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Analysis

Environmental value of green spaces in Japan: An application of the life satisfaction approach

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ABSTRACT

This study applies the Life Satisfaction Approach to evaluate green spaces in terms of its affluence, people's preference for greenery, and distance from people's houses. Data are derived from a survey of 2158 respondents in the two largest regions of Japan (Kanto and Kansai) and the green coverage rate is derived from Geographic Information System (GIS) data. The estimation results show that (1) people's marginal willingness to pay (WTP) for green space decreases as the current amount of green space increases; (2) they show how people's marginal WTP increases in proportion with their affection for it, the amount of interaction they have with it, their knowledge of its multiple functions, and the quality of greenery with which they normally come in contact; and (3) the results reveal the various marginal WTP values for green spaces in terms of distance from respondents' houses.

1. Introduction

Understanding the value of greenery has long been a major focus of research in environmental economics. Various studies have been conducted on this issue, applying the Contingent Valuation Method (CVM) and the Hedonic pricing method (for the survey: Barrio and Loureiro, 2010; Brander and Koetse, 2011; Saphoresa and Li, 2012). There has been an increase in research that has applied CVM to assess the multiple functions of green spaces because of their applicability to both the use and passive use values. However, as Johnston (2006) suggests, prior assessments have often presented substantial hypothetical bias, superficial answers, or strategic responses, and most authors have found significant divergence between stated and actual behaviors. Similarly, the hedonic method may also provide biased results because land prices can be underestimated if changes in the environment are not immediately reflected in land valuations. Bayer et al. (2009), for example, claim that conventional hedonic models underestimate the WTP for clean air. The primary problems of hedonic methods arise from their dependence on the equilibrium assumption, which is met only if there is a sufficiently wide variety of houses, prices adjust rapidly, households have full information, and transaction and moving costs are zero (Frey et al., 2010).

The present study applies the Life Satisfaction Approach (LSA) to assess the value of green spaces. The LSA estimates the marginal utility of both income and non-market goods (such as the functions of a green space) and uses this proxy ratio to calculate the monetary value of the latter. Because the LSA does not address direct responses to the environment, we can avoid superficial answers or strategic responses. Further, since it explicitly captures individual welfare in the absence of market equilibrium, we can ascertain the full utility consequences independent of the degree of capitalization in the housing and labor markets (Frey et al., 2010). Thus, we can expect a different evaluation of the environment from that obtained under the CSV and hedonic approaches. The purpose of the present study is to understand the value of green spaces around the residence. We use the objective indicator, the green coverage rates of the circumference of a residence, calculated using Geographic Information Systems (GIS). Specifically, we investigate how the effects of green spaces on the inhabitants differ by its distance from a residence. We focus on the green spaces in the daily living area, i.e., at distances of 0–100 m, 100–300 m, 300–500 m, 500–1000 m, 1000–1500 m, and 1500–2000 m from a residence.

Literature in field experiments and psychology suggests that the interaction with green has relaxing effects (Hartig et al., 2003; Morita et al., 2007; Park et al., 2010; Lee et al., 2011; Thompson et al., 2012; Tsunetsugu et al., 2013). For example, Tsunetsugu et al. (2013) found that a short-term viewing of forests has physiological relaxing effects, such as lowered diastolic blood pressure and heart rate, viewing forest

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landscapes caused higher parasympathetic nervous activity and lower sympathetic nervous activity than urban landscapes, and induced a positive mood. Even if the green coverage rate is the same, when inhabitants have more opportunities to interact with green spaces (or walk) around residential areas they may receive greater benefits from green spaces than those who have few opportunities to be in close contact with nature. Similarly, if people have a great affection for green spaces, or possess knowledge regarding the multiple functions of green spaces, then they may receive more benefit from the green spaces than those with the same green coverage rate around their residence. Furthermore, the quality of green spaces may have a relationship to people's moods. The present study, therefore, considers people's preference for greenery using the following parameters: (1) affection for neighborhood greenery, (2) affection for world greenery, (3) degree of interaction with greenery in the last five years, (4) degree of remembered interaction with greenery until the age of 12 years, (5) level of knowledge regarding the multiple functions of forests, (6) quality of greenery within a 5-min walk from home, and (7) quality of greenery within a 15-min walk from home.

This research makes contributions to the existing literature as follows: (a) we identify the economic value of green spaces around residences in Japan by applying the LSA to investigate how the effects of green spaces on well-being differ in terms of existing coverage, distance from the residence, and people's preference for greenery, and (b) we contribute to the literature by incorporating endogeneity into the discussion using instrumental variables in LSA.

The remainder of the article is organized as follows. Section 2 reviews recent studies. Section 3 describes our dataset and Section 4 presents the estimation model. Section 5 summarizes our estimation results and Section 6 concludes.

2. Literature Review

Application of the LSA is growing in the literature. Primarily, previous studies have used the LSA to estimate the amount of damage caused by air and noise pollution,[1] whereas few analyze the monetary value of green spaces. To our knowledge, research works on the relationship between green spaces and residents' well-being have been presented by Smyth et al. (2008) for China, Ambrey and Fleming (2011, 2013) for Australia, MacKerron and Mourato (2013) for UK, and Kopmann and Rehdanz (2013) for 31 European countries.

Smyth et al. (2008) empirically determine that parks in China's urban areas significantly increase well-being. Ambrey and Fleming (2011) also examine the relationship between parks and well-being. They use regression analysis to examine the relationship between well-being and "the distance between residences and parks" in Australia. The results of the analysis show that parks can increase well-being; especially, parks within 50 km of one's residence have a relatively larger positive effect. Ambrey and Fleming (2013) use the more objective green coverage rate data from GIS as an index of the amount of green spaces. In particular, the green coverage rate of a residence in a 700 m neighborhood shows a statistically significant increase in well-being for inhabitants of urban areas in Australia. Using this result, the value of green spaces in major cities (parks, community parks, cemeteries, stadiums, national parks, natural reserve areas) has been valued monetarily using LSA. The result of this analysis shows that the marginal WTP (MWTP) annually for a 1% increase in green spaces (i.e., 143 m^2) is $467 per capita.

MacKerron and Mourato (2013) use unique data obtained from a smartphone application that signals participants at random moments and presents a brief questionnaire while determining the respondent's geographical coordinates using satellite positioning (GPS). They have collected over one million responses from more than 20,000 participants and investigate the relationship between momentary subjective well-being and individuals' immediate environments within the UK. The estimation result implies that participants are significantly and substantially happier when they are outdoors in all green or natural habitat types than when they are in urban environments. Kopmann and Rehdanz (2013) use the European Quality of Life Survey (EQLS) from 31 European countries, with a total of 35,634 observations, and the Coordination of Information on the Environment (CORINE) Land Cover database, which provides information for 44 land-cover categories in a raster format of 100 m resolution for European countries (2006 data). The estimation results indicate that MWTPs tend to be higher for natural areas that are scarcer, and that a nonlinear relationship between land cover and well-being is preferred to a linear relationship, which implies decreasing benefits from individual landscape amenities.

In the current study, we contribute to the existing literature on LSA by separating data on green spaces by distance (the shape of donuts) and showing how the effects of green coverage rates differ by the current levels of green coverage rates, distance from people's houses, and people's preferences for green spaces. We also contribute to the literature on LSA by considering endogeneity using instrumental variables and higher-definition land cover data than previous literature.[2]

With regard to distance form people's houses, Sander et al. (2010) analyze the green coverage rates of Ramsey County and the urbanizing Dakota County to the south, in Minnesota (United States). They find that a 10% increase in green coverage within 100 m and 250 m of a home increases its property value by 0.48% ($1371) and 0.29% ($836), respectively. However, a statistically significant relationship between the green coverage rates and value of properties situated more than 250 m away is not found. Sander and Haight (2012) focus on the green coverage rates of Dakota County, and find a 10% increase in green coverage rate within a 100 m, 250 m, 500 m, and 750 m radius of a home increases its property value by 0.58% ($1853), 0.32% ($1030), 0.61% ($1947), and 0.35% ($1102), respectively. No literature applying the LSA considers the effect of green coverage rates within walking distance of residences.

In association with people's preference for greenery, Neilson and Wichmann (2014) consider the role of social networks in the nonmarket valuation of public goods. They construct a model of valuing public goods and find that network structure almost always matters both for utility and valuation. These authors suggest that even if the presence of public goods (such as a park) does not generate private utility for an individual, if that public good provides his or her friends with utility, which he or she values, then the individual in question might have a positive WTP for that good. The authors also suggest that a certain individual might only derive enjoyment from the park when visiting with friends rather than alone. This may imply that memories of interacting public goods with their family or friends affect valuation of green space around residences. In relation to memories of interaction, attachment to public goods may affect an individual's valuation of them. For instance, Larson et al. (2013) suggest that place of residence, involvement in community activities, country of birth, and the length of time respondents have lived in the region are important determinants of how people value the natural environment surrounding them. Moreover, understanding the benefits of the public goods in question may also affect their valuations. No study applying LSA investigates how the effects of green spaces differ by preferences for green spaces, such as interaction with, affection to, and knowledge of green spaces; thus, this study considers these factors.

[1] There has been extensive research on air pollution, such as the works presented by Welsch (2002, 2006), MacKerron and Mourato (2009), Luechinger (2009, 2010), Ferreira and Moro (2010), Menz (2011), and Tsurumi et al. (2013). In addition, there has also been considerable research on airport noise (van Praag and Baarsma, 2005), climate (Ferreira and Moro, 2010; Maddison and Rehdanz, 2011), floods (Luechinger and Raschky, 2009), and droughts (Carroll et al., 2009).

[2] Our greenspace data's smallest diameter is 15 m for "parks, green spaces, etc." and 20 m for "forests, wastelands, etc.," "rice fields," and "fields and other agricultural land."