

Willingness-to-pay for TV Broadcasting Provided through the Internet in Japan: With a Focus on Information Shortage during the Earthquake Disaster

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Mobile devices, such as smartphones and tablets, are increasingly taking on a more critical role than conventional ICT equipment, such as desktop PCs, in people's lives. Simultaneously, there has been a reduction in people's, mainly young people's, consumption of TV broadcasting; this has caused a decline in audience ratings. Consequently, NHK and commercial broadcasters have begun offering their programs online. This study aims to investigate users' evaluations of mobile applications for distributing programs through the Internet. The evaluation focused mainly on the time around the significant earthquake. The Contingent Valuation Method and Price Sensitivity Measurement were employed to correct consumers' price-related data. Indexes, such as Willingness to Pay, Indifference Price, and Optimal Prices were calculated, and the impact of utilizing other broadcasting services, digital content, and demographics were verified. The results demonstrated that the service provides certain economic benefits to users; however, it was difficult for broadcasters to collect compensation for the service.

Keywords: Digital content services, Earthquake broadcasts, CVM, PSM

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1. Introduction

The primary devices used to consume digital content have changed from TV sets and desktop computers to smartphones and tablet PCs. This change in viewer preferences has led to declining audience ratings for TV programs (NHK Broadcasting Culture Research Institute 2021). Consequently, the Japan Broadcasting Corporation (NHK) and other commercial broadcasters have begun operating video streaming services and a missed-program webcast to increase their viewership. The decision regarding whether the central axis of broadcasting services should be shifted to the Internet is crucial for devising future management strategies for broadcasters. The provision for accessing broadcast programs through smartphone apps was employed as a case study. The empirical estimation attempted to reveal users' willingness to pay (WTP) for this service, which is essential for evaluating its economic sustainability. This research focused on the period during the major earthquake as mobile phones and smartphones have excellent portability, which would enhance the value of mobile broadcasting services during an emergency.

The originality of this study lies in its combination of Contingent Valuation Method (CVM) and Price Sensitivity Measurement (PSM) to derive various indicators and examine the WTP among

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mobile broadcasting users. Notably, to the authors' knowledge, this is the first attempt to implement a parametric analysis using socio-economic variables in PSM. Other distinctive features of the research are the comparative analysis between NHK and private broadcasters and the detailed examination focusing on the role during disasters. Based on the results of the empirical survey, when providing this service, a substantial proportion of respondents are in favor of making it free, and careful consideration is required when setting a price. Additionally, it was revealed that there is a tendency for positive evaluations of this service in earthquake-affected areas.

2. Background of the Research

2.1. Internet TV services in Japan

In Japan, TV services are mainly provided by the public broadcasting service—NHK and Commercial broadcasting services. The NHK operates on receiving fees, while commercial broadcasters use advertising revenue (NHK Broadcasting Culture Research Institute 2022). The NHK's income from reception fees had risen for six consecutive years from JPY 643.8 billion in FY 2013 to JPY 723.1 billion in FY 2019; however, it decreased significantly to JPY 700.5 billion in FY 2020 due to the impact of the COVID-19 epidemic (NHK 2013–2021). Similarly, commercial broadcasting services saw their income fall to JPY 1,986.3 billion in FY2020, facing an 11.9% decrease from FY 2019.¹ Some surveys reported that the audience rating of conventional TV broadcasting services had recovered to a certain extent during the epidemic (Impress Research Institute 2020). However, the amount of time spent by teens viewing TV was 73 minutes on weekdays (93 minutes on holidays), and by those in their 60s, it was 271 minutes on weekdays (335 minutes on holidays) (MIC,² 2021). There is a concern that the long-term audience rating will decline unless young people watch TV. Moreover, the usage of Internet streaming services, such as Amazon Prime Video, Netflix, and Hulu, saw a significant increase during this period. In 2020, viewers of real-time telecasts accounted for 69.9%, and viewers of TV recordings accounted for 69.6% (Impress Research Institute 2021).³ Similarly, viewers of free video distribution services accounted for 30.7%, and those of paid video distribution services were 25.6%.⁴ In addition, corporate advertisements, which are the primary source of revenue for commercial broadcasters, were also shifting towards Internet media. In 2019 TV accounted for 26.8% of Japanese companies' total advertising expenses, and Internet media accounted for 24.0%. In 2020, this trend was reversed; TV accounted for 26.9%, while internet media accounted for 28.5%. Finally, in 2021, the difference between TV and internet media broadened, with TV accounting for only 27.1% and

¹ The total content market in Japan (FY2021) was JPY11,698 billion, of which TV broadcasting and related services accounted for JPY3,195 billion (Digital Content Association of Japan 2021). Among the Japanese market of the broadcasting industry (FY2020), core terrestrial broadcasters accounted for JPY2,264 billion (59.4%), commercial satellite broadcasters accounted for JPY362 billion (9.2%), cable TV companies accounted for JPY501 billion, and NHK accounted for JPY737 billion (18.7%) (MIC 2021).

² Ministry of Internal Affairs and Communications, Japan

³ Respondents were allowed multiple answers in the usage of those media.

⁴ The number of paid video distribution service viewers increased by 5.5% from the previous year (21.1%).

internet media accounting for 31.7% of total corporate advertising, thus leading the difference between them to reach 4.5% (Dentsu, 2022).⁵

Under these circumstances, the NHK and commercial broadcasters have sought to utilize the Internet for TV broadcasting. The revised Broadcasting Law, which permits simultaneous broadcasting at all times, came into effect in January 2020; consequently, the NHK started the *NHK Plus service* in April 2020. This service distributes video content over the Internet for PCs and mobile devices and achieved 1.22 million subscriptions about ten months after the service began (NHK et al. Bureau 2021). NHK Plus added a missed-program webcast in March 2021, through which subscribers could watch programs up to one week later. The NHK Plus service is provided to NHK subscribers without additional charges and can be used to create up to 5 accounts for family members. Commercial broadcasters began offering a missed-program webcast in October 2015 through their official portal, *TVer*. This service provided more than 300 programs, including popular content, such as serial TV dramas, and has recorded many viewers (Yomiuri News, 2021). Broadcasting content on TVer includes commercials similar to a regular TV program; therefore, viewers are not required to pay additional charges. These over-the-top (OTT) type video distribution services enable users to watch anytime, anywhere, using a smartphone or tablet; therefore, further synergistic effects are expected to occur if the broadcast content of NHK and commercial broadcasters are distributed together regularly on the Internet.

The advantages of such services are not limited to entertainment; they can also be used to spread essential information during an emergency. For example, following the 2011 Great East Japan Earthquake,⁶ 120 TV transmission stations were stopped in 11 prefectures, including three prefectures in Tohoku—Miyagi, Fukushima, and Iwate prefectures; however, the broadcast about the earthquake began two minutes after the earthquake by NHK, and the regular programs were changed to disaster-related reports. A total of 254 hours of disaster-related news was broadcasted by NHK and commercial broadcasters for 12 days after March 11, 2011 (MIC, 2013). Similarly, during the 2016 Kumamoto earthquake,⁷ NHK and commercial broadcasters started emergency news programs right from the beginning of the earthquake on April 14, 2016 (Sankei News, 2016). Unlike traditional broadcasting, people generally have access to news on mobile devices after significant earthquakes,

⁵ Internet advertisements include digital advertisements derived from four mass communication media (newspapers, magazines, radio, and television).

⁶ The Great East Japan Earthquake was a massive earthquake with a magnitude of 9.0 that occurred around 14 : 46 on March 11, 2011. It is the largest earthquake in the observation history of Japan (Cabinet Office 2011). Its epicenter was about 24 km off the Pacific Ocean in the Tohoku region, and it led to 15,899 deaths, 2,526 people going missing, and 6,157 injuries; additionally, 404,893 houses were utterly destroyed, washed away, or partially destroyed (National Police Agency 2021). The damage was concentrated in the Tohoku region of Miyagi, Iwate, and Fukushima prefectures, with 99.6% dead, 99.8% missing, and 73.8% injured.

⁷ The Kumamoto earthquake (2016 Kumamoto earthquake) refers to a series of seismic activities that occurred after 21 : 26 on April 14. Between April 14th and 16th, seismic activity of intensity 7 occurred twice, seismic activity of intensity more than 6 occurred twice, and seismic activity of intensity less than 6 occurred three times (Magnitude 5.4–7.3) (Cabinet Office 2016). It was the first instance when earthquakes with a seismic intensity of 7 occurred in succession since the establishment of a seismic intensity of 7 in 1949. Of the 273 dead, 270 were concentrated in the Kumamoto Prefecture, and 206,886 houses were completely or partially destroyed (Cabinet Office 2016).

which are unfortunately expected to happen throughout the year. Thus, video streaming services play an essential information dissemination role, especially in Japan.

2.2. Research questions

Considering the above circumstances, this research examines the value of internet-based broadcasting services for mobile devices. It empirically evaluates the monthly charge that users can afford to pay for them. Specifically, the empirical survey targets applications that enable viewing TV streaming in real-time (simultaneous broadcasts) and past broadcasts (missed-program webcast) using smartphones. Simultaneously, the study also focuses on how large-scale disasters, such as earthquakes, change users' awareness about the importance of this service and assesses whether their evaluations of these services increased. Thus, the survey plan focused on the Tokyo metropolitan area, *a densely populated place*, and the areas that have experienced large-scale earthquakes in the 2010s, such as the Tohoku region and Kumamoto prefecture, and on news reports spread via video streaming service apps on smartphones. The difference between the two types of broadcasting services: governmental broadcasting—NHK; and private broadcasting—commercial TV services—was also investigated as NHK requires monthly fees from all subscribers, while commercial TV media are generally free. The main research items examined in the empirical survey are as follows:

1. How do users economically rate the simultaneous broadcasts and missed-program webcasts through mobile terminals?
2. How are the evaluations different between NHK single service and NHK and commercial media joint service?
3. Is there any change in evaluating mobile video streaming services after people experience large-scale earthquakes?
4. Do users' experiences of other paid content services, video distribution services, and smartphone apps affect the evaluation of mobile video streaming services?
5. To what extent do users' demographics, such as age and gender, influence mobile services and media usage?

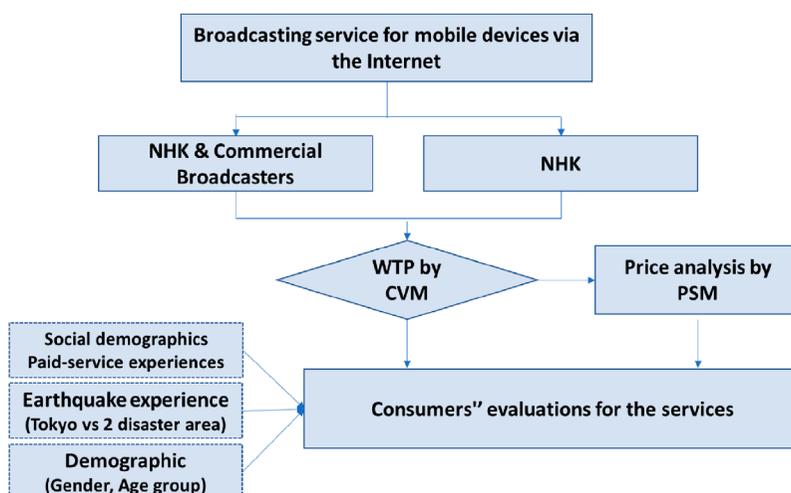
3. Empirical Research

3.1. Framework of empirical research

Two survey techniques were employed to verify the research items: Contingent Valuation Method: CVM and Price Sensitivity Measurement: PSM. Both methods are implemented to collect price information on consumers' goods and services. This research aims to collect multiple price indicators and achieve a more comprehensive and multifaceted examination using the two methods. The analysis procedure described in the previous chapter is represented in Fig. 1.

The following services were assumed during data collection of consumer evaluations for CVM and PSM, as it is necessary to show the specific service in the survey.

Fig. 1. Procedure of the analysis



The Virtual video streaming services for mobile devices:

The services allow users to watch TV broadcasts in real-time (simultaneous broadcasts) or past broadcasts (missed programs) by downloading a dedicated app to mobile terminals, such as smartphones and tablets.

Two service settings were verified: the NHK single service and the NHK and commercial broadcasters' joint service.

3.2. Contingent Variation Method: CVM

CVM is a method that estimates users' WTP using a questionnaire survey. The respondents were asked to rate how much they would pay for a specific good or service in a virtual situation. CVM is a procedurally established method applied in various research fields, especially environmental economics (Arrow et al., 1993). This survey created questions like those in Fig. 2 regarding the value of two services, such as NHK single service and NHK & commercial broadcasting service.

CVM monetarily evaluates the consumer surplus on the demand curve, which increases after offering virtual goods/services. However, the NHK Plus service does not require an additional fee. Similarly, TVer, a commercial broadcasters' service, is also free, although its scope is limited to programs viewers that miss in the regular broadcast. Therefore, viewers' consideration for using both the NHK single service and the NHK and commercial broadcasters' service is zero. Nonetheless, it is meaningful to carry out CVM to measure the evaluation of goods/services that the users consider appropriate after the service has been provided.⁸ According to the Broadcasting Law, the obligation for the NHK reception fee is incurred upon setting up a TV for receiving broadcasts. However, there was

⁸ The empirical survey was conducted in March 2018, and the NHK plus service started in April 2020. Therefore, respondents of this survey were not aware of the possibility that this service would be released for free in the future.

no such arrangement for receiving broadcasts on smartphones or tablets. The survey results can be helpful when mobile terminal users, who do not have a TV, are charged for the NHK's mobile broadcasting service in the future.⁹

Fig. 2 Questions in CVM: Case of NHK & commercial broadcasting service

Currently, Japan Broadcasting Corporation (NHK) and commercial broadcasters in your area are planning to provide a service that allow you to watch TV streaming in real time (simultaneous broadcasts) and past broadcasts (missed-program webcast) with smartphone application. The download of this application itself is free, but you are required to bear a reasonable burden in order to watch the programs. Remarkably, in the event of an emergency disaster such as an earthquake, you can to use this application to view safety information, lifeline information, relief supplies distribution information, refugee lists, regional reconstruction information, and so on.

Do you think it is acceptable to use it if its monthly charge for this application is JPY 【 * * * 】 ?

Please answer this question after fully considering that the money can be used to purchase other goods or services, if you do not spend it on this service.

The questionnaire implemented the single-bounded dichotomous choice question method in which respondents answered yes if they were willing to pay a randomly presented amount of money.¹⁰ In this survey, the amount of money was designed as ten levels of prices in the range of JPY100 to JPY4,400. The data is approximated on the acceptance rate curve using the Weibull Distribution (Fig. 3) and calculating the acceptance rate for each price and WTP.

If a respondent answers yes when the amount T is offered, they are considered to be willing to pay for all amounts below T . Implementing survival function; this can be expressed as follows:

$S(t)$: Probability that respondents will pay up to t

$$S(t) = \Pr(T > t) \tag{1}$$

T : An amount offered to the respondents

Basic characteristics of $S(t)$,

It is not increasing function,

If $t=0$, then $S(t)=S(0)=1$,

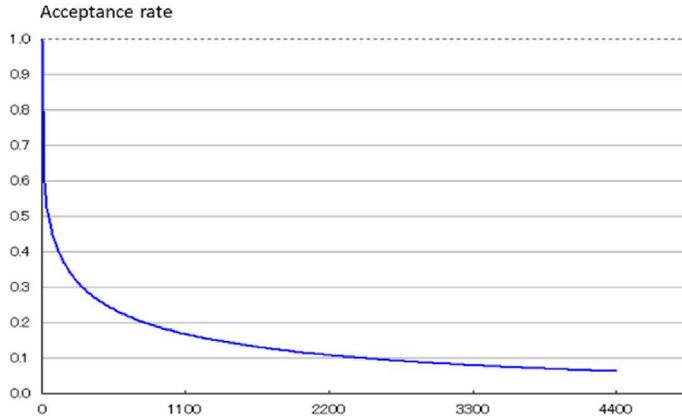
If $t=\infty$, then $S(t)=S(\infty)=0$.

⁹ The Broadcast Act, Article 64: Reception Contract and Reception Fees (excerpt)

(1) Persons installing reception equipment capable of receiving the broadcasts of NHK shall conclude a contract with NHK for the reception of the broadcasts.

¹⁰ The range of the amount offered in the survey was decided with the data obtained from a preliminary survey.

Fig. 3 Acceptance rate curve (Weibull Distribution)



Applying the Weibull distribution model for survival analysis, the acceptance rate $S(t)$ is represented as (2).

$$S(t) = \exp \left[- \exp \left(\frac{\ln T - \mu}{\sigma} \right) \right] \quad (2)$$

e, μ, σ : parameters¹¹

To analyze the effects of the respondent's demographics and experiences on the acceptance rate, model (2) incorporates covariates into parameter μ .

$$S(T) = \exp \left[- \exp \left(\frac{\ln T - \beta'Xi}{\sigma} \right) \right] \quad (3)$$

Xi : Personal attributes related to an individual i

β' : Parameter vector for attributes

Each parameter was estimated using the maximum likelihood estimation method.

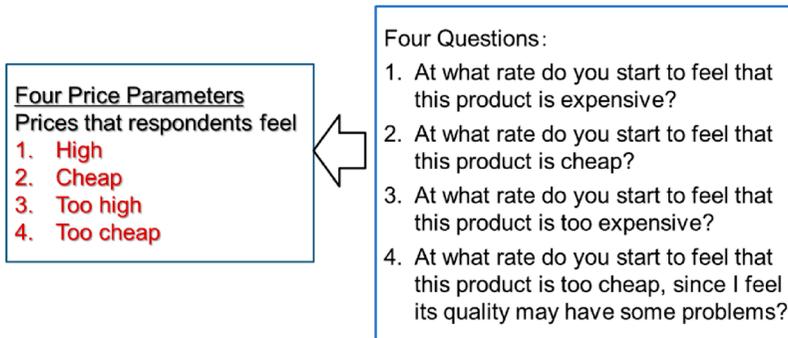
3.3. Price Sensitivity Measurement: PSM

PSM assumes that the price of a product or service represents its quality, and calculates four specific price indexes.¹² A questionnaire survey collects four price-related responses about a target product or service. The responses consist of prices at which respondents begin to feel *cheap*, *expensive*, *too expensive*, and *too cheap* (because they doubt the quality of goods or services). Unlike CVM, PSM does not

¹¹ Considering Hazard function $h(t)$ of Weibull distribution, the slope of $h(t)$ changes depending on scale parameter σ .
 $\sigma=1$: linear (Same as Exponential distribution)
 $\sigma>1$: Downward to the right
 $\sigma<1$: Rising to the right

¹² As an essential feature of price, Van Westendorp (September 1976) points out indicators of quality for consumers (Capitalization hypothesis).

Fig. 4 Questions used in PSM



ask for details related to decision-making regarding purchasing a target good or service; its output neither plots the demand curve nor the WTP; however, its production provides various suggestions regarding price and the purchasing power of consumers.

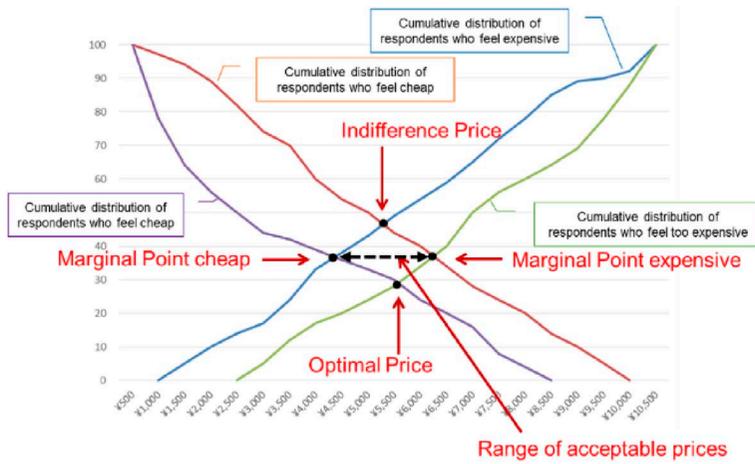
The answers to the four questions were plotted as a graph, as shown in Fig. 5. Prices that the respondents felt were *high* or *too high* were drawn as curves rising to the right, and prices that respondents felt were *cheap* or *too cheap* were drawn as curves falling to the right. This created the following four intersection points:

- Indifference Price (IP): the number of respondents, who feel that the rate is *high*, is similar to the number of people who feel it is *cheap*.
- Optimal Price (OP): the number of respondents, who feel that the price is *too high*, is similar to those who feel that it is *too cheap*.
- Marginal Point cheap (MPC): Below this price, the number of respondents, who feel that the rate is *too cheap*, is higher than those who feel it is *high*.
- Marginal Point expensive (MPE): above this price, the number of respondents, who feel that the rate is *too high*, is higher than those who feel it is *cheap*.

In this empirical research, Indifference Price (IP) and Optimal Price (OP) were used as price indicators for assessing the value attributed by users to internet-based mobile broadcasting services.

This research explores an attribute analysis of 4 prices in PSM to verify the effects of the respondent's demographics and experiences as CVM. Attribute analyses with a parametric model in PSM are not standard. Lipovetsky (2006) used ordinary logistic regression to calculate theoretical price, confidence interval, and elasticity parameters. Salamandic et al. (2014) showed that the optimal price differed depending on consumers' brand awareness of cosmetics. Okuse (2015) applied a non-parametric duration model to analyze prices in PSM; this research is the first of its kind, as it employs attribute analyses with a full parametric duration model for PSM. Like CVM's parametric studies, Weibull

Fig. 5 A graph plotted in PSM



distribution is introduced to fit price curves of feeling *cheap* and *too cheap*. However, the prices representing the feeling that it was *high* and *too high* are curves rising to the right, and these prices can not fit equation (3) as the survival function does not increase. Therefore, those two prices are converted to the reciprocal to bring them to the right and apply Weibull survival regressions. Later, the reciprocal is reverted when the marginal prices are calculated.

3.4. Survey plan

The empirical survey collected data regarding demographic variables, such as age, gender, income-related indexes, and usage history of media and mobile services, especially paid services, along with the main questions about CVM and PSM. The survey’s respondents were mainly from the Tokyo metropolitan area (Tokyo, Kanagawa, Saitama, and Chiba prefectures), as well as the Tohoku region (Miyagi, Iwate, and Fukushima prefectures) and Kumamoto Prefecture, which have experienced severe damage from massive earthquakes in the 2010s. The outline of the empirical survey is shown in Fig. 6.¹³

4. Result and Examination of the Empirical Survey

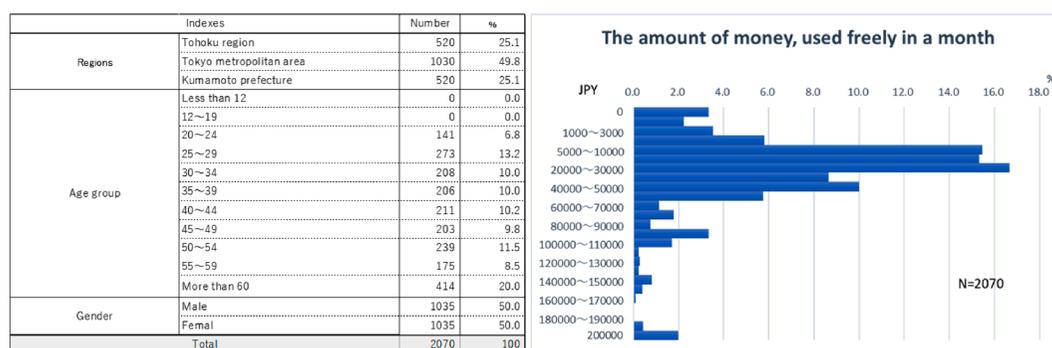
4.1. Respondents’ characteristics

The data collected in this survey was obtained from survey panels of a web-research company. They were recruited and registered on the website via PCs, mobile phones, smartphones, and tablets, and qualified respondents for each questionnaire were assigned by the company. Therefore, respondents of this survey could connect to the Internet with these devices as a prerequisite and had at least a certain level of Internet skills. Demographic characteristics of the respondents were controlled at the design stage of the survey to ensure that 50% were from the Tokyo metropolitan area (Tokyo, Kanagawa,

¹³ The survey was conducted in March 2018, and the findings of this study were obtained. However, since the second author was a member of the Study Group on Issues Concerning Broadcasting in MIC, this manuscript was written in 2022 after the discussions were completed and the NHK’s services were implemented.

Fig. 6 The outline of the empirical survey

Executing agency	Waseda University, Institute for Digital Society
Survey method	Internet survey
Implementation period	March, 2018
Respondents detail	Total samples: 2070
	Tokyo metropolitan area (Tokyo, Kanagawa prefecture, Saitama prefecture, Chiba prefecture)
	Tohoku region (Miyagi prefecture, Fukushima prefecture, Iwate prefecture) Kumamoto prefecture

Fig. 7 Characteristics of Respondents

Saitama, Chiba prefecture), 25% were from the three Tohoku prefectures (Miyagi, Fukushima, Iwate prefecture), and 25% were from the Kumamoto prefecture (Fig. 7). The male-female ratio was also controlled to be 50 : 50. The average age was 45.01 years as the age group was not controlled for.¹⁴ Next, the amount of money that can be used freely in a month was collected as an income index.¹⁵ The mode of this income index was JPY20,000–JPY30,000, and 2.0% of the respondents had JPY200,000 or more, while 3.3% responded that they had JPY0.

Since this survey targeted mobile services, the usage of mobile phones and smartphones by the participants was examined. Fig. 8 demonstrates that the number of smartphone users exceeded 80%, while that of conventional mobile phones (feature phones) was 23.0%. These penetration rates were high compared to the result of the Japanese governmental statistics for the same period, in which the number of smartphone users was 64.7%, and that of conventional mobile phones/Personal Handy

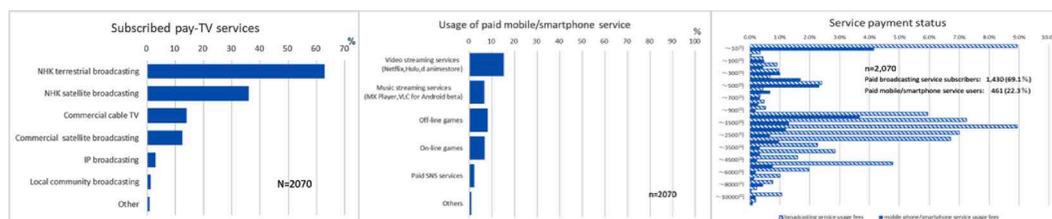
¹⁴ As of October 2018, the national average age in Japan was 47.2 years old, and the population was 36.58 million in Tokyo metropolitan area, 5.42 million in three Tohoku prefectures, and 1.76 million in Kumamoto prefecture (Statistics Bureau, MIC 2018). The male-female ratio was 50.6 : 50.4 in the Tokyo metropolitan area, 48.9 : 51.1 in the three Tohoku prefectures, and 47.2 : 52.8 in the Kumamoto prefecture. Typically the benefits of individuals were aggregated after the differences between survey samples and the population were adjusted to calculate the social benefits of a group or region in the CVM.

¹⁵ Individual annual income and annual household income were also collected. However, since respondents included students, homemakers, and retirees, the amount of money, which can be used freely in a month, was applied as an income index.

Fig. 8 Respondents' current mobile terminals (Multiple answers allowed)

Indexes		Number	%
Mobile terminal used (Multiple answers allowed)	Smartphone	1713	82.8
	Conventional mobile phone (feature phone)	476	23.0
	Other	5	0.2
Total Respondents		2070	106

Fig. 9 Subscriptions to paid services and the amounts of their payments



Phones was 26.3 (MIC, 2019). It was assumed that the respondent's characteristics of being a web research company employee affected the aggregate results.

Fig. 9 shows the subscription status for paid broadcasting services, usage of paid mobile/smartphone services, and the monthly payment amount. The subscription rate to NHK terrestrial broadcasting was 62.3% among the participants in this survey. Compared to the national average of 81.2% at the end of FY2018, this status was about 20% lower (Nikkei News, 2020). This may be because respondents to this survey included about 30% of students and housemakers. Therefore, another family member may have paid the NHK fee without notice. Regarding other broadcasting subscriptions, 35% of respondents were subscribed to the NHK satellite broadcasting services (BS and CS¹⁶), and 35% were subscribed to cable TV or private satellite broadcasting services. Respondents who subscribed to these services could be considered willing to pay for broadcast services. However, the usage rates of paid mobile/smartphone services, including the most popular video streaming services, were only 15.2%. Music streaming services were used by 6.6% of respondents, and offline and online games were used by 8.2% and 6.9%, respectively. This result showed that respondents in this survey did not frequently use paid mobile phone/smartphone services. Regarding the monthly payment amount for paid services, the mode of paid broadcasting service subscribers was between JPY1,500 and JPY2,000, and 52% of the respondents were distributed between JPY1,000 and JPY3,000, when the responses were limited to those who had actually made a payment. For the usage rates of paid mobile/smartphone services, the mode of paid mobile/smartphone service users was between JPY900 and JPY1,000, and 57% of respondents were distributed between JPY300 and JPY2,000 when the respondents' answers were limited to those who had actually made a payment.

¹⁶ BS: NHK programs transmitted by broadcasting satellites; CS: NHK programs transmitted by Communication Satellite.

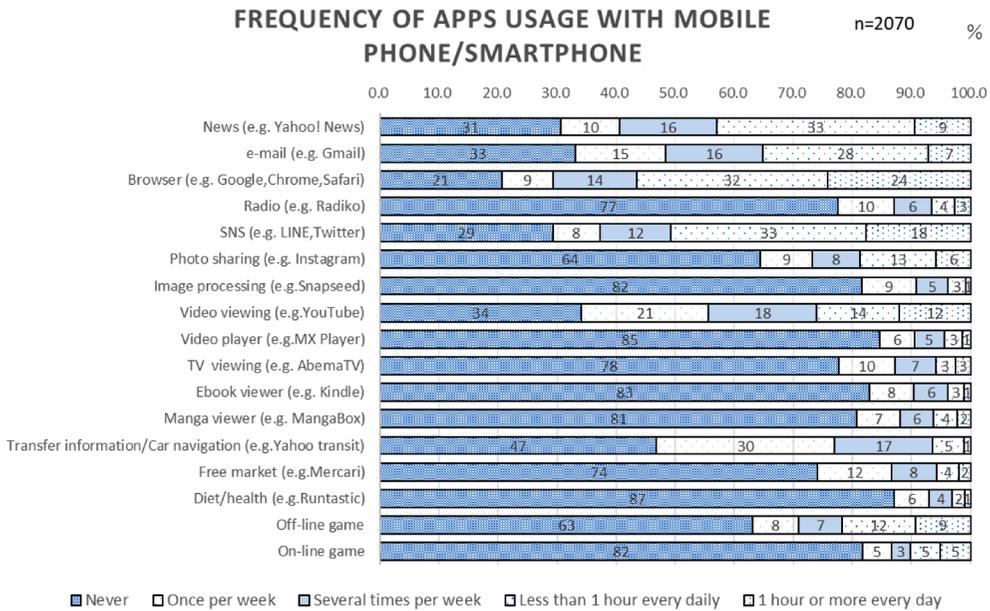
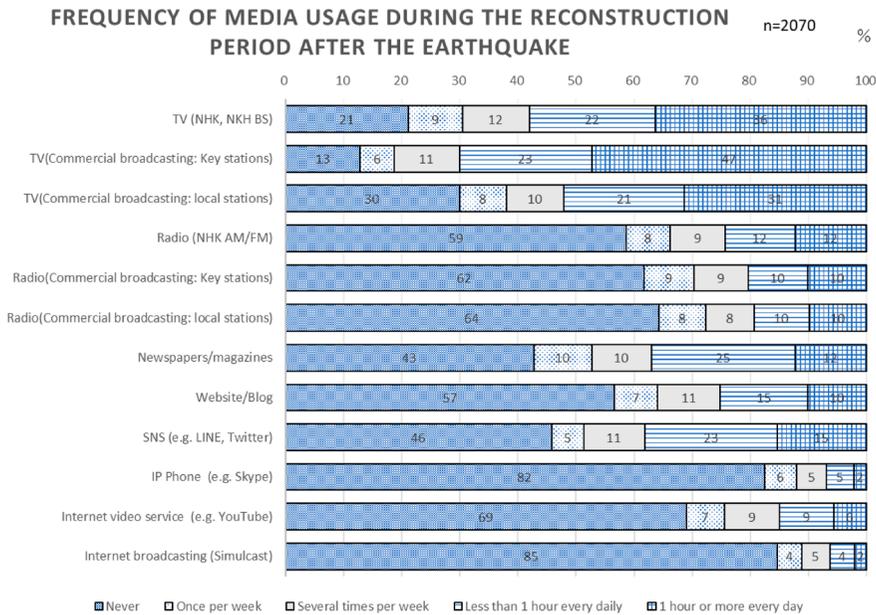
Fig. 10 Frequency of apps usage with mobile phone/smartphone

Fig. 10 shows the survey results for app usage frequency with mobile phones/smartphones, regardless of whether they were free or paid. Video viewing services were frequently used, following essential smartphone apps like browsers, SNS, news apps, and email apps. In contrast, 84.8% of the respondents had never used a dedicated player to view video. The latter had a low penetration rate, and the NHK Plus and TVer apps are expected to change this situation. Regardless of whether it is paid or free, mobile phone/smartphone app providers can access users' data, such as usage history, and profit from advertisements or undertaking marketing using those data. Personal data is utilized in several services, such as location information (car navigation apps), purchase information (free market apps), health information (diet/healthcare apps), and so on. Video viewing service apps are also expected to utilize such data and develop value-added services. Next, to examine the trend in mobile phone/smartphone apps by gender and age, cross-tabulation analyses of data in Fig. 10 were conducted (Appendix. 1). As a result, males frequently used radio, TV, video player, eBook viewer, and online game apps. In contrast, females frequently used SNS, photo sharing, image processing, and free-market apps. While many apps were used less regularly as respondents aged, transfer information and car navigation apps were not affected by age, and news apps were used less frequently by young people. This result clearly showed that the frequencies of using apps varied depending on gender and age.

4.2. Media usage during the reconstruction period after the earthquake

Many people used the NHK terrestrial television broadcasting during the Great East Japan Earthquake of 2011, and its usage rate was overwhelmingly high at 80.4% (MIC, 2011). Commercial TV, including local stations, also saw colossal viewership, with its usage rate reaching 56.9%. The survey

Fig. 11 Frequency of media usage during the reconstruction period after the earthquake



covered the media usage status during the reconstruction period after the earthquake, and the results are summarized in Fig. 11. The respondents indicated their usage status of each form of media on a five-point scale from *Never* to *1 hour or more every day*. As in the MIC survey, NHK terrestrial television broadcasting and Commercial TV frequencies were notably high compared to other media. Internet video service and broadcasting were used less frequently than traditional media, such as newspapers and radio, and internet media, such as websites, blogs, and SNS. Similar to the usage frequency of mobile phones/smartphone apps, this result should differ depending on respondents' gender and age. Cross-tabulation analyses were then conducted to confirm it (Appendix 1). The results showed no notable differences based on the participants' gender on television and radio. Internet video services were popular among males, and internet broadcasting and SNS were popular among females. In addition, it was observed that the frequency of using television and radio increased with the respondent's age. Similarly, the frequency of using Internet-mediated media decreased with an increase in age. The results of this cross-tabulation analysis demonstrated that during the reconstruction period after the earthquake, young females used simultaneous broadcasting, while young males used overlooked broadcasting (video service).

Additionally, the difference in media usage during the reconstruction period after the earthquakes was verified between the Tokyo metropolitan area and the Tohoku region, and Kumamoto Prefecture, where residents experienced considerable earthquakes in the 2010s. Fig. 12 shows the average scores

Fig. 12 Comparison of media usage frequency among regions

Media	Tokyo metropolitan	Tohoku region	Kumamoto pref.	Chi-square	Significance
TV (NHK, NKH BS)	3.4	3.5	3.4	.37	.83
TV (Commercial broadcasting: Key stations)	3.9	3.8	3.8	1.58	.45
TV (Commercial broadcasting: local stations)	2.6	3.7	3.8	254.05	.00
Radio (NHK AM/FM)	1.9	2.5	2.1	73.15	.00
Radio (Commercial broadcasting: Key stations)	1.8	2.3	2.0	51.48	.00
Radio (Commercial broadcasting: local stations)	1.6	2.5	2.1	158.15	.00
Newspapers/magazines	2.5	2.7	2.4	5.97	.05
Website/Blog	2.2	2.1	2.0	11.52	.00
SNS (e. g. LINE, Twitter)	2.6	2.2	2.9	50.26	.00
IP Phone (e. g. Skype)	1.4	1.2	1.4	20.66	.00
Internet video service (e. g. YouTube)	1.8	1.7	1.8	2.22	.33
Internet broadcasting (Simulcast)	1.4	1.3	1.3	10.87	.00

for media usage during the reconstruction period after the earthquake in the three regions.¹⁷ There was no significant difference in NHK and commercial broadcasting (key stations) among the three regions. Local commercial broadcasters and radio broadcasts were used more frequently in the Tohoku region and the Kumamoto prefecture than in the Tokyo metropolitan area. However, the usage frequencies of internet-mediated media, such as websites, blogs, and internet broadcasting (simulcast), were significantly higher in the Tokyo metropolitan area than in the other two regions. It is speculated that, while radio broadcasting was used as a lifeline in the disaster areas, Internet-mediated media were implemented to collect information about the disaster in remote areas. The Kumamoto prefecture had the highest usage frequency for SNS, followed by the Tokyo metropolitan area and the Tohoku region. The people in Tohoku may not have used SNS as commonly as in the other regions, as SNS had not become widespread in this region when the Great East Japan Earthquake struck in March 2011.¹⁸ The data of this survey showed that the average score for the usage of broadcasting via the Internet (video service and simulcast) was low in both the Tokyo metropolitan area and the other areas which experienced massive earthquakes, as they were not reliable media sources during the time of disaster recovery in the 2010s.

4.3. Evaluation of broadcasting services for mobile devices by CVM

Fig. 13 shows the WTP acceptance rates for mobile broadcast content. More than 80.0% of the respondents did not intend to pay for mobile broadcasting services for NHK single content and the NHK & commercial broadcasters' content. This indicates that Japanese subscribers were less conscious of paying for broadcast services for mobile devices.

¹⁷ The average score of 5 levels, from *Never to Use for 1 hour or more every day*, was calculated, and Kruskal Wallis tests were conducted to confirm the differences among regions.

¹⁸ Twitter started its service on July 15, 2006, and the Japanese version was released on April 23, 2008 (Twitter Blog 2008). LINE, the most popular SNS app in Japan, started its service on June 23, 2011, and it is said that Mr. Lee Hae Jin, the president of NHN Co. Ltd. developed it after seeing victims looking for their families in the Great East Japan Earthquake (JoongAng Ilbo Japanese version 2012).

Fig. 13 WTP acceptance rates for mobile broadcast content

Willingness to Pay	NHK single contents	NHK and commercial broadcasters' contents
Yes	390(18.9%)	360(17.4%)
No	1,679(81.1%)	1,709(82.64%)

(n=2,069)

Fig. 14 Reasons not to pay for mobile broadcast content



After respondents indicated their unwillingness to pay in the CVM questionnaire, they were asked to choose a reason from the multiple choices. Fig. 14 summarizes these responses. For the NHK single content and NHK & commercial broadcasters' content, 16% and 18% of the respondents, respectively, chose "I am willing to pay a fee for using the broadcast viewing application; however, the amount presented is too high." They were not considered resistance responses as they compared the benefits and costs of these services and decided not to introduce them. This behavior was reasonable within the demand framework.

On the other hand, the following three choices were considered resistance answers since they had clearly expressed opposition or were not finding any value in broadcasting services for a mobile device.

- I do not want to use paid broadcast applications on mobile devices at any price.
- Government should invest in creating mobile broadcast services, which should be funded by tax.
- I am against any service which offers paid mobile broadcast applications.

The respondents who chose these three resistance answers constituted 77% of the responses. The results of the Wilcoxon signed-rank test between acceptance rates in NHK single service and that in NHK & commercial broadcasters' service showed that they did not significantly differ (Appendix 2(1)). In Fig. 15, responses to CVM questions are plotted using the Weibull distribution, and the WTP for each price is visualized. Fig. 16 shows three indicators of WTP (mean, cut-off mean,¹⁹ median) for

¹⁹ Since the Weibull distribution has a long tail shape (Fig. 3), the arithmetic means include a small number of very high WTP. Cut-off mean trims the tail and considers respondents' maximum WTP as the highest question choice, in this case, JPY4,400. Conversely, the median is close to 0 if many respondents do not intend to pay, as in this survey.

Fig. 15 Willingness to pay and acceptance rate

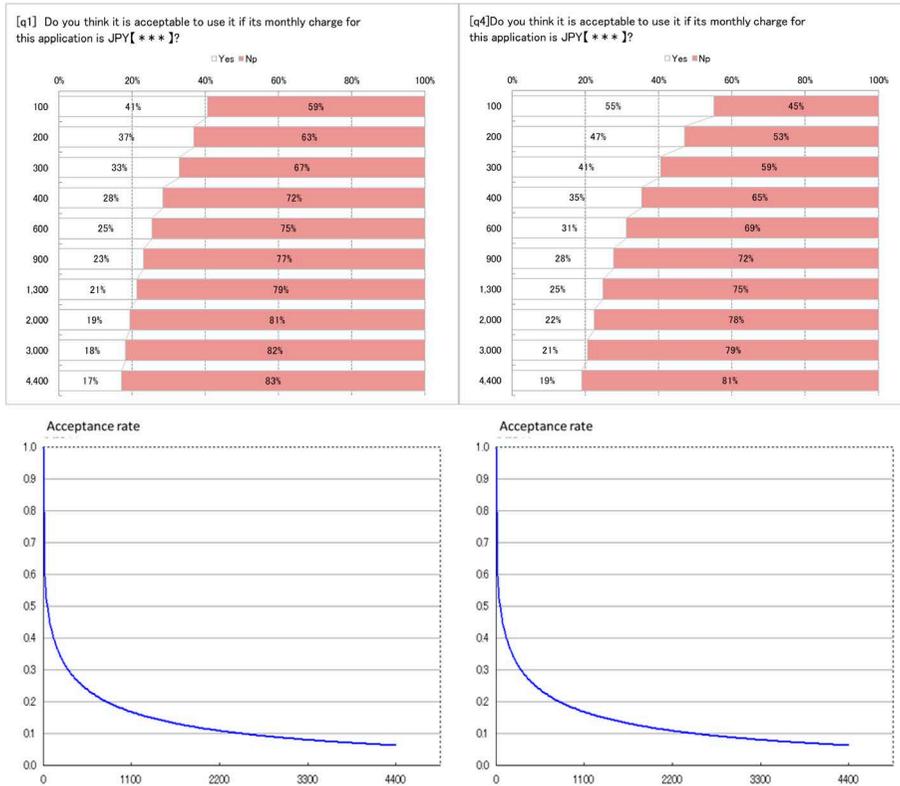


Fig. 16 Willingness to Pay calculated with CVM

Services	Indexes	Tokyo metropolitan	Tohoku region	Kumamoto prefecture
NHK & commercial broadcasters	Mean	¥1,228	¥593	¥742
	Mean(Cut-off)	¥577	¥330	¥429
	Median	¥41	¥11	¥25
NHK	Mean	¥656 (¥572)	¥388 (¥205)	¥456 (¥286)
	Mean(Cut-off)	¥496 (¥81)	¥375 (¥-45)	¥399 (¥30)
	Median	¥70 (¥-29)	¥109 (¥-98)	¥70 (¥-45)
After weight adjustment by an income index				
Services	Indexes	Tokyo metropolitan	Tohoku region	Kumamoto prefecture
NHK & commercial broadcasters	Mean	¥1,062	¥742	¥832
	Mean(Cut-off)	¥499	¥413	¥481
	Median	¥36	¥13	¥28
NHK	Mean	¥567 (¥495)	¥486 (¥256)	¥511 (¥321)
	Mean(Cut-off)	¥429 (¥70)	¥469 (¥-56)	¥448 (¥33)
	Median	¥61 (¥-25)	¥137 (¥-123)	¥78 (¥-50)

(): Difference between NHK & commercial broadcasters and NHK services

three regions: the Tokyo metropolitan area, the Tohoku region, and the Kumamoto Prefecture.

The lower half of Fig. 16 shows WTP indexes weight-adjusted by an income-related index (amount of money used freely in a month). The WTP indexes were considered more appropriate when

comparing the three regions.²⁰ The upper half of Fig. 16 shows that the WTP indexes in the Tokyo metropolitan area were higher than those in the areas that experienced massive earthquakes. The lower half of Fig. 16 shows that the evaluation of each region was leveled, and the differences were not significant compared to those of the upper half. It must be noted that the cut-off means in the Tohoku region and Kumamoto prefecture reversed to that of the Tokyo metropolitan area after weight adjustment. A comparison of the means between the NHK single service and the NHK & commercial broadcasters' service is shown in the lower part of Fig. 16. The data shows that the NHK service ranges from JPY486 to JPY567 in three regions. In contrast, the NHK & commercial broadcasters' service ranges from JPY832 to JPY1,062. The cut-off means of the NHK mobile content ranges from JPY429 to JPY 469 in three regions. In contrast, the NHK & commercial broadcasters' mobile content ranges from JPY413 to JPY499, as shown in the lower part of Fig. 16. These numbers were smaller than the means, and their differences were modest. The results for the medians were relatively low as more than 80% of the respondents had no intention to pay a monetary consideration, that is, $WTP=0$. The lower part of Fig.16 shows that the median of NHK single service ranged from JPY61 to JPY137, while that of NHK & commercial broadcasters' services ranged from JPY13 to JPY36.

These results clarify that implementing a universal charge to mobile broadcasting services is not easy as there were a lot of resistant responses against paid mobile broadcasting services, and less than 20% of the respondents had a positive WTP. Evaluating the amount of WTP demonstrated differences in means and cut-off means in the NHK single mobile service. NHK & commercial broadcasters' service was not constant among regions, and that straightforward suggestions could not be obtained from the results. However, the WTP acceptance rates were significantly higher in the Tohoku region and the Kumamoto prefecture, which experienced huge earthquakes, than in the Tokyo metropolitan area for the NHK & commercial broadcasters' service (See Appendix 2(2)).

The impact of socio-economic attributes, such as gender and age groups, and usage experiences of paid services, such as broadcasting and digital content, were examined using the WTP model with Weibull distribution. Fig. 17 shows the results of the attribute analyses for the NHK single service and the NHK & commercial broadcasters' service in the three regions. Socioeconomic attributes, such as gender and age groups, were significant only in some areas. Conversely, in many cases, the users' experiences of paid services, specifically NHK reception fees, paid subscriptions with a smartphone, and NHK usage frequency, were significantly positive. Paid subscription with a smartphone was the coefficient that possessed a positive marginal effect in all models, except for NHK & commercial broadcasters' service in the Tohoku area. The maximum positive marginal effect of these coefficients was JPY138 in the case of the NHK mobile service in Tokyo. Additionally, the marginal effects of significant factors in the NHK single service were higher than that of the NHK & commercial broadcasters' service in all regions.

²⁰ The weights are calculated using the average amount of money that is free in a month in three area, as shown in Fig. 9 (Tohoku region; JPY 27,348, Tokyo metropolitan area JPY 39,576 and Kumamoto prefecture JPY30,529).

Fig. 17 Results of the WTP Weibel estimations with attributes

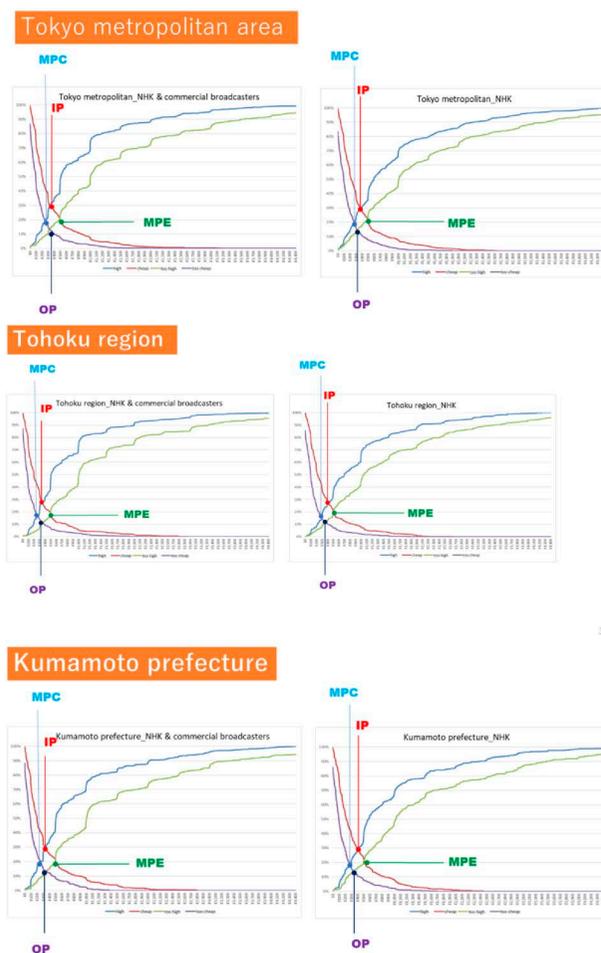
Tokyo metropolitan_NHK & commercial broadcasters					Tokyo metropolitan_NHK				
Total					1030				
Initial likelihood					-462				
Maximum likelihood					-408				
Chi-square test					0.00				
Likelihood ratio index					0.13				
Items	Coefficient	Z-value	p-value	Marginal effect	Items	Coefficient	Z-value	p-value	Marginal effect
The amount of money, used freely in a month	0.1360	1.01	0.31		The amount of money, used freely in a month	0.0454	0.40	0.69	
Gender	-0.0196	-0.08	0.94		Gender	0.1810	0.84	0.40	
Age group	-0.1490	-2.55	0.01	¥-8	Age group	0.0485	0.97	0.33	
Paying NHK reception fee	0.7700	2.58	0.01	¥43	Paying NHK reception fee	0.4110	1.63	0.10	
Subscribing paid application(s) for smartphone	2.0200	5.89	0.00	¥113	Subscribing paid application(s) for smartphone	1.4900	5.32	0.00	¥138
Frequency of watching NHK	0.2680	2.86	0.01	¥15	Frequency of watching NHK	0.2050	2.33	0.02	¥19
Frequency of watching commercial broadcasters	-0.1130	-1.07	0.28		Frequency of watching commercial broadcasters	0.0349	0.39	0.70	
Frequency of watching local broadcasters	0.1850	2.15	0.03	¥10	Frequency of watching local broadcasters	0.2240	0.90	0.37	¥21
Frequency of using the Internet (PC)	0.0660	0.77	0.44		Frequency of using the Internet (PC)	0.1220	1.85	0.10	
Frequency of using the Internet (smartphone)	-0.2280	-2.47	0.01	¥-13	Frequency of using the Internet (smartphone)	-0.0376	-0.49	0.63	
Constant	4.9700	7.29	0.00		Constant	2.8000	4.32	0.00	
σ	2.7100	9.22			σ	2.2800	10.80		
Tohoku region_NHK & commercial broadcasters					Tohoku region_NHK				
Total					520				
Initial likelihood					-169				
Maximum likelihood					-161				
Chi-square test					0.00				
Likelihood ratio index					0.05				
Items	Coefficient	Z-value	p-value	Marginal effect	Items	Coefficient	Z-value	p-value	Marginal effect
The amount of money, used freely in a month	0.5050	2.08	0.04	¥9	The amount of money, used freely in a month	0.1230	1.07	0.29	
Gender	-0.6030	-1.40	0.16		Gender	-0.1100	-0.49	0.62	
Age group	0.0477	0.45	0.65		Age group	-0.0853	-1.49	0.14	
Paying NHK reception fee	1.0700	2.13	0.03	¥19	Paying NHK reception fee	0.5190	2.02	0.04	¥67
Subscribing paid application(s) for smartphone	0.5480	1.02	0.31		Subscribing paid application(s) for smartphone	0.5080	1.80	0.07	¥66
Frequency of watching NHK	-0.0154	-0.09	0.93		Frequency of watching NHK	0.0627	0.66	0.51	
Frequency of watching commercial broadcasters	-0.1370	-0.70	0.48		Frequency of watching commercial broadcasters	-0.0519	-0.49	0.63	
Frequency of watching local broadcasters	-0.0925	-0.44	0.66		Frequency of watching local broadcasters	0.0902	0.81	0.42	
Frequency of using the Internet (PC)	0.0599	0.41	0.68		Frequency of using the Internet (PC)	-0.0488	-0.61	0.54	
Frequency of using the Internet (smartphone)	-0.1740	-1.12	0.26		Frequency of using the Internet (smartphone)	-0.1220	-1.48	0.14	
Constant	4.6100	3.64	0.00		Constant	6.0200	9.47	0.00	
σ	3.2500	5.36			σ	1.6200	8.80		
Kumamoto prefecture_NHK & commercial broadcasters					Kumamoto prefecture_NHK				
Total					520				
Initial likelihood					-200				
Maximum likelihood					-183				
Chi-square test					0.00				
Likelihood ratio index					0.09				
Items	Coefficient	Z-value	p-value	Marginal effect	Items	Coefficient	Z-value	p-value	Marginal effect
The amount of money, used freely in a month	0.1430	0.78	0.44		The amount of money, used freely in a month	0.2960	2.00	0.05	¥27
Gender	1.1100	3.13	0.00	¥41	Gender	0.3260	1.15	0.25	
Age group	-0.0941	-1.15	0.25		Age group	-0.0817	-1.17	0.24	
Paying NHK reception fee	0.4450	1.20	0.23		Paying NHK reception fee	0.1280	0.41	0.68	
Subscribing paid application(s) for smartphone	1.1400	2.54	0.01	¥42	Subscribing paid application(s) for smartphone	1.0300	2.61	0.01	¥94
Frequency of watching NHK	0.3470	2.56	0.01	¥13	Frequency of watching NHK	0.2840	2.53	0.01	¥26
Frequency of watching commercial broadcasters	-0.3350	-2.04	0.04	¥-12	Frequency of watching commercial broadcasters	-0.1620	-1.18	0.24	
Frequency of watching local broadcasters	0.1340	0.78	0.44		Frequency of watching local broadcasters	0.1150	0.82	0.41	
Frequency of using the Internet (PC)	0.0162	0.15	0.88		Frequency of using the Internet (PC)	0.0929	0.94	0.35	
Frequency of using the Internet (smartphone)	-0.0607	-0.50	0.62		Frequency of using the Internet (smartphone)	0.0845	0.84	0.40	
Constant	4.5200	5.06	0.00		Constant	4.3200	5.70	0.00	
σ	2.5700	6.56			σ	2.1100	8.04		

4.5. Evaluation of broadcasting services for mobile devices by PSM

Immediately after replying to questions for the CVM, respondents of the questionnaire from the Tokyo metropolitan area, the Tohoku region and the Kumamoto prefecture answered scale rating questions about four price indicators of PSM. These indicators were *high*, *cheap*, *too high*, and *too cheap* for the NHK single service and the NHK & commercial broadcasters' service. The price range of the scale rating questions was from JPY0 to JPY5,000. The data were then plotted, as shown in Fig. 18. Intersections of the four indicators were specified as *Indifference price (IP)*, *optimum price (OP)*, *Marginal Point: expensive (MPE)*, and *Marginal Point: cheap (MPC)*.

IP, the indicator corresponding to the intersection of the number of respondents who felt that the price was high and the number of respondents who felt the price was cheap, was considered the repre-

Fig. 18 Output of Price Sensitive Analysis



sentative index to introduce this paid service from the consumer’s point of view. Similarly, OP, which corresponds to the intersection of the number of respondents who felt that the price was *too high* and the number of respondents who felt that the price was *too cheap*, was considered an important index to know respondents’ awareness of the prices of the services.

According to the results in Fig. 19, IP was JPY384 to JPY 420 for NHK single service and JPY328 to JPY 355 for NHK & commercial broadcasters’ service. OP was JPY324 to JPY359 for NHK single service and JPY315 to JPY362 for NHK & commercial broadcasters’ service. Although the content in the NHK & commercial broadcasters’ service was more prosperous than those in the NHK single service, the evaluations of the former were JPY56 to JPY66 lower than those of the latter in IP and almost the same in OP. A t-test was conducted for the four PSM prices: *high*, *too high*, *cheap*, and *too cheap* (Appendix 2.3) to compare the differences in evaluation between the NHK single service and the NHK & commercial broadcasters’ service. Only the evaluation of *high* in NHK single service exceeded that in NHK & commercial broadcasters’ service significantly in all regions. Subsequently,

Fig. 19 Price Sensitive Analysis: Price indexes

		(JPY/Month)		
		Tokyo metropolitan area	Tohoku region	Kumamoto prefecture
NHK & commercial broadcasters	Indifference price	¥328	¥355	¥343
	Optimum price	¥324	¥359	¥346
	Marginal Point: expensive	¥255	¥278	¥261
	Marginal Point: cheap	¥499	¥500	¥500
NHK	Indifference price	¥384 (¥-56)	¥420 (¥-65)	¥409 (¥-66)
	Optimum price	¥315 (¥9)	¥362 (¥-3)	¥344 (¥2)
	Marginal Point: expensive	¥274 (¥-19)	¥300 (¥-22)	¥284 (¥-23)
	Marginal Point: cheap	¥495 (¥4)	¥506 (¥-6)	¥509 (¥-9)

(): Difference between NHK & commercial broadcasters and NHK services

the differences among regions, the Tokyo metropolitan area, the Tohoku region, and the Kumamoto prefecture, were also verified statistically; however, there was no significant difference (Appendix 2.4).

Next, the influences of socio-economic attributes, and the usage of paid broadcasting services and digital content on four price levels of PSM, such as *high*, *too high*, *cheap*, and *too cheap*, were investigated. The prices felt *cheap* and *too cheap* were the curves with the downward slope, which were similar to the WTP curve of CVM; therefore, they could be approximated using Weibull distribution as usual. However, the analyses with prices that were felt to be *high* and *too high* used their reciprocal values to fit the Weibull distribution. Fig. 20 shows the total outputs of the PSM calculations, which were created from 4 prices, prices that were felt to be *high*, *too high*, *cheap*, and *too cheap*, two services, *NHK single contents*, and *NHK & commercial broadcasters' contents*, and three regions, *Tokyo metropolitan area*, *the Tohoku region*, and *Kumamoto Prefecture*. All 24 models passed the chi-square tests, even though the likelihood ratio indexes were low, and 4–8 attributes were significant in each model. Therefore, these 24 estimations were considered to be valid.

In Fig. 20, when comparing the coefficients of models for prices that were felt *cheap* and *too cheap*, the coefficients of models for prices that were felt to be *high* and *too high* were assumed to be overestimated. This made it difficult to consider the implications of the magnitude of marginal effects. Similar overestimation typically happens when Willingness to Accept (WTA), whose curves also draw the trails which rise to the right, are analyzed in CVM (Kim et al., 2015). In the case of WTA, some respondents request unrealistic amounts of money, and even if not, it is not easy to arrive at an accurate value because people often value goods as payments in their daily lives but rarely as receipts (NOAA, 1993; MLIT, 2009). Kahneman et al. (1990, 2004) pointed out that the value people lose is more significant than those they feel they earn, even if they are objectively the same (endowment effect). The WTA survey often asks respondents why they feel lost, such as the deprivation of the

Willingness-to-pay for TV Broadcasting Provided through the Internet in Japan

Fig. 20 Attribute analyses in PSM

Tokyo metropolitan_NHK & commercial broadcasters

Prices that feel <i>high</i>					Prices that feel <i>cheap</i>				
Total					Total				
Initial likelihood					Initial likelihood				
Maximum likelihood					Maximum likelihood				
Chi-square test					Chi-square test				
Likelihood ratio index					Likelihood ratio index				
Items	Coefficient	Z-value	p-value	Marginal effect	Items	Coefficient	Z-value	p-value	Marginal effect
Constant	4.53	22.61	0.00		Constant	-6.12	-26.66	0.00	
The amount of money, used freely in a month	0.01	1.06	0.29		The amount of money, used freely in a month	0.00	0.57	0.57	
Gender	0.24	3.58	0.00	¥-1,443	Gender	0.01	0.08	0.93	
Age group	-0.02	-6.41	0.00	¥1,870	Age group	0.00	1.86	0.06	¥-10
Paying NHK reception fee	0.20	2.69	0.01	¥-1,652	Paying NHK reception fee	-0.23	-3.12	0.00	¥51
Subscribing paid application(s) for smartphone	0.32	3.93	0.00	¥-1,225	Subscribing paid application(s) for smartphone	-0.35	-4.33	0.00	¥88
Frequency of watching NHK	0.11	4.60	0.00	¥-3,367	Frequency of watching NHK	-0.06	-2.28	0.02	¥14
Frequency of watching commercial broadcasters	-0.01	-0.28	0.78		Frequency of watching commercial broadcasters	0.05	1.85	0.06	¥-11
Frequency of watching local broadcasters	0.04	1.87	0.10	¥-9,561	Frequency of watching local broadcasters	-0.07	-3.05	0.00	¥16
Frequency of using the Internet (PC)	-0.06	-2.56	0.01	¥5,649	Frequency of using the Internet (PC)	0.00	0.12	0.90	
Frequency of using the Internet (smartphone)	-0.07	-2.77	0.01	¥4,806	Frequency of using the Internet (smartphone)	0.14	5.74	0.00	¥-29
σ	1.39				σ	1.00			
Prices that feel <i>too high</i>					Prices that feel <i>too cheap</i>				
Total					Total				
Initial likelihood					Initial likelihood				
Maximum likelihood					Maximum likelihood				
Chi-square test					Chi-square test				
Likelihood ratio index					Likelihood ratio index				
Items	Coefficient	Z-value	p-value	Marginal effect	Items	Coefficient	Z-value	p-value	Marginal effect
Constant	4.93	24.18	0.00		Constant	-5.06	-22.07	0.00	
The amount of money, used freely in a month	0.02	2.14	0.03		The amount of money, used freely in a month	0.00	-0.36	0.72	
Gender	0.27	3.96	0.00	¥-2,309	Gender	-0.01	-0.14	0.89	
Age group	-0.02	-7.06	0.00	¥2,940	Age group	0.00	1.62	0.11	
Paying NHK reception fee	0.22	2.86	0.00	¥-2,705	Paying NHK reception fee	-0.23	-3.01	0.00	¥29
Subscribing paid application(s) for smartphone	0.31	3.86	0.00	¥-2,184	Subscribing paid application(s) for smartphone	-0.26	-3.05	0.00	¥35
Frequency of watching NHK	0.11	4.28	0.00	¥-6,322	Frequency of watching NHK	-0.05	-1.67	0.10	¥6
Frequency of watching commercial broadcasters	0.00	-0.04	0.97		Frequency of watching commercial broadcasters	0.06	2.05	0.04	¥-7
Frequency of watching local broadcasters	0.03	1.43	0.15		Frequency of watching local broadcasters	-0.06	-2.70	0.01	¥8
Frequency of using the Internet (PC)	-0.07	-2.90	0.00	¥8,692	Frequency of using the Internet (PC)	0.02	0.67	0.50	
Frequency of using the Internet (smartphone)	-0.08	-3.07	0.00	¥7,561	Frequency of using the Internet (smartphone)	0.15	5.81	0.00	¥-17
σ	1.42				σ	1.12			

Fig. 20 Continued

Tohoku region_NHK & commercial broadcasters

Prices that feel <i>high</i>					Prices that feel <i>cheap</i>				
Total					Total				
Initial likelihood					Initial likelihood				
Maximum likelihood					Maximum likelihood				
Chi-square test					Chi-square test				
Likelihood ratio index					Likelihood ratio index				
Items	Coefficient	Z-value	p-value	Marginal effect	Items	Coefficient	Z-value	p-value	Marginal effect
Constant	5.65	20.70	0.00		Constant	-6.41	-18.57	0.00	
The amount of money, used freely in a month	0.03	2.12	0.03	¥-19,407	The amount of money, used freely in a month	-0.02	-1.92	0.06	¥5
Gender	-0.12	-1.24	0.22		Gender	0.26	2.82	0.01	¥-58
Age group	0.00	0.25	0.81		Age group	0.00	0.28	0.78	
Paying NHK reception fee	0.40	3.89	0.00	¥-1,203	Paying NHK reception fee	-0.18	-1.78	0.07	¥39
Subscribing paid application(s) for smartphone	0.34	2.83	0.01	¥-1,633	Subscribing paid application(s) for smartphone	-0.29	-2.40	0.02	¥70
Frequency of watching NHK	-0.06	-1.71	0.09	¥8,119	Frequency of watching NHK	-0.08	-1.95	0.05	¥18
Frequency of watching commercial broadcasters	0.02	0.48	0.63		Frequency of watching commercial broadcasters	0.03	0.70	0.49	
Frequency of watching local broadcasters	-0.05	-1.17	0.24		Frequency of watching local broadcasters	0.09	1.94	0.05	¥-18
Frequency of using the Internet (PC)	-0.07	-2.33	0.02	¥6,629	Frequency of using the Internet (PC)	0.05	1.72	0.09	¥-12
Frequency of using the Internet (smartphone)	0.05	1.48	0.14		Frequency of using the Internet (smartphone)	0.08	2.25	0.02	¥-17
σ	1.04				σ	0.99			
Prices that feel <i>too high</i>					Prices that feel <i>too cheap</i>				
Total					Total				
Initial likelihood					Initial likelihood				
Maximum likelihood					Maximum likelihood				
Chi-square test					Chi-square test				
Likelihood ratio index					Likelihood ratio index				
Items	Coefficient	Z-value	p-value	Marginal effect	Items	Coefficient	Z-value	p-value	Marginal effect
Constant	5.77	20.95	0.00		Constant	-5.11	-15.24	0.00	
The amount of money, used freely in a month	0.02	1.61	0.11		The amount of money, used freely in a month	-0.01	-0.96	0.34	
Gender	-0.11	-1.18	0.24		Gender	0.17	1.70	0.09	¥-21
Age group	0.00	0.29	0.77		Age group	0.00	-0.49	0.63	
Paying NHK reception fee	0.45	4.37	0.00	¥-1,800	Paying NHK reception fee	-0.09	-0.85	0.40	
Subscribing paid application(s) for smartphone	0.44	3.56	0.00	¥-2,298	Subscribing paid application(s) for smartphone	-0.28	-2.16	0.03	¥39
Frequency of watching NHK	-0.07	-1.87	0.06	¥12,545	Frequency of watching NHK	-0.04	-0.92	0.36	
Frequency of watching commercial broadcasters	0.02	0.44	0.66		Frequency of watching commercial broadcasters	0.10	1.82	0.07	¥-11
Frequency of watching local broadcasters	-0.04	-0.90	0.37		Frequency of watching local broadcasters	0.00	0.06	0.95	
Frequency of using the Internet (PC)	-0.06	-1.96	0.05	¥13,732	Frequency of using the Internet (PC)	0.08	2.49	0.01	¥-10
Frequency of using the Internet (smartphone)	0.08	2.36	0.02	¥-11,230	Frequency of using the Internet (smartphone)	0.05	1.33	0.18	
σ	1.08				σ	1.13			

Fig. 20 Continued

Kumamoto prefecture_NHK & commercial broadcasters

Prices that feel *high*

Total	520
Initial likelihood	-924
Maximum likelihood	-890
Chi-square test	0.00
Likelihood ratio index	0.04

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	4.33	15.38	0.00	
The amount of money, used freely in a month	0.02	1.61	0.11	
Gender	0.57	5.73	0.00	¥-633
Age group	0.00	-0.15	0.88	
Paying NHK reception fee	0.06	0.59	0.56	
Subscribing paid application(s) for smartphone	0.40	3.34	0.00	¥-1,077
Frequency of watching NHK	0.08	2.28	0.02	¥-4,930
Frequency of watching commercial broadcasters	-0.02	-0.47	0.64	
Frequency of watching local broadcasters	-0.02	-0.47	0.64	
Frequency of using the Internet (PC)	-0.08	-2.71	0.01	¥4,176
Frequency of using the Internet (smartphone)	-0.09	-2.59	0.01	¥4,052
σ	1.32			

Prices that feel *cheap*

Total	520
Initial likelihood	-924
Maximum likelihood	-822
Chi-square test	0.00
Likelihood ratio index	0.02

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	-5.38	-17.97	0.00	
The amount of money, used freely in a month	-0.03	-2.40	0.02	¥7
Gender	-0.15	-1.61	0.11	
Age group	0.00	-0.31	0.76	
Paying NHK reception fee	-0.09	-0.96	0.34	
Subscribing paid application(s) for smartphone	-0.43	-3.61	0.00	¥114
Frequency of watching NHK	-0.09	-2.62	0.01	¥22
Frequency of watching commercial broadcasters	0.12	2.69	0.01	¥-26
Frequency of watching local broadcasters	-0.08	-1.89	0.06	¥20
Frequency of using the Internet (PC)	0.04	1.26	0.21	
Frequency of using the Internet (smartphone)	0.05	1.61	0.11	
σ	1.04			

Prices that feel *too high*

Total	520
Initial likelihood	-930
Maximum likelihood	-891
Chi-square test	0.00
Likelihood ratio index	0.04

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	5.00	17.25	0.00	
The amount of money, used freely in a month	0.02	1.81	0.07	¥-33,401
Gender	0.61	6.14	0.00	¥-1,065
Age group	0.00	-0.67	0.50	
Paying NHK reception fee	-0.10	-0.98	0.33	
Subscribing paid application(s) for smartphone	0.39	3.29	0.00	¥-1,977
Frequency of watching NHK	0.12	3.29	0.00	¥-6,201
Frequency of watching commercial broadcasters	-0.05	-1.02	0.31	
Frequency of watching local broadcasters	-0.07	-1.50	0.13	
Frequency of using the Internet (PC)	-0.06	-1.88	0.06	¥11,044
Frequency of using the Internet (smartphone)	-0.10	-3.00	0.00	¥6,258
σ	1.34			

Prices that feel *too cheap*

Total	520
Initial likelihood	-799
Maximum likelihood	-784
Chi-square test	0.00
Likelihood ratio index	0.02

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	-4.58	-14.87	0.00	
The amount of money, used freely in a month	-0.03	-1.94	0.05	¥4
Gender	-0.14	-1.40	0.16	
Age group	0.00	-0.06	0.95	
Paying NHK reception fee	-0.03	-0.29	0.77	
Subscribing paid application(s) for smartphone	-0.33	-2.69	0.01	¥48
Frequency of watching NHK	-0.08	-2.12	0.03	¥10
Frequency of watching commercial broadcasters	0.12	2.47	0.01	¥-14
Frequency of watching local broadcasters	-0.09	-1.92	0.06	¥12
Frequency of using the Internet (PC)	0.08	2.61	0.01	¥-10
Frequency of using the Internet (smartphone)	0.06	1.70	0.09	¥-7
σ	1.14			

Fig. 20 Continued

Tokyo metropolitan_NHK

Prices that feel *high*

Total	1030
Initial likelihood	-1886
Maximum likelihood	-1810
Chi-square test	0.00
Likelihood ratio index	0.04

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	4.55	23.01	0.00	
The amount of money, used freely in a month	0.01	1.00	0.32	
Gender	0.29	4.24	0.00	¥-1,316
Age group	-0.02	-6.21	0.00	¥2,085
Paying NHK reception fee	0.23	2.96	0.00	¥-1,555
Subscribing paid application(s) for smartphone	0.36	4.34	0.00	¥-1,190
Frequency of watching NHK	0.13	5.21	0.00	¥-3,141
Frequency of watching commercial broadcasters	-0.02	-0.82	0.41	
Frequency of watching local broadcasters	0.04	1.74	0.08	¥-9,947
Frequency of using the Internet (PC)	-0.05	-2.37	0.02	¥6,718
Frequency of using the Internet (smartphone)	-0.08	-3.29	0.00	¥4,395
σ	1.38			

Prices that feel *cheap*

Total	1030
Initial likelihood	-1618
Maximum likelihood	-1586
Chi-square test	0.00
Likelihood ratio index	0.02

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	-6.24	-26.98	0.00	
The amount of money, used freely in a month	0.00	-0.20	0.84	
Gender	-0.02	-0.38	0.70	
Age group	0.00	1.35	0.18	
Paying NHK reception fee	-0.10	-1.33	0.18	
Subscribing paid application(s) for smartphone	-0.27	-3.40	0.00	¥70
Frequency of watching NHK	-0.06	-2.39	0.02	¥19
Frequency of watching commercial broadcasters	0.07	2.59	0.01	¥-15
Frequency of watching local broadcasters	-0.08	-3.59	0.00	¥20
Frequency of using the Internet (PC)	0.05	2.22	0.03	¥-12
Frequency of using the Internet (smartphone)	0.09	3.90	0.00	¥-21
σ	0.99			

Prices that feel *too high*

Total	1030
Initial likelihood	-1893
Maximum likelihood	-1816
Chi-square test	0.00
Likelihood ratio index	0.04

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	4.91	24.10	0.00	
The amount of money, used freely in a month	0.01	0.74	0.46	
Gender	0.29	4.30	0.00	¥-2,031
Age group	-0.02	-6.59	0.00	¥3,013
Paying NHK reception fee	0.25	3.16	0.00	¥-2,281
Subscribing paid application(s) for smartphone	0.34	4.11	0.00	¥-1,955
Frequency of watching NHK	0.12	4.65	0.00	¥-5,469
Frequency of watching commercial broadcasters	-0.01	-0.28	0.78	
Frequency of watching local broadcasters	0.04	1.62	0.11	
Frequency of using the Internet (PC)	-0.06	-2.60	0.01	¥9,548
Frequency of using the Internet (smartphone)	-0.09	-3.45	0.00	¥6,571
σ	1.40			

Prices that feel *too cheap*

Total	1030
Initial likelihood	-1461
Maximum likelihood	-1437
Chi-square test	0.00
Likelihood ratio index	0.02

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	-5.19	-21.85	0.00	
The amount of money, used freely in a month	0.00	-0.39	0.70	
Gender	-0.12	-1.63	0.10	
Age group	0.00	1.70	0.09	¥-6
Paying NHK reception fee	-0.09	-1.20	0.23	
Subscribing paid application(s) for smartphone	-0.21	-2.37	0.02	¥30
Frequency of watching NHK	-0.07	-2.47	0.01	¥10
Frequency of watching commercial broadcasters	0.04	1.57	0.12	
Frequency of watching local broadcasters	-0.06	-2.40	0.02	¥8
Frequency of using the Internet (PC)	0.06	2.53	0.01	¥-8
Frequency of using the Internet (smartphone)	0.10	3.65	0.00	¥-12
σ	1.09			

Willingness-to-pay for TV Broadcasting Provided through the Internet in Japan

Fig. 20 Continued

Tohoku region_NHK

Prices that feel high

Total	520
Initial likelihood	-813
Maximum likelihood	-793
Chi-square test	0.00
Likelihood ratio index	0.03

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	5.76	21.05	0.00	
The amount of money, used freely in a month	-0.02	-1.60	0.11	
Gender	-0.16	-1.68	0.09	¥3,578
Age group	-0.01	-1.38	0.17	
Paying NHK reception fee	0.34	3.28	0.00	¥-1,610
Subscribing paid application(s) for smartphone	0.39	3.20	0.00	¥-1,648
Frequency of watching NHK	-0.01	-0.19	0.85	
Frequency of watching commercial broadcasters	0.05	1.23	0.22	
Frequency of watching local broadcasters	-0.06	-1.30	0.20	
Frequency of using the Internet (PC)	-0.09	-2.84	0.01	¥6,059
Frequency of using the Internet (smartphone)	0.07	1.91	0.06	¥-8,874
σ	1.08			

Prices that feel cheap

Total	520
Initial likelihood	-782
Maximum likelihood	-758
Chi-square test	0.00
Likelihood ratio index	0.03

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	-7.36	-20.53	0.00	
The amount of money, used freely in a month	-0.01	-0.74	0.46	
Gender	0.30	3.30	0.00	¥-71
Age group	0.01	2.54	0.01	¥-20
Paying NHK reception fee	-0.25	-2.52	0.01	¥57
Subscribing paid application(s) for smartphone	-0.22	-1.84	0.07	¥56
Frequency of watching NHK	-0.09	-2.22	0.03	¥21
Frequency of watching commercial broadcasters	0.03	0.62	0.54	
Frequency of watching local broadcasters	0.06	1.49	0.14	
Frequency of using the Internet (PC)	0.08	2.48	0.01	¥-18
Frequency of using the Internet (smartphone)	0.10	2.87	0.00	¥-22
σ	0.92			

Prices that feel too high

Total	520
Initial likelihood	-813
Maximum likelihood	-794
Chi-square test	0.00
Likelihood ratio index	0.02

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	6.14	21.75	0.00	
The amount of money, used freely in a month	-0.01	-0.85	0.40	
Gender	-0.17	-1.81	0.07	¥5,232
Age group	-0.01	-1.80	0.07	¥12,946
Paying NHK reception fee	0.32	3.11	0.00	¥-2,639
Subscribing paid application(s) for smartphone	0.32	2.65	0.01	¥-3,053
Frequency of watching NHK	0.00	0.11	0.91	
Frequency of watching commercial broadcasters	0.05	1.08	0.28	
Frequency of watching local broadcasters	-0.05	-1.09	0.27	
Frequency of using the Internet (PC)	-0.08	-2.58	0.01	¥10,371
Frequency of using the Internet (smartphone)	0.07	2.02	0.04	¥-13,184
σ	1.08			

Prices that feel too cheap

Total	1030
Initial likelihood	-720
Maximum likelihood	-703
Chi-square test	0.00
Likelihood ratio index	0.02

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	-5.84	-17.15	0.00	
The amount of money, used freely in a month	0.00	0.01	0.99	
Gender	0.21	2.09	0.04	¥-28
Age group	0.00	1.06	0.29	
Paying NHK reception fee	-0.19	-1.84	0.07	¥25
Subscribing paid application(s) for smartphone	-0.19	-1.42	0.16	
Frequency of watching NHK	-0.06	-1.35	0.18	
Frequency of watching commercial broadcasters	0.00	0.06	0.95	
Frequency of watching local broadcasters	0.04	0.96	0.34	
Frequency of using the Internet (PC)	0.09	2.63	0.01	¥-11
Frequency of using the Internet (smartphone)	0.11	3.04	0.00	¥-14
σ	1.03			

Fig. 20 Continued

Kumamoto prefecture_NHK

Prices that feel high

Total	520
Initial likelihood	-918
Maximum likelihood	-883
Chi-square test	0.00
Likelihood ratio index	0.04

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	4.52	15.90	0.00	
The amount of money, used freely in a month	0.01	0.74	0.46	
Gender	0.57	5.75	0.00	¥-723
Age group	0.00	-0.71	0.48	
Paying NHK reception fee	0.12	1.19	0.23	
Subscribing paid application(s) for smartphone	0.38	3.15	0.00	¥-1,286
Frequency of watching NHK	0.11	3.22	0.00	¥-4,052
Frequency of watching commercial broadcasters	-0.06	-1.31	0.19	
Frequency of watching local broadcasters	-0.01	-0.24	0.81	
Frequency of using the Internet (PC)	-0.05	-1.49	0.14	
Frequency of using the Internet (smartphone)	-0.09	-2.82	0.01	¥4,228
σ	1.30			

Prices that feel cheap

Total	520
Initial likelihood	-807
Maximum likelihood	-788
Chi-square test	0.00
Likelihood ratio index	0.02

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	-6.21	-19.04	0.00	
The amount of money, used freely in a month	-0.01	-0.74	0.46	
Gender	-0.15	-1.65	0.10	
Age group	0.01	1.92	0.06	¥-15
Paying NHK reception fee	-0.03	-0.33	0.74	
Subscribing paid application(s) for smartphone	-0.29	-2.50	0.01	¥75
Frequency of watching NHK	-0.12	-3.42	0.00	¥30
Frequency of watching commercial broadcasters	0.14	2.99	0.00	¥-30
Frequency of watching local broadcasters	-0.13	-2.83	0.01	¥32
Frequency of using the Internet (PC)	0.01	0.24	0.81	
Frequency of using the Internet (smartphone)	0.07	2.20	0.03	¥-16
σ	0.96			

Prices that feel too high

Total	520
Initial likelihood	-927
Maximum likelihood	-891
Chi-square test	0.00
Likelihood ratio index	0.04

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	4.89	16.76	0.00	
The amount of money, used freely in a month	0.01	1.21	0.23	
Gender	0.57	5.67	0.00	¥-1,174
Age group	0.00	-1.15	0.25	
Paying NHK reception fee	0.03	0.29	0.77	
Subscribing paid application(s) for smartphone	0.35	2.88	0.00	¥-2,235
Frequency of watching NHK	0.13	3.72	0.00	¥-5,571
Frequency of watching commercial broadcasters	-0.04	-0.82	0.41	
Frequency of watching local broadcasters	-0.04	-0.89	0.37	
Frequency of using the Internet (PC)	-0.04	-1.31	0.19	
Frequency of using the Internet (smartphone)	-0.11	-3.17	0.00	¥5,983
σ	1.33			

Prices that feel too cheap

Total	520
Initial likelihood	-743
Maximum likelihood	-729
Chi-square test	0.00
Likelihood ratio index	0.02

Items	Coefficient	Z-value	p-value	Marginal effect
Constant	-5.01	-15.37	0.00	
The amount of money, used freely in a month	-0.01	-0.51	0.61	
Gender	-0.20	-2.08	0.04	¥28
Age group	0.00	1.12	0.26	
Paying NHK reception fee	0.00	0.01	0.99	
Subscribing paid application(s) for smartphone	-0.28	-2.25	0.02	¥42
Frequency of watching NHK	-0.09	-2.31	0.02	¥12
Frequency of watching commercial broadcasters	0.08	1.70	0.09	¥-11
Frequency of watching local broadcasters	-0.12	-2.44	0.02	¥17
Frequency of using the Internet (PC)	0.07	2.03	0.04	¥-9
Frequency of using the Internet (smartphone)	0.07	2.05	0.04	¥-9
σ	1.06			

natural environment and its compensation.²¹ The psychology of respondents when responding to prices that they feel is *high* or *too high* in PSM is yet to be elucidated. Hence, only the sign conditions of significant marginal effects were considered here. The sign conditions of marginal effects revealed that socio-economic attributes, such as gender and age, were significant only in several services and some regions. In contrast, usage experiences of paid broadcasting services and digital content were significant in many services and regions. The usage experiences positively impacted the prices that were felt to be *cheap* or *too cheap* and negatively on those that were felt to be *high* and *too high*. These opposite movements created synergistic effects, pushed up the price, which respondents considered appropriate for mobile broadcasting services, and shifted PSM price indexes, such as *IP* and *OP*, to the right in Fig.18. This suggests that the results of attribute analyses in PSM were consistent with those in CVM concerning each factor's influence to price indexes.

4.6. Comparison and evaluation of empirical results

In CVM, the WTP is calculated from the respondents' decision-making process on purchasing the service at the presented prices. In contrast, the PSM estimates *IP* and *OP* from respondents' answers related to price, such as *high*, *too high*, *cheap*, and *too cheap*. Therefore, there is no decision-making process for consumers' purchases in PSM. Consequently, even if the survey target is the same, it is reasonable that the two methods will derive different results. Still, the multifaceted analyses with two methods, which seek appropriate prices for goods and services, should offer fruitful insights. Since this study aims to investigate the proper price of broadcasting services for mobile devices, the results of both analyses were compared and considered from various angles. Additionally, the trial of the first PSM analyses by full-parametric duration model with Weibull distribution was not as effective as conventional CVM full-parametric analysis. While its framework was shown to be valid, the impact of its attributes could not be adequately measured in the present situation. However, their results support CVM's attribute analyses as the sign conditions of both analyses were identical. This trial could aid in improving further price-related research in CVM and PSM.

Regarding the user's monetary evaluation of mobile broadcasting services, the following values were obtained from the empirical results of this survey (Fig. 21). Since the WTP for both services was evaluated higher by about JPY100 than *IP* and *OP*, it can be said that indexes of PSM were evaluated *modestly*.

²¹ Another explanation for the overestimation of WTA is possible from a microeconomic perspective. When the service is provided in CVM, consumers' evaluation is measured as the consumer surplus on the demand curve. Comparing the case in which the price of the service is free, the consumer surplus decreases along the demand curve as the price of the service rises. WTP is considered an Equivalent Variation (EV), the maximum amount consumers must pay to reach the post-change utility level while retaining the pre-change price when the price rises. On the other hand, WTA is considered a Compensating Variation (CV), the minimum amount that must be given to a consumer to keep the consumer at the same level of utility as before the change while keeping the price after the change when the price rises. If there is no Income Effect, the results are the same for both WTP and WTA question formats because $CV = \text{Consumer Surplus} = EV$ in the demand curve; however, because the service in this research is considered normal service (normal good) with income effects, $CV > \text{Consumer Surplus} > EV$. Therefore, WTA is the most exaggerated evaluation for respondents in this framework.

Fig. 21 User's monetary evaluation of mobile broadcasting services

Methods/Indexes	Services	Results
CVM Willingness to Pay (Representative value: cut-off mean)	NHK single service	Ranged from JPY429 to JPY469
	NHK & commercial broadcasters' services	Ranged from JPY413 to JPY499
PSM Indifference Price and Optimum Price	NHK single service	Ranged from JPY315 to JPY420
	NHK & commercial broadcasters' services	Ranged from JPY324 to JPY359

The following conclusions about the subjects of verification in this research are derived from the empirical results of the survey.

1. CVM could calculate positive WTP; however, it is not easy to introduce the universal charge system since more than 80% of respondents had no intention to pay monetary consideration.
2. Medians of the WTP in the CVM were less than JPY100; therefore, universal fees for mobile broadcasting services should be appropriately set low even if they are introduced.
3. In the case of 20% of the respondents who revealed positive WTP, appropriate prices derived from CVM and PSM could be set between JPY300 to JPY500 per month.

Next, the difference between services, NHK & commercial broadcasters combined service, and NHK single service, can be inferred as follows:

4. In CVM and PSM analyses, no significant advantage was observed when commercial broadcasters were coupled.
5. It was even observed that appropriate prices declined when commercial broadcasters entered the services.

The following results were obtained about the relationship between experiences of earthquakes and the evaluation of mobile broadcasting services, which received particular attention in this study.

6. When regional income differences were not considered, many indicators in the CVM were higher in the Tokyo metropolitan area than in the Tohoku region and Kumamoto prefecture, which experienced massive earthquakes.
7. When regional income differences were considered, indicators in CVM were leveled, and the two regions that experienced massive earthquakes had a higher cut-off mean than the Tokyo metropolitan area.
8. The PSM revealed that the two regions that experienced massive earthquakes tended to evaluate this service highly; however, this relationship was not consistent.

The following results were obtained regarding the usage experiences of the paid broadcasting services and the smartphone apps when evaluating mobile broadcasting services.

9. It was confirmed that the usage experiences of paid broadcasting, video, and smartphone services positively influenced both acceptance rates and WTP for mobile broadcasting services.

In particular, paid smartphone app users had high acceptance rates and WTP for these services.

Finally, the following results were obtained regarding the differences among gender and age groups in the frequency of app usage with mobile phones/smartphones and the frequency of media usage during the reconstruction period after the earthquake.

10. Usages of mobile apps and usage of media during the reconstruction period varied depending on gender and age; however, their impacts were limited in the attribute analyses of CVM and PSM.

According to findings 4 and 5, commercial broadcasters' content might decline the evaluation of mobile broadcasting services; however, these causalities were not evident within this survey, and even more investigation is necessary. A possible hypothesis is that since commercial broadcasting services run on advertising revenue and people watch them for free, they might resist paying even for an internet-based service. The differences in gender and age did not appear in the results of CVM and PSM; however, they may be revealed if the questions regarding video streaming services were made more specific. The hypothesis has been partly verified that a large-scale earthquake experience will increase people's recognition of the importance of mobile broadcasting services and their WTP for the services. As stated in findings 6 and 7, the Tokyo metropolitan area tended to have the highest scores among the three regions when the income level was not considered. However, when income level was considered, the two regions that experienced the earthquake exceeded the Tokyo metropolitan area concerning the cut-off mean in the WTP. Since the contents of the broadcasting services for mobile devices are the same as that of the conventional TV broadcasting services, the usage rate of these services will increase further as younger generations begin to constitute a more significant portion of the population and smartphone users increase. This conclusion is supported by the usage rate of mobile broadcasting services, which was higher for younger generations.

5. Conclusion and Discussion

Using empirical data, this study analyzed the benefits of broadcasting services provided through mobile devices. The questionnaire examined two services, the NHK single service and the NHK & commercial broadcasters' service, and the differences in evaluations in the Tokyo metropolitan area, the Tohoku region, and Kumamoto prefecture, which experienced significant earthquakes in the 2010s. The result revealed that some people intended to pay for paid broadcasting services for mobile devices. However, many respondents were reluctant to pay for these services. This suggests that pricing should be given sufficient consideration when providing these services. The study revealed that a positive evaluation of these services tended to be high in the areas which experienced massive earthquakes.

While this study measures users' benefits in having access to broadcasting services through Internet-based mobile devices, it does not justify additional fees for existing Internet-based services for a broadcaster. The NHK is currently providing broadcasting services for mobile devices on free *NHK*

Plus service as an additional service to terrestrial broadcasting subscribers; therefore, economic benefits revealed in this study are free of charge. In addition, the *TVers* service provides free commercial broadcaster content with advertisements via the Internet. This type of value provision by broadcasters may be a great stimulus to regain viewers, especially young viewers, who have shifted their interest to internet-based streaming services, such as YouTube and TikTok. Since viewers continue to hope to consume video content anywhere and anytime, smartphones and tablets will become even more essential devices. Consequently, accelerating mobile broadcasting services will become very important for TV networks to retain their relevance in the national media.

This study has several limitations. The generalizability of the results is limited because a survey company's panels conducted the questionnaire. Additionally, while respondents of the web questionnaire survey can use the Internet well and access mobile broadcasting services if they wish, the elderly and young people, who cannot participate in this kind of web survey, may have a different experience or expectations regarding mobile broadcasting services. Therefore, broadcasters should consider that those groups also have access to information in the mobile age, especially during catastrophic situations, such as massive earthquakes. Providing earthquake-related information is crucial for avoiding life-threatening conditions in Japan; it is also essential to consider this theme from the standpoint of crisis management and the approach that presupposes economic benefits.

Appendix 1: Media Usage by Gender and Age

Cross tabulations by gender and age group were conducted to confirm differences in the data for *Fig. 10 Frequency of apps usage with mobile phone/smartphone*, and *Fig. 11 Frequency of media usage during the reconstruction period after the earthquake*. The left side in Fig. A1 results from cross-tabulations by gender and age regarding *the frequency of app usage with mobile phones/smartphones*. While apps for news, email, and browsers did not differ much by gender, apps such as radio, TV, video players, eBook viewers, and online games had high usage rates among males. Females were observed to use SNS, photo sharing, image processing, and free-market apps more than males. Furthermore, while the usage rates of many apps declined as respondents' age increased, that of transfer guidance/car navigation apps was not affected by age, and that of news apps was relatively low among younger age groups. The right side in Fig. A1 results from cross-tabulations by gender and age regarding *media usage frequency during the reconstruction period after the earthquake*. While there was no significant difference in the use of TV and radio by gender, the use of internet video services was higher among males. Similarly, females tended to access social media and Internet simultaneous broadcasting more often than males. The usage rate of TV and radio increased with the age of the respondents; however, newspapers and magazines were less affected by age. Furthermore, the usage rate of Internet-mediated media increased with a decrease in age. It will be crucial to consider those differences in age and gender when diffusing mobile video streaming services.

Appendix 2: Verification of the Difference between Broadcasting Services and Regions

(1) The differences in payment acceptance rates between the NHK single service and the NHK & commercial broadcasters' service were analyzed based on the questionnaire data. Wilcoxon signed-rank test was implemented to verify the differences in the CVM responses, which were accumulated data consisting of Yes or No when respondents were presented with one of the 10 prices ranging from JPY100 to JPY4,400. The results in Fig. A2 show that the two services were not significantly different in the three regions.

(2) The difference in acceptance rates among areas, such as the Tohoku region and Kumamoto prefecture, which experienced significant earthquakes, and the Tokyo metropolitan area was analyzed. They were verified with the Wilcoxon signed-rank test (Fig. A3), and the acceptance rates of NHK & commercial broadcasters' services were significantly higher in the Tohoku region and Kumamoto prefecture than those in the Tokyo metropolitan area.

(3) The PSM data ranged from JPY0 to JPY5,000 and were examined with an independent t-test to check the difference between NHK single service and NHK & commercial broadcasters' service. Fig. A4 shows that prices that were felt to be *high* were significantly higher for the NHK single service than the NHK & commercial broadcasters' service in all three regions. For prices that were felt to be *cheap*, the NHK single service was significantly higher than the NHK & commercial broadcasters' service only in the Tohoku region. For prices that were felt *too expensive*, the NHK & commercial broadcasters' service was significantly higher than NHK single service, only in the Tokyo metropolitan area. At the same time, there was no significant outcome in prices that were felt to be *too cheap*. Consequently, these prices were not constant other than for prices that were felt to be *high*; therefore, it was also challenging to clarify the differences between the two services concerning the PSM indexes, *IP* and *OP*, which were obtained from these prices.

(4) Similar to Appendix 2(3), the differences in the four prices of PSM among the Tohoku region and Kumamoto prefecture, which experienced significant earthquakes, and the Tokyo metropolitan area were verified. As a result of tests of average differences in Fig. A5, no significant difference was found among all prices and areas.

Declarations

Funding:

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Ethical Approval:

All respondents of the empirical survey in this research were the member monitors of the marketing research company, Macromill Co. Ltd, a Japan Marketing Reassert Association member, which supports and agrees with the ICC/ESOMAR International Code on Market, Opinion, and Social Research and Data Analytics.

Informed consent:

The member monitors were informed of the contents of the survey before they participated in this survey and voluntarily agreed to the participation.

Author's contribution:

Otsuka and Mitomo contributed substantially to the study concept, data analysis, and interpretation and drafted the manuscript.

Data availability statement:

In the case of reasonable requests, the datasets in the manuscript will be available from the corresponding author.

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