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Estimating the Social Value of Digital Signage Landmarks as Sustainable Tourist Attractions

Lihua Quan ¹, Insu Hong ², Taejun Lee ³ and Changsok Yoo ^{1,*} 

¹ Department of Culture, Tourism & Content, Kyung Hee University, Seoul 02447, Republic of Korea; junryeohwa@khu.ac.kr

² CJ Logistics, Seoul 04513, Republic of Korea; iaminsu@gmail.com

³ KDI School of Public Policy & Management, Sejong 30149, Republic of Korea; davidtjlee@kdischool.ac.kr

* Correspondence: csyoo@khu.ac.kr; Tel.: +82-2-961-0425

Abstract: As urban tourism increases, digital signage landmarks are frequently utilized to develop and enhance the attractiveness of cities for tourism. However, the benefits of this development for local residents have not been fully explored from a sustainability perspective. Thus, this study aims to quantitatively analyze local residents' perceptions of digital signage landmarks in urban areas using one of the prominent icons, the Samseong-dong free display zone in Seoul, Korea. To measure the overall value of the landmarks, this study used a double-bounded dichotomous choice contingent valuation method and spike model. Based on the surveys of 600 respondents in Korea, the results show that a household's willingness to pay to support the landmark annually is KRW 5401 (USD 4) on average in the form of income tax. The perceived annual value for the landmark is about KRW 790 million (USD 60 million), surpassing that of typical tourism attractions in Korea.

Keywords: digital signage; landmarks; sustainable urban tourism; CVM; Korea



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1. Introduction

Out-of-home (OOH) advertising, a commercially and physically rentable asset located outside of buildings in both public and commercial spaces, is one of the oldest existing media industries and an essential channel for communicating with consumers in cities [1], and it acts as one of the elements constituting the urban landscape within the urban environment [2,3]. Most importantly, OOH advertising, often in a massive form, serves as a physical landmark that contributes to the city's image, providing the city's brand and identity. Advertising reflecting the local culture and social characteristics provided through OOH advertising contributes to creating a sense of place in the region, thus holding meaningful value in tourism [4,5]. Despite its multiple benefits across the advertising, tourism, and public sectors, OOH advertising poses challenges due to resource demands and sustainability concerns during content updates [6]. Excessive OOH advertising has faced criticism for negatively impacting the urban landscape visually [7–9]. Moreover, over a third of OOH advertising revenue is spent on producing single-use media, leading to financial drawbacks.

With the advancement of ICT technology, the ability for OOH advertising to seamlessly integrate into the urban landscape has been enhanced, and many of the drawbacks traditionally associated with OOH advertising have been mitigated [10]. Digital signage is a term that comprehensively refers to out-of-home (OOH) advertising based on digital technology. Some scholars refer to digital outdoor advertising as digital signage [11,12], while others use the term DOOH (digital out-of-home) advertising media [13,14] in a broader sense.

The digital signage market is exhibiting remarkable annual growth rates due to the development and integration of related technologies, as well as the easing of government regulations. By 2027, this market is projected to surpass the revenue of traditional OOH advertising, which is currently experiencing a slowdown [15]. The global market size of

digital signage was estimated at USD 24.86 billion in 2022 and is expected to expand at a Compound Annual Growth Rate (CAGR) of 8.0% until 2030 [16].

Digital signage, compared to traditional OOH advertising, not only has a lesser environmental impact but also wields substantial influence in urban tourism due to its large scale and brightness [17]. Of the successful urban landmarks utilizing digital signage-based OOH advertising, notable examples include Times Square in New York City, Piccadilly Circus in London, and the recently sensational Sphere in Las Vegas, which has garnered global attention. Specifically, the Sphere is a prime example of this trend, representing a cutting-edge space that utilizes various digital technologies and special effects, thereby establishing itself as a prominent attraction [18]. Thus, many cities are trying to develop digital signage landmarks to promote urban tourism [19].

While the development of new urban tourist destinations brings about positive impacts such as cultural exchange, employment opportunities, and environmental enhancements [20–22], it also accompanies negative consequences, including conflicts between local residents and tourists, environmental pollution, increased living costs, and traffic congestion [21,23,24]. Therefore, garnering support from local residents is essential to developing an urban landmark. This support encompasses multiple facets, ranging from economic gains to cultural, social, and environmental benefits [25]. However, there is a lack of quantitative research on the quantitative measurement of the benefits that urban tourism brings to local residents [26].

To address the existing research gap, this study aims to quantitatively analyze local residents' perceptions of digital signage landmarks in urban areas from the perspective of sustainable tourism. It specifically focuses on a prominent example of such a landmark: the Samseong-dong free display zone, a cluster of digital signages in Seoul, Korea, which has emerged as a unique urban attraction. By employing the contingent valuation method, recognized in environmental economics for its effectiveness in appraising the value of non-market assets, this research seeks to quantify the economic and social impact of this digital landmark. This methodological choice is pivotal for providing a comprehensive economic analysis of digital signage, highlighting its crucial role in urban tourism and policy development. This approach aims not only to deepen our understanding of the community perceptions of these digital landmarks but also to contribute to a broader comprehension of their overall impact on urban environments. The quantitative and monetary understanding of the communities and environments surrounding landmarks suggested by this research will help the tourism industry to develop balanced tourism attractions for urban tourism.

2. Literature Review

2.1. Digital Signage

Dennis and Joško Brakus [12] clearly define digital signage as involving the use of screens in public places to display videos, with content that may include advertising, community information, entertainment, and news. They emphasize that this encompasses dynamic and contextualized content wherein advertisements or other content are displayed in some form of digital or electronic screen. Furthermore, they argue that this digitization offers new opportunities and advantages compared to traditional outdoor advertising [13]. In other words, digital signage can be defined as a comprehensive service system that goes beyond mere digital information and advertising media, integrating video, information, and advertising with user interaction capabilities.

Initially, digital signage was primarily used for advertising purposes, but its function and role in society have continually expanded due to advancements in display and information and communication technology (ICT) [27]. Contrary to digital signage, there are growing concerns about the commercialization of urban spaces by traditional outdoor advertising as a form of visual pollution in cities [28,29]. Scholars with this perspective argue that outdoor advertising disrupts the appropriate appearance and orderly arrangement of cities [9,30]. This is attributed to the rapid increase in outdoor advertising due to its

relatively low production costs and high impact, combined with the lack of appropriate policies regulating the content and placement of advertisements [9]. Efforts to reduce visual pollution from outdoor advertising have led to establishing guidelines and regulations at the national and city levels regarding the size, content, and placement of advertisements [31]. These discussions have largely proceeded without active consideration of the various technical and material conditions of digital signage. Unlike traditional advertising, digital signage seems to enhance the strategic value of the city as a space, suggesting the need for a new perspective in the discussion about digital signage [31]. As seen in Times Square in New York City, Piccadilly Circus in London, and the Sphere in Las Vegas, digital signage is now a symbol of a city's brand, and it also contributes to enhancing the cityscape's quality [32]. This phenomenon is consistent with the argument by Seixosa and Cadarso [5]. They suggest that outdoor advertising structures can be an essential aspect of urban landscapes, possessing the ability to adapt to and perceive various socio-cultural contexts, which contributes to strengthening regional identity and place awareness. The contribution of digital signage to a city is naturally connected to enhancing its urban tourism [33].

2.2. Sustainable Urban Tourism

Tourism has emerged as a crucial economic sector for major nations worldwide with the expansion of global economic and technological advancements. Concurrently, the impact of the tourism industry on the environment, such as the destruction of natural ecosystems, increased air and water pollution, and greenhouse gases, is becoming serious. The recognition of these environmental issues in the tourism industry has driven the transformation of traditional tourism and stimulated the birth of the concept of sustainable tourism [34].

While the concept of sustainable tourism originated from environmental concerns, the inherent nature of tourism necessitates a balanced approach not just to the environment but also to local communities and economies. Consequently, despite the existence of various definitions of sustainable tourism, there is a universal acceptance of the need to promote balanced development across the three pillars of sustainability: economic, social, and environmental, collectively known as the 'Triple Bottom Line' [35,36]. With the growing implementation of sustainable tourism practices, there has been a recognition of the need for a more nuanced approach beyond the Triple Bottom Line. Consequently, the argument for categorizing the key factors of tourism sustainability into five distinct elements has gained traction. These elements include economic health, the satisfaction of guests, a healthy culture, the protection of resources, and the well-being of locals, collectively termed as 'the Magic Pentagon of Sustainable Tourism' [37]. In this vein, sustainable urban tourism can be defined as a state in which tourism development and progress bring economic benefits to the city while preserving its local identity through the inherited development of the city's unique nature, culture, and history, thereby maintaining a continual flow of tourist visitation to urban spaces [36,38].

Cities have strong potential as tourist destinations and cultural attractions are densely clustered in relatively small areas. Urban landmarks, such as unique political relics, architectural marvels, museums, and extensive commercial facilities, which are seldom found outside urban areas, coupled with excellent accessibility, have increased the demand for tourism in cities [39–41]. Because of this, most cities have come to recognize tourism as a crucial engine for economic growth and as a representative tool for urban regeneration, ensuring the sustainability of the city. This has led to the initiation of various policies and investments to support the industry and attract tourists. Initiating large-scale investment to boost urban tourism is becoming a global phenomenon [42,43].

Due to the inherent nature of cities, where touristic and non-touristic areas are intermingled, the support of local residents is essential for the revitalization and sustainable development of urban tourism [44]. Social exchange theory is usually adopted to explain the decision-making process of local residents on urban tourism. This theory suggests that individuals assess the costs and benefits of an issue before deciding on their support

level [45,46]. Thus, a positive perception of the benefits derived from urban tourism is likely to increase support for its development, whereas perceived costs may weaken this enthusiasm [26]. In line with this, the support for urban tourism development by local residents is not limited to economic gains for the region; it also includes a recognition of the cultural, social, and environmental benefits [25]. This broader understanding of benefits further reinforces local residents' support for urban tourism, as it aligns with enhancing their quality of life [47]. However, there is a lack of quantitative research on the measurement of the benefits that urban tourism brings to local residents. Thus, this study tries to explore the appropriate methodology for assessing them, particularly focusing on the technology-based landmark.

2.3. City Landmarks and Sustainability

Landmarks constitute a pivotal component in shaping urban image and identity. These entities extend beyond specific buildings, encompassing distinct and identifiable elements such as open spaces, signage, and storefronts that stand out from their surroundings [48,49]. The development of such landmarks is recognized as integral, serving multiple functions by establishing urban identity, elevating tourism levels, and stimulating the city's economic vitality [49–51]. With the increasing homogeneity of cities due to globalization, the unique characteristics of a city are becoming important for attracting tourists [52]. Therefore, many cities are now actively using landmarks to create a distinctive and appealing image as a way to build sustainable tourist destinations [53].

In urban tourism, landmarks serve as places where tourists can engage in tourism activities and gain experiences. Tourists often focus on specific areas with many attractions, including landmarks, and use these experiences to form their overall impression of the city or country [54]. Therefore, landmarks play a crucial role in creating a strong brand for a place, helping to increase the future value, profitability, and loyalty of visitors in urban tourism [4]. However, the contribution of landmarks to the sustainability of urban tourism is controversial. While landmarks perform the important function of marking location and providing a sense of place, they are primarily aimed at promoting international tourism. Thus, there are growing concerns that even successful landmarks may not really help local communities much [55]. On the other hand, scholars also contend that urban landmark projects do not always lead to these negative impacts. They also insist that even if there are some negative impacts, the benefits are much greater for local communities [4,50].

Particularly in cities like Seoul, Tokyo, and Shanghai, where innovation is a key part of urban core values, landmarks with innovative technology can align well with the expectations and image anticipated by both local residents and tourists. Such landmarks go beyond merely being valuable tourism resources. They have the potential to enhance the cultural identity and social cohesion of city residents [56,57]. Furthermore, the functional elements of city landmarks, which are enhanced through new technologies, can form novel experiences for both local residents and tourists, creating contexts that foster interactions between them [58]. While these technology-based landmarks hold various values, how these values are integrated into and perceived in residents' daily lives has not yet been fully explored. Thus, it seems to be crucial to assess the impact of these new, technology-driven landmarks on local residents within the context of sustainable urban tourism.

3. Study Area

The Samseong-dong free display zone in Seoul, South Korea, is a key area of focus. To encourage the change of OOH advertising to a digital signage format, the Korean government has introduced the Outdoor Advertising Free Display Zone (aka the free display zone). In contrast to the regulations imposed on general outdoor advertisements, the concept of a free display zone relaxes restrictions on the size, height, color, and other display methods of outdoor advertisements to encourage creativity and innovations in the digital signage industry and to promote local economy. Through the free display zone, the Korean government is expected to enhance informational vibrancy in urban areas, which

serves not only as a means for advertising and information dissemination but also as a tool for implementing cultural content. Additionally, the Korean government also expects an enhancement of the quality of the cityscape due to the designation of free display zones [32]. In August 2016, the Korean government initiated a competition for the designation of free display zones. This initiative called on major local governments throughout Korea to nominate suitable areas for these free display zones. Through a fierce competition that lasted several months, Samseong-dong in Seoul was selected as the best location from among 11 contenders.

The Samseong-dong free display zone is strategically located around COEX (Figure 1), Seoul's largest convention center, and the Korea Trade Center, creating a vibrant tourism district that melds business, culture, tourism, and shopping. This zone encompasses four buildings within the district, covering an area of 78,400 square meters. Presently, the Samseong-dong free display zone operates 20 digital signages. This includes innovative forms of digital signage that were previously not feasible or difficult to implement within Korea's legal framework. As a result, the area has become a signature part of Seoul's nightscape. A notable feature is the K-pop square at the center of the zone, which boasts Korea's largest digital signage, measuring 81 m × 20 m. This signage is renowned for its three-dimensional media, showcasing groundbreaking 3D digital advertisements and media art. An example is the 2018 media art piece "Wave", which created a captivating anamorphic illusion, making the two-dimensional display appear as a vast water tank. This unique media art has garnered popularity in Korea and internationally, establishing a new standard for media art and advertising in these zones [32,59].

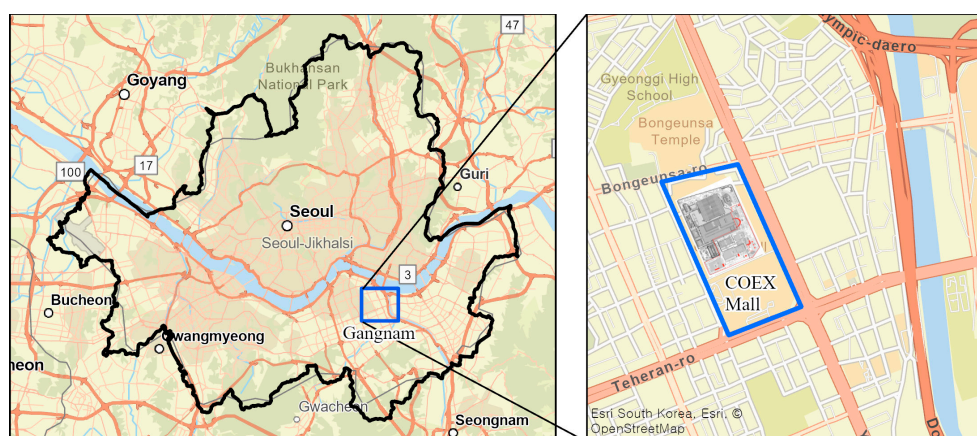


Figure 1. Location of Samseong-dong free display zone in Seoul.

The Samseong-dong free display zone has emerged as a tourism landmark, not just for its distinctive and diverse digital signage, uncommon in other areas, but also for the array of K-pop events and festivals associated with the digital signage in the K-pop square. The synergy between the large digital signage and offline events has offered unique experiences previously unseen at conventional events. Before the pandemic, the zone was a central hub for over 20 annual festivals and events, cementing its status as a significant cultural and social venue.

4. Methodology

4.1. Contingent Valuation Method

In this study, we aim to quantitatively analyze local residents' perceptions of digital signage landmarks, especially the Samseong-dong free display zone in Seoul, from the perspective of sustainable tourism. We use the contingent valuation method (CVM) to estimate the amount residents are willing to pay to mitigate any perceived decrease in value. The CVM is a methodology that measures the total economic value of non-market goods by asking individuals to imagine hypothetical scenarios where they must make

decisions and then conducting surveys to determine their choices in such situations [60,61]. This method has been increasingly applied recently for valuing non-market goods in the fields of the environment [62], tourism [63], and culture [64,65].

The CVM involves presenting respondents with structured questionnaires that propose hypothetical changes in a situation and then asking them to report their willingness to pay for these changes [63]. Specifically, we used the double-bounded dichotomous choice (DBDC) Spike CVM in this study. This method has a simple response format, allowing researchers to set multiple initial payment amounts, thereby reducing non-response rates and starting-point bias [61,66]. Unlike the typical DBDC CVM model, it also allows for considering the respondents unwilling to pay any cost [67,68].

The DBDC Spike CVM survey asks respondents about their willingness to pay for preserving the Samseong-dong free display zone in a "Yes/No" format, leading to typically two or three choices based on their responses. If a respondent is willing to pay the first proposed amount A_i , the second proposed amount ($A_i^h = 2 \times A_i$) is double the first value. If the respondent answers "No" to the first proposed amount A_i , the second proposed amount ($A_i^l = A_i/2$) is half the initial amount. If a respondent answers "No" to both the first and second questions ("No-No"), it indicates no willingness to pay, and the payment amount is considered to be between 0 and A_i^l . Therefore, in this study, we aim to capture respondents who answered "No-No" and are unwilling to pay in two ways. First, an additional question was asked to determine whether the payment cost was zero and to separate those respondents' DBDC spike CVM [69,70]. Second, a payment resistance survey was used to exclude those resistant to paying. Consequently, the response patterns in the DBDC Spike CVM survey of this study are "Yes-Yes", "Yes-No", "No-Yes", "No-No-Yes", and "No-No-No".

The DBDC Spike CVM model is based on Hanemann's utility difference model [61]. The respondents' satisfaction, depending on their willingness to pay for the evaluated object under given income constraints, can be expressed by the indirect utility function Formula (1).

$$u(j, y; S) = v(j, y; S) + \varepsilon_j, \quad j = 1 \text{ or } 0 \quad (1)$$

Here, y represents income and j is a dummy variable indicating the acceptance of the proposed amount. When a respondent is willing to pay the proposed amount A ($j = 1$), the utility function takes a higher value than when they are not willing to pay ($j = 0$). This implies that the respondent's utility is greater, even if paying the amount A reduces their income. The utility difference function in such a scenario is presented in Equation (2).

$$\Delta v = v(1, y - A; S) - v(0, y; S) + (\varepsilon_1 - \varepsilon_0) \quad (2)$$

If we consider the random variable WTP (willingness to pay) as C , it has a cumulative distribution function $G_C(\bullet; a, b)$. When maximizing the utility for a respondent willing to pay the proposed amount A , it can be expressed as in Equation (3):

$$Pr(\text{yes}) = Pr(C \geq A) = 1 - G_C(A) \quad (3)$$

Furthermore, to effectively incorporate the characteristics of many respondents with zero willingness to pay into the model, we apply the spike model to the estimation to reflect payment resistance. The spike model differentiates respondents who answered "No" to both proposed prices and reflects their WTP. Assuming the cumulative distribution function of WTP as a logistic function and applying the spike model, it can be defined as in Equation (4) [67]:

$$G_{WTP}(A; a, b) = \begin{cases} [1 + \exp(a + bA)]^{-1} & \text{if } A > 0 \\ [1 + \exp(a)]^{-1} & \text{if } A = 0 \\ 0 & \text{if } A < 0 \end{cases} \quad (4)$$

The probability of the observable response patterns in this study is defined as in Equation (5):

$$\begin{aligned}
 Pr(\text{yes} - \text{yes}) &= Pr(C_i \geq A_i^h) = 1 - G_C(A_i^h; a, b) \\
 Pr(\text{yes} - \text{no}) &= Pr(A_i < C_i \leq A_i^h) = G_C(A_i^h; a, b) - G_C(A_i; a, b) \\
 Pr(\text{no} - \text{yes}) &= Pr(A_i^l < C_i \leq A_i) = G_C(A_i; a, b) - G_C(A_i^l; a, b) \\
 Pr(\text{no} - \text{no} - \text{yes}) &= Pr(0 < C_i < A_i^l) = G_C(A_i^l; a, b) - G_C(0; a, b) \\
 Pr(\text{no} - \text{no} - \text{no}) &= Pr(C_i = 0) = G_C(0; a, b)
 \end{aligned} \tag{5}$$

The log-likelihood function of the DBDC spike CVM model is as follows in Equation (6), where I_i^{YY} , I_i^{YN} , I_i^{NY} , I_i^{NNY} , and I_i^{NNN} are indicator variables that take a value of 1 if the respective situations of (Yes-Yes), (Yes-No), (No-Yes), (No-No-Yes), (No-No-No) occur, and 0 otherwise.

$$\begin{aligned}
 \ln(L) &= \sum_i^N \{ I_i^{YY} \ln [1 - G_C(A_i^h; a, b)] + I_i^{YN} \ln [G_C(A_i^h; a, b) - G_C(A_i; a, b)] + \\
 &I_i^{NY} \ln [G_C(A_i; a, b) - G_C(A_i^l; a, b)] + I_i^{NNY} \ln [G_C(A_i^l; a, b) - G_C(0; a, b)] + \\
 &I_i^{NNN} \ln G_C(0; a, b) \}
 \end{aligned} \tag{6}$$

The average value of the WTP is defined in Equation (7).

$$WTP_{mean} = \int_0^\infty [1 - G_C(A)] dA - \int_{-\infty}^0 G_C(A) dA \tag{7}$$

Therefore, the average WTP in the DBDC spike CVM model is as follows in Equation (8):

$$WTP_{mean} = \frac{1}{b} \ln[1 + \exp(a)] \tag{8}$$

To understand the impact of respondents' socio-economic characteristics on their responses to the WTP questions, it is necessary to analyze a model that includes covariates. When covariates are included, the α in the above equations is replaced with $\alpha + x_i' \beta$. Here, x_i is a vector of the covariates reflecting the socio-economic characteristics of the respondents, and β is a vector of parameters that need to be estimated.

4.2. Survey Design

The survey of this study is divided into four parts. In Area I, we inquired about the age, gender, and region of respondents to collect basic demographic information. For the region, we divided respondents according to whether they live in Seoul and, if so, whether they reside in the Gangnam-gu. Before this question, we provided the respondents with a two-minute video introducing the Samseong-dong free display zone. Then, we led the respondents to the following survey based on the provided information. In Area II, we asked about their perception of the Samseong-dong free display zone as a landmark. In Area III, we aimed to estimate the value of the landmark that is the Samseong-dong free display zone. For this, we first introduced a hypothetical situation concerning the Samseong-dong free display zone and then proposed amounts, twice, based on the double-bounded dichotomous choice (DBDC) model. If the respondent answered 'no' to both proposed amounts, we checked for payment refusal and further confirmed payment resistance for those who refused to pay. Finally, in Area IV, we structured the survey to inquire about respondents' demographic characteristics such as education level, marital status, and income.

The study's participant pool encompasses adults from across South Korea, extending beyond the immediate vicinity of the research area. While the perceived value of a landmark typically resonates most strongly with local residents, the Samseong-dong free display zone

is an exception. Its utilization of advanced technology imbues it with a broader significance that transcends local boundaries, making it a matter of national interest.

Acknowledging the possibility of regional differences in perceptions of the Samseong-dong free display zone's landmark value, the study is designed to discern whether such variations exist. To this end, the participant group of 600 is evenly split between residents of Seoul and those from other regions. This approach is further refined within the Seoul cohort: half of these participants (150 individuals) are from the Gangnam-gu, where the free display zone is located, and the other half are from different districts in Seoul. This segmentation allows for a nuanced exploration of perceptual differences based on geographic proximity to the landmark. The participants were selected through simple random sampling, and the survey was conducted online from 22 August to 1 September 2023.

The range of the proposed amounts in landmark value studies varies. Looking at major CVM studies in the tourism sector in Korea from 2017 to 2023, the value individuals perceive of tourist sites ranges from KRW 8343 to KRW 78,095 [71–76]. Accordingly, using the DBDC model, we set the prices to five different levels, as shown in Table 1, ranging from a minimum of KRW 1000 to a maximum of KRW 52,000.

Table 1. Initial Price Allocation Distribution.

Classification	Price Determination (KRW)			Allocation of Samples		
	Initial	Low	High	Gangnam-gu	Seoul	Outside Seoul
A	2000	1000	4000	30	30	60
B	5000	2500	10,000	30	30	60
C	11,000	5500	22,000	30	30	60
D	18,000	9000	36,000	30	30	60
E	26,000	13,000	52,000	30	30	60

Notes: KRW denotes South Korean won. As per the Bank of Korea (www.bok.or.kr) accessed on 27 November 2023, the USD to KRW exchange rate is USD 1 = KRW 1303.27.

4.3. Demographics of Respondents

The basic demographic information of the respondents analyzed is in Table 2. as follows. Regarding gender, 60.85% of the respondents were male and 39.17% were female. The age distribution of the respondents showed that 8.00% were in their 20s, 25.50% in their 30s, 36.33% in their 40s, and 28.67% in their 50s. Regarding educational level, 57.5% of respondents had a university degree, 24.00% had a postgraduate degree, 9.50% had a junior college degree, and the rest had a high school education. The monthly household income of respondents was highest in the KRW 4 to 6 million range at 27.67%, followed by over KRW 8 million (26.83%), KRW 2 to 4 million (21.33%), and KRW 6 to 8 million (19.33%). Considering that the average median monthly income for a four-person household in Korea in 2023 was KRW 5.4 million, the income distribution of our sample reflects the national statistics well.

Table 2. Descriptive statistics of the respondents.

Characteristics		Frequency	Ratio (%)
Gender	Male	364	60.83
	Female	235	39.17
Age	20–29	48	8.00
	30–39	153	25.50
	40–49	218	36.33
	50–59	172	28.67
	60 or above	9	1.50

Table 2. Cont.

Characteristics		Frequency	Ratio (%)
Education	High school and below	54	9.00
	Junior college	57	9.50
	University	345	57.50
	Graduate school	144	24.00
Average monthly household income (KRW 10,000)	Less than 200	29	4.83
	200~399	128	21.33
	400~599	166	27.67
	600~800	116	19.33
	More than 800	161	26.83

Notes: KRW denotes South Korean won. As per the Bank of Korea (www.bok.or.kr) accessed on 27 November 2023, the USD to KRW exchange rate was USD 1 = KRW 1303.27.

5. Results

5.1. Distribution of Willingness to Pay (WTP) Responses

In this study, respondents were randomly divided into five groups. Initially, each group was presented with a starting price, and their acceptance of it was recorded. If the response was ‘yes’, a price double the initial offer was presented; if ‘no’, a price half the initial offer was proposed, to elicit WTP responses. The distribution of each type of response is shown in Table 3. Of all respondents, 336 chose payment refusal, so a detailed examination of the reasons for this refusal was conducted. As a result, about one third of all respondents, 207 in total, were identified as payment resisters. This proportion is similar to the typical rate of payment resistance (37.8%) observed in general CVM studies in Korea, confirming no issues with the model or scenario [69]. Consequently, payment resisters were excluded from the model in this analysis.

Table 3. Distribution of responses based on the bid amount.

Initial Bid (KRW)	Subsequent Bid (KRW)	Response					Sample Size
		Yes-Yes	Yes-No	No-Yes	No-No-Yes	No-No-No	
2000	1000	0	0	9	86	59	95
	4000	11	14	0	0	0	25
5000	2500	0	0	11	96	68	107
	10,000	7	6	0	0	0	13
11,000	5500	0	0	3	101	65	104
	22,000	6	10	0	0	0	16
18,000	9000	0	0	10	96	68	106
	36,000	9	5	0	0	0	14
Totals		35	40	42	483	336	600

Notes: KRW denotes South Korean won. As per the Bank of Korea (www.bok.or.kr), as of 27 November 2023, the USD to KRW exchange rate was USD 1 = KRW 1303.27.

5.2. WTP Results

The results of estimating the WTP without applying covariates, using the DBDC spike CVM model, are shown in Table 4. To facilitate the application of the maximum likelihood estimation method, the bid amounts used were in units of KRW 1000. The spike of the model was statistically significant and was estimated at 0.41. The proportion of respondents who reported a WTP of zero was 32.8% among the valid respondents,

indicating that the spike value was appropriately estimated. The estimated coefficient for the bid amount shows a negative sign, meaning that the higher the bid amount, the lower the probability of accepting it, thus indicating that the survey was conducted properly. Generally, models without covariates are used as a base model for estimating the per capita WTP. Accordingly, the annual average household WTP derived from the base model was estimated at KRW 5401, and the 95% confidence interval based on 5000 bootstraps, according to Krinsky and Robb [77], ranged from KRW 4383 won to KRW 6549.

Table 4. Estimation results for the spike model.

Variables	Estimates ^c
Constant	0.35 (3.776) ***
Bid ^a	−0.16 (−16.159) ***
Spike	0.41 (18.387) ***
Number of observations	393
Log-likelihood	−666.42436
Mean WTP per household per year	KRW 5400.8
95~99% confidence interval ^b	KRW 4382.6 to 6548.5

Notes: ^a the unit is KRW 1000; ^b the confidence intervals are calculated by the use of the Monte Carlo simulation technique of Krinsky and Robb [77] with 5000 replications; ^c ***: $p < 0.001$.

Based on the analysis results, the probability of payment relative to the payment amount is organized as shown in Figure 2.

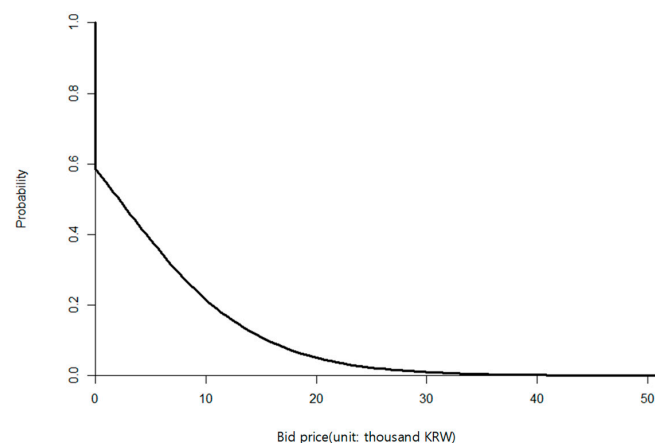


Figure 2. Probability of payment relative to the payment amount.

The effects of demographic variables on the WTP are examined in Table 5. The analysis showed that age, gender, education level, and marital status did not affect the WTP, while income significantly impacted the WTP at the 5% significance level.

Table 5. Estimation results of the spike model with (demographic) covariates.

Variables	Estimates ^b
Constant	−0.44 (−0.777)
Bid ^a	−0.17 (−16.167) ***
Spike	0.41 (18.148) ***
Age	0.03 (0.226)
Gender (Male)	0.18 (0.945)
Education	−0.03 (−0.026)
Income	0.194 (2.317) *
Marital Status (Married)	−0.09 (0.230)
Number of Observations	393
Log-likelihood	−662.104689

Notes: ^a the unit is KRW 1000; ^b ***: $p < 0.001$, *: $p < 0.05$.

The effect of residential area on the WTP was examined in Table 6. People in Seoul tended to have a lower WTP than those in other areas, although this was not statistically significant. On the other hand, living in Gangnam-gu did not affect the WTP. While the frequency of visiting Gangnam-gu was not significant, the frequency of meetings in Gangnam-gu was significant, suggesting that frequent meetings in Gangnam-gu indicate a personal preference for the area. Since there was no statistically significant difference in WTP according to residential area, this study assumed that the WTP estimated from the basic model is the national average WTP. We aimed to estimate the value of the landmark in the Samseong-dong free display zone.

Table 6. Estimation results of the spike model with (residential area) covariates.

Variables	Estimates ^b
Constant	−0.23 (−0.991)
Bid ^a	−0.16 (−16.216) ***
Spike	0.41 (17.970) ***
Residence in Seoul	−0.33 (−1.359)
Residence in Gangnam-gu	0.14 (0.527)
Working in Gangnam-gu	0.27 (0.936)
Frequency of visits to Gangnam-gu	0.23 (0.232)
Frequency of gathering in Gangnam-gu	0.22 (2.016) *
Number of observations	393
Log-likelihood	−659.04

Notes: ^a the unit is KRW 1000; ^b ***: $p < 0.001$, *: $p < 0.05$.

Based on the analysis results, the estimated value of the landmark in the Samseong-dong free display zone is shown in Table 7. Since the WTP derived from the CVM analysis is the annual WTP per household, the landmark value was estimated by multiplying it by the national number of households. The number of households used was based on the 2022 census, and the WTP was estimated as zero for the 32.8% refusal rate in the model. As a result, the value of the Samseong-dong free display zone as a landmark is about KRW 49 billion annually, and assuming that Samseong-dong free display zone maintains its current value for about ten years, its total value amounts to approximately KRW 7041 billion. In this case, a social discount rate of 4.5%, used by the Korean government, is applied [78].

Table 7. Estimated value of the landmark.

Number of Households (1000)	Zero Bid Refusal Rate	Average WTP (KRW/Year)	Annual WTP (KRW 100 Million)	Total Value (KRW 100 Million)
21,774	32.8%	5400.807	790	7041

Notes: KRW denotes South Korean won. As per the Bank of Korea (www.bok.or.kr), accessed on 27 November 2023, the USD to KRW exchange rate was USD 1 = KRW 1303.27.

5.3. Discussion

To help our understanding of the valuation results from our study, we summarized other contingent valuation studies of Korean landmarks. The Samseong-dong free display zone, a tourist attraction and a landmark using advanced technology, shows higher value than historical temples or ecosystems from a tourism perspective. On the other hand, it is valued lower than major tourist attractions like Namhansanseong, mainly due to Namhansanseong's multiple attributes such as history, environmental protection, and its role as a tourist attraction and landmark.

This valuation is consistent across different demographics and distances from the signage, suggesting a widespread appreciation for the landmark as a symbol of innovation and modernity. The findings underscore the importance of local resident support for the sustainability of such landmarks, despite concerns over the visual pollution often associated with out-of-home (OOH) advertising. This study highlights the efforts to mitigate negative

impacts, such as a careful selection of the landmark's location to minimize light pollution and curating content to reflect local culture and preferences. Notably, the inclusion of media art and K-pop content in the advertising mix not only supports commercial objectives but also enhances local cultural value.

Nonetheless, it must be noted that a direct financial comparison based solely on CVM results may not provide a complete assessment of a landmark's value. This is due to the variation in target values, the timing of the study, and the context within which the results are derived across different CVM studies. The intention behind the comparative presentation in Table 8 is to facilitate a broader understanding of the monetary evaluation practices for landmarks in Korea.

Table 8. Summary of the valuing of Korean tourist sites and public facilities.

Classification	Details	Annual Value (KRW Billion per Year)	Reference
landmark	Samseong-dong free display zone	79.0	
heritage	Namhansanseong Fortress	129.1	Shin and Lee [79]
heritage	Confucianism symbol tree	51.6	Jung and Lee [75]
nature	Ecosystem of Munseon area	34.0	Kwon, Kim [80]
heritage	Jogyesa Buddhist temple	25.4	Lim, Kim [81]
nature	Parasitic Volcanic Sieve	10.1	Lee [82]
facility	A public library	4.4	Ko, Shim [83]

6. Conclusions

6.1. Theoretical Implications

This study investigates the transformation of urban landscapes through digital signage, specifically examining the Samseong-dong free display zone in Seoul, Korea, from a sustainable tourism perspective. This transition from traditional to digital advertising not only revolutionizes the industry but also introduces potential sustainability benefits by reducing waste and creating new urban landmarks. This research reveals that these digital signage landmarks are valued by local residents at over KRW 79 billion annually, indicating their significant perceived value over traditional cultural or natural landmarks. This valuation is consistent across different demographics and distances from the signage, suggesting a widespread appreciation for the landmark as a symbol of innovation and modernity. The implications of these findings are manifold, extending across theoretical, practical, and future research dimensions.

This research contributes to the academic discussion about urban sustainability by demonstrating that digital signage landmarks can have a positive impact on local communities and tourism, provided that their design and content are thoughtfully managed. It suggests that the integration of technology into urban landscapes, when carried out responsibly, can contribute to the creation of meaningful and valued public spaces. This study also calls for further exploration into the balance between commercial interests and community well-being in the context of urban digital advertising, pointing towards a future where technology and sustainability coexist harmoniously for the enhancement of urban environments.

This study also provides insightful implications for the measurement of urban sustainability. This study enhances the conventional contingent valuation method (CVM) used in tourism research, presenting a more effective value measurement model. Traditionally, the Single-Bound Dichotomous Choice (SBDC) model has been prevalent in tourism, and gauges willingness to pay through one question [82]. However, critiques from environmental economics highlight its limitations in accurately measuring a willingness to pay and

its propensity for overestimation [84]. This study adopts the double-bound dichotomous choice (DBDC) model, which incorporates additional questions to refine the accuracy and efficiency of willingness-to-pay assessments. Moreover, this study addresses the issue of payment resistance in valuing intangible aspects, recognizing that such resistance can skew model efficiency [67]. This study improves valuation accuracy by distinguishing between genuine unwillingness to pay and mere resistance and incorporating a spike model to estimate those with zero willingness to pay.

This novel application of an advanced CVM in tourism, a method already established in environmental economics, opens new avenues for more precise and efficient value measurement in the tourism sector. Furthermore, this study advocates for quantitative tools in the developing of sustainable urban policies. While the CVM has been a mainstay in environmental economics for valuing intangible assets, its extension to tourism—particularly for valuing natural landscapes and cultural heritage—is a newer development.

6.2. Practical Implications

This study's quantitative approach, novel in assessing modern technology-infused media like digital signage landmarks, aims to provide actionable insights for urban policy-making and tourism industry development, highlighting the need for interdisciplinary collaboration beyond tourism and environmental economics. Recognizing that urban components possess diverse values, this study underscores the necessity of incorporating these multifaceted values into urban policy [48,57,85]. In Korea, establishing free display zones, initially intended to stimulate market activity and increase advertising revenue, has also fostered new tourism landmarks. While their contribution to tourism was a primary consideration, quantifying this impact was essential. This study demonstrates multi-dimensional achievements, including enhancing urban sustainability through a digital transformation in outdoor advertising, creating tourism landmarks, and strengthening city branding through deregulation and focused initiatives. To maximize these benefits, ongoing, multifaceted measurements and analyses of policy impacts are crucial. This study also underscores the need to reassess traditional urban regulatory frameworks in light of new technologies and environments, suggesting that deregulation can lead to novel value creation.

The implications of this research can also extend to the realm of destination marketing for Seoul. As the capital city of South Korea and a global metropolis, Seoul's image and attractiveness as a tourist destination are paramount. The findings of this study, particularly the positive perception and high valuation of the digital signage in the Samseong-dong free display zone, highlight an important aspect of urban tourism: the interplay between technological innovation, local culture, and tourist attractions.

The high valuation of the digital signage landmarks by local residents, regardless of their proximity, indicates a city-wide recognition of these landmarks as integral to Seoul's urban identity. This recognition is not just limited to the local residents but also resonates with a wider audience, both nationally and internationally. Digital signage landmarks, therefore, can serve as a symbol of Seoul's modernity and technological advancement, aspects that are increasingly important in destination marketing.

6.3. Limitations and Directions for Future Research

It is also crucial to look at some limitations of our findings. Our study primarily targets domestic respondents, excluding foreigners due to constraints in measuring the landmark's tourism value, potentially overlooking the perceptions of international tourists. This factor should be considered when interpreting the findings. Additionally, the study relies on online surveys, a deviation from the face-to-face approach recommended in traditional CVMs to minimize survey bias, primarily due to time and cost considerations. Lastly, the study focuses exclusively on the landmark value of the Samseong-dong free display zone, not fully encompassing its broader implications as a city symbol, a branding tool, and a marker of national technological prowess. While not thoroughly examined in this study, these aspects warrant consideration during data interpretation.

Thus, future research directions should focus on broadening the scope to include the perceptions of international tourists, thus offering a more comprehensive view of the tourism value of digital signage landmarks. Additionally, a deeper examination of landmarks' roles in city branding, their contribution to a national technological narrative, and their symbolic value across local and global contexts is imperative. This integrated approach would significantly contribute to our understanding of the multifaceted impacts of digital signage on urban tourism and sustainability.

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