Influences of current neighbourhood characteristics on Hanoian's actual residential choices and subjective expectations

Minh Tu TRAN [a], Makoto CHIKARAISHI [b], Junyi ZHANG [c], Akimasa FUJIWARA [d]

[a,c,d] *Graduate School for International Development and Cooperation, Hiroshima University, Japan*
[b] *JSPS Research Fellow, Department of Urban Engineering, The University of Tokyo, Japan*; *E-mail: chikaraishi@ut.t.u-tokyo.ac.jp*
[a] *E-mail: tminhtu85@gmail.com*
[c] *E-mail: zjy@hiroshima-u.ac.jp*
[d] *E-mail: afujiw@hiroshima-u.ac.jp*

Abstract: Bearing in mind that people may have rational expectations conditional on current information, this paper provides additional insights about the influences of current neighbourhood characteristics on household residential location choice behaviour from such a perspective by comparing actual choices and subjective expectations. Using data in Hanoi, Vietnam in 2005 and multinomial logit models, it is found that current neighbourhood characteristics surely influence subjective expectations for the future residential location, but the influences are different from those on actual choices in the sense that signs and/or magnitudes of parameters of some specific neighbourhood characteristics change significantly. With the above results, it is concluded that subjective expectations in the research of residential location choice behaviour should be paid more attention.

Keywords: neighbourhood characteristics, residential location, subjective expectation, Hanoi.

1. INTRODUCTION

Over the past three decades, residential location choice modelling has become one of the most prevalent research topics in transport/urban planning and economics by applying the utility-maximization theory. Originally, MacFadden (1977) introduced a family of probabilistic choice models that can deal with revealed preference (RP) data about housing location choice. In these models, it is supposed that an individual is a rational decision maker who maximizes the choice utility. The utility of each alternative in a choice set is a function of attributes of alternative and consumer characteristics. In line with this research, numerous studies using RP data have discussed the problem of residential location choice (Bhat & Guo, 2004; Duncombe, Robbins, & Wolf, 2001; Guo & Bhat, 2007; Sermons & Koppelman, 2001; Zondag & Pieters, 2005).

Recently, the value of subjective expectations (SE) in understanding and predicting choice behaviour has been recognized by researchers in both economic and psychological fields. Klaauw (2012) indicated that such data could provide similar information about the decision process in the same way as do data on current or retrospective behaviour. In the literature of residential location choice, however, little attention has been paid to SE in representing future choices. Hence, this paper makes an effort to explore SE for future housing location by comparing with RP.

The Oxford English Dictionary defines expectation as "a strong belief that something will happen or be the case". In the context of residential location choice, future expectation

may be referred as a belief that people will or should live in a certain neighbourhood where they may satisfy their needs and preferences. For example, a young family without kids currently reside in a neighbourhood quite far from the city centre with lower levels of infrastructures (e.g., health care and educational facilities). However, they may expect to live in a neighbourhood near the city centre with better infrastructures because they may plan to have a baby in near future. Probably, their expectations for future choices are affected by their memory of facilities in neighbourhoods. In other words, the attributes of previous locations may be important determinants of future residential choices. Practically, Chen et al. (2008) found the effects of prior commute distance and open space on current residential location choices by analysing the data collected in the United States. This paper also investigates the effects of prior attributes of neighbourhoods on future residential location choices but in the context of Hanoi, Vietnam. To the authors' knowledge, no relevant studies have been done in Hanoi. Conditional on current information (e.g., neighbourhood characteristics and household attributes), it is assumed that people may rationally think about their expectations for future choices in housing location. In this paper, therefore, we examine whether or not current neighbourhood characteristics significantly influence Hanoians' expectations for future housing location choices by comparing with actual choices (i.e., RP).

As mentioned above, discrete choice models using RP data often assess the influences of current neighbourhood characteristics on actual choices and policies in relation to neighbourhood design have been recommended based on these results. Possibly, SE choices (i.e., expectations for future choices in the present) are different from RP choices (actual choices made in the past), leading to the variations in signs and/or numeric values of model parameters. This results in the different suggestions of policies in relation to neighbourhood design. For instance, in developing countries, many households with more young adults actually reside far from the city centre with a few recreational places, even if they have high preferences for recreational activities. It is difficult to buy a house near city centre because of high housing prices. In such a case, the estimation results of RP models may show the negative impact of recreational land on these households' choices. However, these households may expect that housing prices may be reduced in the future due to government interventions in the land market (e.g., providing loans with preferential interest rate or supporting housing supply side). Consequently, they may expect that they would reside in the neighbourhoods with a high percentage of recreational land. This means that percentages of recreational land in neighbourhoods may be positively associated with their expectations for future choices. Hence, this paper examines how the effects of current neighbourhood characteristics on SE choices are different from those on RP choices, by developing RP and SE based residential location choice models.

The remainder of this paper is organized as follows. Section 2 describes the study area, data sources and results of aggregate analysis. Section 3 presents the methodology used in empirical analysis and the results of RP and SE models. Finally, the paper is concluded in Section 4 along with a discussion of future research issues.

2. DATA

2.1. Study Area and Data Processing

This study uses data collected in a Household Interview Survey (HIS) conducted by JICA (Japan International Cooperation Agency) in Hanoi, Vietnam in 2005. Although the administrative boundary of Hanoi was officially expanded towards the western part of the city

in 2008, we only focus on 14 districts within the old Hanoi area (see Figure 1), which spatial area and population are described in Table 1. The survey was done as a part of The Comprehensive Urban Development Programme in Hanoi Capital City of the Socialist Republic of Vietnam (HAIDEP) (JICA, 2007). In this project, the targeted survey area consists of old Hanoi city area (including 14 districts or 228 zones) and adjacent areas in old Ha Tay and Vinh Phuc provinces.

Source: HAIDEP project

Figure 1. Study area

Table 1. Area and population in 2005 of study area by districts

Study area	Area (km^2)	Population (persons)	Population Density (persons/km^2)
Urban Core	34.59	1,014,500	29,329.3
Ba Dinh	9.25	217,700	23,535.1
Hoan Kiem	5.29	153,900	29,092.6
Hai Ba Trung	10.09	290,300	28,771.1
Dong Da	9.96	352,600	35,401.6
Urban Fringe	145.37	934,000	6,425.0
Tay Ho	24.01	112,400	4,681.4
Thanh Xuan	9.08	208,800	22,995.6
Cau Giay	12.03	190,700	15,852.0
Hoang Mai	40.32	235,700	5,845.7
Long Bien	59.93	186,400	3,110.3
Suburban	741.94	1,233,000	1,661.9
Soc Son	306.51	267,900	874.0
Dong Anh	182.14	302,600	1,661.4
Gia Lam	114.73	207,900	1,812.1
Tu Liem	75.63	289,800	3,831.8
Thanh Tri	62.93	164,800	2,618.8
Whole city (old Hanoi)	**921.9**	**3,181,500**	**3,451.0**

Source: Edited based on Hanoi Statistical Yearbook 2010

The survey collected information on the following categories: socio-economic attributes (i.e. household and individual attributes), daily activities, opinions on transport environment and satisfactions with current living conditions.

In this survey, respondents were also asked to show their expectations about housing type and location. The exact question is: "Please choose housing type and location that you want to live in the future" and respondents were asked to only choose one type of houses and one location in a given choice set. In this study, we only used the data on the location. It is important to note that the survey is not a stated preference experiment in which respondents make a decision based on clearly-defined hypothetical choice attributes. The choice set includes the 14 districts within the old Hanoi area and some towns in adjacent areas and no concrete alternative attributes were provided. Since the information used for respondents' decisions was not available in the survey, the observed subjective expectation data was, in fact, elicited in an unspecified scenario. Manski (1999) posed three *incomplete scenarios* for eliciting choice expectations in survey questions, consisting of unspecified scenarios, feasible scenarios, and counterfactual scenarios. In the case of the first scenarios, respondents are asked to make unconditional predictions of their behaviour. An example of such scenario is "Looking ahead, do you expect to have any (more) cars?".

This paper examines the residential location choice only among three types of neighbourhoods: urban core, urban fringe, and suburban neighbourhoods. The final sample for the analysis in this paper comprises 13,712 individuals that are representatives of the same 13,712 households. In addition, land use characteristics, socio-economic and demographic attributes at the district level were collected from external sources.

2.2. Aggregate Analysis

The land use characteristics were obtained from the aforementioned HAIDEP project. The land use profile is available at the level of administrative unit (i.e., the district level). In addition, socio-economic and demographic data are obtained from Hanoi Statistical Yearbook 2010 that includes detailed information of each district from 2005 to 2010 such as population, average population by urban or rural areas, the number of non-stated industrial establishments by district and number of elementary schools by district.

Table 2 shows the distributions of residential locations in RP and SE choices. It can be confirmed that there is a slight increase in the share of residing in the urban core from 39.59% (RP data) to 41.96% (SE data), while the shares of the urban fringe and suburban residence in the future expectation decreases.

The differences between RP and SE choices indicate that RP-based residential location may not reflect people's best preferences. This phenomenon can be partially explained by overall assessment on living environments. As shown in Figure 2, a preliminary analysis revealed that the biggest issues of living conditions are almost observed in suburban neighbourhoods, including water supply, sanitary treatment, and solid waste collection services. For example, 79.29% of interviewees living in suburban neighbourhoods answered that there was no piped water supply, while only 2.34% in the urban core. Similarly, the top two issues are "no sanitary treatment" and "no solid waste collection" in suburban neighbourhoods, reported by 42.61% and 22.39% of respondents, respectively. Hence, there is a possibility that people have a propensity to reside in the urban core because there is lack of urban facilities and services in suburban neighbourhoods. On the other hand, the respondents living in the urban core and the urban fringe are more dissatisfied with air quality and tranquillity (see Figure 3). The noisy pollution and deterioration in air quality may be

caused by the high traffic volume on roads in these areas. Clearly, peoples' experiences in current neighbourhood characteristics would influence their expectations for future choices.

Table 2. The distribution of residential locations in RP and SE choices

Type of neighborhood	Share in residential location choice	
	RP choice (current choice)	SE choice (future expectation)
Urban core	5428 (39.59%)	5753 (41.96%)
Urban fringe	3992 (29.11%)	3840 (28.00%)
Suburban	4292 (31.30%)	4119 (30.04%)
Total	13712	13712

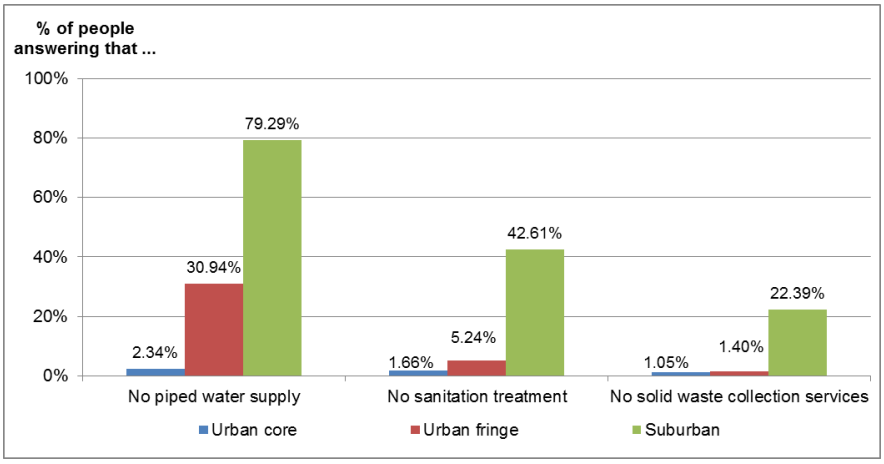

Figure 2. People's perceptions about living conditions by neighbourhoods

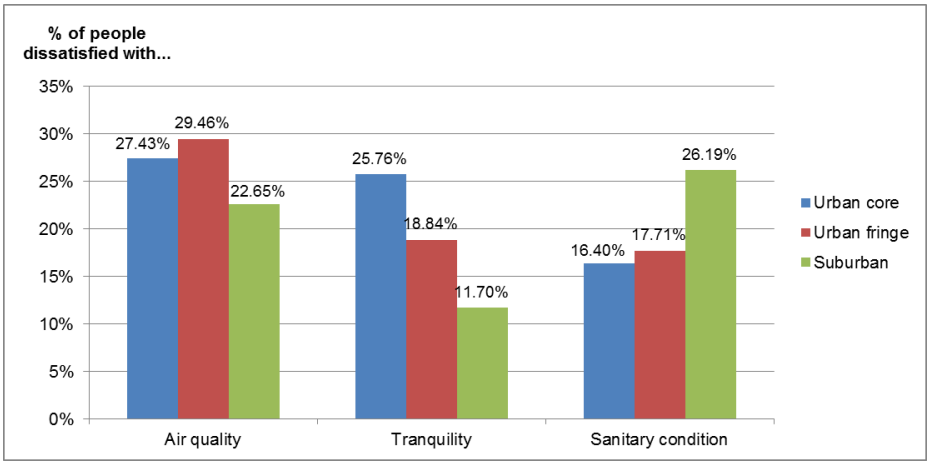

Figure 3. People's dissatisfaction with living environments by neighbourhoods

3. ANALYSIS OF RP AND SE BASED RESIDENTIAL LOCATION CHOICES

3.1. Models and Variables

Here, the multinomial logit (MNL) model is used, which has been widely used in the modelling of residential location choice behaviour. We recognize the fact that RP and SE choices may have different sets of influential factors. Since our main purpose of this study is

to confirm how neighbourhood characteristics influence SE choices and RP choices, two separate RP and SE models are estimated by using the same set of explanatory variables. Since different households may have different preferences for neighbourhood characteristics, such heterogeneity is incorporated into the modelling process.

Let n be an index that represents household (n = 1, 2,…, N) and i be an index of alternative (i = 1, 2,..., I). Then the utility functions of RP and SE models are defined in equations (1) and (2), respectively:

$$U_{ni}^{RP} = V_{ni}^{RP} + \varepsilon_{ni}^{RP} = \beta^{RP} Z_{ni}^{RP} + \alpha^{RP} Z_{ni}^{RP} X_n^{RP} + \varepsilon_{ni}^{RP} \quad (1)$$

$$U_{ni}^{SE} = V_{ni}^{SE} + \epsilon_{ni}^{SE} = \beta^{SE} Z_{ni}^{RP} + \alpha^{SE} Z_{ni}^{RP} X_n^{RP} + \epsilon_{ni}^{SE} \quad (2)$$

where,

V_{ni}^{RP}: the deterministic component of the RP choice utility,
V_{ni}^{SE}: the deterministic component of the SE choice utility,
Z_{ni}^{RP}: the vector of current neighbourhood characteristics,
X_n^{RP}: the vector of household attributes,
β^{RP}, α^{RP}: the vectors of unknown parameters in the RP utility function,
β^{SE}, α^{SE}: the vectors of unknown parameters in the SE utility function, and
ε_{ni}^{RP}, ϵ_{ni}^{SE}: the error terms of RP and SE utility functions, which are assumed to be independently and identically Gumbel-distributed across alternatives.

As described above, both RP and SE models follow the same assumptions about the utility maximization and distributions of error terms made in the MNL model. In the survey, RP choices were made for actual location in the past. In contrast, SE choices for future were made in the present based on incomplete scenarios. In this sense, RP choices may be more reliable than SE choices. Such different reliability levels are usually reflected in the evaluation of error terms. Since these two models are estimated separately, such differences cannot be explicitly identified. This is one of the limitations of this study.

In this study, explanatory variables in Table 3 were selected based on literature review and preliminary studies. The neighbourhood characteristics include land use attributes and residential attractiveness (measured at the district level). Differences in the sensitivities to neighbourhood characteristics across households are taken into account adding interaction terms between household attributes and neighbourhood characteristic, following the idea of existing studies (e.g., Bhat & Guo, 2004, 2007). These interactions terms may not only moderate effects of land use on residential location choice but also control for self-selection issue. Litman (2011) defined self-selection as “the tendency of people to choose locations based on their travel abilities, needs and preferences”. There are two main sources that cause residential self-selection, including: attitudes and socio-demographics (Mokhtarian & Cao, 2008). We do not intend to deal with attitudes in this paper. With respect to the latter source, an example of self-selection is that households with kids are more likely to choose a location close to educational facilities than those without kids. In this study, hence, household attributes such as income, number of workers, number of children, number of seniors, and vehicle ownership, were selected. In both models, neighbourhood characteristics and their interaction with household attributes are introduced as explanatory variables.

Table 3. Explanatory variables of residential location choice models

Explanatory variable	Definition	Mean	SD
Household socio -demographics			
HH income	Monthly household income (million VNDs)	6.143	5.403
No. of children 6	Number of children aged below 6 years old	0.343	0.640
No. of children 6-10	Number of children aged between 6 and 10 years old	0.183	0.418
No. of seniors	Number of senior members aged above 60 years old	0.632	0.799
No. of adults 16-60	Number of active adults aged between 16 and 60 years old	2.793	1.336
No. of motorcycles	Number of motorcycles	1.476	1.002
Presence of car	Car availability (1=Yes, 0=No)	0.013	0.115
No. of workers	Number of workers	1.993	1.156
Land use attributes			
Commercial and business land	Percentage of commercial and business-related land in a neighbourhood	1.886	2.009
Medical and welfare land	Percentage of medical and welfare land in a neighbourhood	0.755	0.975
Mixed residential and commercial land	Percentage of mixed residential and commercial land in a neighbourhood	0.219	0.311
Park and recreational land	Percentage of park and recreational land in a neighbourhood	1.602	1.678
Transport and service land	Percentage of transport and service land in a neighbourhood	8.140	3.451
Urban residential land	Percentage of urban residential land in a neighbourhood	29.489	20.184
Residential attractiveness			
Kindergartens	Ratio of number of kindergartens to population (schools/1000 persons)	0.089	0.012
Primary schools	Ratio of number of primary school to population (schools/1000 persons)	0.077	0.018
Urban population	Ratio of population living in urban area	0.690	0.439
NSO industrial establishments	Ratio of number of non-stated industrial establishment to population (establishments /1000 persons)	5.089	2.657

3.2. Estimation results

This sub-section presents estimation results of models obtained using data from the previously mentioned 13,712 households in Hanoi (see Table 4).

It is observed that there are three variables that show different signs of parameters in the RP and SE models. First of all, the percentage of medical and welfare land is positively associated with residential location choice in the RP model, while its parameter is negative in the SE model. There is a possibility that the households in the RP context may prefer areas with higher fraction of land devoted to medical and welfare land. However, once they are in the SE circumstance may tend to stay away from such areas. This finding implies that city planners or managers may face the dilemma whether they should locate the hospital or medical centre near or far away from residential areas. It is hard to answer why people are shy away from zones with higher percentage of medical land. This issue may be explained by connecting to results of overall assessments of living environments. Figure 2 shows that the respondents are very sensitive to living conditions, especially sanitary conditions and solid waste collection in their neighbourhood. The solid and water waste from the hospitals and welfare are a serious issue in Hanoi due to the lack of treatment facilities. Duong et al. (2008) investigated six top hospitals in Hanoi and found that there was a lack of wastewater treatment plants in five out of the six hospitals. In addition, they figured out that the hospitals are important point sources contributing to water quality issues, especially discharge of wastewater without treatment into the receiving ambient waters (p.973). Therefore, people

may not want to reside in the locations with high rate of medical land due to such environmental issues. Second, the "park and recreational land" variable has a positive impact on the residential location choice in the RP model, but the parameter sign becomes negative in the SE model. Simply speaking, the result of RP model indicates that households may locate themselves in areas with higher percentage of land devoted to park and recreational land, while that of the SE model means that people tend to escape from such areas. Third, the RP model results show that the households are likely to reside in areas of higher urbanization (i.e. the majority of population live in urban area). However, this variable in the SE model has shown a negative impact on residential location choice, implying that households are shy away from such places. As shown in Figure 3, respondents living in the urban core and the urban fringe tend to be dissatisfied with air quality and tranquillity. These findings seem to be consistent with the negative effect of "urban population" variable as shown in the estimation results of the SE model.

Table 4. MNL estimation results for residential location choices

Explanatory variables	RP			SE		
	β_{RP}	t-value	$\beta_{RP} * \bar{X}$	β_{SE}	t-value	$\beta_{SE} * \bar{X}$
Alternative-specific constant terms						
Urban fringe	4.251***	10.834		2.059***	5.348	
Suburban	12.991***	7.242		-34.105***	-16.421	
Land use variables (including interaction terms with household attributes)						
Commercial and business land	0.159***	4.016	0.299	0.613***	15.124	1.156
- Interaction with HH income	-0.017***	-7.194	-0.196	-0.008***	-3.644	-0.092
- Interaction with No. of workers	-0.055***	-8.029	-0.207	-0.039***	-6.159	-0.147
Medical and welfare land	0.237**	2.386	0.179	-0.260***	-2.669	-0.196
- Interaction with No. of senior	0.038***	3.026	0.018	0.016	1.357	0.008
Mixed residential and commercial land	0.910***	4.399	0.199	3.092***	15.315	0.677
- Interaction with HH income	-0.318***	-24.060	-0.430	-0.166***	-11.260	-0.225
Park and recreational land	0.097**	2.471	0.155	-0.104***	-2.753	-0.167
- Interaction with No. of adults 16-60	-0.013	-1.842	-0.059	-0.013**	-2.023	-0.059
Transport and service land	-0.026**	-2.016	-0.212	-0.161***	-12.434	-1.311
- Interaction with No. of motorcycles	0.048***	13.642	0.576	0.039***	11.933	0.468
- Interaction with Presence of car	0.066**	2.480	0.007	0.083***	3.261	0.009
Urban residential land	0.128***	22.540	3.775	0.022***	4.266	0.649
- Interaction with HH income	0.014***	28.413	2.540	0.008***	16.181	1.451
Residential attractiveness (including interaction terms with household attributes)						
Kindergartens	-56.639***	-15.425	-5.028	-0.499	-0.136	-0.044
- Interaction with No. of children 6	4.362***	2.589	0.133	3.106**	2.021	0.095
Primary schools	127.816***	25.844	9.880	0.320	0.063	0.025
- Interaction with No. of children 6-10	4.305***	2.863	0.061	2.670	1.908	0.038
Urban population	6.406***	3.403	4.417	-40.393***	-18.649	-27.853
- Interaction with No. of adults 16-60	-0.067**	-2.333	-0.129	-0.053**	-1.958	-0.102
NSO industrial establishments	-0.292***	-12.955	-1.486	-0.002	-0.077	-0.010
- Interaction with No. of workers	0.111***	19.170	1.126	0.062***	11.787	0.629
Sample size	13,712			13,712		
Initial Log-Likelihood	-15064.17			-15064.17		
Converged Log-Likelihood	-11653			-12934.14		
Rho-square	0.226			0.141		
Adjusted rho-square	0.224			0.139		

Note: $\beta * \bar{X}$ is used to the partial utility (indicating the relative influence) with respect to each variable
(***) Significant at 1% level; (**) Significant at 5% level

The rest of variables in RP and SE models have the same signs of parameters, but differ in the magnitude of the impacts. Among these variables, several neighbourhood

characteristics in the SE model (e.g., commercial and business land, mixed residential and commercial land, and transport-related land) show relative increases in the numerical values of parameters, implying that these characteristics may have more impacts on people's future expectations in the SE circumstance. These findings also indicate that households may tend to locate in areas with a higher percentage of land devoted to commercial land, mixed commercial and residential land in both RP and SE choice situations. Interestingly, as expected, all interaction terms between land use attributes and household income are closer to zero value in the SE context, indicating that the effects of household income on housing location in the SE model are smaller than those in the RP model. For instance, the parameter of interaction between urban residential land and household income are 0.014 (RP) and 0.008 (SE). On the other hand, these interaction terms are still significantly associated with residential location choice in the SE model. These results imply that people may consider their current economic abilities in choosing where they live even in unspecified scenarios. Parameters on transport-related land use variables show negative signs for both models, implying that households are likely to stay away from areas with higher land invested in transportation. This may be explained by linking to overall assessment of dissatisfaction with air quality and tranquillity. In Figure 3, the results indicate that a higher percentage of respondents in the urban core and the urban fringe are not satisfied with air quality and tranquillity. The noise pollution may be caused by road traffic as examined by some existing studies. Phan et al. (2010) explored the features of road traffic noise in Hanoi by investigating seven sites within the urban fringe and core. The results showed that "the traffic noise in Hanoi was characterized by relatively high noise exposure level due to the large number of motorbikes and frequent horn sounds" (p.479).

Some parameters of neighbourhood characteristics show a substantial decrease in numerical values in the SE model, compared with those in the RP model, indicating that effects of such neighbourhood characteristics on people's future expectations for residential location choices may be diminished. First, there are positive impacts of the primary school and urban residential land on the housing location choice in both model estimation results. However, the influences of such neighbourhood characteristics in the RP model are larger than those in the SE model. Similarly, the negative effects of kindergartens and non-stated owned industrial establishments on residential location choice are found in both RP and SE models. However, three of these four variables are not statistically significant in the SE model, including kindergartens, primary schools and non-stated owned industrial establishments.

Finally, several parameters of interaction terms between neighbourhood characteristics and household attributes show similar results in both RP and SE models. The interaction term between transport-related land and household motorcycle ownership are 0.048 (RP) and 0.039 (SE), indicating that the household with a higher level of motorcycle ownership may prefer areas with a high percentage of transport-related land. Similarly, the parameters of interactions with the presence of car in both models are quite the same, 0.066 (RP) and 0.083 (SE). In addition, there are also similar effects of kindergartens and primary schools on decisions of households with/without children in choosing where to live. For example, the parameters of "interaction with No. of children 6" variable in RP and SE models are 4.362 and 3.10, respectively, implying that households with more children aged below 6 years old tend to reside in a area with a higher ratio of kindergartens. These results indicate that kids play a very important role in household's decision on where to live.

4. CONCLUSION

This paper empirically explored the value of subjective expectation in explaining and modelling residential location choice behaviour focusing on the influence of current neighbourhood characteristics in the context of Hanoian's choice. A key concern here was that current neighbourhood characteristics may affect not only RP choices (i.e. actual choices made in the past) but also SE choices (i.e., expectations for future choices). Using data of a household survey conducted by JICA in Hanoi in 2005, this study investigated how the influences of current neighbourhood characteristics on peoples' housing location choices are different between RP and SE circumstances. As an empirical analysis, RP and SE models were separately estimated by using the same set of explanatory variables.

The model estimation results showed that several parameters differ in signs and numeric values in the two models. With respect to the signs, three parameters of neighbourhood characteristics have different signs, including medical and welfare land, park and recreational land, and ratio of population living in urban area. These indicate that the current living environments may have opposite effects on people's expectations about future housing location choices to actual choices. In term of numeric values, there is an increase or decrease in magnitudes of parameter in SE models, compared with RP model. These results indicate that the current living environments may have ascending or descending influences on Hanoians' subjective expectations about residential location choices in future. The rest of variables show similar impacts on both RP and SE choices such as the effects of primary schools on decisions of households with and without kids. In conclusion, this paper has emphasized the potential of using subjective expectation data in explaining and understanding residential location choice behaviour.

This paper has some limitations. First, the use of MNL model may not reflect actual choice mechanisms because of its assumptions about error terms and it may be worth using choice models allowing more general features of error terms. Second, unrevealed information for the subjective expectation may result in a variety of preference heterogeneity, which should be properly represented by more advanced choice models. Third, RP and SE choices have not been linked in the model development process. As noted by Zhang et al. (2007), the current action in making a choice should be considered in connection with past or future choices. In this sense, it may be necessary to develop a combined RP-SE residential location choice model. Finally, this paper has not dealt with the mechanisms which describe how people form and update their expectations about future choices. Hence, further studies from such a viewpoint may be required.

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