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Which telecom services should be sustained as national minimum services?

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1. Introduction and Research Questions

Universal service is an important policy issue in the telecommunications field. In Japan, universal service is defined as a basic telecommunication service that must meet three key requirements: (1) essentiality, (2) affordability, and (3) availability. The Ministry of Internal Affairs and Communications (MIC) in Japan designates the following services as the basic telecommunication service via the public switched telephone network: (a) subscriber telephone line access, including telephone call service to remote islands using analog fixed phones; (b) public pay phones, classified as a category which requires installation to ensure minimum outdoor communications; and (c) free emergency calls to the police, fire department, and Coast Guard. The local call service was a part of the basic service, but has been excluded from the list since 2006 (MIC, 2006).

More recently, new services such as mobile phones, and IP-based services such as Voice over IP (VoIP), have emerged in the telecommunications field. These emerging services may make the expansion of universal services inevitable, particularly when universal services are defined on the basis of their functionality. This concept is known as universal access. If the definitions of universal services are to be reconsidered, consumer preferences must be taken into account. Even when considering the services on a functional basis, since the provision of telecommunication services generally involves economies of scale, at least collective decision making by, for example, municipal governments, is needed for service choices sustained in a given area.

Sustaining (accessibility: possibility of using) telecommunication services, rather than using them, are considered to be non-market goods. A typical tool used to measure non-market goods is the stated preference (SP) approach, in which researchers obtain information from a survey on how consumers value goods and services, by asking respondents to state their preferences under hypothetical scenarios. In general, the methods used for this approach are the contingent valuation method (CVM) and conjoint analysis. These methods estimate the willingness to pay (WTP) for a good or service. The resulting estimates can be used to calculate the total social benefits. Mitomo

and Tajiri (2010) also applied CVM to evaluate Japan's broadband access demand from the aspect of universal access.

In this study, we consider these preferences and investigate consumer preferences for sustaining various telecommunication services including plain old telephone services (POTS), mobile phone services, and IP-based services. More specifically, we adopt the CVM approach to measure the WTP for sustaining IP telephony services, POTS, mobile phone services, as well as fiber-to-the-home (FTTH) and non-FTTH broadband internet access services, using an online survey conducted in December 2010. In the online survey, respondents were asked to state their WTP to prevent the abolition of these services in the case that their abolition was hypothetically proposed. However, these telecommunication services cannot be viewed in isolation. For example, mobile telephony is replacing the fixed-line telephone in many situations. It is therefore necessary to consider the substitutability between each telecommunication service to achieve universal access. This in turn implies that universal services are defined on the basis of their functionality. Thus, in this survey, every possible combination of the above five services is considered as a hypothetical service abolition. For example, WTPs to prevent the simultaneous abolition of various combinations such as the IP telephony service and POTS, or the IP telephony service, POTS, and mobile phone service, are measured. The key intention of this study is to take into account this substitutability between various telecommunication services in terms of universal access.

Our analysis reveals the following results: First, at least currently, consumers prefer sustaining verbal communication services to data transmission services. Second, in the case where one fixed phone service, such as IP telephony or POTS is available, not many consumers want to pay to prevent the abolition of another fixed phone service. Thus, POTS could be substituted for IP telephony service, especially when universal services are defined on the basis of their functionality. Finally, FTTH services are currently not necessarily required if non -FTTH services are available.

2. Stated Preference Experiment

In December 2010, we conducted an SP survey in collaboration with the Information Communications Research Institute of Japan to estimate the WTP for sustaining one or more telecommunication services. Our questionnaire explores consumer acceptance of an increase in tax to prevent abolition of telecommunication services in their own district of residence. We assumed an increase in tax to facilitate understandability among respondents. Under this assumption, respondents intuitively understand that these payments would be paid even if they did not use the services and that a usage fee would have to be paid based on their use of these services.

Figure 1 illustrates a sample questionnaire. Our questionnaire bundles each question according to five telecommunication services: IP telephony services (IP), POTS, Mobile phone services (MOB), Broadband access services except FTTH (non-FTTH) and FTTH broadband

access services (FTTH). Each table shows a combination of two levels—"Discontinued" and "Continued"—for each service. Two levels and five services produce 2^5 (32) cases as possible combinations. However, the case that all the services are continued is meaningless for our purpose and therefore we consider the remaining 31 cases. Among these, the five cases constructed from discontinuing one service and continuing the remaining four services, and the case that all the services were discontinued, were asked to all respondents. For the remaining 25 cases, a five-question set (case) was asked to each respondent that are divided into five blocks.

Question

Suppose the following five telecom services were discontinued due to a deficit balance in your own area, and that these services could be continued only if the residents accept an increase in tax to subsidize the service carriers.

- IP telephony services (IP)
- Plain old telephone services (POTS)
- Mobile phone services (MOB)
- Broadband access services except FTTH (non-FTTH); for example, xDSL CATV, and so on.
- FTTH broadband access services (FTTH)

In the case that the services shown as "Discontinued" in the following table would be discontinued without your acceptance of increase in tax, please state your preference regarding the maximum amount of increase in tax (per month).

Note:

- The services shown as "Continued" in the table would be continued even without your acceptance.
- This tax should be paid even if you did not use the services.
- Besides this tax, a usage fee should be paid based on your use.
- Currently IP telephony service is offered as an optional service under broadband access services. However, suppose that IP telephony services and broadband services were independent in this question.

Example of Table

Discontinued	IP telephony services
Discontinued	Plain old telephone services
Continued	Mobile phone services
Continued	Broadband access services except FTTH
Discontinued	FTTH broad-band access services

The respondents chose one of 20 alternatives, from 0 to over JPY50000 for each question.[1] These are a respondent's WTP for preventing abolition of each service combination showing as "discontinued." These are interpreted as resistance to discontinue each service combination.

[1] The 20 alternatives were as follows: 1. Accept the abolitions, 2. Up to JPY10, 3. Up to JPY50, 4. Up to JPY100, 5. Up to JPY250, 6. Up to JPY500, 7. Up to JPY750, 8. Up to JPY1000, 9. Up to JPY1500, 10. Up to JPY2000, 11. Up to JPY3000, 12. Up to JPY5000, 13. Up to JPY7500, 14. Up to JPY10000, 15. Up to JPY15000, 16. Up to JPY20000, 17. Up to JPY30000, 18. Up to JPY40000, 19. Up to JPY50000, 20. Over JPY50000 (Free Answer:)

The experiment was pre-tested several times by asking respondents if they understood the terminology (i.e., whether they felt they could meaningfully evaluate the hypothetical situations) and what their attitude was about the number and presentation of the experiments. A few revisions were made in the survey's terminology after the first pre-test. In the pre-tests, we also noticed that each respondent has his or her own upper limit; that is, there exists a budget constraint. For example, a respondent answered, "JPY 10000," to the question regarding preventing a case of three services' abolitions, and she also answered the same amount for a five services' case. We could interpret the additional two service abolitions as being unimportant for her, and that her budget constraint could be considerable. In other words, we could assume that she could not afford sustaining telecommunication services. This kind of response appeared even with different combinations of additional services' abolitions. Therefore, the case of all the services being discontinued was asked to each respondent to capture his or her upper limit on affordability of telecommunication services.

Participants were taken from a survey panel organized by an Internet survey company (goo research, Inc.). Respondents were asked a series of eleven questions. The sample size was 781. The sample distribution was proportionate to that of Japan's Internet users.

3. Model Specifications

The main purpose of this study is to capture consumer preferences regarding which telecommunication services should be sustained as national minimum services, taking into account the substitutability between each service. The number of every possible combination of substitutability patterns would have become unwieldy had we considered all possible combinations of services. Therefore, to narrow the patterns we divided services into verbal communication services (IP, POTS, and MOB) and data transmission services (non-FTTH and FTTH), and then classified the following possible "continued" and "discontinued" combinations:

For the verbal communication services category:

A) All the verbal communication services (IP, POTS, and MOB) are discontinued.
B) POTS and MOB are discontinued, but IP is retained.
C) IP and MOB are discontinued, but POTS is retained.
D) Only MOB is discontinued, but IP and POTS are retained.
E) Only IP is discontinued, but POTS and MOB are retained.
F) IP and POTS are discontinued, but MOB is retained.
G) Only POTS is discontinued, but IP and MOB are retained.

For the data transmission services category:

H) All broadband data transmission services (non-FTTH and FTTH) are discontinued.

I) Non-FTTH services are discontinued, but FTTH services are retained.

J) FTTH services are discontinued, but non-FTTH services are retained.

We coded a dummy variable which takes the value of 1 if each question (tables shown to respondents) fits to each case from A) to J). In this sense, a baseline case, where all the dummy variables take the value 0, is that in which all the services continue to remain. These dummy variables are used as independent variables in the following equation:

$$WTP_{nm} = \beta_{A,n}A_m + \beta_{B,n}B_m + \beta_{C,n}C_m + \beta_{D,n}D_m + \beta_{E,n}E_m + \beta_{F,n}F_m + \beta_{G,n}G_m + \beta_{H,n}H_m + \beta_{I,n}I_m + \beta_{J,n}J_m + \varepsilon_{ij}$$

The random disturbance term ε_{ijt} is assumed to be distributed as iid normal. The dependent variable (WTP_{nm}) in this equation corresponds to individual n's response to question m. However, the dependent variable has a lower limit and an upper limit, since these WTPs are non-negative, and each respondent has his or her upper limit of affordability. As mentioned in the earlier section, this budget constraint is assumed to be the WTP for preventing abolition of all services. The question on this case was asked to all respondents, and the response to this question is used as the upper limit for each respondent. We apply two-sided Tobit estimation to this equation.

In addition, we also employ Random Parameter Tobit (RPT) estimation considering each respondent's preference variation. The RP model captures preference variation by introducing stochastic terms into the coefficients created through deviations from the mean preferences and by allowing these terms to be correlated with each other. Each unknown coefficient $\beta_{j,n}$ $j \in AtoJ$, is assumed to be distributed by being truncated normally across the population. Each coefficient reflects WTP for preventing abolition of each case of service combinations; therefore, it cannot take a value less than 0.

Moreover, we estimate the equation with another independent variable—the WTP ratio of "the response to each question" and "the response to the question of preventing abolition of all services." This "WTP ratio" variable ranges from 0 to 1. Each estimated coefficient implies the importance of discontinued services based on all services. Employing the WTP ratio variable instead of the WTP itself contributes to the leveling of each consumer's absolute level of WTP.

4. Estimation Results

As stated in Section 3, we assumed the parameters for all coefficients follow a truncated normal distribution. Subsequently, for the RPT model estimation, we proceeded with the Maximum

Simulated Likelihood (MSL) method for estimation by setting 500 Halton draws.[2] Because a respondent repeatedly completes eleven questions, we regarded the data as a type of panel data.[3] We thus applied a standard random-effect method in which random draws were repeatedly reused for the same respondent.

Before estimating the RPT model, we estimated the standard Tobit models. Tables 1 and 2 present the estimation results of Tobit models; significant estimates can be observed with appropriate signs. Each coefficient except the coefficient of variable E), "IP: discontinued and POTS and MOB: continued," takes significantly positive values. This indicates that consumer resistance is very small to the abolition of IP telephony only.

Table 1: Tobit Estimation Result: WTP level

Variable			Mean (b) of β [a] (JPY/month)	
	Discontinued	**Continued**		
A)	**IP,POTS,MOB**	-	1879.3	(0.000)
B)	**POTS,MOB**	**IP**	985.1	(0.000)
C)	**IP,MOB**	**POTS**	785.1	(0.000)
D)	**MOB**	**IP,POTS**	691.5	(0.000)
E)	**IP**	**POTS,MOB**	-82.6	(0.073)
F)	**IP,POTS**	**MOB**	657.5	(0.000)
G)	**POTS**	**IP,MOB**	232.0	(0.000)
H)	**FTTH,nFTTH**	-	1100.3	(0.000)
I)	**nFTTH**	**FTTH**	183.5	(0.000)
J)	**FTTH**	**nFTTH**	457.9	(0.000)
Std. Div. of Sigma			1237.7	(0.000)

[a] p-value in parentheses.

Table 2: Tobit Estimation Result: WTP Ratio

Variable			Mean (b) of β [a]	
	Discontinued	**Continued**		
A)	**IP,POTS,MOB**	-	1.6213	(0.000)
B)	**POTS,MOB**	**IP**	0.9239	(0.000)
C)	**IP,MOB**	**POTS**	0.7671	(0.000)
D)	**MOB**	**IP,POTS**	0.7073	(0.000)
E)	**IP**	**POTS,MOB**	0.0444	(0.261)
F)	**IP,POTS**	**MOB**	0.6635	(0.000)
G)	**POTS**	**IP,MOB**	0.3393	(0.000)
H)	**FTTH,nFTTH**	-	0.9743	(0.000)
I)	**nFTTH**	**FTTH**	0.2524	(0.000)
J)	**FTTH**	**nFTTH**	0.4793	(0.000)
Std. Div. of Sigma			1.0856	(0.000)

[a] p-value in parentheses.

[2] Bhat (2001) shows that 100 Halton sequence draws are more efficient than 1,000 random draws for simulating an MSL model. In fact, with 125 Halton draws, he found the simulation error to be half as large as with 1,000 random draws and smaller than with 2,000 random draws (see also Train 2000). For further information on Halton draws, see Halton (1960) and Train (2000).

[3] See Allenby and Rossi (1999) for details.

The RPT model estimation results are shown in Tables 3 and 4. Although the orders of estimated coefficients' values are similar to those of the standard Tobit estimations, the RPT model estimations indicate a large variation in consumer tastes based on some of the estimated standard deviations of each coefficient's density. Therefore, we hereinafter focus on results from the RPT model estimation.

Table 3: Random Parameters Tobit Estimation Result: WTP level

Variable			Mean (b) of β [a] (JPY/month)		Standard Deviation of β [a] (JPY/month)	
	Discontinued	Continued				
A)	IP,POTS,MOB	-	539.9	(0.000)	541.9	(0.000)
B)	POTS,MOB	IP	451.8	(0.000)	169.4	(0.012)
C)	IP,MOB	POTS	409.4	(0.000)	24.8	(0.708)
D)	MOB	IP,POTS	334.7	(0.000)	430.5	(0.000)
E)	IP	POTS,MOB	-51.6	(0.044)	1034.9	(0.000)
F)	IP,POTS	MOB	322.3	(0.000)	79.1	(0.195)
G)	POTS	IP,MOB	123.5	(0.000)	537.9	(0.000)
H)	FTTH,nFTTH	-	453.8	(0.000)	1717.7	(0.000)
I)	nFTTH	FTTH	150.4	(0.000)	1492.5	(0.000)
J)	FTTH	nFTTH	283.0	(0.000)	1646.2	(0.000)
Std. Div. of Sigma			588.4	(0.000)		

[a] p-value in parentheses.

Table 4: Random Parameters Tobit Estimation Result: WTP Ratio

Variable			Mean (b) of β [a]		Standard Deviation of β [a]	
	Discontinued	Continued				
A)	IP,POTS,MOB	-	0.610	(0.000)	0.010	(0.837)
B)	POTS,MOB	IP	0.522	(0.000)	0.065	(0.115)
C)	IP,MOB	POTS	0.468	(0.000)	0.023	(0.530)
D)	MOB	IP,POTS	0.453	(0.000)	0.598	(0.000)
E)	IP	POTS,MOB	0.070	(0.000)	1.191	(0.000)
F)	IP,POTS	MOB	0.398	(0.000)	0.429	(0.000)
G)	POTS	IP,MOB	0.279	(0.000)	0.967	(0.000)
H)	FTTH,nFTTH	-	0.401	(0.000)	0.031	(0.219)
I)	nFTTH	FTTH	0.187	(0.000)	0.899	(0.000)
J)	FTTH	nFTTH	0.310	(0.000)	0.675	(0.000)
Std. Div. of Sigma			0.354	(0.000)		

[a] p-value in parentheses.

Comparing the WTP levels among parameters, consumers have the greatest resistance to case A), where all the verbal communication services were discontinued. Even in the case that only IP is retained and both POTS and MOB are discontinued (case B), consumer resistance is almost the same as to the no broadband services case (case H). In this sense, at least currently, consumers prefer sustaining verbal communication services to data transmission services.

As for verbal communication services, only POTS is defined as a universal service in Japan. In case G, where only POTS is discontinued, consumers would prefer to pay JPY 123.5 (approximately USD 1.5) per month to prevent this abolition. In the current universal service fund system in Japan, about JPY 10 per month for each subscription of verbal communication services is collected for sustaining POTS. Our estimation results show that on an average, consumers are ready to pay approximately 10 times that amount for it. Comparing cases E and G, we can presume that consumers prefer POTS to IP telephony. However, the WTP for case G is also relatively small. In other words, in the case where one fixed phone service such as IP telephony or POTS is available, not many consumers want to pay to prevent the abolition of another fixed phone service. This implies that POTS could be substituted for an IP telephony service, especially when universal services are defined on the basis of their functionality. Besides, the WTP for case D (JPY 335), where mobile phone services are discontinued and fixed phone services are retained is not so different from that for case F (JPY 322), where both fixed phone services are discontinued and mobile phone services are retained. It shows that the existence of mobile phone services does not lead to consumer acceptance to the abolition of fixed phone services. This result implies that currently, consumers regard mobile phone services and fixed phone services as different services. We need to take this fact into account when universal services are defined on the basis of their functionality.

For data transmission services to be considered as universal service, MIC mapped out “The road of FTTH: Hikari no Michi” as the vision of the prevailing FTTH service. Although the broadband access services abolition case (case H) shows high resistance, our estimation results indicate that FTTH services are currently not necessarily required if non-FTTH services are available.

5. Concluding Remarks

In this study, we adopted the CVM approach to measure the WTP for five types of telecommunication services, considering substitutability between these services in terms of universal access. Our analysis revealed the following results: First, at least currently, consumers prefer sustaining verbal communication services to data transmission services. Second, in the case where one fixed phone service such as IP telephony or POTS is available, not many consumers want to pay to prevent the abolition of another fixed phone service. This indicates that POTS could be substituted for IP telephony service, especially when universal services are defined on the basis of their functionality. Finally, FTTH services are currently not necessarily required if non-FTTH services are available.

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