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Leave or Live a Legacy? Using the Choice Experiment to Value Olympic Venues for Post-use

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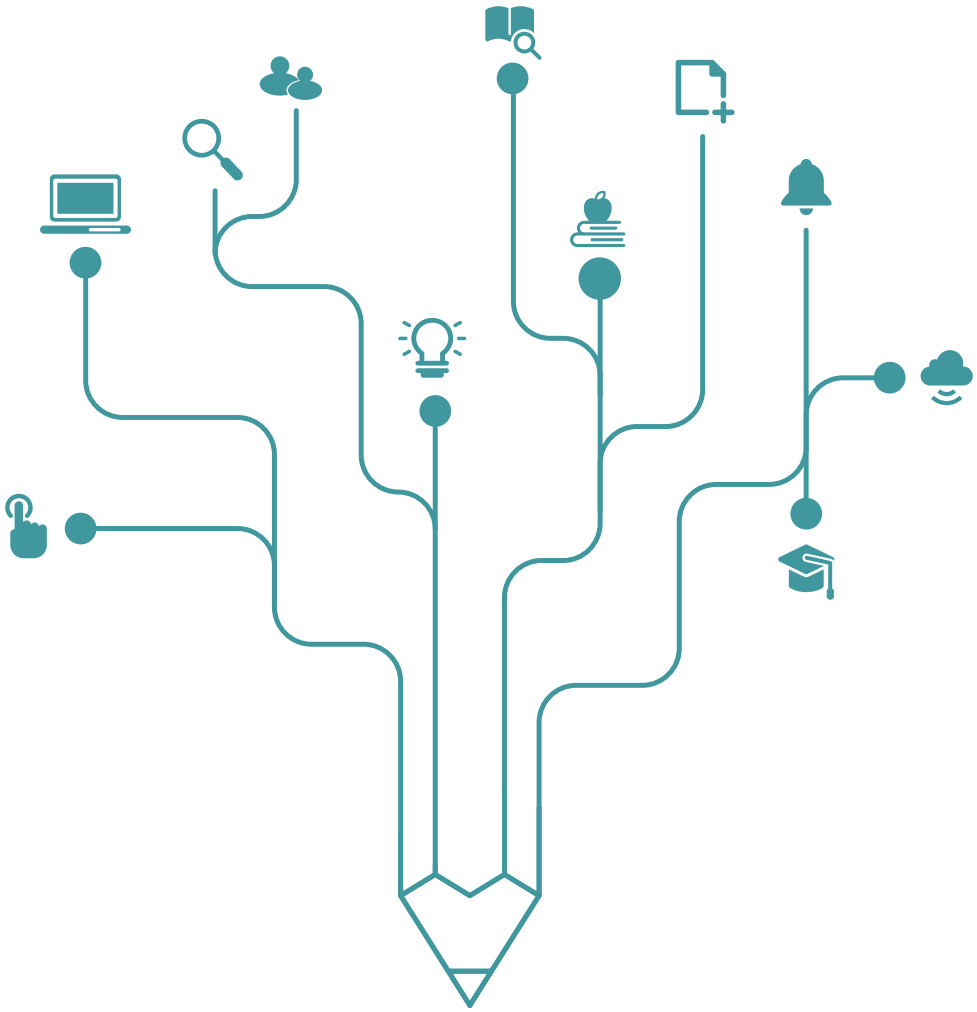

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Abstract

This study attempts to apply a choice experiment to quantifying the benefits of services provided by post-use programs of three Olympic venues in the Republic of Korea: the hockey center, the oval, and the sliding center. We consider the trade-offs between price and programs of three venues for selecting a preferred alternative and derive the marginal willingness to pay (WTP) estimate for each program. As a result, the households' annual WTP for the hockey center, the oval, and the sliding center is found to be 10,372, 10,698, and 12,574 Korean won, respectively. This study is expected to provide policy makers with useful information for evaluating and planning programs for post-use of venues for mega-events such as the Olympics.

Keywords: Olympic venue, Choice experiment, Mega-event, Willingness to pay

JEL classification: Q51, L83, Z20, Z32

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I. Introduction

The Olympics is a global mega-event that requires a lot of effort to prepare, and building new stadiums or upgrading existing ones is an important part of that effort. Hosting the 2018 Winter Olympics in PyeongChang, the Republic of Korea (hereafter, Korea) built several new venues. However, incomplete post-use planning led to poor post-use of some of these venues. In the meantime, the local government that owns Olympic venues prepared a post-Olympic operation plan for three of those venues, which had not been used properly over more than a year since the Olympics. This study aims to estimate the benefits of operating three Olympic venues as planned under new post-use plans.

Studies estimating the value of tourist destinations or attractions often rely on surveys. This is because the subject of the evaluation is often not traded in the market, and even if it is traded, the shadow price, not the market transaction price, must be derived. The willingness to pay (WTP) of respondents is derived through a questionnaire, and representative methods of this stated preference approaches include the contingent valuation method, which asks about the WTP directly, and the choice experiment, which uses the results of choosing from among several alternatives. This study applies the latter, which is appropriate to use when there are multiple attributes to be evaluated and is relatively less exposed to potential cognitive biases.

Research on valuing tourist destinations or attractions using choice experiments is extensive and the methodology has been established as well as standardized. Subjects of valuation include, but are not limited to, cultural heritage (e.g. Bravi and Gasca, 2014; Durán et al., 2015), national parks (e.g. Juutinen et al., 2011; Chaminuka et al., 2012), eco-tourism (e.g. Hearne and Salinas, 2002; Mejía and Brandt, 2015), theme parks (e.g. Kemperman et al., 2000; Chang et al., 2021), cruise travel (e.g. Lee and Yoo, 2015; Mahadevan and Chang, 2017), and hotel choice (e.g. Kim and Park, 2017). In the domain of sport

tourism, we can name Lyu and Han (2017) and Shin and Lyu (2019). While the latter estimates spectators' WTP for professional baseball park sportscape, the former assesses sport tourists' preferences for travel products customized for the 2018 Pyeongchang Winter Olympic Games. To the best of the author's knowledge, however, there has been no case evaluating the post-use value of a venue for a mega-event such as the Olympics.

Applying established choice experiment methodology, this study derives respondents' WTP for four or seven programs depending on the post-use plans for three Olympic facilities by estimating trade-offs between price and service provided by each program. The post-use plans can be broadly divided into three areas: (1) elite sports development, (2) training and educational use, and (3) recreational use. When considering each area as an attribute of the venue, each attribute contains potentially multiple programs. Providing more programs then means possessing higher levels of that attribute. This study's choice experiment uses this hierarchical structure.

As a result, we found that respondents highly value programs that serve the venue's original purpose such as training for national teams. Also, we found that when respondents predicted that they would be unlikely to actually use a program, they gave it a relatively low value.

The rest of this paper is structured as follows. Section II introduces three venues for 2018 PyeongChang Winter Olympic Games, their challenges, and future operation plans. Section III describes the design for choice experiment and the implementation of survey. Section IV then discusses the estimation results and Section V is devoted to concluding remarks.

II. Venues for 2018 PyeongChang Winter Olympic Games and Their Post-utilization

The Winter Olympics 2018 held in PyeongChang, Korea was the nation's first winter Olympic games. Therefore, after being selected as the host in July 2011, Korea decided to build six new facilities out of a total of 12 venues and a temporary stadium for the opening and closing ceremonies, as shown in Table 1. After the Olympics, there was controversy about the post-utilization of three specific venues,

TABLE 1—OVERVIEW OF THE WINTER OLYMPICS 2018 FACILITIES

Cluster	Venue	Event	Work	Construction/Overlay cost	Ownership
Pyeongchang Mountain Cluster	Alpensia Biathlon Centre	Biathlon	Overlay	11.4	GP
	Alpensia Cross-Country Centre	Cross-country skiing, Nordic combined	Overlay	19.5	GP
	Alpensia Ski Jumping Centre	Ski jumping, Nordic combined, snowboarding (big air)	Overlay	11.5	GP
	Alpensia Sliding Centre	Luge, bobsleigh, skeleton	New construction	114.1	GP
	Jeongseon Alpine Centre	Alpine skiing (downhill, super-G, combined)	New construction	203.4	GP
	Phoenix Snow Park	Freestyle skiing, snowboarding	Renovation	59.9	PP
	Pyeongchang Olympic Stadium	Opening and closing ceremonies	New construction	63.5	GP
	Yongpyong Alpine Center	Alpine skiing (slalom, giant slalom)	Overlay	18.0	YR
Gangneung Coastal Cluster	Gangneung Curling Centre	Curling	Renovation	13.4	GC
	Gangneung Hockey Centre	Ice hockey (men's tournament)	New construction	106.4	GC
	Gangneung Ice Arena	Sort track speed skating, figure skating	New construction	134.0	GC
	Gangneung Oval	Long track speed skating	New construction	126.4	GC
	Kwandong Hockey Centre	Ice hockey (women's tournament)	New construction	62.7	GP

Note: GP=Gangwon Province, PP=Pheonix Pyeongchang Co., Ltd., YR=HJ Magnolia Yongpyong Hotel and Resort Co., Ltd., and GC=Gangneung City.

namely Alpensia Sliding Centre, Gangneung Hockey Centre, and Gangneung Oval. The biggest problem of these newly built venues is that there was not enough discussion in advance about how to use the facilities after the Olympics. Consequently, they are not expected to generate enough revenue to cover the large operating cost. Table 2 reveals information on the size and project costs of these three facilities, which are subject to analyses of the current study.

TABLE 2—OVERVIEW OF THE OLYMPIC VENUES SUBJECT TO ANALYSIS

Venue	Hockey center	Oval	Sliding center
Total floor area	Main stadium: 23,062m^2 Auxiliary arena: 5,689m^2	37,846m^2	-
Number of seats	Main stadium: 9,500 Auxiliary arena: 495	7,600	7,000
Construction period	Jul 2014 – Mar 2017	May 2015 – Nov 2017	Dec 2013 – Feb 2018
Total project cost (billion KRW)	109.2	126.3	114.4

TABLE 3—OVERVIEW OF THE POST-UTILIZATION PLANS OF OLYMPIC VENUES SUBJECT TO ANALYSIS

Category	Hockey center	Oval	Sliding center
Hosting international competitions	6 competitions per year	1 competition per year	2 competitions per year
Hosting domestic competitions	24 competitions per year	5 competitions per year	4 competitions per year
Training national teams	National team training camp	National team training	National team training
Training general players	Camp and coach training	General players training	General players training
Sports clubs' use	Available on weekends and weekday afternoons	Sports clubs' use	-
Experiencing Camp	6 youth ice hockey camps per year	Public experience camp	-
Convention and performance	1 exhibition and 4 concerts per year	5 exhibitions and 12 concerts per year	-
Public experience	Operating public experience center	Public experience program	Public experience program
After-school activity	After-school activity for 4 elementary schools	After-school activity for 4 elementary schools	-
Training class	-	Public class	Monthly public class
Rental	Store rental	Store rental	Store and office rental
Expected annual revenue (million KRW)	761.5	934.1	1,156.1

After the Olympics, these three venues were used differently. First, the Alpensia Sliding Centre (hereafter, the sliding center) has been used as a training facility for national teams and student athletes. Due to cost limitations, the track was frozen and used only during the winter season, and only a starting training facility was used in the summer. Due to safety concerns, it was not available for public use at all. In contrast, many previous Olympic venues including Whistler Sliding Centre in Vancouver, Utah Olympic Park in Salt Lake City, and Olympic Sports Complex in Lake Placid provide passenger bobsleigh and/or skeleton (wheeled or genuine depending on the season) experiences in summer and winter for general visitors.

Second, the Gangneung Hockey Centre (hereafter, the hockey center) was used more actively than the sliding center. It was used as the main training facility for the national para ice hockey team. Meanwhile, it was not only used as a training ground for general players, but also hosted domestic age-group hockey league matches and competitions both domestic and international. The hockey center hosted a few events, including figure skating ice shows, at the main stadium but its auxiliary arena has been left largely unused.

Third, the Gangneung Oval (hereafter, the oval) had the lowest utilization because of the high cost of freezing and maintaining ice in such a large space. Since the Olympics ended, the ice in the oval has never been frozen, leaving the space unused. In fact, there was much controversy about the post-Olympic use of the oval even before its construction. Finally, it was decided to demolish it after the Olympics due to maintenance difficulties, and so it was built without some necessary equipment such as air conditioning amenities. After the Olympics, however, the decision to demolish it was overturned. The cost of freezing and maintaining ice was so high that attempts were made to use the indoor facility for purposes other than skating. Unfortunately, the operation of the oval, which did not have the necessary amenities, required significant additional costs, which led to it being completely unused.

In late 2018, the Provincial government that own the three venues mapped out operational plans to improve their post-use as summarized in Table 3. The operating plans aim to encourage use by both

professional athletes and the general public, focusing on the original function of each facility. The plans can be broadly divided into three areas: (1) elite sports development, (2) training and educational use, and (3) recreational use. The elite sports development area focuses on providing training opportunities and hosting competitions to improve professional sports skills. Therefore, they aim to enable training of national team members and professional players in different age groups. In the area of training and educational use, the purpose is to expand the base of experience for each sport. Where possible, plans were made to regularly operate programs for sports clubs' uses, youth camps, monthly classes, and after-school activities. The recreational use area was designed as a measure to increase the profitability of facility operation by providing programs that will arouse the interest of the general public. Plans in this area aim to run regular programs that allow visitors of all ages to experience things in a non-professional way, occasionally hold events such as performances, and provide opportunities to view the facility and surrounding scenery. If such a plan did not generate sufficient demand, the government considered demolishing the three venues as an alternative.

III. Choice Experiment

To estimate the value of three Olympic venues, this study aims to apply a standard (discrete) choice experiment, which encompasses a variety of multi-attribute preference elicitation techniques. Advantages of the choice experiment is manifold. First, it is convenient in estimating the value of each attribute that makes up a non-market good. This is useful because policies often concern with changing one or more attribute levels, rather than losing or gaining a good as a whole (Hanley et al., 1998). Second, it allows respondents to systematically evaluate trade-offs among multiple attributes. This trade-off process may encourage respondent introspection and facilitate consistency checks on response patterns (Johnson and Desvousges, 1997). Third, as it does not ask for the WTP of respondents, it reduces the possibility of cognitive biases and the number of protest responses, especially those involving tax increases or willingness to accept service degradation in return for payment (Yoo et al., 2008). It also

increases the amount of information obtained from each respondent by presenting multiple choice sets, thus reducing the required sample, and hence reducing the costs of the survey (Yoo et al., 2008).

3.1. Objects to be Valued and Attributes

As mentioned earlier, the objects to be valued by this study are three Olympic venues. The valuation through the choice experiment is made on each of the attributes that each venue can provide. In determining the attributes for valuation, we can follow recommendations of previous studies as listed below. First, the attributes should be independent or nearly independent of one another (Kwak et al., 2001). Second, there should only be a small number of attributes, preferably not more than six, because trade-offs become difficult to understand if there are too many attributes (Phelps and Shanteau, 1978). Third, attributes should be describable by combining simple explanations and visual instruments such as photographs, charts, and pictures. Fourth, attributes should be scientifically meaningful and important facts about expected service should not be omitted. Fifth, attributes should mean something to people and be able to relate a reason for having WTP for the potential use of the venue (Yoo et al., 2008).

Using the five screening criteria above, we reorganized the services specified in their future operation plans shown in Table 3. In so doing, we conducted extensive interviews with experts including policy analysts, researchers, and professors in different fields. Consequently, we identified three service attributes for the hockey center and the oval: (1) elite sports development, (2) training and educational use, and (3) recreational use. For its unique characteristics, we identified only two service attributes for the sliding center identically but excluding training and educational use. Table 4 shows these attributes, as well as the price attribute, and how each level of attributes was defined. If a venue is operated in the future, the level of service attributes is determined as including one or more of the programs presented in Table 3. In cases where there are two programs planned within an attribute, such as elite sports development and recreational use, there are four levels in total: none (demolition), only one of two programs, and both together. In contrast, for training and educational use of the hockey center and the oval

in which there are three programs each, a total of eight levels (1 for none, 3 for one, 3 for two, and 1 for all three programs) exist.

The price attribute is presented as annual income tax increases per household to be both realistic and familiar to respondents. Unlike service attributes, which have a level of zero when demolished, it was announced that demolition costs would be incurred, and an appropriate amount was designated accordingly to the price attribute. We determined all the levels of the price attribute through a pretest.

TABLE 4—ATTRIBUTES AND THEIR LEVELS OF OLYMPIC VENUES

Attribute	Hockey center	Oval	Sliding center
Service I: Elite sports development	1. 0 2. Training national teams 3. Holding competitions 4. Training national teams and holding competitions	1. 0 2. Training national teams 3. Holding competitions 4. Training national teams and holding competitions	1. 0 2. Training national teams 3. Holding competitions 4. Training national teams and holding competitions
Service II: Training and educational use	1. 0 2. Sports clubs' use 3. Youth camp 4. After-school activity …(Combinations of above)	1. 0 2. Sports clubs' use 3. Monthly class 4. After-school activity …(Combinations of above)	-
Service III: Recreational use	1. 0 2. Public experience 3. Performance 4. Public experience and performance	1. 0 2. Public experience 3. Performance 4. Public experience and performance	1. 0 2. Public experience 3. Scenery and track viewing 4. Public experience, and scenery and track viewing
Price (KRW)	1. 30 1'. 80 2. 1,000 3. 2,000 4. 3,000 5. 5,000	1. 50 1'. 100 2. 1,000 3. 2,000 4. 3,000 5. 5,000	1. 50 1'. 100 2. 1,000 3. 2,000 4. 3,000 5. 5,000

Note: 1. Level 1 (and 1' for price) indicates the counterfactual (demolition) level of each attribute.
2. For training and educational use, different combinations of level 2, 3, and 4 are used although they are omitted for the sake of brevity.

3.2. Survey

We prepared a draft of survey questionnaire, reviewed it with experts in a polling company, and revised it with a focus group to make sure respondents understand the questions and feel comfortable to

answer to them. The finalized survey questionnaire consists of 3 sections. The first part was intended to measure respondents' general attitude about the Olympics, winter sports, and the venue to familiarize them with the attributes of the venue being evaluated, and to elicit information about their past experiences with these attributes. To enhance respondents' understanding when progressing through this part, the interviewer provided a supplementary booklet to respondents that contains descriptions of venue including location, scale, existing similar facilities, and future operation plans as well as visual aids including color photographs of venue and activities similar to those planned. The second part contains questions for choice experiment analysis designed to elicit respondents' WTP to each of service attributes by estimating trade-offs between price and service attributes. Lastly, the final part gathers the socioeconomic information of respondents including age, income, education, vocation, residence, and family.

It is well-known that a key problem encountered in a choice experiment is information overload, i.e. there are too many alternatives with too many complex combinations of attributes (Lee and Yoo, 2009). Therefore, an effective process for determining the choice set from which respondents make their choices is essential. More specifically, it is important to carefully define the attribute space so that it contains the relevant portion of the policy question being asked. Furthermore, using the statistical design theory, we must construct choice sets that can produce coefficient estimates that are not confounded by other factors. Following the established convention, we used an orthogonal main effects design, which is effective in isolating the effects of individual attributes on choice (see Yoo et al., 2008 and Lee and Yoo, 2009). The ability to design in this orthogonality is a major advantage over the revealed preference random utility models, where attributes are often found to be highly correlated in practice (Hanley et al., 1998).

In this study, each venue has two service attributes (elite sports development and recreational use) that are classified into four levels, and a price attribute with six levels. In addition, the hockey center and the oval have one more service attribute that is differentiated into eight levels, namely training and educational use. Meanwhile, each choice experiment question includes a total of 3 alternatives of which 2

represent the operations of post-use programs and the other represents the fixed counterfactual, i.e. demolition. Accordingly, there are $(4^2\times8\times6)^2$ possible combinations of attributes and levels to form the choice sets for each of the hockey center and the oval, and $(4^2\times6)^2$ for the sliding center. Since it is impractical to ask respondents to choose from all of these combinations, we drew a subset of all possible choice sets to choose 60 choice sets. These chosen choice sets were then divided into 3 sets of 20 choices each. Fig. 1 shows an example of the choice set that was used in the survey instrument. During the survey, the interviewer asked each respondent to choose one out of three alternatives (A, B, and C (demolition)), and this process was repeated with 20 different choice sets presented to the same respondent.

	Alternative A	Alternative B	Alternative C (Demolition)
Elite sports development	● Training national team	● Training national team ● Holding competitions	None
Training and educational use	● Sports clubs' use ● Youth camp ● After-school activity	● Sports clubs' use	None
Recreational use	● Public experience ● Performance	● Public experience	None
Additional annual household income tax	KRW 5,000	KRW 1,000	KRW 30
Check only one alternative which you prefer among Alternative A, B, and C.	☐	☐	☐

FIGURE 1. A SAMPLE CHOICE SET USED IN THIS STUDY

Since the survey was the first attempt that uses a choice experiment for evaluating the Olympic venues, it was not clear whether the respondents had fully understood the trade-offs between price and other service attributes of the venue described in the scenario although we refined the questionnaire through focus group interviews. Therefore, we conducted face-to-face interviews in which we asked detailed questions to respondents to make sure that their responses are reliable. The survey was carried out nationwide in Korea between April 10 and May 1, 2019.

Sampling with stratification and fieldwork were done by the interview experts of a professional polling firm. Taking into account the characteristics of the households, the randomly selected heads of households or housewives with income over 20 years old were interviewed at their homes to maximize the scope for detailed questions and answers. As a result, we obtained a total of 8,000 choice data from 400 respondents for each of the venues.

IV. Random Utility Model and Estimation

Here, we discuss the theoretical basis and empirical methodology of this study. When conducting a survey that presents the choice set C_i to respondent i, the indirect utility function U_{ij} for respondent i who chooses alternative j in C_i can be expressed as

$$U_{ij} = V_{ij}(Z_{ij}, S_i) + e_{ij} \text{ for all } j \text{ in } C_i.$$

The indirect utility function U_{ij} can be decomposed into the deterministic part V_{ij} and the stochastic part e_{ij}. While the research cannot observe the latter, the former is specified as a function of attributes Z_{ij} in alternative j chosen by respondent i and the characteristics of respondent i, S_i. The probability that respondent i chooses alternative j in the choice set C_i is given by

$$\Pr(j|C_i) = \Pr(U_{ij} > U_{ik}) = \Pr(V_{ij} - V_{ik} > e_{ik} - e_{ij}). \quad (1)$$

for all $k \neq j$ in C_i.

To deal with this probability, we need to know the distribution of the stochastic part e_{ij}. Following convention, we assume that they are independently and identically distributed (*iid*) with the type-I extreme-value (or Gumbel) distribution which implies that the difference $e_{ik} - e_{ij}$ follows the *iid* logistic

distribution (McFadden, 1973). Consequently, the probability (1) can be expressed as

$$\Pr(j|C_i) = \frac{\exp(V_{ij})}{\sum_{k \in C_i} \exp(V_{ik})}. \quad (2)$$

In the current study, each respondent was given 20 choice sets and asked to choose the most preferred alternative out of three including the demolition alternative. Since choice results were either ‘‘yes’’ or ‘‘no’’, the log-likelihood function can be written as

$$\ln L = \sum_{i=1}^{N} \sum_{j=1}^{3} \left(y_{ij} \ln(\Pr(j|C_i)) \right). \quad (3)$$

where y_{ij} is a binary variable whose values is 1 if respondent i chooses alternative j and 0 otherwise. The total number of respondents for each venue was 400 resulting in a total of $N = 400 \times 20 = 8{,}000$ observations. Consistent with previous studies, we parametrize the deterministic part V_{ij} in the indirect utility as a linear combination of attributes and an alternative-specific constant, ASC_j,

$$V_{ij} = ASC_j + \sum_{s=1}^{S} \beta_s Z_{sij} + \beta_p Z_{pij}. \quad (4)$$

where Z_{sij} and Z_{pij} represents service (or program) of a venue provides and price, respectively. As discussed above, the number of programs S varies by venue, with the hockey center and oval having seven each and the sliding center having four. Accordingly, β’s are the parameters to be estimated for each associated program that influences the respondent’s utility. Once we plug (4) in (2) and thus (3), we can estimate β’s using the maximum likelihood estimation (MLE).

Lastly, to estimate the marginal willingness to pay (MWTP) against the demolition (i.e. null) level of each program in an attribute, we can obtain the marginal rate of substitution between price and each

service attribute since it represents the MWTP (see Mott et al., 2020 for its accuracy in reporting). We can then totally differentiate equation (4) such that

$$MWTP_s = -\frac{\partial V/\partial Z_s}{\partial V/\partial Z_p} = -\frac{\beta_s}{\beta_p} \qquad \text{for all } s = 1, \dots, S. \tag{5}$$

in which we assume that all the other programs' levels remain constant for each s.

IV. Estimation Results and Discussions

The estimation results of the model using the MLE are presented in Table 5. All coefficients of the attributes in the indirect utility function are statistically significant at the 0.01% significance level. Moreover, their signs are obtained as expected. The coefficients of the service attributes are all positive, which means that as the level of these attributes increases, the probability of choosing alternatives rather than the counterfactual (demolition so that providing zero service level) alternative increases. The coefficient of the price is negative, which confirms that increasing levels of price have a negative effect on utility.

Moreover, we can compare programs within an attribute of each venue. First, within the attribute of the elite sports development, respondents indicated that the training function for national teams was of higher utility than hosting competition matches for all three venues. This appears to be due to two reasons: (1) these three venues were originally built to host the Olympic Games and are therefore perceived as facilities for professional athletes, and (2) respondents who live far from the venues may rate their likelihood of actually visiting and watching the competitions as low. Second, respondents picked out the use of sports clubs as the most valuable among the programs in the attribute of training and educational use. This may be because, as before, they appreciated the use of sports clubs for relatively professional exercise based on the perception that the venues are high-quality facilities. Evaluations of subsequent programs appear to have been influenced by judgments about visitation or use. For example, if

respondents live far from the venue, they may value a youth camp that they can enroll their children in relatively highly, but a monthly class that is less likely to be available relatively low. Lastly, for the recreational use attribute, we can see that a significantly higher value was given to the program (i.e. public experience) for which the venue is used for its original purpose than performance or scenery and track viewing.

TABLE 5—ESTIMATION RESULTS USING THE MAXIMUM LIKELIHOOD ESTIMATION

Variables		Hockey center	Oval	Sliding center
Price		-.2440*** (.0112)	-.2444*** (.0112)	-.1783*** (.0152)
Service I: Elite sports development	Training national teams	.5834*** (.0374)	.5437*** (.0372)	.7864*** (.0350)
	Holding competitions	.3475*** (.0387)	.3622*** (.0387)	.4436*** (.0338)
Service II: Training and educational use	Sports clubs' use	.3496*** (.0387)	.3664*** (.0343)	
	Youth camp	.3407*** (.0351)		
	Monthly class		.2290*** (.0351)	
	After-school activity	.3166*** (.0343)	.3269*** (.0342)	
Service III: Recreational use	Public experience	.4289*** (.0344)	.5260*** (.0344)	.5680*** (.0329)
	Performance	.1654*** (.0369)	.2607*** (.0368)	
	Scenery and track viewing			.4438*** (.0329)
No. of observations		8,000	8,000	8,000
Log-likelihood		-7874.2665	-7833.5231	-8046.3008
Pseudo R-squared		.1041	.1087	.0845

Note: Asterisks indicate statistical significance: *, $p < 0.1$; **, $p < 0.05$; ***, $p < 0.01$.

We can now estimate the household's MWTPs to the operation of a program using the equation (5). The results of MWTP estimates are shown in Table 6. For example, the annual average MWTP for training national teams at the hockey center is 2,387 Korean won (KRW), which is statistically significantly different from zero at the 0.1% significance level by using the standard error calculated via the delta method (Kanninen, 1993).

TABLE 6—MARGINAL WILLINGNESS TO PAY FOR EACH ATTRIBUTE

Attribute	Program	Hockey center		Oval		Sliding center	
		Estimate	%	Estimate	%	Estimate	%
Service I: Elite sports development	Training national teams	2.3866*** (.1590)	23.01	2.2242*** (.1584)	20.79	4.4109*** (.2077)	35.08
	Holding competitions	1.4240*** (.1680)	13.73	1.4818*** (.1671)	13.85	2.4877*** (.2078)	19.79
	Subtotal	3.8106	36.74	3.7060	34.64	6.8986	54.87
Service II: Training and educational use	Sports clubs' use	1.4326*** (.1500)	13.81	1.4991*** (.1493)	14.01		
	Youth camp	1.3962*** (.1528)	13.46				
	Monthly class			.9370*** (.1588)	8.76		
	After-school activity	1.2975*** (.1507)	12.51	1.3375*** (.1499)	12.50		
	Subtotal	4.1263	39.78	3.7736	35.27		
Service III: Recreational use	Public experience	1.7575*** (.1481)	16.94	2.1522*** (.1465)	20.12	3.1858*** (.1998)	25.34
	Performance	.6777*** (.1824)	6.53	1.0664*** (.1684)	9.97		
	Scenery and track viewing					2.4891*** (.2034)	19.80
	Subtotal	2.4352	23.48	3.2186	30.09	5.6749	45.13
Total		10.3720	100	10.6981	100	12.5735	100

Note: 1. The unit is thousand Korean won (KRW) per annum.
2. Asterisks indicate statistical significance: *, $p < 0.1$; **, $p < 0.05$; ***, $p < 0.01$.
3. Numbers in parentheses are asymptotic standard errors and they were calculated via the delta method.
4. Numbers in columns labeled with % represent percentages occupied in the MWTP for a venue.

By summing the MWTPs of programs up to the attribute, we can obtain the MWTP by attribute, and furthermore, the sum of these becomes the MWTP for the venue. As a result, the MWTP for the sliding center was KRW 12,574, which was higher than the MTWP for other two venues, which were slightly over KRW 10,000. Comparing the magnitude of MWTPs among attributes in the venue, the hockey center and oval showed the highest proportions of training and educational use, at 39.8% and 35.3%, respectively. Conversely, the MWTP had the lowest share of recreational use of these venues. The proportion of the MWTP for the elite sports development attribute in the sliding center exceeded half (54.9%). The comparison of MWTPs between programs within each attribute is the same as the discussion

above when interpreting results in Table 5.

Using the annual average MWTP for a household in Table 6, we can calculate the annual WTP for each venue by multiplying it by the number of households in Korea. According to the Statisitics Korea, the national statistics office, there were 20,343,188 households nationwide in 2019. Therefore, the total WTPs are KRW 211.0 billion, 217.6 billion, and 255.8 billion for the hockey center, the oval, and the sliding center, respectively.

V. Concluding Remarks

This study was motivated by the need for quantitative information to help policy makers to map out attractive and effective plans to promote the post-use of three Olympic venues. To estimate the benefits through the WTP, we used the choice experiment that can produce the MWTP for individual attributes and further for each of planned programs. The survey was systematically conducted and the estimation obtained all coefficients in the model different from zero, which are statistically significant.

Comparing the magnitudes of MWTPs, the findings are sufficient to provide insights to future planning of similar venues: (1) respondents highly value programs that serve the venue's original purpose such as training for national teams, and (2) when respondents predicted that they would be unlikely to actually use a program, they gave it a relatively low value. Therefore, when establishing similar post-use plans in the future, it would be desirable to seek ways to maintain the original functions of the venue and increase use by nearby residents.

Nevertheless, this study has a few limitations. First, the derived WTP may not be sensitive to the level of the program. For example, due to the time and budget limitation, we could not confirm whether respondents' perceptions changed correspondingly when the program allocates different (hypothetical) amount of time to sports clubs' activities. Second, although we simply added up the average WTP per household to calculate the total benefit, it is necessary to consider socioeconomic factors such as the distance between the residence and the venue to obtain a more precise value.

Finally, this case study strongly suggests that when hosting mega-events such as the Olympics in the future, it is necessary to thoroughly establish plans for post-use from the time of construction of the venues. In particular, quantitatively evaluating and establishing a post-use plan using a stated preference approach like this study will be a good example of evidence-based policymaking.

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