qquad (14)$$

Again, most of the estimates have signs and magnitudes consistent with economic intuition. The average homeowner is willing to pay HK$1,197 per year for home that is 10% higher in floor, HK$26,348 per year for a 10% increase in gross area and HK$9,524 per year for a 10% increase in the net gross ratio. Homeowners are very sensitive to the age of housing units. They are, on average, willing to pay almost HK$2,075 less per year if housing units are 10% older. The average homeowner is willing to pay HK$3,204 to avoid the Gini coefficient in the constituency area to increase by 10%. Again, the Gini coefficient is an important consideration for a homeowner: the homeowner is indifferent between a 1% increase in the Gini coefficient and a 1.25% decrease in the size of the housing unit. For example, the homeowner is indifferent between the Gini coefficient going down from 0.50 to 0.45 and the size going up from 1000 square feet to 1012.5 square feet.

Fig. 2 plots the first stage coefficients of Gini on the rental price. If we take the rental price of the housing unit as a proxy of the buyer's wealth, Fig. 2 shows that richer household dislikes income inequality more than less rich household. The third stage estimation described above can enable us to quantify this.

In the third stage estimation, we include four demographic variables in the regression (11):

- age;
- monthly household income ('000);
- marital status (dummies for married, widowed, and separated, and single is the omitted group); and
- education (dummies for less than high secondary, more than high secondary but less than college, and college or above, and high secondary is the omitted group).[21]

For these variables, we exclude the data of people living in public rental housing who are not homeowners. We then calculate the mean of these variables to be the control variables. In the calculation of mean age for each constituency area, we exclude certain age groups which are not likely to purchase a housing unit. In particular, we exclude people under age of 25. Results are shown in Table 6. First, homeowners with higher income dislikes income inequality

[20] But this price drop is not due to the external effects at the district level as they are captured by district fixed effects.

[21] High secondary means completing Form 5, the level at which a student is about 17 years old. This is roughly equivalent to finishing high school in the US.

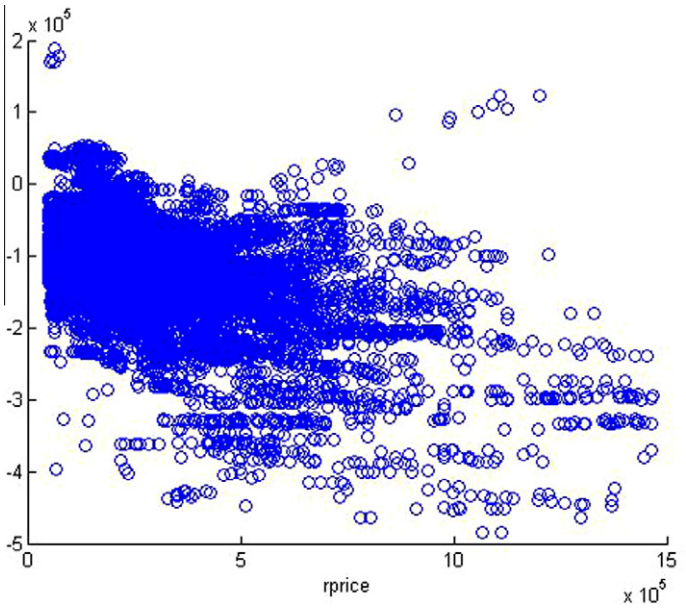


Fig. 2. Scatter plot of coefficients of Gini and RPrice.

Table 6
Willingness to pay for income inequality as a function of household demographics.

Age	62.8 (38.4)
Household income (in $1000 s)	−39.2 (7.0)
% Less than high secondary education	−90.6 (23.9)
% Above high secondary education	−54.6 (35.2)
% College or above	−42.2 (19.8)
% Married	35.5 (23.8)
% Widowed	20.2 (67.9)
% Divorced	23.5 (73.3)
% Separated	−192.1 (185.1)
Constant	−1039.5 (2500.2)

Mean R^2 – 0.1268.

more. For each HK$1000 increase of monthly income the willingness to pay for a 10% increases in Gini goes down by HK$40 per year. Second, older homeowners have a higher tolerance for income inequality. One year increase in age increases the willingness to pay for a 10% higher Gini by HK$62.8 per year. While the distribution of the willingness to pay is weakly related to marital status, it is strongly related to education level. Comparing to the omitted high secondary education group, the lowest education group is much more willing to pay for reducing inequality, For each 1% increase in the probability that the average adult household member receive less than high secondary education, the willingness to pay for a 10% higher Gini increases by HK$90.6 per year.[22] The same holds for the two higher education groups, but by a less significant and much smaller amount.

7. A small natural experiment

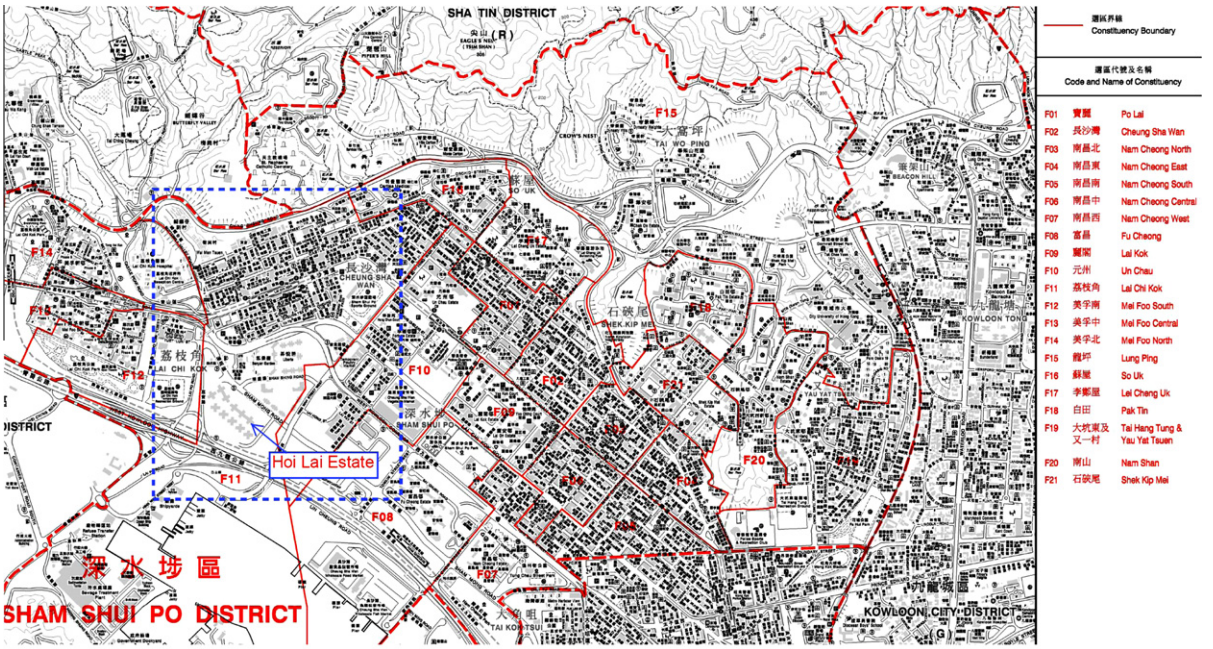
If the Gini coefficient and the percentage of public housing are correlated with some omitted variable that affects house price, we cannot establish a causal relationship between house price and local income inequality. To address the potential endogeneity problem, we take advantage of an exogenous policy change.

Under the recommendation of the Hong Kong SAR government, the Housing Authority of Hong Kong stopped the production and sale of housing units under the Home Ownership Scheme (HOS) from 2003 onwards. For each unsold HOS project that were either completed or ongoing when the policy change announcement was made, the government would adopt one of the following five options: (1) lease modifications to enable private developers to sell the flats in the private market; (2) sale to the Hong Kong Housing Society for re-housing purposes; (3) use as government departmental quarters; (4) use as guesthouses for Mainland tours or groups; and (5) conversion to public rental housing.[23] Except for four projects (Hunghom Peninsula, Kingsford Terrace, Tung Tao Court, and Hiu Kam Court), decisions for other unsold HOS projects were not made at that time.

Some projects that were jointly developed by the government and the private sector were sold to the private sector, usually under the suspicion that the government

[22] The reader may find it puzzling that both people with low education and with high income have a larger distaste for income inequality. Remember that the coefficients should be interpreted *ceteris paribus*. That is, the impact of education level is interpreted by holding income constant, and vice versa.

[23] For more background on the ceasing of the HOS, see a paper by the Legislative Council Panel on Housing that can be accessed at http://www.legco.gov.hk/yr02-03/english/panels/hg/papers/hg0318cb1-1129-4-e.pdf.



Constituency Areas in the Sham Shui Po District

Fig. 3. Constituency areas in the Sham Shui Po district.

was selling at too low a price. The notorious Hunghom Pennisula case is one example (see Leung, 2004) that led to a political disaster for the government. While turning an HOS project into rental public housing estate has a negative impact on the house price of nearby private housing units as we have shown, politically it was an easy decision to make: it was welcomed by the many people who were eligible and waiting for public housing (2 million people were already renting public housing, and with over 100,000 people on the waiting list),[24] and it only hurt the few thousands of people who owned a housing unit nearby. Both the government and political parties preferred taking this easy route rather than risking another public relation disaster. Because of that it is reasonable to assume that the government's choice of which HOS project to be changed into public rental housing is uncorrelated with the house price in the affected neighborhood, we can use the policy change as an exogenous shock to (1) the Gini coefficient and (2) the percentage of public housing in that neighborhood.

The case of Hoi Lai Estate in Cheung Sha Wan, Kowloon, which was an HOS project changed into rental housing, can serve as a natural experiment. Hoi Lai Estate is located in the constituency area Lai Chi Kok, which itself is within the Sham Shui Po district. Before Hoi Lai Estate, there was no public rental housing but only middle-to-upper private housing estates and schools in that constituency area. The policy change increases the proportion of public housing in that constituency area from 0% to 31% and the Gini coefficient from 0.494 to 0.496 from 2004 to 2005, the year in which residents moved in the estate.[25] To estimate the impact of the policy change, we look at the house prices of Lai Chi Kok and the 20 nearby constituency areas in the Sham Shui Po district (see Figs. 3 and 4) and see if house price in Lai Chi Kok drops relative to that in nearby constituency areas.

We make use of a news database, WiseNews (wisenews.wisers.net), to conduct keyword search on the announcement of the policy. WiseNews is the major online news database similar to the ProQuest newsstand database (proquest.com) in the US that archives all major news from almost all newspapers and magazines in Hong Kong. We conducted keyword search using several keywords related to Hoi Lai Estate and the policy between 13 November, 2002 when sale of HOS was stopped suddenly, and May 15, 2004 when the government announced to change Hoi Lai Estate into public rental housing. Because the government did not mention the ultimate decision on Hoi Lai Estate at the time when sale of HOS was stopped, and we did

[24] At the end of June 2011, there were about 155,600 applications on the Waiting List for the HKHAs public rental housing. The average waiting time for PRH for general applicants was about 2.2 years.

[25] The reader may be concerned with the small change in the Gini coefficient. Since we only have Census data in 2006 (the previous one is 2001) and the policy change is in 2004, we have to calculate the Gini coefficient using only data in 2006. First, we calculate the Gini coefficient using all the population in that area. Next, we proxy the original Gini coefficient in 2004 by calculating the coefficient and dropping the population in public housing. The change in the Gini coefficient is surely biased downwards: the presence of public housing will drive the wealthier households out of the area in 2004, and by 2006 the income inequality will be much less severe than right after the policy change. In addition, Gini coefficient in Hong Kong only changes from 0.525 in 2001 to 0.533 in 2006. Though changes in the Gini coefficient over time tend to be small, in this paper we identify the impact of inequality through cross-sectional variations (which are much larger as reported in the paper).

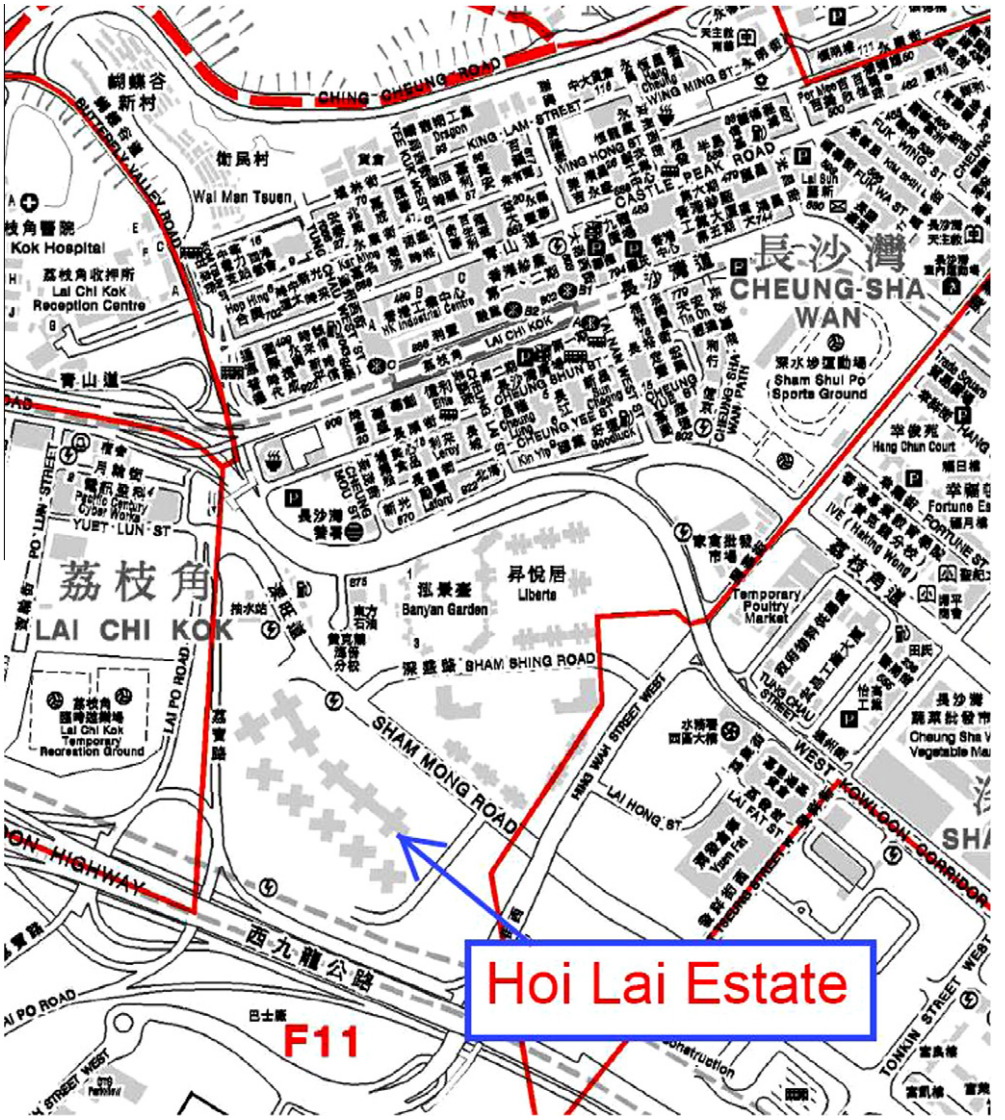


Fig. 4. Constituency area: Lai Chi Kok.

Table 7
Summary of housing units transacted in May 2004.

	Lai Chi Kok	Other C.A.s in Sham Shui Po	C.A.s in Group A	C.A.s in Group B
RPrice	224,920 (55,726)	125,350 (70,194)	142,685 (115,008)	128,744 (37,326)
Age of structure	0.05 (2.76)	26.86 (8.34)	15.66 (6.56)	1.49 (2.68)
Floor	33.77 (16.35)	9.78 (5.90)	16.27 (10.64)	33.17 (12.03)
Gross area (sq. ft.)	702.06 (101.21)	711.68 (249.73)	605.74 (251.99)	553.22 (96.51)
Net gross ratio (%)	0.74 (0.02)	0.82 (0.07)	0.75 (0.07)	0.71 (0.02)
Bay window (sq. ft.)	34.53 (12.72)	1.62 (5.85)	23.74 (15.86)	26.49 (7.17)
Swimming pool	0.94 (0.24)	0.003 (0.06)	0.80 (0.40)	0.97 (0.18)
	$N = 408$	$N = 293$	$N = 140$	$N = 122$

not find any news related to Hoi Lai Estate between 13 November, 2002 and May 15, 2004. These suggest that the policy change was not expected.

Because there is no evidence of major shocks in the housing market two weeks before and two weeks after the announcement, we extract the housing transactions

Table 8
Demographics of Lai Chi Kok and the five comparison constituency areas.

	Lai Chi Kok	Fo Tan	Hung Hom Bay	Kornhill Garden	Shau Kei Wan	Wong UK
Median income	HK$12,000	HK$13,750	HK$11,500	HK$15,000	HK$10,000	HK$13,000
Gini	0.494	0.495	0.518	0.492	0.493	0.500
% Less than High secondary edu.	40	39	43	37	51	37
% Above	38	44	37	40	38	43
% College or above	22	17	20	23	12	21

Table 9
Implicit hedonic prices from natural experiment (Std. Err.).

Constant	Sham Shui Po as control group −115,573.1 (20,661.0)	Group A as control group −97,322.8 (54,273.2)	Group B as control group −84,755.8 (79,306.2)
Floor	552.4 (88.9)	722.9 (88.3)	662.3 (74.5)
Net gross ratio (%)	861.4 (306.1)	440.3 (614.1)	303.7 (1113.1)
Gross area (sq. ft.)	265.8 (13.4)	307.1 (15.7)	302.9 (14.0)
Bay window (sq. ft.)	1099.7 (167.8)	1210.7 (161.6)	1006.5 (240.8)
Age of structure	−984.1 (283.9)	−2641.2 (741.7)	−3609.1 (807.1)
Announcement	1101.4 (3662.9)	1352.2 (6042.3)	1681.3 (3383.2)
Lai Chi Kok	−813.2 (7160.9)	10,133.5 (13,812.7)	19,230.4 (5992.5)
Announcement × Lai Chi Kok	−12,627.9 (4962.9)	−11,586.8 (7029.3)	−12,553.9 (4837.5)
District fixed effect for treatment group	No	Yes	Yes
	$N = 701$	$N = 548$	$N = 530$

in the Sham Shui Po district occurred between May 1, 2004 and May 31, 2004.[26] Table 7 summarizes the characteristics of the housing units transacted in May 2004.

Since there were three new private housing complex in Lai Chi Kok being sold on the market in that period,[27] the number of transaction is higher, the ages of the housing unit are smaller, and the buildings are taller in Lai Chi Kok compared to those in other constituency areas in Sham Shui Po. While the net gross ratio is slightly lower, the gross area is about the same between the units transacted in Lai Chi Kok and the rest of Sham Shui Po.

To evaluate the impact of this announcement on the housing market in Lai Chi Kok, we run the following regression:

$$\begin{aligned}\text{RPrice}_j = {} & \phi_0 + \phi_1 \text{Floor} + \phi_2 \text{Netgross} + \phi_3 \text{Grossarea} \\ & + \phi_4 \text{Baywindow} + \phi_5 \text{Swimming pool} + \phi_6 \text{Age} \\ & + \phi_7 \text{Announcement} + \phi_8 \text{Lai Chi Kok} \\ & + \phi_9 (\text{Announcement} \times \text{Lai Chi Kok}) + u_j\end{aligned}$$

where *Announcement* is an indicator function which equals one if the date of transaction is after May 15, 2005, and *Lai Chi Kok* is an indicator function which equals one if the housing unit is located in Lai Chi Kok. The treatment effect, is ϕ_9, captures the drop in rental prices of housing units in Lai Chi Kok right after the announcement.

With a control group, our result is not biased even if there is some city-wide negative price shock that affects all private housing units equally. But if there is some unobserved negative price shock that affects more or only affects private housing units with similar characteristics as those in Lai Chi Kok, our result is biased. To address this problem, we replace the observations in the rest of Sham Shui Po with two other groups A and B of different constituency areas as the control group. In Group A we handpick five other constituency areas which have similar demographics with Lai Chi Kok. The five constituency areas are Fo Tan, Hung Hom Bay, Kornhill Garden, Shau Kei Wan and Wong UK. Two of them (Fo Tan and Wong UK) are located in New Territories, one (Hung Hom Bay) is located in Kowloon and the remaining two (Kornhill Garden and Shau Kei Wan) are located in Hong Kong Island. Just like in Lai Chi Kok before the announcement, there is no public housing in any of these constituency areas. And as shown in Table 8, the demographics among the five constituency areas are very similar. In Group B we have Sycamore, located in Kowloon. Similar to Lai Chi Kok, the transactions in Sycamore are mainly from a new private housing complex, Metro Harbour View. From the third column in Table 7, we can see that the characteristics of the housing units are very similar between Lai Chi Kok and Sycamore.

The first column of Table 9 reports the results when we use Sham Shui Po as the control group. Most of the coefficients are consistent with the hedonic regression in Table 4, except for bay window. The parameter of interest, ϕ_9, has an estimate of −12,628., and is statistically significant at 5% level. Since the policy change increases the proportion of public housing in that Lai Chi Kok from 0% to 31% and Gini coefficient from 0.494 to 0.496, the results in Table 4 implies that the RPrice would drop by $73,166.5 \times 0.02 + 45,505.7 \times 0.31 \approx 15,570$, which is reasonably close to 12,628.[28]

[26] We also use transactions occurred four and six weeks before and after May 15, 2004. Results are similar and thus omitted here.

[27] The three complexes are Banyan Garden, Liberte and Pacifica. See Figs. 3 and 4 for their exact locations.

[28] We also consider the possibility of a neighborhood price trend. Results are similar and reported in the Appendix.

The second and third column of Table 9 report the results when Group A and Group B are used as the control group. The estimates of ϕ_9, is still around −12,000 and statistically significant at 10% level. Some coefficients estimates like age and swimming pool are a bit off in those two columns since there is not much variation in the age of structure and swimming pool for the two groups.

8. Counterfactuals

In previous sections, we show that homeowners have a large and statistically significant distaste for income inequality in their neighborhood. At the same time, local income inequality is induced by the presence of public rental housing. In our data, out of the 89,090 homes transacted between 2005 and 2006, 27,738 of them are located in constituency areas in which there is public rental housing. One natural question to ask is thus: If the Hong Kong government separates private and public housing completely, so that private homeowners do not have public rental housing in their neighborhood, what would be the welfare gain for homeowners?

To answer this question, we conduct the following counterfactual experiment. Suppose Hong Kong government reallocates the poorest 50% public rental housing units to constituency areas exclusive to public rental housing. At the same time, we leave the location of homeowners unchanged. This can improve welfare of homeowners through two channels. First, Gini coefficients in some constituency areas decrease. In particular, out of the 199 constituency areas in which we have property transaction data, income inequality in 79 constituency areas changes under this policy. Second, the percentage of public housing units in those 79 constituency area would drop by 50%.

Since most transactions (61,456) took place in constituency areas in which this policy has no effect, the welfare of these homeowners are not affected by this policy. For the rest of the homeowners (27,738), the average welfare gain improves HK$8,126 per year, in which HK$2,150 is due to lower Gini in those constituency areas and HK$5,976 is due to 50% decrease of public housing units in those constituency areas.[29]

Is HK$8,126 per year a large amount? We can get an idea of the magnitude by using our results in Table 5. The amount of welfare gain is roughly equivalent to increasing the housing unit by 20 square feet or reducing the age of the housing unit by 5 years, both of which are quantitatively important.

9. Conclusion

People dislike living near others who have a lower or higher income level, and the distaste is substantial: on average, a homeowner is willing to pay about HK$3,200 for a 10% drop of the local Gini coefficient, and it is the same as the amount a home buyer is willing to pay for a 1.25% increase in the size of the housing unit. We also find that the distaste for income inequality varies with demographics: it goes up with income and goes down with age. To avoid the potential endogeneity problem, we make use of a policy change in 2004 and conduct a natural experiment using a small part of the sample, and the results are similar. To gauge the relevance of our results, we show through a counterfactual experiment that reallocating part of the public rental housing improves homeowners' welfare by an economically significant amount. Of course, the experiment ignores the potential problems of grouping all low-income individuals in one area.

Our results are local, and we also ignore how income distribution is endogenously formed in each constituency area. The main purpose of this paper is to identify the preference for local income inequality among homeowners, though our results point to further questions: Why do homeowners dislike income inequality, even after controlling for the presence of public housing and district fixed effects? Should public housing policymaking take into account such a preference? How does this preference effect local income distribution over time? We leave these questions for future research.

Acknowledgments

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Appendix A. Additional results

In this Appendix we present three sets of results. First, we show the summary statistics of the housing units of the initial sample, the sample without missing variables and the sample that can be matched with Census data (the sample we actually used in the paper). Second, we show the first-step results with an interaction term between public housing and Gini coefficient. Third, we show the first-step results with constituency-level income as an additional neighborhood characteristic.

A.1. Summary statistics for different samples

Please refer to Table A.1 for the summary statistics of the initial sample, sample with missing variables dropped, and the final sample that can be matched to Census data. In fact, during the first step of the sample selection process we have eliminated housing units that are older than those in the final sample. Old housing units tend to have missing gross area or net area due to the more relaxed construction law then. We can also see that those housing units have lower average floor (older buildings are shorter), cheaper, and less likely to have club house or swimming pool. Other features are rather similar.

We have a good reason to drop housing units that are really old: they are much less frequently transacted. In

[29] We have done the experiment for reducing public housing by 75%, and the welfare change is about HK$12,000.

Table A.1
Summary statistics of the main sample and the missing data samples.

Variable	Address matched (main sample)	Missing variable	Initial sample
Price ($HK Million)	2.48 (1.91)	3.18 (2.66)	2.61 (4.02)
Floor	18.47 (12.54)	21.35 (14.55)	16.02 (13.24)
Gross area (sq. ft.)	717.68 (255.75)	756.36 (282.33)	745.19 (374.79)
Net area (sq. ft.)	567.18 (215.73)	588.81 (231.87)	567.22 (279.78)
Bedrooms	2.39 (0.56)	2.38 (0.59)	2.39 (0.62)
Living rooms	1.86 (0.34)	1.90 (0.30)	1.88 (0.33)
Age of structure	13.22 (7.85)	9.46 (8.82)	16.76 (13.07)
Swimming pool	0.79 (0.41)	0.81 (0.39)	0.45 (0.50)
Club house	0.53 (0.50)	0.67 (0.47)	0.35 (0.478)
Std. Dev. in parenthesis	$N = 89,090$	$N = 161,096$	$N = 357,931$

Table A.2
First-step estimation results with the interaction term.

Variable	Mean	Std. Dev.	25%	50%	75%
Constant	1379.2	96036.7	−59124.1	−14,173	37508.9
Floor	684.6	65.6	651.1	670.9	700.4
Net gross ratio (%)	1213.06	531.73	1092.13	1173.35	1281.84
Gross area (sq. ft.)	382.6	16.0	375.6	381	386.9
Bay window (sq. ft.)	−295.6	109.8	−326.1	−302.7	−275.4
Age of structure	−1505.4	1414.4	−1570.7	−1526.5	−1464.1
Const. area Gini	−77063.6	44220.9	−88682.5	−74314.5	−62,477
Const. area public housing (%)	−53050.9	51,175	−55218.8	−53,229	−51250.4
Const. area Gini × const. area public housing (%)	69036.4	252729.4	3002.7	66234.6	128184.7

Table A.3
First-step estimation results with the constituency income.

Variable	Mean	Std. Dev.	25%	50%	75%
Constant	1351.5	96250.5	−59116.1	−15364.2	36815.7
Floor	694.9	79.3	653.2	677.2	711.8
Net gross ratio (%)	118513.1	21203.1	109557.7	117469.4	126533.8
Gross area (sq. ft.)	373	16.2	362.3	370	380
Bay window (sq. ft.)	−257.4	96.7	−283.4	−259.6	−232.6
Age of structure	−1491.6	189.9	−1589.2	−1534	−1445.4
Const. area Gini	−71089.4	31248.5	−88216.2	−70604.8	−53727.9
Const. area public housing (%)	−43319.9	6415.3	−46324.4	−44068.8	−41848.5
Const. area income (HKD 1000)	−938.4	442.7	−1142.5	−886.4	−657.5

addition, some transactions of these old housing units are not for residential purpose but to speculate that the government or some private company will buy out the old building for redevelopment.

In the second sample selection process, we have mainly eliminated newly built housing units that are not yet recorded as part of the building list in each constituency area.[30] We can see that average age is lower and the housing units are more expensive. Other features are rather similar.

A.2. First-step estimation results with interaction term between Gini and public housing

Please refer to Table A.2 for the first-step results including an interaction term between public housing percentage and Gini coefficient. The impact of the interaction term is large (as the magnitude of the interaction term is very small, being the product of two ratios) but its standard error is even larger. All other estimates, including the impact of Gini coefficient, are not too different from those without the interaction term. The only exception is that the impact of public housing, though with a similar magnitude, is now imprecisely estimated. According to Table A.2, it is unlikely that our results will be affected much by the interaction term.

A.3. First-step estimation results with constituency income

We do not include the constituency-level average income as one of the neighborhood characteristics in our main specification because that will be included in our third step estimation. Of course, one can argue that constituency income should be included in the first step as it is clearly correlated with the Gini coefficient in that area, or the estimation suffers from omitted variable bias. Table A.3 provides the results of the first-step estimation by including constituency-level income. The impact of Gini coefficient is

[30] The lists are provided by the Electoral Affair Commission. Please go to http://www.eac.gov.hk/en_txt/distco/2003dc_boundary_description.htm.

Table A.4
Implicit hedonic prices from natural experiment with time trend (Std. Err.).

	Sham Shui Po as control group	Group A as control group	Group B as control group
Constant	−140373.3 (21,559.6)	−93392.1 (59625.4)	−32411.9 (79,253)
Floor	504.2 (11.9)	655.9 (90.1)	589.4 (77.3)
Net gross ratio (%)	913.3 (322.8)	548.6 (662.8)	−217.7 (1095.5)
Gross area (sq. ft.)	264.5 (11.9)	305.8 (15.4)	301.3 (14.7)
Bay window (sq. ft.)	1095.5 (169.7)	1,213.9 (179.8)	932.4 (239.0)
Age of structure	−971.7 (294.5)	−2,734.0 (761.8)	−3844.6 (843.2)
Announcement	26,927.5 (3,950.0)	−44,870.4 (8,740.7)	−31005.2 (10481.2)
Lai Chi Kok	−29,477.4 (26,579.7)	16,749.0 (16975.0)	29,468.1 (6,543.6)
Announcement × Lai Chi Kok	−16,589.5 (6,171.8)	−16,383.0 (12,983.4)	−36,326.8 (11,494.2)
District fixed effect for treatment group	No	Yes	Yes
	$N = 701$	$N = 548$	$N = 530$

smaller by a negligible amount. The impact of constituency-level income is negative, but the size is small. A one standard deviation change of constituency-level income (about HKD 4000) leads to a drop in about HKD 4000 in rent per year, which is not economically significant at all. Of course, by including the income variable in the first stage we are not able to investigate heterogeneity of the WTP.

A.4. Natural experiment

We consider the possibility of a time trend (e.g., price is going down) during the sample period of our natural experiment (May 2004) by adding a day dummy interacting Lai Chi Kok term in the regression.[31] Table A.4 provides the results. Most of the estimates are similar to the ones in our benchmark regression in Table 9. The estimates of ϕ_9 are more negative at around −16,589.

References

Alesina, A., Baqir, R., Easterly, W., 1999. Public goods and ethnic divisions. Quarterly Journal of Economics 114 (4), 1243–1284.

Bajari, P., Benkard, C.L., 2005a. Demand estimation with heterogenous consumers and unobserved product characteristics: a hedonic approach. Journal of Political Economy 113 (6), 1239–1276.

Bajari, P., Benkard, C.L., 2005b. Hedonic price indexes with unobserved product characteristics. Journal of Business and Economics Statistics 23 (1), 61–75.

Bajari, P., Kahn, M.E., 2005. Estimating housing demand with an application to explaining racial segregation in cities. Journal of Business and Economics Statistics 23 (1), 20–33.

Bajari, P., Kahn, M.E., 2008. Estimating hedonic models of consumer demand with an application to urban sprawl. Hedonic Methods in Housing Market. Springer.

Bayer, P., Ferreira, F., McMillan, R., 2007. A unified framework for measuring preferences for schools and neighborhoods. Journal of Political Economy 115 (4), 588–638.

Berry, S., Levinsohn, J., Pakes, A., 1995. Automobile prices in market equilibrium. Econometrica 63 (4), 841–890.

Boyle, M.A., Kiel, K.A., 2001. A survey of house price hedonic studies of the impact of environmental externalities. Journal of Real Estate Literature 2, 117–144.

Fan, J., Gijbels, I., 1996. Local Polynomial Modelling and Its Applications: Monographs on Statistics and Applied Probability, vol. 66. CRC, London, UK.

Fernandez, R., Rogerson, R., 1996. Income distribution, communities, and the quality of public education. Quarterly Journal of Economics 111 (1), 135–164.

Gans, H.J., 1961. The balanced community: homogeneity or heterogeneity in residential areas? Journal of the American Planning Association 27 (3), 176–184.

Ioannides, Y.M., 2002. Residential neighborhood effects. Regional Science and Urban Economics 32, 145–165.

Ioannides, Y.M., Zabel, J.E., 2003. Neighborhood effects and housing demand. Journal of Applied Econometrics 18 (5), 563–584.

Ioannides, Y.M., Zabel, J.E., 2008. Interactions, neighborhood selection adn housing demand. Journal of Urban Economics 63, 229–252.

Kiel, K.A., Zabel, J.E., 2008. Location, location, location: the 3L approach to house price determination. Journal of Housing Economics 17, 175–190.

Leung, C.K.Y., 2004. The lessons from the Hunghom Pennisula incident. Hong Kong Economic Journal 25.

Leung, C.K.Y., Lau, C.K.G., Leong, Y.C.F., 2002. Testing alternative theories of the property price-trading volume correlation. Journal of Real Estate Research 23 (3), 253–264.

Leung, C.K.Y., Leong, Y.C.F., Wong, S.K., 2006. Housing price dispersion: an empirical investigation. Journal of Real Estate Finance and Economics 32 (3), 357–385.

Nevo, A., 2000. A practitioner's guide to estimation of random coefficients logit models of demand. Journal of Economics and Management Strategy 9 (4), 513–548.

Petrin, A., 2002. Quantifying the benefits of new products: the case of the minivan. Journal of Political Economy 110 (4), 705–729.

Rossi, P., Allenby, G., McCulloch, R., 2005. Bayesian Statistics and Marketing. John Wiley and Sons, Hoboken, NJ.

Rossi-Hansberg, E., Sarte, P.-D., Owens, R., 2010. Housing externalities. Journal of Political Economy 118 (3), 485–535.

Tricomi, E., Rangel, A., Camerer, C.F., O'Doherty, J., 2010. Neural evidence for inequality-averse social preferences. Nature 463 (25), 1089–1092.

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