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# A prospect theory-based analysis of housing satisfaction with relocations: Field evidence from China

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## ABSTRACT

This paper proposes a theoretical framework based on prospect theory to explain the determinants of housing satisfaction among relocated residents. We test the two most important elements of prospect theory, namely, reference point dependence and loss aversion. For reference point dependence, we investigate the presence of both internal and external reference points; for loss aversion, we test its effect directly by comparing coefficients in loss and gain domains and indirectly by verifying the presence of the endowment effect. Our study area is Xiamen, China, where the recent urbanization development provides a natural experiment setting to reliably test our hypotheses. Our empirical findings provide convincing evidence to support the four hypotheses developed from prospect theory, indicating that prospect theory is a working theory to better understand the motivations and concerns of relocated residents. Policy recommendations are subsequently derived to reduce social conflicts and disharmony caused by urban redevelopment and relocations.

## 1. Introduction

Development-induced displacements are a growing global phenomenon that may lead to violations of the right to adequate housing as defined in the Habitat Agenda (UN-Habitat, 2011). The motivation for housing demolition and resettlement is to acquire land for development rather than to improve the livelihood of the displaced households, whose relocation is often involuntary. This situation gives rise to many economic, social, and political problems. For example, monetary compensation determined by the authority may not cover all the economic, social, and psychological losses incurred by the displaced households (Pils, 2016). Relocating households to urban fringes with inadequate infrastructures and amenities can also result in gentrification, loss of neighborhood cohesion, and weakening of neighborhood ties (He & Wu, 2007; Liu, Wu, Liu, & Li, 2017; Wu, 2004b, 2016). The large financial stakes involved in redevelopment projects often lead to unethical behaviors of local authorities in their effort to speed up the resettlement process (O'Brien & Deng, 2015; Song, Wang, & Lei, 2016) and even to self-immolation behaviors by displaced residents as a way to voice their objection to unfair treatments (Pils, 2016). Social tension resulting from disputes and conflicts over involuntary relocation is not

uncommon (see, for example, Hui & Bao, 2013; Shih, 2010). Thus, redevelopment and resettlement policies should be designed to achieve not only economic efficiency but also fairness, equality, and inclusion (Cernea, 1997). This challenging task cannot be accomplished without a good understanding of factors that determine displaced residents' satisfaction toward relocation policies.

As a specific domain of life satisfaction, residential satisfaction can be seen as residents' subjective evaluation of their homes and neighborhood environment relative to certain benchmarks (Ibem & Amole, 2013). Some studies have shown that residential satisfaction is influenced by social comparison (Vera-Toscano & Ateca-Amestoy, 2008) and have-want discrepancy (Cao & Wang, 2016; Huang, Dijst, & Weesep, 2017; Jansen, 2013; Jansen, 2014b). Existing literature has emphasized the impact of housing conditions (Fang, 2006; Li & Song, 2009; Oakley, Ruel, & Reid, 2013), neighborhood characteristics, and household demographics (Cao & Wang, 2016; Day, 2013; Jansen, 2014a; Kearns & Mason, 2013; Keene & Ruel, 2013; Wu, 2004b) on relocation satisfaction. However, investigations into the psychological determinants of relocation satisfaction are limited. Houses are not just consumption goods, they also carry social, political, and cultural values. Housing relocation involves the reconstruction of physical buildings and the

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renaissance of its socio-psychological meanings to households (Atkinson, 2015; Davidson, 2011; Keene & Ruel, 2013; Kleinhans & Kearns, 2013). Therefore, a behavioural approach<sup>1</sup> is needed to understand whether and how psychological factors contribute to the relocation satisfaction of displaced households. There are some applications of behavioural insights in the urban economics and public policy domains (Chetty, 2015; Thaler, 2016). For example, reference dependence helps explain why farmers experienced welfare loss after land requisition (Li, Huang, Kwan, Bao, & Jefferson, 2015) and why the Beijing Olympic regeneration caused disadvantaged residents to anticipate relocation to undesirable areas (Wang, Bao, & Lin, 2015). In both studies, all respondents were better off in absolute terms as they were given compensation for their lost land or have benefited from amenity improvement from the regeneration projects. However, some of them felt worse off as the outcomes fell short of their expectations. Consequently, the same outcome could lead to divided responses given very different expectations. Although these studies are not directly related to our research topic, they do highlight the importance and benefits of considering psychological factors in the public policy domain. Further studies along this direction are clearly needed.

To fill this gap in the literature, we use prospect theory (PT) (Kahneman & Tversky, 1979), a well-established model in behavioural sciences, to explain the determinants of housing satisfaction among relocated residents. We test the two most important elements of PT, namely, reference point dependence and loss aversion. For reference point dependence, we investigate the presence of both internal and external reference points; for loss aversion, we test its effect directly by comparing coefficients in loss and gain domains and indirectly by verifying the presence of the endowment effect. Our study area is Xiamen, China, where the recent urbanization frenzy provides a natural experiment setting to reliably test our hypotheses.

The rest of the paper is organized as follows. Section 2 provides the theoretical framework and the hypotheses based on PT. Section 3 presents details of the empirical implementation of our theoretical models. Section 4 discusses the empirical findings. Section 5 presents the conclusions.

## 2. Theoretical framework and testable hypotheses

Prospect Theory was developed by Kahneman and Tversky (1979). It is often considered as a psychologically more accurate model of decision making under risk and uncertainty. Different from the assumption of *Homo economics* in the standard economic theory, it adopts the *Homo sapiens* assumption (with a psychological motivation) to explain and predict human behaviour (Thaler, 2016). There are four elements in PT: reference dependence, loss aversion, diminishing sensitivity, and probability weighting. Over the last four decades, PT has been extended to the analysis of riskless choice (Thaler, 1980; Tversky & Kahneman, 1991) and applied in a wide range of topics, including finance, insurance, labour supply, and the endowment effect (Barberis, 2013).

Under PT, people derive values (i.e., utilities) from gains or losses, which are measured relative to reference points rather than from absolute levels of outcomes. The behaviors of decision makers are different in these two domains, with responses to the same level of changes in the loss domain being greater than those in the gain domain. This phenomenon is coined as loss aversion. These two most important elements of PT can be illustrated by Eq. (1) as follows (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992).

$$v(X) = \begin{cases} (X - r)^a & X \geq r \\ -\lambda(r - X)^c & X < r \end{cases} \quad (1)$$

where  $v(X)$  is the value function based on outcome  $X$ , and  $r$  is the reference point. The first part of the equation defines the gain domain, where  $X$  is greater than  $r$ , while the second part of the equation specifies the loss domain, where  $X$  is below  $r$ .  $\lambda > 1$  reflects that individuals' value function in the loss domain is steeper than that in the gain domain (i.e., loss aversion).  $\lambda$  is conventionally called the loss aversion coefficient.  $a$  and  $c$  are the parameters to capture the diminishing sensitivity effect, where  $a < 1$  and  $c < 1$ .

PT is an improvement over standard economic theory because it considers both the consumption utility derived from the outcome itself (i.e.,  $X$ ) and the gain/loss utility defined by comparisons with a reference point (i.e.,  $r$ ). This advantage is particularly relevant to the housing market, where decisions are often affected by aspirations and expectations, which are robust and valid reference points in many related areas (see, for example, Cao & Wang, 2016; Jansen, 2013; Jansen, 2014a; Li et al., 2015; Vera-Toscano & Ateca-Amestoy, 2008; Wang et al., 2015). Determining the reference points in the application of PT is important because outcomes are compared to these points and are coded and evaluated in terms of the comparison (Kahneman, 1992). Tversky and Kahneman (1991) suggest that reference points can be an individual's current position, aspirations, norms, or social comparisons, among others. These factors are classified into internal and external comparisons in the happiness or life satisfaction literature (see, for example, Clark, Frijters, & Shields, 2008). Internal comparison means the individual is compared to herself over time, while external or social comparison involves comparing oneself with relevant others or a peer group.

In the context of residential relocation, the housing satisfaction of displaced residents is likely to be affected by both types of reference points. Residential relocation is a lengthy and complex process wherein relocated households form concrete expectations toward the outcome as well as compare their own outcomes with those in other similar projects. These expectations and comparisons serve as reference points in the relocated households' decision function and subsequently affect their overall satisfaction level. We test the effect, if any, of these two types of reference points on relocated households in Hypotheses 1 and 2.

**Hypothesis 1 (internal reference point hypothesis).** The housing satisfaction of relocated households depends on the discrepancy between their relocation outcome and their ex ante expectations.

According to Hypothesis 1, the ex ante expectation of relocated households serves as a natural reference point in determining their satisfaction toward their relocation outcomes. Expectations are believed to play a role in reference point formation for satisfaction evaluation (Clark, 1997; Clark et al., 2008), and happiness is determined by the gap between achievement and aspiration (Dolan, Peasgood, & White, 2008; Easterlin, 2003; Frey & Stutzer, 2002). The discrepancy between what one has and what one would like likewise influences housing satisfaction (Cao & Wang, 2016; Jansen, 2013; Jansen, 2014a). When expectation is considered as an anchor, the satisfaction of displaced households is influenced by the degree to which the outcome exceeds, meets, or falls short of one's expectation. If the perceived relocation outcome exceeds their expectation, the displaced family will consider this unexpected result as a gain, which increases satisfaction. Conversely, if the relocation outcome is perceived to be worse than anticipated, the household will regard this negative disconfirmation as a loss, which results in disappointment and dissatisfaction.

**Hypothesis 2 (external reference point hypothesis).** Comparisons with relevant others or peer groups indicate the worse-off households have low levels of housing satisfaction.

Social comparison is the counterpart of the economists' concept of

<sup>1</sup> According to Cambridge English Dictionary, 'behavioural' is defined as 'relating to behaviour'. In this study, however, 'behavioural' carries a different meaning. Specifically, 'Behavioural analysis' applies insights from behavioural economics and cognitive psychology in decision making under risk and uncertainty. This approach has seen wide applications in the public policy domain (see, for instance, Linder, Lindahl, & Borgstrom, 2018; Nakamura, Suhrcke, & Zizzo, 2017; Oliver, 2013).

interdependent preference (Easterlin, 2003) and is considered a central phenomenon within human societies in social psychology (Adams, 1963; Festinger, 1954). It also has an important role in determining housing satisfaction (Vera-Toscano & Ateca-Amestoy, 2008). When displaced families compare their situation with similar households, they gain knowledge of their positions in the outcome distribution among all relevant reference groups. If the outcome of their housing relocation is considered inferior to that of other households, the household will regard this outcome difference as a loss, which will result in feelings of unfairness, indignation, and dissatisfaction. On the other hand, if the outcome is perceived to be better than that of their peer groups, the family will be in the gain domain and have a high level of satisfaction.

The second application of PT in relocation satisfaction study is loss aversion. We test the effect of loss aversion both directly and indirectly by using Hypotheses 3 and 4, respectively.

**Hypothesis 3 (direct test of loss aversion effect).** For the same amount of deviation from the reference point, relocated households in the loss domain experience more changes (i.e., decreases) in housing satisfaction level than do households in the gain domain.

If loss aversion is present, displaced households will be more sensitive to losses than to gains relative to the reference points identified in Hypotheses 1 and 2. The underlying psychological and neural mechanisms for loss aversion is rather complex. Using experiment data, Kermer, Driver-Linn, Wilson, and Gilbert (2006) found that respondents underestimated their ability to rationalize losses and overestimated their tendency to dwell on losses. Subsequently, losses have greater hedonic impact than gains. Losses are also associated with heightened automatic arousal, such as pupil dilation and increased heart rate, compared with equivalent gains (Hochman & Yechiam, 2011). Yechiam and Hochman (2013) found that losses increase on-task attention. Such asymmetric allocation of attention between losses and gains leads to distinct effects on performance, arousal, frontal cortical activation and behavioural consistency. Evidence supports the role of loss aversion in satisfaction judgments in the domains of pay, happiness, and marketing (see, for example, Knight, Song, & Gunatilaka, 2009; Ordonez, Connolly, & Coughlan, 2000; Vendrik & Woltjer, 2007). Satisfaction toward relocation outcomes or expectations relative to others can display this loss aversion pattern as well. Specifically, the pain associated with receiving a relocation outcome lower than the level of others or of expectations outweighs the pleasure associated with getting a positive outcome of the same magnitude. Thus, for a loss-averse household, receiving less than expected will cause relocation satisfaction to decrease more than a same-size positive disconfirmation will increase relocation satisfaction. The same effect applies to external comparison as well.

**Hypothesis 4 (indirect test of loss aversion effect).** Endowment effect (in the form of place attachment) is a significant determinant of housing satisfaction toward relocations.

We indirectly test the presence of loss aversion by investigating one of its most robust outcomes, namely, endowment effect. Endowment effect is probably the most commonly used example of the application of loss aversion in decision making (Knetsch, Tang, & Thaler, 2001; Thaler, 1980). It implies that the individual's valuation of a good increases when it becomes part of her endowment, which results in exchange asymmetries and willingness-to-accept/willingness-to-pay gaps (Kahneman, Knetsch, & Thaler, 1990; Knetsch, 1989). Loss aversion is stronger and the reluctance to surrender goods increases when people's attachment to the goods increases (Ariely, Huber, & Wertenbroch, 2005; Ericson & Fuster, 2014).

In the housing market, endowment effect manifests itself in the form of place attachment, that is, the special sentimental attachments residents have to the place where their houses are located. Emotional attachment to ownership leads to the endowment effect (Ariely et al., 2005; Shu & Peck, 2011). In the context of housing market, people are

often emotionally attached to the places where they live. When this emotional tie is strong, one may be reluctant to move away from her current residence (i.e., place attachment), even if moving is a completely rational decision by standard economic theory; the emotional loss needs to be compensated in order to make the move acceptable. This causes home-sellers to ask for a higher price than buyers' offers, which lead to the willingness-to-sell and willingness-to-buy gap, or the endowment effect. Therefore, in housing market place attachment and endowment effect are two sides of the same coin (i.e., loss aversion).

The disruption of place attachment is among the most notable impacts of displacement on the well-being of households (Fried, 2000). In a UK study, outmovers who live far from their previous neighborhood are less likely to be satisfied (Kearns & Mason, 2013). Place attachment is also indispensable in the redevelopment of urban China (Song, Chiang, & Li, 2012). In our pilot study, we also identified a similar strong emotional attachment to original residence and preference for on-site resettlement among the respondents as in Song et al. (2012).

The preference of displaced households for returning to their original place is well understood when the endowment effect is considered. Although the demolition of houses and the disintegration of the community inevitably rupture the emotional connections to the place, return settlement provides families the opportunity to maintain a stable self-identify, retain their social networks, and familiarize themselves with access to public facilities and services. If households are forced to relocate far from their original place, it will take time to reestablish relations with others in the new neighborhoods, resulting in a lack of the feeling of rootedness to the new place. Thus, the endowment effect will, on average, induce a higher satisfaction for the households that relocated close to their original place than for those that relocated far.

### 3. Empirical implementations

Without losing any generality, the basic relationship between the satisfaction of relocated households and its determinants can be described by Eq. (2).

$$S = \alpha + [\beta_1(X - r) | X \geq r] + [-\beta_2(r - X) | X < r] \quad (2)$$

where  $S$  is the displaced resident's reported satisfaction with the outcomes of residential relocation,  $X$  is the relocation outcome we wish to study, and  $r$  is a vector of reference points. When field data are used in the empirical analysis, Eq. (2) must be augmented with control variables to account for other factors that may influence the observed satisfaction level, as illustrated in Eq. (3).

$$S = \alpha + [\beta_1(X - r) | X \geq r] + [-\beta_2(r - X) | X < r] + \theta P + \gamma Z + \varepsilon \quad (3)$$

where  $Z$  represents a matrix of control variables, such as socio-demographic factors, information set, physical housing, and neighborhood characteristics.  $P$  is a measurement of place attachment, which has a coefficient  $\theta$  that can determine the presence of the endowment effect.  $\varepsilon$  is the error term.

To test Hypotheses 1 and 2, we include two reference points in vector  $r$ , which gives rise to Eq. (4).

$$S = \alpha + \beta_{11}EC_{gain} - \beta_{21}EC_{loss} + \beta_{12}SC_{gain} - \beta_{22}SC_{loss} + \theta P + \gamma Z + \varepsilon \quad (4)$$

where  $EC$  and  $SC$  measure the comparison with expectation and social comparison, respectively.  $EC_{gain} = 1$ , when outcome exceeds expectation and zero otherwise.  $EC_{loss} = 1$ , when outcome is below expectation and zero otherwise.  $SC_{gain}$  and  $SC_{loss}$  are defined in the same way.

To test Hypothesis 1, we expect that  $\beta_{11}$  is significantly positive and  $\beta_{21}$  is significantly negative. For Hypothesis 2 to be true,  $\beta_{12}$  should be significantly positive and  $\beta_{22}$  should be significantly negative. If  $\beta_{11} < |\beta_{21}|$  and  $\beta_{12} < |\beta_{22}|$ , then Hypothesis 3 is supported. The presence of the endowment effect (i.e., Hypothesis 4) is tested with  $\theta$ .

### 3.1. Study area and institutional background

China has been responsible for the largest proportion of the world's displacement caused by development (Xue, Wang, & Xue, 2013). Tens of millions of families, both in the countryside and in inner cities, have been uprooted and relocated for urban redevelopment, infrastructure construction, industrial zone development, and nature conservation. For example, in Shanghai, 113.76 million m<sup>2</sup> of housing was demolished from 1995 to 2015, leading to the displacement of over 1 million households, or 25.5% of the total registered households in the city.<sup>2</sup> Given that most of these relocations in China are involuntary, increasing social tension has resulted from the disputes and conflicts over residential relocation (Hui, Bao, & Zhang, 2013; Shih, 2010). The situation is further exacerbated by inequalities in displacement compensation and resettlement housing allocation (Chen, 2012; Hu, Hooimeijer, Bolt, & Sun, 2015; Qian, 2015; Tang, Hao, & Huang, 2016; Yang, Zhang, Meng, & McCarn, 2015), and corruptions (Song et al., 2016). According to the State Bureau of Letters and Calls, appeals and complaints associated with demolition and relocation have consistently comprised the largest proportion of all cases in China, with the figure reaching 20.8% as of April 2016. An enhanced understanding of relocated residents' satisfaction is crucial to address this threat to social harmony and political stability. The scale of redevelopment projects and the diversity of the country offer a wealth of data to test our hypothesis.

Xiamen City is selected as the study area of this research. Xiamen is located in the Southeast coast of Fujian Province and across the Taiwan Strait (Fig. 1). From 2000 to 2015, the city's population increased by 88.29%, and its GDP grew at 13.32% annually.<sup>3</sup> Along with rapid economic development and population expansion, the city has undergone rapid urban expansion and urban redevelopment. The annual average construction areas of housing expropriation in Xiamen stood at 2.1 million m<sup>2</sup> between 2000 and 2015. Furthermore, Xiamen is one of the first five special economic zones, and in 2002, it was authorized by the Ministry of Land and Resources of China as a pilot city to conduct land expropriation system reform. Therefore, it is economically and politically important to study the effectiveness of housing expropriation and resettlement policies in Xiamen.

Among the six administrative districts in Xiamen, the Siming and Huli districts constitute the traditional Xiamen City core region (see the highlighted area in Fig. 1). In 2015, the population in these two districts accounted for 51.94% of the total population in Xiamen, though this region only covers 9.28% of the total land area of Xiamen City. To renovate the old urban area and promote the functional transformation of urban space, many urban redevelopment projects have been launched in these two districts. Consequently, we select these two districts as the study area.

In Xiamen, displaced households can select either ownership swap (i.e., swap their old houses for new ones) or monetary compensation. In general, a family with a large demolished house can have an option for a large relocation house. The value of the demolished housing is determined by a property appraisal agency appointed by the government. Furthermore, it is common practice to give cash incentives to encourage households to vacate the site promptly. The district government is responsible for housing expropriation, compensation, and resettlement within the administrative jurisdiction. For example, local governments decide whether a building or a part of a building is illegal and is thus not eligible for compensation, whether a family is living in an overcrowded environment and should be allocated more housing spaces, whether affected households should be relocated on the original site or off-site, and whether any discretion should be practiced in specific compensation plans. Therefore, local governments play important roles

in determining the relocation outcomes.

### 3.2. Data collection and descriptive statistics

We choose one of the most significant redevelopment projects, i.e., *Chenggong Avenue construction project*, for our empirical investigation. This key municipal-level infrastructure project affected most of the core region in Xiamen by relocating over 1350 families among six resettlement communities across the island (Fig. 1).

The content and the structure of the questionnaire were determined based on a comprehensive literature review and semi-structured interviews of five local government officials who were involved in the resettlement project. We also conducted in-depth interviews among 20 relocated households to further improve the questionnaire design. All of these interviews were completed in June 2016. The first draft of the questionnaire was tested by a pilot run with a sample size of 40 in July 2016. The final version of the questionnaire, after incorporating all feedback and comments from aforementioned steps, consisted of five sections that cover socio-demographic characteristics, housing and neighborhood characteristics (before and after the resettlement), residential satisfaction measurements, reference points measurements, and details of the relocation process, respectively.

We adopted stratified sampling approach to select respondents from the study area. Specifically, we used the six settlement areas as the strata, from which sub-samples were determined based on the proportion of displaced households in each of the six neighborhoods. Similar to the strategies adopted in Hu et al. (2015) and Wang et al. (2015), we randomly identified respondents in public areas in each chosen neighborhood (e.g. community common room, green space, and walkway) and conducted face-to-face interviews to complete the questionnaires. A small gift was given to the respondents for participation upon completion of the interviews.

A total of 280 interviews were conducted, with 253 valid responses collected. This is 18.74% of the 1350 dislocated households in the project. The sample size is large enough to ensure a maximum of 6% of margin of error and 95% confidence interval estimation (i.e.,  $n \geq 223$ ), and satisfies the rule of thumb to determine the minimum sample size in regression analysis (i.e.,  $n$  is at least ten times of the number of explanatory variables, or  $n \geq 180$  in our final model). More importantly, the sample is a good representation of the population. For example, 62.59% of the 1350 displaced households are relocated off-site; while this proportion in our sample is 63.64%. Further details of sample descriptive statistics can be found in Table 1. Variable definitions and descriptive statistics are given in Table 2.

The dependent variable is the overall satisfaction of households with the forced residential relocation, which is defined as the degree to which a displaced family feels satisfied with the outcomes of residential displacement. A multi-indicator approach may be more appropriate when measuring a theoretical construct or latent variable, in the literature. However, a single-item statement is widely used to measure the overall residential satisfaction or general happiness because the way the single-item question is asked suggests that individuals' replies evaluate numerous attributes of the whole package (Clark & Oswald, 1996; Paul & Guilbert, 2013). The current study is concerned about the determinants of overall satisfaction with residential relocation rather than the concrete components of residential satisfaction. Therefore, we adopt a single-item statement on a three-point Likert scale to measure the overall satisfaction with residential displacement. The survey question is "All things considered, how satisfied are you with the outcome of the residential relocation in general?" The responses are coded as "1" for dissatisfied, "2" for neutral, and "3" for satisfied.

To test the internal reference hypothesis, we use the residents' comparison of relocation outcomes with their expectations. An important question is how the expectation is formed. In the displacement process, households form expectations of relocation outcomes based on the available information, which typically is the blueprint of a specific

<sup>2</sup> Source: Shanghai Statistical Yearbook, 2016.

<sup>3</sup> Source: Xiamen Statistical Yearbook, 2016.

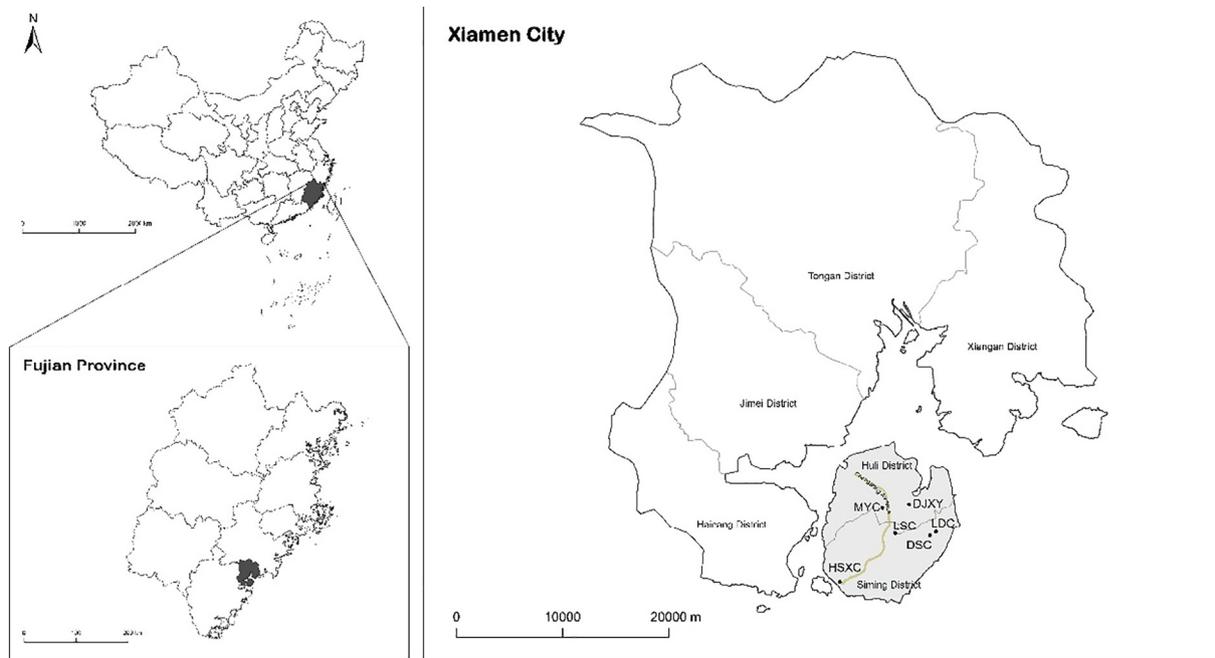


Fig. 1. Location of study area and survey sites.

Note: The six relocation sites or survey sites of our study are marked as HSXC, LSC, DSC, LDC, DJXY, and MYC, respectively.

**Table 1**  
Descriptive statistics of the sample profile.

Variable	Choice	Sample	Percentage
Gender	Male	127	50.2%
	Female	126	49.8%
Age	Below 30	31	12.25%
	Between 30 and 39	51	21.16%
	Between 40 and 49	64	25.3%
	Between 50 and 59	66	26.09%
	60 and above	41	16.21%
Education	Primary school and below	63	24.9%
	Middle school	78	30.83%
	High school	48	18.97%
	Three-year college education	28	11.07%
	University and above	36	14.23%
Monthly income	Below 3500	25	9.88%
	3500–6000	75	29.64%
	6000–8000	68	26.88%
	8000–10,000	36	14.23%
	10,000–15,000	28	11.07%
	Above 15,000	21	8.3%

residential resettlement program distributed by the government. Therefore, this variable is measured according to the response of the residents to the following question: “Compared to your expectation based on the blueprint of residential resettlement promised by the government, do you think your relocation outcome is worse off, about the same, or better off?” The answers to this question are coded as 1, 2 and 3, respectively. In the displacement process, it is common that project is still at the planning stage when affected households are provided with the blueprint to illustrate what the future relocated housing units and community would be like. The blueprint, therefore, serves as a reference point for their evaluations of the actual residential outcomes.

The three variables are defined to facilitate the test of the external reference hypothesis. The definition of social comparison variables depends crucially on the identification of reference groups. Empirical evidence shows that people compare themselves to the groups with whom they interact more frequently (Clark & Senik, 2010). In the context of residential relocation, it is reasonable to consider that

displaced households compare the outcomes of their residential relocation to that of other families with similar pre-relocation conditions. The compared group can either be involved in the same project or come from other projects in the same neighborhood. To test whether different comparison effects exist for different reference groups, we divide the other displaced families into three groups according to the degree of closeness: relatives, friends, and others (i.e., strangers). We use a subjective self-assessed comparison of the families’ resettlement situation to that of the reference group in the survey questions. For example, the question about the comparison with relatives is “Compared to your relatives who live in the same or nearby communities and also have been relocated, do you think your residential relocation is worse off, about the same, or better off?” Similar questions are used for the two other reference groups.

To test the last hypothesis, we use a same/other neighborhood approach and devise a dummy variable to represent the proximity of the residential relocation to the original place. The value is 0 if the resettlement housing is far from the original residential place of the households, and 1 if the family is relocated on-site or near the original residence. The corresponding question is “What type of relocation are you classified in: (1) return resettlement (on-site or within 1 km of the original residence); (2) far from the original residence (more than 1 km away)”. We adopted this ‘one kilometer’ benchmark after consulting similar studies in the literature (Huang et al., 2017; Kearns & Parkinson, 2001). This variable is used to determine the place attachment effect in residential replacement, if any. In China, local governments make decisions on where and how to build rehousing projects, while affected residents can only passively accept the arrangements (Xu & Zhang, 2017; Zhao & Zou, 2017). In other words, most, if not all, relocations are forced. However, people do have the options of being located on-site or off-site. However, the outcome is often the result of a twist of luck. In our study, whether one falls into the group of on-site relocation is random and is independent of her own choice – it is essentially a lottery run by the government. Thus, affected residents are randomly allocated into the same- and other-neighborhood groups, which makes the variable a valid construct to capture the effect of place attachment.

To isolate the net effects of the aforementioned behavioural factors, we use the multivariable analysis to control for socio-demographic

**Table 2**  
Variable definition and descriptive statistics.

Category	Variable	Definition	Mean	Max	Min	Std. dev
Dependent variable Demographic	Satisfaction with relocation	1 = dissatisfied, 2 = neutral, 3 = satisfied	2.2885	3	1	0.7714
	Gender	1 = male, 0 = female	0.5020	1	0	0.5010
	Age	Age of the respondent	46.1621	82	22	12.8088
	Education	Educational attainment in years	10.2806	19	3	3.9697
	Income	Monthly household income in CNY: 1 = below 3500, 2 = 3500–6000, 3 = 6000–8000, 4 = 8000–10,000, 5 = 10,000–15,000, 6 = above 15,000	3.1186	6	1	1.4204
	Knowledge about policies	Policy information	1 if the resident knows details of the housing compensation and resettlement policies; 0 otherwise	0.5652	1	0
Physical housing	Improvement of housing space	1 if construction area increases after relocation; 0 otherwise	0.8024	1	0	0.3990
	Housing quality	1 if housing quality is perceived to be low, 3 if housing quality is perceived to be high	2.2451	3	1	0.8233
Neighborhood characteristic	Location	1 if resettlement housing is located in Siming District; 0 if it located in Huli District	0.7391	1	0	0.4400
	Public service	1 if public service cannot meet household's needs at all; 5 if it can meet needs completely	3.4427	5	1	0.9352
Psychological factors	Proximity to original place	1 for return resettlement; 0 otherwise	0.3636	1	0	0.4820
	Comparison with relatives	1 if perceived to be worse than relatives; 3 if perceived to be better off	1.9681	3	1	0.6316
	Comparison with friends	1 if perceived to be worse than friends; 3 if perceived to be better off	1.9801	3	1	0.6838
	Comparison with unfamiliar persons	1 if perceived to be worse than others except relatives and friends; 3 if perceived to be better off	2.0754	3	1	0.6959
	Comparison with expectation	1 if perceived to be worse than expectations; 3 if perceived to be better off	2.0949	3	1	0.7499

variations, knowledge of relocation policy, quality of resettlement housing units, and neighborhood characteristics. Gender, age, educational level, and income are considered as socio-demographic factors. Although there are many other socio-economic variables available, most of them are found to be insignificant in similar studies (see, for instance, Fang, 2006; Li & Song, 2009). We choose these four factors based on a review of several most relevant studies in the literature (Day, 2013; Fang, 2006; Li & Song, 2009; Wu, 2004a). The knowledge of respondents on the relocation policy is measured by the question “Do you know the details of the housing compensation and resettlement policies before displacement?” The quality of relocation housing units is determined by two variables: a dummy that equals 1 when the construction area increases after relocation and 0 otherwise, and a three-point Likert scale measurement of a resident's perception regarding the quality of the relocated housing unit. Finally, the neighborhood characteristics are defined by both objective and subjective measures. The former is a location dummy, which takes a value of 1 if the resettlement housing is located in Siming District and 0 otherwise. The latter is the subjective perception of residents about whether the public amenities and public services (e.g., school, hospital, public transportation, recreation facilities) in the neighborhood can meet their needs (ranging from 1 for completely inadequate to 5 for completely adequate).

#### 4. Empirical findings and discussions

Because the dependent variable “residential satisfaction after relocation” is an ordinal variable, we used ordered logistic regression to estimate the empirical models. The choice of ordered logistic model is based on its advantages over general linear models in the analysis of ordinal data (Menard, 2000). An approximate Likelihood Ratio (LR) test is performed to test whether the proportional odds assumption, one important assumption underlying ordered logistic models, holds. We also use McFadden's pseudo R-squared to gauge how well the models fit the data (Menard, 2000).

We estimate a total of five models as presented in Table 3. Model 1 is the baseline case in which only control variables are included. We subsequently add internal comparison variables and place attachment indicator to obtain Model 2. Finally, the three alternative measures of external comparison are included to estimate Models 3 to 5. The LR tests show that Chi-squared statistic is significant for all models, while McFadden's R-squared suggests that the overall goodness of fit is greatly improved after the successive incorporation of psychological factors in

Models 2 to 5. Specifically, the explanatory power of Models 3 to 5 is almost twice that of Model 1. This finding indicates that comparisons with multiple referents play an important role in the resident's evaluation of relocation outcome.

Across all models, the coefficient estimates for control variables are largely in line with our expectations derived from the literature. Most of the demographic variables, except for education, are insignificant across all model specifications, a result that is consistent with that in Fang (2006) and Li and Song (2009).<sup>4</sup> Residents who are knowledgeable about the resettlement policy are on average more likely to report a high level of satisfaction. Similar findings can be found in studies on public housing redevelopment in western countries (Goetz, 2013; Kearns & Mason, 2013; Lawson, Kearns, Egan, & Conway, 2015). In terms of neighborhood characteristics, the location dummy is not significant, which simply indicates that the two districts are highly similar. The subjective self-assessment of public service quality, on the other hand, has a strong and positive influence on relocation satisfaction among various model specifications, which is a common finding in the literature (e.g., Day, 2013; Oakley et al., 2013).

Both measurements of resettlement housing unit quality are important determinants of relocation satisfaction. Specifically, the improvement of housing space and the perception of good housing quality boost satisfaction with relocation, an outcome also found in Fang (2006), Li and Song (2009) and Day (2013). Notably, these coefficient estimates become smaller and less significant when relative measurements of the quality of relocation (e.g., social comparison variables) are included in Models 2 to 5. On the one hand, this result confirms the approach adopted in the existing literature by measuring relocation housing quality objectively; the coefficient estimates are consistent and robust across all model specifications. On the other hand, it also highlights the importance of including psychological factors or relative measurements of housing quality, without which the coefficient estimates of absolute measurements could be biased and misleading.

Importantly, coefficient estimates are robust across alternative measurements of external comparison (i.e., in Models 3 to 5).

<sup>4</sup> The coefficient estimates of income variables are significant and negative for some higher-income groups. This trend is largely due to the fact that higher-income households in surveyed redevelopment sites often expanded their houses illegally for use as shops or warehouses. These income-generating extensions generally are not compensated in the relocation process due to their illegal nature. Hence, the owners are less likely to be satisfied with their relocation outcomes.

**Table 3**  
Ordered logit regression estimates of satisfaction with relocation outcome.

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Gender	−0.2394 (0.2803)	−0.4968 (0.3055)	−0.4512 (0.3143)	−0.3146 (0.3358)	−0.3788 (0.3245)
Age	0.0009 (0.0126)	0.0123 (0.0137)	0.0066 (0.0143)	0.0097 (0.0153)	−0.0018 (0.0147)
Education	0.0786* (0.0416)	0.0946** (0.0454)	0.0895* (0.0472)	0.1221** (0.0503)	0.0616 (0.0494)
Income: 3500–6000	−0.5340 (0.4886)	−0.0087 (0.5243)	−0.1179 (0.5406)	−0.4166 (0.5726)	−0.0027 (0.5771)
Income:6000–8000	−1.0804** (0.4945)	−0.7270 (0.5290)	−0.7672 (0.5460)	−0.8487 (0.5850)	−0.9814* (0.5815)
Income:8000–10,000	−1.5469*** (0.5601)	−1.2187** (0.6106)	−1.2471* (0.6351)	−1.6099** (0.6785)	−1.6960** (0.6656)
Income:10000–15,000	−1.0425 (0.6349)	−0.7061 (0.6550)	−0.2674 (0.6709)	−1.0245 (0.7260)	−0.2167 (0.7087)
Income: > 15000	−0.7988 (0.6884)	−0.6306 (0.7251)	−1.1089 (0.7537)	−0.8977 (0.8164)	−0.2936 (0.7910)
Policy information	0.9791*** (0.2900)	0.8192*** (0.3121)	0.7116** (0.3231)	0.8220** (0.3431)	0.7560** (0.3387)
Location dummy	0.2668 (0.3163)	0.0747 (0.3593)	−0.1088 (0.3658)	0.2416 (0.3863)	0.4730 (0.3816)
Public service	0.6149*** (0.1641)	0.5884*** (0.1838)	0.5575*** (0.1893)	0.6645*** (0.2010)	0.5929*** (0.2007)
Improvement of housing space	0.9493*** (0.3411)	0.6582* (0.3663)	0.6359* (0.3747)	0.6991* (0.3911)	0.6916* (0.3952)
Housing quality	1.3210*** (0.1866)	0.7671*** (0.2072)	0.7209*** (0.2145)	0.3973* (0.2283)	0.5347** (0.2202)
Proximity to original place		1.0798*** (0.3431)	0.8918*** (0.3564)	0.8188** (0.3824)	0.8439** (0.3726)
Worse than expectations		−2.3449*** (0.4424)	−2.3084*** (0.4564)	−2.6681*** (0.5138)	−1.9370*** (0.4851)
Better than expectations		1.4932*** (0.3865)	1.3948*** (0.4161)	1.3258*** (0.4564)	1.3049*** (0.4119)
Worse than relatives			−1.5109*** (0.4014)		
Better than relatives			1.1392** (0.5191)		
Worse than friends				−2.6195*** (0.4878)	
Better than friends				1.8257*** (0.5341)	
Worse than others except relatives and friends					−2.7560*** (0.5131)
Better than others except relatives and friends					1.1538*** (0.4093)
McFadden's R-squared	0.2462	0.3741	0.4198	0.4980	0.4707
LR Chi-squared	128.93	195.87	218.58	259.29	245.79
Prob (LR Chi-squared)	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Number of observations	253	253	251	251	252

Standard errors are reported in parentheses. \*\*\*, \*\*, and \* indicate 1%, 5%, and 10% significance, respectively.

Therefore, our discussions on hypothesis testing are based on Models 3 to 5.

First, strong support is found for the *Internal Reference Point Hypothesis*. The coefficients of *better off than expectations* and *worse off than expectations* are significantly positive and negative at the 1% level, respectively. Residents' expectation toward relocation housing serves as an internal reference point in determining their satisfaction level. The more the outcome exceeds (fall short of) their expectation, the higher (lower) the satisfaction level of the residents. Take Model 5 as an example. The odds of being more satisfied are 3.69 (i.e.,  $e^{1.30}$ ) times greater for the “better off than expectation” group when compared with the “the same as expectation” group; the odds of being unsatisfied are 6.94 (or  $e^{1.94}$ ) times larger for the “worse off than expectation” group than the “the same as expectation” group. This outcome is consistent with the findings in marketing research (Anderson & Sullivan, 1993; McKinney, Yoon, & Zahedi, 2002) and reflects the common psychology in the process of satisfaction judgment. This finding has a significant policy implication because of its unique feature of redevelopment and relocation projects. Specifically, a local government needs to provide

master plans or a blueprint of the project before it commences. Affected residents will form their expectations based on this information. However, it usually takes more than two years between the release of the plans and the completion of the project. During this period, adjustments to the project are inevitable, such as changing the unit sizes, the site amenities, the completion time, or even the sites of relocation housing. The local government and developers should practice great caution when considering certain changes to the original plans, particularly when communicating such changes to affected households, because any deviation from the original plans will affect the residents' satisfaction level. This result is especially true when changes are not in favor of the affected household (i.e., making the outcome worse than the expectations).

Second, the *External Reference Point Hypothesis* is also supported by our empirical evidence. All the three social groups are found to be valid external reference points. The coefficients of better-off group are statistically significant with values ranging from 1.14 to 1.83, while the estimators of the worse-off group are significant as well. Both sets of coefficients are larger in magnitude than the coefficient of absolute

measurement of relocation housing quality (i.e., increase of living area and improvement of housing quality). Social comparison matters. Relocation satisfaction depends on how one compared his own outcome with that of others, consistent with the usual findings that relative income matters in determining life satisfaction in the happiness literature. The local government should manage the redevelopment and relocation plans by considering this finding. For example, to encourage affected households to vacate the development site promptly, compensation standards and incentives may vary among different local governments, redevelopment projects, and even at different stages of the same project. Therefore, households in similar redevelopment projects may receive a different relocation arrangement. This will inevitably generate a worse-off group whose satisfaction level toward relocation is adversely affected. Egalitarianism may be a better approach in this practice. While maintaining the overall quality and standard of the relocation projects, local governments should strive to make relocation outcomes as equal and fair as possible for all affected households.

Third, an asymmetric effect of loss and gain exists on relocation satisfaction determination. When both internal and external comparison measurements are used, the estimated coefficients of worse-off variables are all larger in magnitude than those of better-off variables. This is a direct test of the loss aversion hypothesis under PT (i.e., [Hypothesis 3](#)). Our findings suggest that policy makers should be more cautious about situations where relocated households feel worse off by either internal or external comparison. Note the large gap between the coefficient estimates for the third social comparison group, i.e., comparable households other than relatives and friends. These households are most likely to be from similar redevelopment projects in the city. The absolute value of the worse-off variable for this measurement has more than doubled the coefficient estimate of the better-off variable. This once again highlights the importance of keeping redevelopment policies consistent and fair across the city and over time.

Finally, we also find evidence to support the indirect test of loss aversion effect (i.e., [Hypothesis 4](#)). Our findings provide strong evidence that place attachment matters for displaced residents in China's urban transformation, which is in line with [Song et al. \(2012\)](#). Specifically, the estimated coefficient of proximity to original place is statistically significant at the 5% level, with values ranging between 0.82 and 0.89 in Models 3 to 5. Therefore, returning resettlement leads to a greater probability of the respondent being "satisfied" when compared with an off-site relocation. This finding is significant after we controlled for neighborhood characteristics with the variable *Public Service*, and the insignificant estimate of our location dummy confirms the homogeneity of neighborhood characteristics in our study area. All else being equal, relocated households prefer to stay in original sites. The local government should take into account this emotional attachment to their original residence when designing redevelopment plans. Relocating the affected households as close to the original site as possible can minimize the interruption to the households' social life and can, subsequently, enhance their satisfaction toward relocation outcome.

Our findings show that relocation satisfaction depends on how one compares her own outcomes with that of others, and place attachment affects relocation satisfaction significantly. This is consistent with existing empirical evidences from other Chinese cities (see, for instance, [Ho, 2013](#); [Hu et al., 2015](#); [Yu et al., 2017](#)) and some other Western countries (e.g., [Kearns & Mason, 2013](#); [Oakley et al., 2013](#); [Vera-Toscano & Ateca-Amestoy, 2008](#)). Our findings reinforce their arguments that social fairness critically determine the effectiveness and sustainability of urban redevelopment projects. Moreover, our reference dependence framework is analogue to the actual-aspiration gap approach used in the residential satisfaction literature ([Cao & Wang, 2016](#); [Jansen, 2013](#); [Jansen, 2014a](#); [Jiang, Feng, Timmermans, & Li, 2017](#)). Analyzing through the behavioural lens, we confirm their conclusions that individuals' expectations, level of aspiration, or needs are the standards of comparisons when assessing residential satisfaction. We add to the residential satisfaction literature with not only an

alternative analytical tool (i.e., a PT-based theoretical framework) but also reinforcing empirical evidences.

## 5. Conclusions

We developed a theoretical framework based on prospect theory to model the housing satisfaction of displaced households toward urban relocations. Our model predicts that displaced households use both internal and external reference points (or comparable groups) in determining their housing satisfaction. Moreover, their responses to loss and gain are not uniform, with loss mattering more than the same amount of gain in relocation outcomes. We developed four testable hypotheses based on this framework and tested them empirically by using data from Xiamen, China. Our findings not only confirmed existing conclusions about the role of traditional determinants of housing satisfaction (e.g., housing attributes and demographic characteristics) but also provided support to all four hypotheses. We concluded that both reference dependence and loss aversion matters in the studies of urban redevelopment and relocation policies. Future research should take these two factors into consideration.

Prospect theory is the most extensively tested model in behavioural sciences: the seminal work by Kahneman and Tversky in 1979 is the most cited paper of all publications in *Econometrica*.<sup>5</sup> It has been applied in a wide range of disciplines ([Barberis, 2013](#)). However, there are only a few applications of PT in urban studies (e.g., [Hui, Wong, Chung, & Lau, 2014](#); [Wang et al., 2015](#)). In this paper, we develop a PT-based theoretical framework to capture the effect of psychological and social factors in residential satisfaction determination. The theoretical model has good tractability, as is evident from the testable hypotheses derived and verified. Moreover, our empirical findings are in line with existing literature ([Ho, 2013](#); [Hu et al., 2015](#); [Kearns & Mason, 2013](#); [Oakley et al., 2013](#); [Vera-Toscano & Ateca-Amestoy, 2008](#)) and theoretical predictions, which suggests the theoretical framework is congruent with reality nicely. Moreover, the theoretical model has good generality as it does not depend on any spatial or temporal specifications. For example, the definition of the reference point in [Eqs. \(1\) through \(3\)](#) allows researchers to select the appropriate measurement at any time and in any geographic location. Thus, the theoretical model can be applied broadly in the studies of residential satisfaction with relocations and beyond.

On the technical front, this study devises a clever way to employ field data in behavioural studies. "*Perhaps the greatest challenge facing behavioral economics is demonstrating its applicability in the real world. In nearly every instance, the strongest empirical evidence in favor of behavioral anomalies emerges from the lab. Yet, there are many reasons to suspect that these laboratory findings might fail to generalize to real markets*" ([Levitt & List, 2008](#)). Nevertheless, conducting field experiments could be prohibitively costly or even infeasible, and the vast number of controls required for the use of non-experiment field data is often a luxury to have. This is evident from the sample size of the studies reviewed in [DellaVigna \(2009\)](#). We get around this issue by using a natural experiment in Xiamen, China, where a control and an experiment groups were naturally formed, so that the effect of the psychological and social factors can be reliably isolated. This innovation not only ensures the external validity of our study, but also encourages the adaptation of field data in behavioural analysis in urban studies.

Our findings have important practical implications for the design and implementation of urban redevelopment and relocation policies. Firstly, consistency in relocation policies must be maintained across different municipal jurisdictions and over time. The determination of residential satisfaction is reference dependent. Displaced residents make comparisons between relocation/resettlement outcomes with their reference points, and then conclude whether their expectations

<sup>5</sup> Thomas Router Web of Sciences citation count, accessed on 10 May 2018.

have been met, or they are better-off than their socially comparable groups. A negative 'have-want' gap will lead to dissatisfaction even if the housing condition is improved in absolute terms. In other words, good redevelopment and relocation policies must also be fair.

Secondly, the emotional tie of relocated households to their old residence should be sufficiently recognised in policy designs and implementations. Displaced households should be homed as close to their original residence as possible. If this is not feasible, measures should be taken to compensate for such social and psychological losses. This does not have to be financial compensation though, as social belonging is intrinsic in nature, and can be undermined by extrinsic rewards (Deci, Koestner, & Ryan, 1999). Behavioural interventions, such as nudges (Thaler & Sunstein, 2009) may be considered. There are some promising applications of these tools in the public policy domain (For instance, Howlett, 2018; John, Smith, & Stoker, 2009; Oliver, 2013). This is clearly an important direction for future research.

Our empirical findings are based on a cross-sectional survey conducted after the relocation. This subjects our research to two limitations. Firstly, post hoc measurements of subjective constructs such as expectations might contain errors, as people's memory is not perfect. Secondly, there might be confounding factors that are uncontrolled for as the survey is not a randomized control trial (RCT). We must emphasise that RCT is not a feasible approach to study relocation and redevelopment projects given the nature of the projects. Natural experiments, such as the one in this paper, is usually the best option available to researchers in this field. Although our empirical findings might be affected by these potential issues mentioned above, the robustness of coefficient estimates across different model specifications is reassuring. This study is an encouraging attempt to apply behavioural insights in the urban public policy domain, and an invitation for more exciting research along this direction.

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