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# Bundling Information Goods Under “Breakeven” Price

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## Abstract

Bundling under monopoly tends to increase demand and market efficiency, but likely at the expense of transferring consumers’ surplus to firms. Public utilities can use this increase in demand to reduce the monthly fee per consumer. To demonstrate it, I conduct a numerical analysis of the effects of bundling under breakeven price regulation for the Japan Broadcasting Corporation. I estimate the willingness-to-pay for broadcasting services and simulate consumer choices under pure bundling and a-la-carte pricing with breakeven price regulation. Comparing pure bundling and a-la-carte pricing of terrestrial television and satellite television, the increase in demand caused by bundling is very slight due to the strong positive correlation of WTPs. However, compared with a-la-carte pricing, consumer welfare increases by 1.7% with bundling of channels and by 28.2% with bundling of genres.

JEL classification: L82; L30; D49;

Keywords: Bundling; Public utilities; Policy analysis

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## 1. Introduction

Traditionally, economists argued that although bundling information goods increases social welfare, it tends to transfer surplus from consumers to firms (Bakos and Brynjolfsson, 1999). In the media market case, Crawford (2007, 2008), and Crawford and Yurukoglu (2012) find that a-la-carte pricing of cable television increases consumer surplus, and Shiller and Waldfogel (2011) show that bundling of digital music reduces consumer surplus.

Public utilities under breakeven price regulation can use the increase in demand caused by bundling to decrease the monthly fee per consumer. I investigate this possibility with regard to the Japan Broadcasting Corporation.

The Japan Broadcasting Corporation (NHK: abbreviation of Nippon Hoso Kyokai) is Japan's national public broadcasting organization and provides two terrestrial television channels (GTV: NHK General and ETV: Educational Television), three radio channels, and two satellite TV channels (BS1 and BS premium) for Japanese people. Japanese households have to pay a monthly fee if they install the TV tuner but do not need to pay for radio channels. While almost all households install the TV tuner for terrestrial television, the install rate of the satellite television tuner, by the end of 2012, was only 42.6% of the total TV tuner holders. The monthly fee for the terrestrial television only tuner is 1275 yen and for the terrestrial television and satellite television tuner is 2220 yen (around 12 US dollars and 22 US dollars, respectively, at the exchange rate in January, 2014). Consumers who do not watch terrestrial television channels must pay for a bundle of terrestrial television channels and satellite television channels and those who do not watch a particular channel must pay for a bundle of channels.

The annual budget of NHK is subject to review and approval by the Diet of Japan. NHK must use their income to compensate for their expenditure of broadcasting services and it is prohibited for NHK to make any profit. The total income allocated to NHK depends on the number of households with installed TV tuners and the monthly fees. The total expenditure is set to match the total income. Therefore, NHK can be considered to be under breakeven regulation.

The next section presents the estimation methods of WTP for NHK broadcasting services. In section 3, the welfare effects of a-la-carte pricing and bundling are investigated. The last section discusses the findings and provides concluding remarks and suggestions for future research.

## 2. Welfare Effects of Bundling Information Goods

In this section, I describe the literature on the welfare effects of bundling information goods by a monopolist. In the first subsection, I illustrate the welfare effect of break-even regulation for bundling of two goods by a monopolist. In the second subsection, I describe the literature that generalizes the impact of information goods bundling to various scenarios with different correlations between WTPs, and to the multi-product case.

## 2.1 Welfare effect of break-even regulation on bundling

Most of the information goods bundling literature has focused on the monopolist's profit maximization. McAfee, McMillan and Whinston (1989) shows that the monopolist has an incentive to bundle under independent valuations. Hereupon, I follow Belleflamme and Peitz (2010) to show the welfare effect of bundling and generalize it to the break-even price regulation case.

Consider a monopoly firm producing two goods, labeled A and B, at zero cost. Consumers may purchase one unit of A or one unit of B or both. I normalize the total market to be of size 1 and assume that the WTP of consumers for A and B ( $v_1, v_2$ ) are independent and uniform over  $[0, 1]$ . I also assume that a consumer's valuation for the bundle is equal to the sum of his separate valuations for each good. I further assume that budget constraints are not an issue<sup>2</sup>.

I compare three pricing models by a monopolist. First, I introduce the welfare outcome of a-la-carte pricing by a profit-maximizing monopolist. Because of the symmetry of demand, the price of the two goods is the same in equilibrium. The revenue of a-la-carte pricing is equal to  $R^A = 2p^A(1 - p^A)$  where  $p^A$  is the price for each good. The revenue-maximizing price for each good is  $p^A = 0.5$ . The revenue is equal to  $R^A = 0.5$  and the consumer surplus is equal to  $CS^A = 0.25$ .

Second, I consider the pure bundling case. The price of the bundle is  $p^B$  and the revenue is equal to  $R^B = (1 - p^{B^2}/2)p^B$ . The revenue-maximizing price for the bundle is equal to  $p^B \approx 0.816$ . The revenue is equal to  $R^B \approx 0.544 > 0.5 = R^A$  and the consumer surplus is  $CS^B \approx 0.27 > 0.25 = CS^A$ . Hence, bundling increases firm revenue and consumer welfare.

Finally, I examine the scenario of break-even price regulation. The prices that make

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<sup>2</sup> The monthly fee for the terrestrial television and satellite television bundle is 2220 yen. According to the Family Income and Expenditure Survey of Japan, it is only 0.882% of the average household's expenditure in 2013.

the revenue of bundling equal to the revenue of a-la-carte pricing are  $p^B \approx 0.612$  and  $p^B = 1$ , respectively. The consumer welfare at  $p^B \approx 0.612$  equals to  $CS^{BE} \approx 0.43 > 0.27 \approx CS^B$ . Therefore, the introduction of product bundling with a price regulation that equals the monopolist revenue under both pricing schemes increases consumer welfare.

Under break-even price regulation, it is not clear whether the initial price is equal to the revenue-maximizing price. However, when the price for the bundle is the sum of the price of the components ( $p^B = 2p^A$ ), and if  $p^A \leq 1/2$  then  $R^B$  is higher than  $R^A$ . The government and the monopolist do not have any incentive to set a price higher than the profit-maximizing price. Hence, it is straightforward to regard any initial price under break-even regulation as lower than the revenue-maximizing price. Therefore, the introduction of product bundling under break-even price regulation should increase consumer welfare.

## 2.2 Bundling with different correlations of WTP and multiple products

The welfare effect of product bundling depends on the correlation between WTPs and the number of goods bundled. Negative correlation in preferences for bundle components increases the revenue gain after the introduction of bundling (Stigler, 1963; Adams and Yellen, 1976). In the case of uniform distribution between  $[0, 1]$  with correlation, Belleflamme and Peitz (2010) show that bundling outperforms a-la-carte pricing only if the correlation is lower than  $\sqrt{1/7}$ . When the correlation is larger than  $\sqrt{1/7}$ , bundling decreases revenue, the break-even price of the bundle is higher than the sum of a-la-carte prices, and consumer welfare decreases.

The number of goods bundled has an impact on the welfare effect of bundling. Bakos and Brynjolfsson (1999) show the greater the number of bundled goods with IID uniformly distributed WTPs, the larger the increase in the demand for goods and the transfer of consumer surplus to firm's profit. Fang and Norman (2006) show that similar results are obtained for a given finite number of goods when the distribution of the valuations is symmetric and log-concave.

Summarizing the above mentioned literature, the bundling of information goods with IID uniformly distributed WTP increases the demand for goods, and break-even regulation contributes to increase consumer surplus. However, it depends on the number of products bundled and the distribution of WTP. Hence, empirical research on information goods bundling needs to relax the distributional assumptions of WTP estimates. In the next section, I introduce the data and econometric model used to

estimate WTPs for the bundle components.

### 3. The Data and Econometric Model

In this section, I define the data and econometric model used to estimate WTPs. In the first subsection, I describe the public opinion poll conducted by NHK. In the second subsection, I explain the interval regression model that is used to estimate WTPs.

#### 3.1 The NHK public opinion poll

NHK carries out a public opinion poll once a year. I use the poll data obtained in January 2013. In the poll, respondents are faced with triple-bounded dichotomous choices that reveal the willingness-to-pay for terrestrial television and satellite television. The choice tree for terrestrial television services is shown in Figure 1. The consumers who answer the questions about WTP for terrestrial television services are classified into 9 intervals as follow: Over 3000, 2999 to 2500, 2499 to 2000, 1999 to 1500, 1499 to 1000, 999 to 500, 499 to 250, 249 to 1, and 0. Similarly, consumers who answer the equivalent questions about WTP for satellite television are classified into 9 intervals as follows: Over 2000, 1999 to 1500, 1499 to 1250, 1249 to 1000, 999 to 750, 749 to 500, 499 to 250, 249 to 1, and 0. Table 1 shows the number of respondents per interval and the number of respondents who pay a monthly fee. In addition, the poll asks about percentages of WTP within two terrestrial television channels, and radio and percentages of WTP within of two satellite television channels. Furthermore, the poll investigates the percentage of WTP within 10 classified genres. NHK classifies their programs in the following 10 genres. G1: The news, commentary, G2: Sports, G3: Life and social information, G4: Youth and education, G5: Culture and welfare, G6: Science and nature, G7: Drama, G8: Entertainment, music and traditional arts, G9: Movie and animation, G10: Large-scale plan program.

Table 1 Counts of WTP intervals and payment rates

Figure 1 Poll question about WTP for terrestrial television services

#### 3.2 The Interval Regression Model

WTP estimates using OLS or discrete choice models such as the LOGIT model are not suitable to investigate the welfare effect of bundling. First, OLS estimates that assign values on midpoints or in an even more ad hoc basis to observations do not result in

general in consistent estimates (Stewart, 1983). Second, the discrete choice models that are widely used by the BBC and Human Capital (2004), and Finn, McFadyen and Hoskins (2003) to evaluate the WTP for public broadcasting services not only rely on assumptions over the distributional form of the random component of WTP, but also directly assume the distribution of WTP. However, logistic, extreme value and normal distributions, which are well used for discrete choice models, are log-concave and thus ensure that the bundling increases revenue (Fang and Norman, 2006).

I use the interval regression model to avoid assigning ad hoc values for intervals and assuming log-concave distribution. The interval regression model provides consistent estimates when the dependent variable is grouped.

Following Stewart (1983), the WTP is assumed to be given by

$$y_i = x_i' \beta + u_i \quad (1)$$

where  $y_i$  is the unobserved dependent variable,  $x_i$  and  $\beta$  are both  $J \times 1$  vectors, the former being regressors and the latter unknown parameters. The  $u_i$  are assumed to be IID normally distributed random variables with zero mean and variance  $\sigma^2$  and to be independent of  $x_i$ . The conditional distribution of the unobserved dependent variable is given by

$$y_i | x_i \sim N(x_i' \beta, \sigma^2). \quad (2)$$

The conditional distribution of  $y_i$  under the observed  $x_i$  is normal. However, the distribution of  $y_i$  depends on the unrestricted distribution of  $x_i$  and does not always belong to a log-concave distribution. The observed  $y_i$  is K intervals that divide the real line and the first and K-th intervals are open-ended. The conditional expectation of  $y_i$  is

$$E(y_i | A_{k-1} < y \leq A_k, x_i) = x_i' \beta + \sigma \left[ \frac{f(Z_{k-1}) - f(Z_k)}{F(Z_k) - F(Z_{k-1})} \right] \quad (3)$$

where  $Z_k = (A_k - x_i' \beta) / \sigma$ , and  $f$  and  $F$  are the density function and cumulative distribution of the standard normal, respectively. I estimate  $\beta$  and  $\sigma$  by the Maximum Likelihood estimation provided by Stewart (1983).

To determine the distribution of WTPs, I use the interval regression estimator to find out the point estimator of WTPs for every respondent. I regress the interval of WTP for terrestrial television and satellite television services on income, the opportunity cost of

watching TV (measured by wage), the socio demographic characteristics of respondents, the number of TVs in the household, hours of TV watched, and the number of terrestrial television channels in the region<sup>3</sup>. Table 2 shows the summary statistics of the independent variables.

Table 2 Summary statistics of independent variables

The interval regression estimation results are shown in Table 3. As shown in Table 1, many respondents who have a WTP lower than the monthly fee actually pay the monthly charge. It means that respondents reveal their preference to pay the monthly fee rather than not to pay it. If respondents pay the monthly fee nevertheless their WTP for terrestrial television services is smaller than the monthly fee for terrestrial television services, it shows they have some other willingness-to-pay for public broadcasting services. I named it as WTP for public broadcasting institution and calculate its minimum threshold<sup>4</sup>. Summary statistics of WTPs are shown in Table 4.

Table 3 Results of interval regression

Table 4 WTP for terrestrial television and satellite television

The total average WTP for terrestrial television and for public broadcasting institution is 1,339 yen, which is larger than the 1,275 yen monthly fee for terrestrial television services. However, the total average WTP for terrestrial television, satellite television and public broadcasting institution is 1,918 yen, which is smaller than the 2,220 yen monthly fee for terrestrial television and satellite television. These findings are consistent with the fact that almost all households install the terrestrial television tuner but over half of the households do not install the satellite television tuner. The correlation of WTPs for terrestrial television and for satellite television is 0.81. A high correlation between the WTP for two goods means that the effect of bundling might be small. The distributions of WTPs for terrestrial television and for satellite television, as

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<sup>3</sup> Japanese commercial channels are licensed for every broadcasting region which are mainly defined as the 47 prefectures. Only few large economic regions, namely Tokyo, Nagoya and Osaka, constitute one broadcasting region each.

<sup>4</sup> Respondents who pay the monthly fee reveal their preference as [WTP for terrestrial television/satellite] + [WTP for public broadcasting institution]  $\succ$  [monthly fee for terrestrial television/satellite television]. It means that the minimum limit of [WTP for public broadcasting institution] is [monthly fee for terrestrial television/satellite television] – [WTP for terrestrial television/satellite television].



well as the correlation between both WTPs are shown in Figures 2, 3, and 4, respectively.

Figure 2 Distribution of WTP for terrestrial television

Figure 3 Distribution of WTP for satellite television

Figure 4 Correlation between WTP for terrestrial television and for satellite television

An analytical solution for bundling may be achieved when WTPs are normally or uniformly distributed. However, a Kolmogorov-Smirnov test against normal distribution rejects at the 1% level the hypothesis that the WTPs for terrestrial television and satellite television are normally distributed. It is also clear that the said WTPs are not uniformly distributed. Therefore, I do a counterfactual analysis on the sample.

Based on the poll's answers about the percentage of WTP for each channel and genre, I allocate the corresponding share of the total WTP for terrestrial television and satellite television to each channel and genre. The summary statistics of WTPs and correlations for channels and genres are shown in Table 5 and 6, respectively.

Table 5 WTP per channel

Table 6 WTP per genre

The minimum WTP value per channel and genre is 0 and the median WTP value for genres 4 and 9 is also 0. Consumers have various WTP for each channel and genre. The correlation matrix of WTPs per channel shows that there is a negative correlation between channels in the same spectrum. Such correlation results partially depend on the research design of the NHK poll. Nevertheless, various correlations of WTP mean that product bundling allows increasing the demand of broadcast services.

In the next section, I simulate the choice of sample respondents and evaluate the welfare outcome under various counterfactual conditions.

#### 4. Bundling and a-la-carte pricing

To investigate the respondents' choice of a-la-carte pricing and bundling of spectrum, I assume the following consumer behavior model. Under the present contract form,

consumers choose the contract that yields the highest surplus between the terrestrial television-only service contract and the terrestrial television and satellite television contract. Under the counterfactual a-la-carte pricing strategy, consumers sign up for any given component if the WTP for such component is larger than the corresponding a-la-carte monthly fee. Under the counterfactual bundling strategy, consumers sign up for the terrestrial television and satellite television contract if the sum of WTPs for terrestrial television and satellite television is higher than the bundled monthly fee. As previously mentioned, the factual monthly fee for the terrestrial television only service contract is 1275 yen and that for terrestrial television and satellite television contract is 2220 yen. Therefore, the satellite television solo monthly fee is 945 yen.

At first, I conduct a simulation for the counterfactual contract forms under fixed prices and assuming the above conditions. Table 7 shows the simulated results of consumer choice under factual and counterfactual contract forms with fixed prices.

Table 7 Simulated contracts per spectrum type

Because of the strong correlation between WTPs for terrestrial television and satellite television, no sample respondent is willing to sign up for the satellite television only contract under a-la-carte pricing strategy. Furthermore, numerous respondents do not have enough WTP for satellite television and consequently are not willing to sign up for the broadcast service under the bundling strategy with fixed prices.

Table 8 shows the simulated results of the consumer choice under the counterfactual a-la-carte pricing contract of individual channels. I use two definitions of a-la-carte channel fees. First, prices are set to be uniform within spectrums and are calculated by dividing the terrestrial television fee equally by GTV, ETV and radio, and the satellite television fee by BS1 and BS premium. Then, the fee per terrestrial television channel is 425 yen and the fee per satellite television channel is 462.5 yen. Second, prices are defined as fully distributed cost (FDC). FDC prices are obtained by dividing the total fee of 2220 yen by the cost share of each channel<sup>5</sup>. The cost shares of NHK channels in 2012 are shown in Table 5. The FDC channel fees are: GTV 1189 yen, ETV 311 yen, radio 130 yen, BS1 331yen, and BS premium 240 yen.

Table 8 Simulated contracts per channel

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<sup>5</sup> The cost share of NHK is announced in the annual report of financial accounts.

Under a-la-carte pricing contracts with uniform prices, the number of channels subscribed decreased by 5.1%, and consumer welfare rose four times compared to the present contract form. However, under a-la-carte pricing contract with FDC prices, the number of channels subscribed increased 62%, and consumer welfare rose four times compared with the present contract form. Under uniform prices, social welfare is higher but consumer surplus is lower than those under FDC prices. Therefore, under the a-la-carte pricing contract there is a trade-off between efficiency and consumer surplus.

Table 9 shows the simulated results of consumer choice under counterfactual a-la-carte contract of genres. I set types of two a-la-carte channel prices: uniform and FDC. The uniform price of programs is 222 yen per genre. FDC prices are 803 yen for G1, 352 yen for G2, 261 yen for G3, 140 yen for G4, 127 yen for G5, 60 yen for G6, 173 yen for G7, 181 yen for G8, 50 yen for G9, 73 yen for G10.

Table 9 Simulated contracts per genre

Because a large part of the sample is not willing to subscribe under bundling, the number of subscribed genres per person decreased by 8.2%. However, under uniform a-la-carte pricing contract, the number of genres subscribed increased by 37%. Compared to the present contract form, consumer welfare grew 6.1 times under uniform a-la-carte pricing and 5.3 times under FDC a-la-carte pricing. The number of genres subscribed under FDC a-la-carte is larger than that under uniform a-la-carte pricing and bundling. However, consumer welfare and social welfare under uniform a-la-carte pricing is larger than that of FCD a-la-carte pricing and bundling.

FDC a-la-carte pricing of channels and of genres have a strong demand increasing effect compared with the present contract form under fixed prices. Consumers prefer a uniform fee rather than a FDC fee. According to the theory, bundling without discount decreases consumer welfare and does not increase demand. However, bundling with discount could increase demand and NHK could discount their fee maintaining their revenue. I simulate a-la-carte and bundle pricing with discounts that maintain the revenue under the present contract form. Table 10 shows the simulated results on the consumer choice under a-la-carte pricing or bundling of spectrum with discount.

Table 10 Simulated contracts per spectrum-type with discount

At first, revenue increases with the discount, because the present fee is not at the revenue-maximizing level. The revenue becomes breakeven after the large discount.

Large part of the sample is willing to subscribe under la carte pricing with discount and bundling with discount. Because of the high correlation between WTP, there are small differences between a-la-carte pricing with discount and bundling with discount.

Table 11 shows the simulated results on the consumer choice under a-la-carte pricing or bundling of channels with discount. I set the breakeven revenue as the revenue under the present contract form for the same fee scheme.

Table 11 Simulated contracts per channel with discount

While the uniform fee with discount can decrease the monthly fee by 108 yen per channel, the FDC fee with discount can cut the monthly fee by 71.0%. The large demand increasing effect of a-la-carte pricing with discount leads to a strong welfare improvement. Furthermore, bundling with discount has a larger demand increasing effect than a-la-carte pricing. Under bundling with discount, the whole sample is willing to subscribe to all channels and the consumer welfare is higher than that of other contract forms. Bundling of channels with discount under breakeven regulation offers a pareto improvement effect for NHK channels.

Table 12 shows the simulated results on the consumer choice under a-la-carte pricing and bundling of genres with discount. As in the above case, I set the breakeven revenue as the revenue under the present contract form for the same fee scheme.

Table 12 Simulated contracts per genre with discount

The monthly fee is reduced 125 yen per genre under the uniform fee with discount and decreases by 33.7% under the FDC fee with discount. In contrast with the scenario of subscription per channel, under subscription per genre the uniform price leads to a larger discount than the FDC price. Furthermore, bundling with discount has a larger demand increasing effect than a-la-carte pricing under FDC. The entire sample subscribes to the bundled programs and the large discount increases consumer welfare. However, consumer surplus under FDC and uniform a-la-carte pricing is larger than that under bundling. Although, there is a trade-off between consumer welfare and efficiency, bundling with discount under breakeven regulation has a large welfare increasing effect for NHK.

## 5. Conclusions

I conduct a numerical analysis of the effects of bundling under breakeven price regulation for NHK. The empirical results indicate that there is no demand increasing effect of a-la-carte pricing for spectrum type. However, I found that a-la-carte and bundle pricing have a demand increasing effect for channel and genre choice. The analysis also demonstrates that a-la-carte pricing increases NHK revenue and consumer welfare. In addition, I show that NHK fees are not set at the revenue-maximizing level. The results confirm that under breakeven regulation a-la-carte pricing and bundling with discount have large welfare increasing effects. Thus, opposed to profit-maximizing firms, public regulated firms can use bundling as a tool for pareto improvement.

The present research does not deal with other media markets. NHK's pricing strategies could have an effect on other commercial broadcasting channels. In this research, the number of terrestrial television channels does not have an effect on the WTP for NHK. However, if consumers install the tuner and subscribe to NHK's satellite television channels, the TV ratings may change. Further research is required for the study of bundling under mixed oligopoly. In addition, I do not conduct a mixed bundling simulation. I would like to add a numerical analysis regarding bundle-size pricing (Chu et al, 2011).

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Figure 1 Poll question about WTP for terrestrial television services

Suppose a world without reception fees. Would you pay 1000 yen monthly to watch NHK's terrestrial television channels (GTV, ETV, and radio channels)? This fee is accordingly spent to create programs, develop broadcasting technology and maintain the public broadcasting services. Please consider that your payments are withdrawn from and have an effect on your household budget. In addition, your answer to this question does not influence your reception fees.

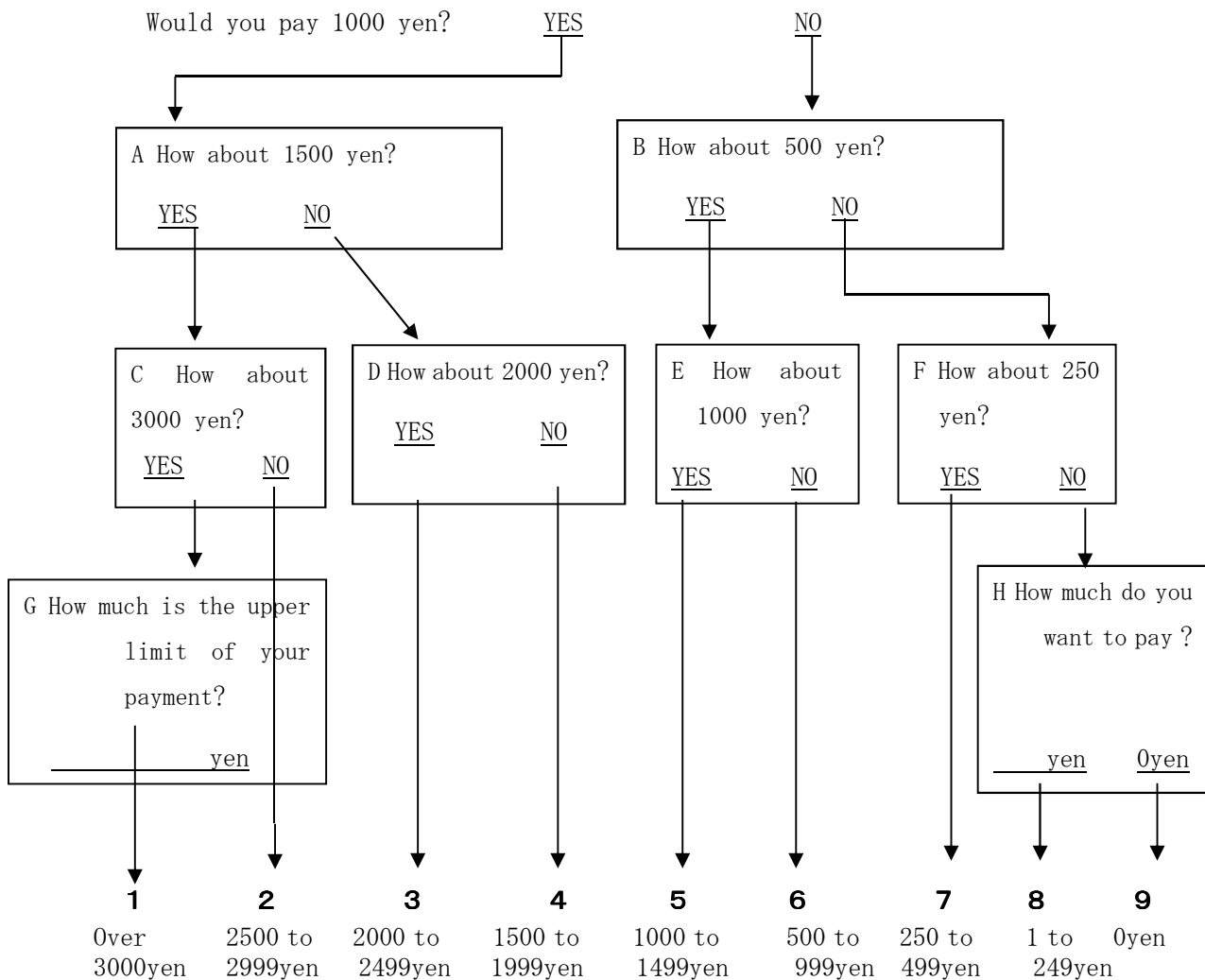


Figure 2 Distribution of WTP for terrestrial television services

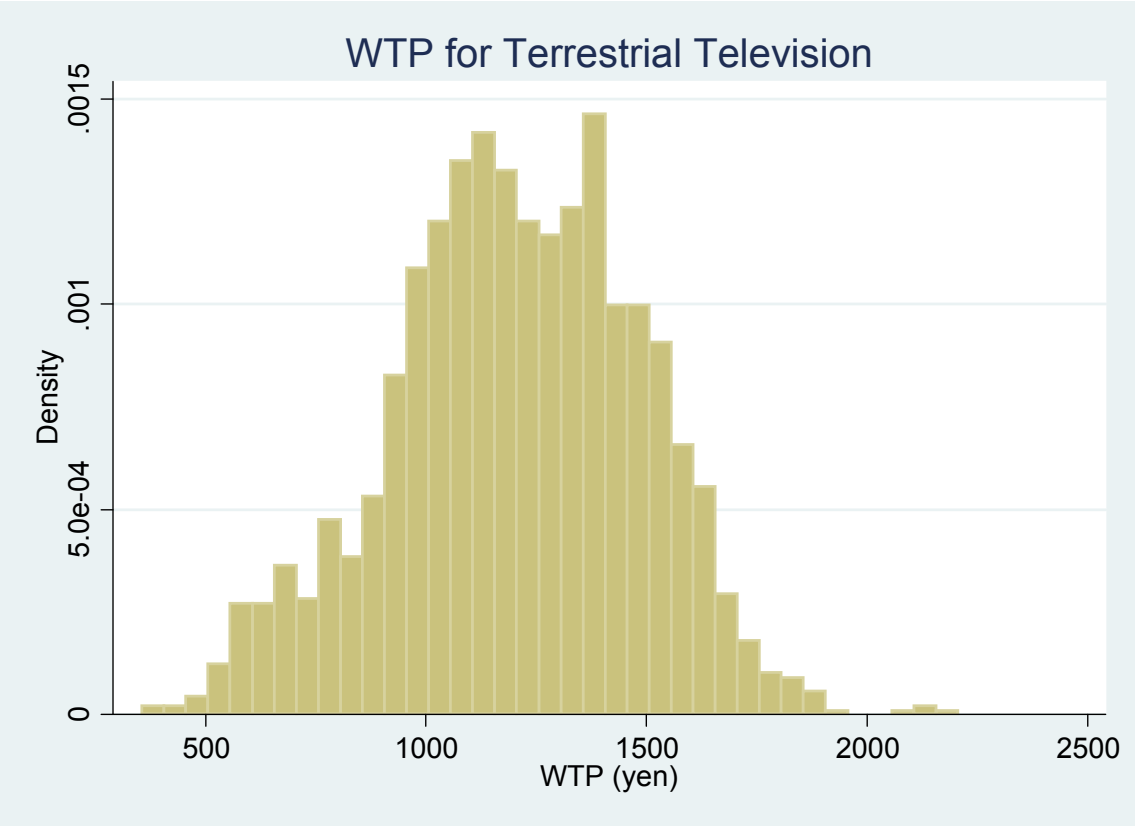




Figure 3 Distribution of WTP for satellite television

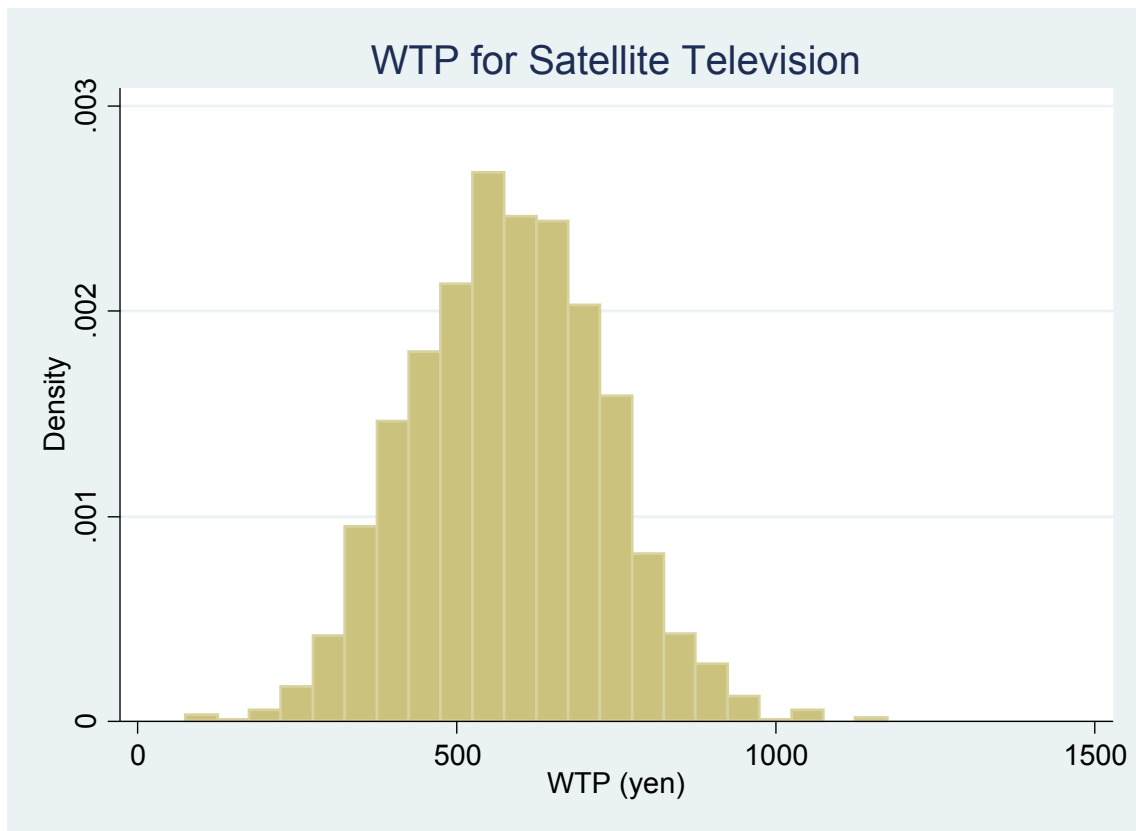


Figure 4 Correlation between WTP for terrestrial television and satellite television

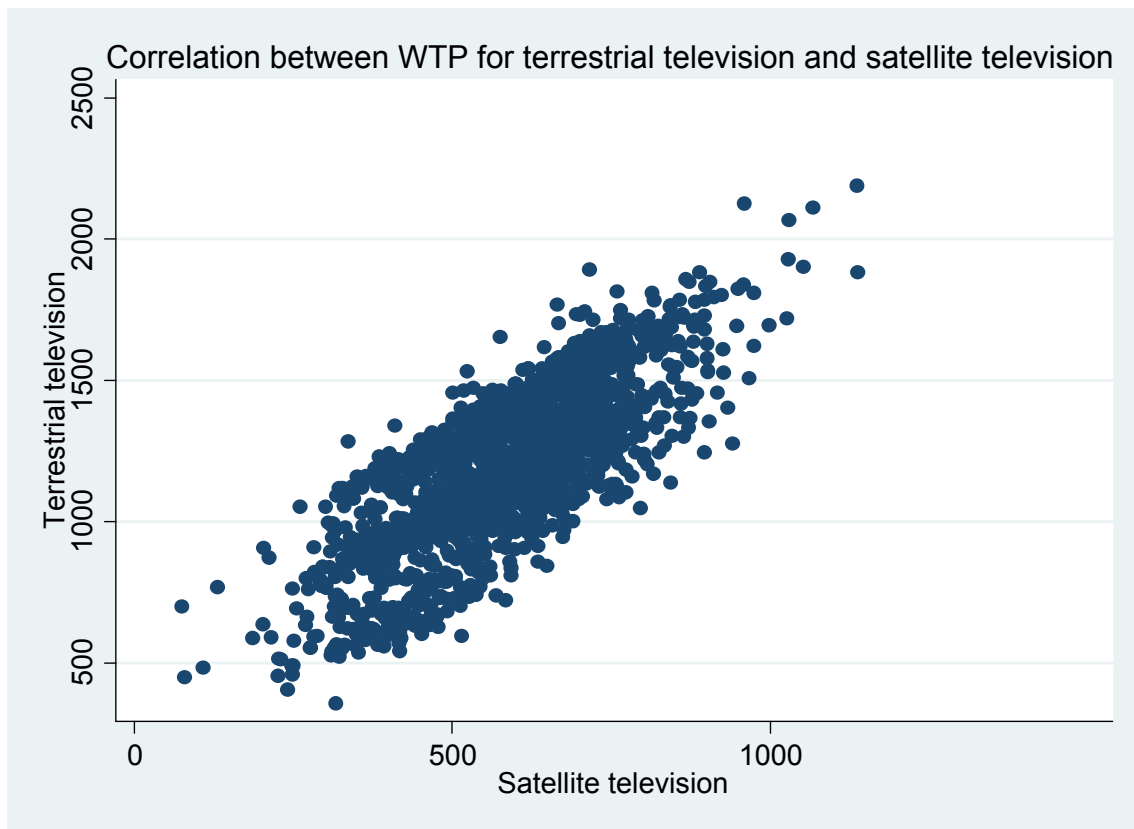


Table 1 Counts of WTP intervals and payment rates

Terrestrial television	Number of Respondents	Number of fee payers	Payment rate	Satellite	Number of Respondents	Number of fee payers	Payment rate
Over 3000	57	57	100%	Over 2000	77	68	88%
2999 to 2500	126	125	99.2%	1999 to 1500	125	97	78%
2499 to 2000	162	155	95.7%	1499 to 1250	46	26	57%
1999 to 1500	434	398	91.7%	1249 to 1000	301	220	73%
1499 to 1000	164	143	87.2%	999 to 750	58	35	60%
999 to 500	310	261	84.2%	749 to 500	242	149	62%
499 to 250	91	73	80.2%	499 to 250	110	57	52%
249 to 1	13	13	100%	249 to 1	15	12	80%
0	410	263	64.1%	0	793	203	26%
Total	1767	1488	84.2%	Total	1767	867	49%

Table 2 Summary statistics of independent variables

	N	Mean	Std.Dev.	Min	Median	Max
Personal yearly Income	1767	313.5823	260.4487		0	200
Personal yearly Income dummy (over 20 million)	1767	0.001698	0.041181		0	1
Wage	1767	279.802	105.6484	140.9	240.3	821.1
Agriculture dummy	1767	0.029994	0.17062	0	0	1
Public servant dummy	1767	0.031126	0.173708	0	0	1
Small firm dummy	1767	0.164686	0.371002	0	0	1
Labour dummy	1767	0.561969	0.496285	0	1	1
Single dummy	1767	0.463498	0.498807	0	0	1
Age	1767	53.1545	18.26272	16	55	89
Square of Age	1767	3158.739	1886.486	256	3025	7921
Homeowner dummy	1767	0.826825	0.378506	0	1	1
Condominium dummy	1767	0.173741	0.378994	0	0	1
Number of TVs (1 to 4)	1766	2.339185	1.1738	0	2	5
Number of TVs (over 5)	1767	0.056593	0.231129	0	0	1
Hours of TV watched (0 to 8 hours)	1762	3.42849	2.110988	0	3	9
Hours of TV watched (over 9 hours)	1767	0.044709	0.206722	0	0	1
Frequent internet user	1767	0.544426	0.498163	0	1	1
Number of TV channels	1767	6.63837	1.099243	3	7	8

Table 3 Results of interval regression

	-6217.2114		-8434.5822	
Number of Observations	1762		1762	
Log Likelihood	-6105.6187		-8382.6173	
	Terrestrial television		Satellite	
	Coefficient	Std. Err.	Coefficient	Std. Err.
Personal yearly Income	0.4350378	0.1193715 ***	0.2705801	0.0850884 ***
Personal yearly Income dummy (over 20 million)	445.1553	528.0862	-12.26538	376.1865
Wage	0.2465603	0.2883284	0.2811345	0.2061933
Agriculture dummy	41.08001	133.4068	42.6257	95.20395
Public servant dummy	320.7552	128.4547 **	107.6952	91.68864
Small firm dummy	44.66545	65.63462	120.808	46.88078 **
Labour dummy	-75.43242	65.31752	-150.3031	46.61645 ***
Single dummy	-53.8715	53.37883	21.18495	38.10191
Age	-18.5803	8.026518 *	-7.861244	5.730362
Square of Age	0.3038334	0.0790638 ***	0.1165541	0.0564202 **
Homeowner dummy	229.4659	85.20489 ***	140.7698	60.91542 **
Condominium dummy	-18.65403	83.80223	122.9957	59.96875 **
Number of TVs (1 to 4)	51.503	24.32019 **	50.90153	17.35404 ***
Number of TVs (over 5)	-103.6444	113.6444	-3.05595	81.19424
Hours of TV watched (0 to 8 hours)	15.11265	13.76759	21.70916	9.827656 **
Hours of TV watched (over 9 hours)	-162.2322	128.4852	-199.2132	91.68471 *
Frequent internet user	-39.74788	56.04364	66.7053	40.04118
Number of TV channels	0.3247701	20.00674	-3.40578	14.26394
Constant	746.414	231.9262 ***	181.2234	165.4686
/lnsigma	6.795072	0.017492 ***	6.462282	0.0176959 ***
sigma	893.4337	15.62797	640.521	11.33459

\* = significant at the 10% level; \*\* = significant at the 5% level; and \*\*\* = significant at the 1% level.

Table 4 WTP for terrestrial television and satellite television

	Terrestrial television	Satellite television	Public broadcasting institution
Average	1202.54	581.1243	136.3769
Std.Dev	332.2188	159.1213	226.3445
Min	459.2621	65.88951	0
Median	1188.753	568.7211	0
Max	2233.799	1154.597	2007.5

	Terrestrial television	Satellite	Public broadcasting institution
Terrestrial television	1		
Satellite	0.8063	1	
Public	-0.4638	-0.4165	1

Table 5 WTP per channel

	WTP_GTV	WTP_ETV	WTP_RAD	WTP_BS1	WTP_BSP
N	1341	1341	1341	940	940
Mean	842.2845	256.8512	146.1389	320.4907	291.8444
Std. Dev.	398.6025	218.2152	189.2436	169.9138	161.7006
Mn	0	0	0	0	0
Median	816.6432	228.7654	99.74597	297.511	281.0618
Max	2137.652	1210.786	1689.927	1058.252	996.6791
WTP share	45.6%	13.9%	7.9%	17.4%	15.8%
Cost share	54.0%	14.1%	5.9%	15.0%	10.9%

Correlation	WTP_GTV	WTP_ETV	WTP_RAD	WTP_BS1	WTP_BSP
WTP_GTV	1				
WTP_ETV	-0.4446	1			
WTP_RAD	-0.2912	-0.0756	1		
WTP_BS1	0.3652	0.0163	0.0224	1	
WTP_BSP	0.2049	0.0557	0.0906	-0.5339	1

Table 6 WTP per genre

	WTP_G1	WTP_G2	WTP_G3	WTP_G4	WTP_G5	WTP_G6	WTP_G7	WTP_G8	WTP_G9	WTP_G10
N	1346	1346	1346	1346	1346	1346	1346	1346	1346	1346
Mean	593.0152	239.8551	129.7363	79.43666	119.7792	148.18	199.2873	120.9658	96.78049	118.4607
Std. Dev.	469.1499	283.7162	158.517	123.2966	161.608	185.5813	252.8118	184.2918	162.8357	160.083
Mn	0	0	0	0	0	0	0	0	0	0
Median	471.6891	164.3665	102.6253	0	89.8651	118.3899	143.8807	76.52129	0	81.49448
Max	2619.928	2332.069	1558.947	1519.162	1304.053	1701.796	2623.789	2170.383	2259.554	1432.644
WTP share	32.1%	13.0%	7.0%	4.3%	6.5%	8.0%	10.8%	6.6%	5.2%	6.4%
Cost share	36.2%	15.9%	11.8%	6.3%	5.7%	2.7%	7.8%	8.2%	2.2%	3.3%

Correlation	WTP_G1	WTP_G2	WTP_G3	WTP_G4	WTP_G5	WTP_G6	WTP_G7	WTP_G8	WTP_G9	WTP_G10
WTP_G1	1									
WTP_G2	0.0113	1								
WTP_G3	-0.0725	-0.1262	1							
WTP_G4	-0.2666	-0.1368	0.1462	1						
WTP_G5	-0.15	-0.156	0.1733	0.1366	1					
WTP_G6	-0.0985	-0.1139	0.0778	-0.0009	0.1157	1				
WTP_G7	-0.2005	-0.1192	-0.0771	-0.1132	-0.1043	-0.1025	1			
WTP_G8	-0.2044	-0.1322	-0.0417	-0.0217	-0.044	-0.018	-0.0249	1		
WTP_G9	-0.3343	-0.1076	-0.0677	0.0501	-0.0341	-0.0559	0.0165	0.0511	1	
WTP_G10	-0.1062	-0.0849	0.018	0.019	0.0278	0.0045	-0.0436	0.0481	-0.0169	1



Table 7 Simulated contracts per spectrum

	Present contract form	A-la-carte pricing	Bundling
Social welfare per person	634.42	634.42	482.27
Consumer welfare per person	104.60	104.60	51.34
Revenue per person	529.82	529.82	430.93
Number of airwave and satellite cotracts	26	26	343
Number of airwave only contracts	689	689	0
Number of satellite only contracts	0	0	0
Number of non-subscribers	1052	1052	1424
Total sample	1767	1767	1767

Table 8 Simulated contracts per channel

	Uniform Pricing		Fully Distributed Cost		Bundling
	Present	A-la-carte	Present	A-la-carte	
	contract form	pricing	contract form	pricing	
Social welfare per person	779.69	1156.76	636.65	1054.59	636.65
Consumer welfare per person	127.33	528.83	70.21	336.07	70.21
Revenue per person	652.36	627.93	566.44	718.51	566.44
Number of contracted channels per person	1.53	1.45	1.29	2.09	1.29
Counterfactual contract forms					
GEROP	25	1	224	2	224
_EROP	0	0	0	42	0
G_ROP	0	1	0	26	0
GE_OP	0	2	0	6	0
GER_P	0	4	0	1	0
GERO_	0	1	0	1	0
_ROP	0	1	0	35	0
_E_OP	0	0	0	18	0
_ER_P	0	0	0	68	0
_ERO_	0	0	0	18	0
G_OP	0	4	0	39	0
G_R_P	0	11	0	8	0
G_RO_	0	7	0	22	0
GE_P	0	12	0	6	0
GE_O_	0	30	0	6	0
GER_	402	9	0	0	0
__OP	0	0	0	21	0
__R_P	0	3	0	89	0
__RO_	0	0	0	29	0
_E_P	0	4	0	86	0
_E_O_	0	0	0	25	0
_ER_	0	0	0	13	0
G__P	0	64	0	41	0
G_O_	0	100	0	28	0
G_R_	0	26	0	0	0
GE__	0	85	0	0	0
G__	0	405	0	2	0
_E__	0	27	0	23	0
__R__	0	8	0	41	0
__O_	0	0	0	36	0
__P	0	0	0	76	0
N	443	65	646	62	646
Total	870	870	870	870	870

Table 9 Simulated contracts per genre

	Uniform A-la-carte pricing	FDC A-la-carte pricing	Bundling
Social welfare per person	1346.9	1315.6	587.0
Consumer welfare per person	775.4	679.9	63.9
Revenue per person	571.5	635.7	523.1
Number of contracted genres per person	2.57	3.52	2.36
Number of G1 contract	946	353	299
Number of G2 contract	451	301	299
Number of G3 contract	207	162	299
Number of G4 contract	102	282	299
Number of G5 contract	183	504	299
Number of G6 contract	260	780	299
Number of G7 contract	375	537	299
Number of G8 contract	187	299	299
Number of G9 contract	142	599	299
Number of G10 contract	202	656	299
Number of non-subscribers	116	5	970

Table 10 Simulated contracts per spectrum with discount

	Present contract form	A-la-carte	Bundling
Social welfare per person	634.4	1778.5	1778.6
Consumer welfare per person	104.6	1248.7	1248.8
Revenue per person	529.8	529.8	529.8
Number of airwave and satellite cotracts	26	1760	1762
Number of airwave only contracts	689	2	0
Number of satellite only contracts	0	0	0
Number of non-subscribers	1052	5	5
Total sample	1767	1767	1767
Discount		844.3 yen	1688.6 yen

Table 11 Simulated contracts for channels with discount

	Uniform a la carte pricing	FDC A-la-carte pricing	Bundling
Social welfare per person	1735.9	1859.0	1880.4
Consumer welfare per person	1083.50	1292.6	1314.0
Revenue per person	652.36	566.4	566.4
Number of contracted channels per person	3.29	4.19	5.00
Discount	108 yen	71.0%	74.3%

Table 12 Simulated contracts for genres with discount

	Uniform a la carte pricing	FDC A-la-carte pricing	Bundling
Social welfare per person	1785.2	1582.0	1848.8
Consumer welfare per person	1262.1	946.3	1213.1
Revenue per person	523.1	635.7	635.7
Number of contracted genres per person	5.40	4.63	10.00
Discount	125 yen	33.7%	71.4%