

# Price Discrimination and Universal Service

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## Abstract

This paper theoretically analyzes price discrimination and universal service support. The social desirability of universal service support for the low-income consumers is demonstrated. A new type of price discrimination, named the universal-service and self-selection price discrimination, is shown to be socially desirable in comparison with other pricings, especially in the case where weights are assumed to be socially fair. This new pricing is similar to the Pareto-improving tariff or status-quo-fair tariff.

## I Introduction

Universal service has often been characterized by "prosaic motives and great goals" (Sawhney 1995). While universal service has broad applications, telecommunication has been the most primary application of universal service. It was via the Telecommunication Act of 1996 that the contemporary concept of universal service was defined extensively. The goals of universal service leading to advanced telecommunications services for all must be met by means that enhance rather than distort competition. In other words, affordable quality telecommunications services need to be available to all consumers, including low-income consumers, in all regions of the nation. Universal service support can be classified into three main types: 1) programs for low-income consumers (ex. Lifeline and Link Up), 2) programs for rural, insular, and high-cost areas (ex. the Federal Universal Service Fund), and 3) programs for schools, libraries, and health care providers. It is often said that universal service support has been driven by business reality and economic theory. However, universal service support has not been examined sufficiently from the viewpoint of economic theory, and therefore it is valuable for economists to study theoretically the plausibility of universal service support. This is the purpose of this paper.

To begin with, this paper discusses the social desirability of universal service support through a developed economic model based on modern industrial organization theory. The important element of the model is the price discrimination problem, which has been studied by H. R. Varian, R. Wilson, and others. The model in this paper questions what kind of pricing policy for low-income consumers is socially desirable. The pricing policy composed of self-selection price discrimination and universal service support for the low-income consumers would be socially better than any other price discrimination or uniform pricing. That pricing policy is closely related to the "status quo fairness" and the "Pareto-improving tariff." These theoretical propositions support the universal service support policy, especially for low-income consumers,

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proposed in the 1996 Act from an economic point of view, and this paper is one of the first research works which tries to develop a theoretical foundation of universal service support. Next, the actual application of the theoretical conclusions is discussed. It will be useful to explain the Japanese universal service support policy, which is different from that of the United States. In addition, the discounting strategy for local calls by Nippon Telegraph and Telecom (NTT), which was very controversial in the Japanese telecommunication industry during January, 1998, is evaluated with respect to the theoretical conclusions obtained in this paper. It is important for economists and policy makers to cooperate in developing a refined universal service support which is a new economic approach toward the tradeoff between efficiency and fairness.

The organization of this paper is as follows: Section 1 has provided an introduction. Section 2 offers a brief overview of universal service support and price discrimination, including definitions, historical background, and a policy making discussion of universal service and price discrimination. Section 3 analyzes universal service support for the low-income consumers and demonstrates the self-selection price discrimination with universal service support for the low-income consumers seems to offer the greatest social welfare. Section 4 provides a political discussion about the new discount service of NTT in Japan. Finally, Section 5 presents a discussion of the conclusions of this paper noted above.

## **II A Brief Overview of Universal Service and Price Discrimination**

It will be useful to pause here to take a brief look at basic concepts of universal service and price discrimination before turning to the main analysis. These will be theoretically examined in the following section.

### **II. 1 What is Universal Service?**

In this subsection, the definition, historical background, and political discussion of universal service will be explained. The term universal service in telecommunications, which means that "quality services should be available at just, reasonable, and affordable rates" (sec. 254(b) of the Telecommunications Act of 1996), is quite well-known today. Most economists would accept that universal service is important because defining universal service is, in effect, making choices about the nature of the society itself. Sawhney (1995) discussed why universal service in telecommunications should be supported in our society from three points of view, namely the individual, the social system, and humanity. First, universal access to telecommunications, like education, basic medical care, and postal service, is a basic human right which every person has by virtue of being a citizen. Second, the provision of universal service in telecommunications makes it possible for a social system as a whole to function more efficiently because telecommunications have network externalities, which means that the more valuable the network becomes the more subscribers access it. Third, large-scale networks are a visible feature of a modern society, and an industrialized society would not be able to function without them.

Although there is the strong agreement that universal service support in telecommunications is a key feature in a society, there have been historical myths concerning it. A close study of the historical development of the concept was made by Muller (1993, 1995, 1997). His main

points can be summarized as follows. First, universal service was not originally a commitment to put a telephone in every home or an exchange in every community but an integrated monopoly that could interconnect all telephone users. Second, universal service was redefined and linked to regulated natural monopolies when cross subsidy practices were threatened by competition in the 1970s. Further, it might be surprising that universal service as a political goal was not part of the 1934 Communications Act. There was no word of universal service and no discussion about using regulation, rate averaging, subsidies, jurisdictional separations, and settlement procedures to maintain universal service.

It is via the Telecommunication Act of 1996 that the contemporary concept of universal service was well defined historically. R.Hundt, the ex-chairman of the Federal Communications Commission (FCC), explained universal service as follows, "The Telecommunications Act of 1996 is the first major overhaul of telecommunications law in almost 62 years. It turns the old law on its head. The old law assumed that communications was a natural monopoly. The new law assumes that all parts of the communications marketplace can be made competitive. The new law is intended to end the era of big government in communications and begin the era of genuine competition... There are three goals of the Telecommunications Act; to let anyone enter any communications business, to let any communications business compete in any market against any other, and to remove the legal and economic obstacles that have frustrated competition for too long," (1996). In March, 1996, the Federal Communications Commission convened the Federal-State Joint Board on universal service. After considering a 70,000 page record and holding seven public hearings at which more than fifty experts testified, in November, 1996, the Joint Board issued its "Recommendation" regarding implementation of the new federal universal service support mechanisms. In May, 1997, the FCC adopted a plan for universal service reform that is both comprehensive and complete. The "Order" is guided by the Joint Board's Recommendation and commits to work in close partnership with the states to create complementary universal service support mechanisms (FCC, 1996, 1997).

According to the Recommendation by the Joint Board and the Order by the FCC, the main points of the universal service support mechanism of the 1996 Act can be summarized as follows: 1) the goals of universal service in advanced telecommunications services are to be met by means that enhance rather than distort competition, 2) affordable quality telecommunications should be available to all consumers, including low-income consumers, in all regions of the nation,<sup>1)</sup> 3) all eligible schools, libraries, and rural health care providers should receive telecommunications services at a discount, and 4) the new universal service support mechanisms must be specific, predictable, and sufficient enough to advance the universal service principles enumerated in the 1996 Act.<sup>2)</sup>

Next, let's examine the three types of universal service support: 1) programs for low-income consumers, 2) programs for rural, insular, and high-cost areas, and 3) programs for

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1) Universal service support should be provided for these services: 1) voice grade access to the publicly switched networks, with the ability to place and receive calls, 2) Dual Tone Multi-frequency (DTMF) signaling or its functional equivalent, also known as touch-tone service, 3) single-party service, 4) access to emergency services, including 911 and Enhanced 911 (which identifies a caller's location), 5) access to operator services, 6) access to interexchange services, 7) access to directory assistance, and 8) Lifeline and Link Up for qualifying low-income consumers.

schools, libraries, and health care providers.<sup>3)</sup> Over ten years ago, the FCC established two programs that are currently available to assist low-income consumers. First, the Lifeline program reduces qualified low-income consumers' monthly phone charges through matching federal and state funds. A state may choose not to participate in the Lifeline program. Currently, forty-one states, the District of Columbia, and the U.S. Virgin Islands participate in the Lifeline program. Second, the Link Up program provides federal support that reduces qualified low-income consumers' initial local telephone connection charges by up to one half. Link Up is currently funded by contributions from interexchange carriers. The FCC and the Joint Board recommended revising Lifeline and Link Up in the following manner. First, Lifeline should be expanded to be available in every state, territory, and commonwealth; the federal government Lifeline support amount should be increased, and the state government matching requirement should be modified.<sup>4)</sup> Second, the distribution to low-income consumers should be made competitively and neutrally by requiring all providers of interstate telecommunications services to contribute and by allowing all eligible telecommunications carriers to receive support for offering Lifeline and Link Up.

The support for carriers with high costs should be based on the difference between cost estimates generated by a cost proxy model and a nationwide benchmark. Beginning on January 1, 1999, the responsibility for high-cost support will continue to be split along current jurisdictional lines, with 25 percent of the difference between the forward-looking methodology's cost of service and the national benchmark being funded by the Federal Universal Service Fund. Furthermore, the Long Term Support payments, which currently serve to equalize the Carrier Common Line charges among incumbent local exchange carriers by lowering some and raising others, constitute an impermissible implicit support mechanism. Rural local exchange carriers currently receiving the Long Term Support instead receive a comparable payment from the new

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- 2) The principles enunciated in the 1996 Act are as follows: 1) quality services at just, reasonable, and affordable rates--quality services should be available at just, reasonable, and affordable rates; 2) access to advanced services--access to advanced telecommunications and information services should be provided in all regions of the nation; 3) access in rural and high-cost areas--consumers in all regions of the nation, including low-income consumers and those in rural, insular, and high-cost areas, should have access to telecommunications and information services, including interexchange services and advanced telecommunications and information services; 4) equitable and nondiscriminatory contributions from all providers of telecommunications services--all providers of telecommunications services should make an equitable and nondiscriminatory contribution to the preservation and advancement of universal service; 5) specific and predictable support mechanisms--there should be specific, predictable and sufficient federal and state mechanisms to reserve and advance universal service; 6) access to advanced telecommunications services for schools, health care providers, and libraries--elementary and secondary schools and classrooms, health care providers, and libraries, should have access to advanced telecommunications services; and 7) competitive neutrality--universal service support mechanisms and rules should be applied in a competitively neutral manner.
  - 3) Eligible schools and libraries will be able to purchase at a discount any telecommunications services, internal connections among classrooms, and access to the Internet. Discounts are a minimum of 20% and range from 40-90% for all but the least disadvantaged schools and libraries. Total expenditures for universal service support for schools and libraries are capped at \$2.25 billion per year. Furthermore, approximately 9,600 health care providers in rural areas in the United States will be eligible to receive telecommunications services supported by the universal service mechanism within an annual cap of \$400 million.
  - 4) Each Lifeline consumer would receive \$5.25 in federal support. The federal fund would also provide \$1.00 of additional support for every \$2.00 of support provided by the states, up to a maximum of \$1.75, so that the maximum federal support per consumer would be \$7.00.

universal service support mechanism. To administer the collection and distribution of the support mechanisms, the FCC appoints a universal service advisory board to select a neutral, third-party administrator.<sup>5)</sup> All telecommunications carriers that provide interstate telecommunications services will be obligated to contribute to universal service. Contributions will be based on carriers' gross revenues from telecommunications services.

Finally, what will universal service support bring to our society? For one possible answer, Hundt stated, "The overwhelming majority will buy more communications services with their money or will pay less for the same services they buy today. The replacement of the regime of monopoly with the new paradigm of competition will lead to productivity gains, job growth, investment increases, and the continuing vitality of the American economy," (FCC, 1997). Furthermore, S.Ness, Commissioner of the FCC, stated, "Much of what we are doing is driven by law and by economics. But the results of our decisions have a human face... Not everyone will be satisfied. But no one can say that we have not read the law, considered economic theories and business realities, consulted our consciences, and sought to achieve as much fairness as is humanly possible," (FCC, 1997). In my opinion, however, there have not been so many analyses of universal service support from the viewpoint of economic theory, and therefore it will be valuable for economists to examine more closely the plausibility of universal service support. This is the very theme of this paper.

## II. 2 What is Price Discrimination?

In this subsection, a definition and industrial policy in regards to price discrimination will be proposed. According to Stigler (1987), price discrimination is present "when two or more similar goods are sold at prices that are different ratios to marginal costs." Generally, it is common to follow Pigou's classification of price discrimination. Pigou (1920) classified price discrimination into three types: 1) first-degree or perfect price discrimination--a seller charges a different price for each unit of the goods in such a way that the price charged for each unit is equal to the maximum willingness to pay for that unit; 2) second-degree or self-selection price discrimination--prices differ depending on the number of units of the goods bought, but not across consumers, namely each consumer faces the same price menu, but the menu involves different prices for different amounts of the goods purchased; and 3) third-degree price discrimination--different purchasers are charged different prices, but each purchaser pays a constant amount for each unit of the goods bought, i.e., the last are student discounts and different prices on different days of the week. (See Varian 1989, 600 for detail.)

It should also be noted that there are in general five preconditions for price discrimination implementation: 1) the monopolistic power of a firm; 2) the limitation or absence of resale markets; 3) the firm's ability to monitor customers' purchases; 4) the disaggregated demand data; and 5) the legal feasibility. The last point should be explained in more detail because the legal aspect of price discrimination will closely be related to the policy-making discussion. The Clayton Act of 1914 was the first attempt to regulate price discrimination. The law reflected the reality in those days that a supplier provided goods to a retailer in one region at a price below cost

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5) The FCC has adopted the Joint Board's Recommendation to appoint NECA as the temporary administrator of the support mechanisms.

in order to drive out the competition. Accordingly, the law was intended to protect small businesses from such dumping, not to protect the end consumers. Then, in the early 1930s, the spread of chain stores resulted in strengthening the law against price discrimination. The Robinson-Patman Act of 1936 was enacted to control the large and powerful buyers who could use their size to negotiate more favorable terms than their competitors. However, it has occasionally been noted that because of the ambiguity of the definition of price discrimination in these laws very few cases were successfully brought to trial. (See Varian 1989, 643-646 and Wilson 1993, 10 for detail.)

Price discrimination has recently been utilized by the telephone companies to gain more profits and more information on the customers in telecommunication industries. For example, telephone companies offer a menu of tariffs for measured toll service. Each tariff provides the least-cost service for a particular range of traffic volumes. Rates are also differentiated by distance and time of use. In 1983, AT&T obtained FCC permission to test a new pricing strategy for its residential customers, which was called Optional Calling Plan (OCP) in telecommunications. For an additional monthly charge, the OCP provided reduced per-minute prices for many interstate long-distance calls during off peak periods. These new tariffs were approved by the FCC and went into effect in 1984 under the name Reach-Out America. The Reach-Out America plans have quickly proven to be popular.<sup>6)</sup> AT&T has subsequently introduced additional OCPs, and other interexchange carriers now also offer optional discounted rates for an additional monthly fee. (See Mitchell and Vogelsang 1991 for detail.)

The implementation of price discrimination in telecommunications is often constrained by the distributional considerations for customers. Changing from a uniform tariff to a price discrimination, such as a multi-part tariff or a fully nonlinear tariff, can benefit some customers but affect others adversely. For instance, introducing a two-part tariff with a fixed fee plus a lower marginal price benefits customers with large demands but precludes others from making any purchases at all. Utilities and regulatory agencies, therefore, want to consider modifications that do not disadvantage any customers. For example, the FCC issued its Optional Calling Plan Guidelines Order setting forth general standards in 1985, to protect consumers. This problem of fairness under price discrimination will be taken up again in the subsequent section, which discusses a Pareto-improving tariff. (See Wilson 1993, 108 for detail.)

To sum up, the core of the questions is how to alleviate the tradeoff between efficiency and fairness in telecommunications when universal service support and price discrimination, the major topics in this paper, are economically and politically examined. A model, which is based on modern economic theory, will be developed to analyze theoretically the problems discussed above, and then the political implications of what kinds of universal support and price discrimination would be the most socially desirable will be discussed.

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6) In the first year (1984-85), the Reach-Out America plans "increased the mean minutes of night/weekend calling by 41.9%. The overall price elasticity of the group of optional calling plan subscribers is of the order -2 or higher, considerably larger than AT&T estimates for all residential subscribers," (Mitchell and Vogelsang 1991, 148).

### III Analysis of Universal Service Support for Low-income Consumers

This section will consider universal service support for low-income consumers: for examples, Lifeline and Link Up in the United States. The central problem here is to investigate theoretically what kind of pricing policy is the most socially desirable of the three price discriminations and the uniform tariff discussed in the preceding section. The following conclusions will be obtained in this section. First, the advantages and disadvantages of a monopolistic firm, of the high-income consumers, and of the low-income consumers contradict each other, and therefore it depends upon fairness weights to determine what pricing is the socially best. Second, a self-selection price discrimination with a universal service condition, which is easily implemented with a two-part tariff, is the socially best.

#### III. 1 Definitions, Assumptions, and Models

In this subsection, the basic idea for analyzing price discrimination problems and universal service support will be developed. To begin with, definitions and assumptions will be proposed. Then, the models which investigate the social welfare function under the three price discriminations and the uniform tariff will be advanced. In addition, the equilibrium surpluses will be calculated.

It is here assumed that there are two consumer groups and one monopolistic firm. One consumer group, which is composed of high-income consumers, is called the "high-type (H) market," which is assumed to be uniformly distributed on the interval of  $(-\infty, h]$ . Similarly, the other consumer group, which is composed of low-income consumers, is called the "low-type (L) market," which is assumed to be uniformly distributed on the interval of  $(-\infty, l]$ . Assume at this point  $h > l > 0$ . The H-market is, therefore, interpreted to be the consumer group which places a relatively higher value on the goods the firm supplies than the L-market. See figure 1: the distributional functions of both markets are depicted, where the distributional densities of both the H-market and the L-market are  $a$  and where the consumers of the H-market are uniformly distributed from  $-\infty$  to  $h$  while those of the L-market, from  $-\infty$  to  $l$ . The demand functions follow from the distributional form of the H-market and the L-market. Since both markets are uniformly distributed, both demand functions are represented as linear. See figure 2: the demand

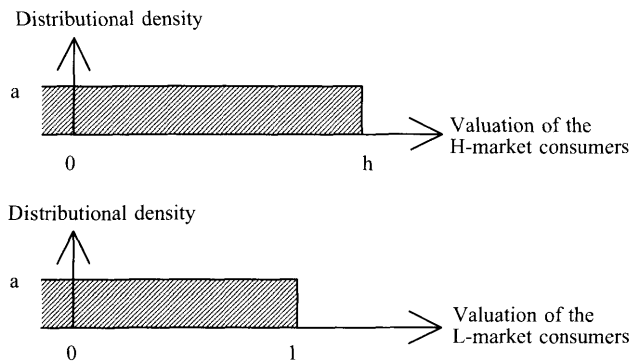


Figure 1. Distributional Functions of the H-market and the L-market

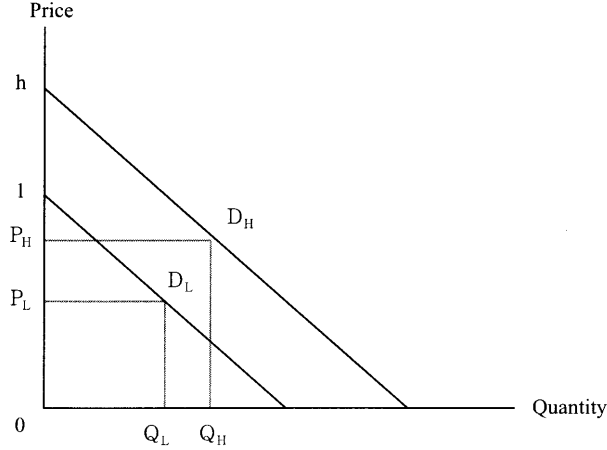


Figure 2. Demand Functions of the H-market and the L-market

function of the H-market ( $D_H$ ) is formulated as  $P_H = h - aQ_H$ , and the demand function of the L-market ( $D_L$ ) is formulated as  $P_L = l - aQ_L$ . The various areas illustrated in figure 2, such as  $\triangle hD_H P_H$ ,  $\triangle lD_L P_L$ ,  $\square P_H D_H Q_H O$ , and  $\square P_L D_L Q_L O$ , are necessary for calculating the equilibrium surpluses investigated later. They are given as follows:  $\triangle hD_H P_H = aQ_H^2/2$ ,  $\triangle lD_L P_L = aQ_L^2/2$ ,  $\square P_H D_H Q_H O = (h - aQ_H)Q_H$ , and  $\square P_L D_L Q_L O = (l - aQ_L)Q_L$ . In addition, for simplicity of analysis, a marginal cost of production is assumed to be normalized without any loss of generalization, namely  $MC = 0$ .

These definitions and assumptions lead us into developing the models which investigate each equilibrium surplus under the first-degree, the second-degree, and the third-degree price discrimination and the uniform tariff. (See Sec. 2 for the categories of the price discriminations.) The maximization problems, the first-order conditions, and the equilibrium surpluses are established below via the models.

The first-degree price discrimination (1st-PD), which is also called the perfect price discrimination since a firm can perfectly exploit all consumer surplus, is modeled as follows. The maximization problem and the constraints for the firm under the 1st-PD are formulated:

$$\begin{aligned} \text{Max}_{\{Q_H, Q_L\}} PS^{(1)} &= R_H^{(1)} + R_L^{(1)} + \square P_H D_H Q_H O + \square P_L D_L Q_L O; \\ \text{s.t. } \triangle hD_H P_H &\geq R_H^{(1)}, \text{ and } \triangle lD_L P_L \geq R_L^{(1)}. \end{aligned} \quad (1)$$

Here the terms  $Q_H$  and  $Q_L$  represent the quantities purchased in the H-market and the L-market respectively; the term  $PS$  represents the producer's surplus; the terms  $R_H$  and  $R_L$  represent the payments of the H-market (consumers) and the L-market (consumers) respectively; and the superscript (1) represents the 1st-PD. At this point, the firm tries to maximize its profit given that the H-market and the L-type market must gain at least zero surplus. The first-order conditions under the 1st-PD are expressed as

$$Q_H^{(1)} = h/a, \text{ and } Q_L^{(1)} = l/a. \quad (2)$$



Let us set that the consumer surpluses in the H-market and the L-market are  $CS_H$  and  $CS_L$  respectively. The equilibrium surpluses, such as the consumer surpluses of the H-market and the L-market, and the firm's profit under the 1st-PD, are expressed as

$$CS_H^{(1)} = CS_L^{(1)} = 0, \text{ and } PS^{(1)} = \frac{h^2 + l^2}{2a}. \quad (3)$$

Let us model the second-degree price discrimination (2nd-PD), which is also called the self-selection price discrimination since a firm proposes a menu of tariffs for measured service and then the consumers choose their preferred tariffs from the menu. It should be noted that the firm is confronted with four constraints in maximizing its profit under the 2nd-PD; two incentive compatibility conditions and two individual rationality conditions. First, the incentive compatibility conditions mean that a consumer group can correctly self-select, not the tariff designed for the other group, but the tariff designed for its own group. Let us set that the bundle  $(Q_H, R_H)$  is designed for the H-market and the bundle  $(Q_L, R_L)$  is designed for the L-market by the firm respectively. The incentive compatibility conditions for the H-market (IC-H) and the L-market (IC-L) are expressed as

$$\begin{aligned} \text{IC-H: } & \int_0^{Q_H} P_H dQ - R_H \geq \int_0^{Q_L} P_H dQ - R_L, \text{ and} \\ \text{IC-L: } & \int_0^{Q_L} P_L dQ - R_L \geq \int_0^{Q_H} P_L dQ - R_H. \end{aligned} \quad (4)$$

Here the H-market has to obtain a higher surplus when it self-selects  $(Q_H, R_H)$  from the menu than when it self-selects  $(Q_L, R_L)$ , and the converse holds for the L-market. Next, the individual rationality conditions mean that both consumer groups should gain at least zero surplus. The individual rationality conditions for the H-market (IR-H) and the L-market (IR-L) are expressed as

$$\text{IR-H: } \int_0^{Q_H} P_H dQ - R_H \geq 0, \text{ and IR-L: } \int_0^{Q_L} P_L dQ - R_L \geq 0. \quad (5)$$

It should also be noted that only the two conditions, namely the IC-H and the IR-L, among the four conditions above are binding if a "single crossing property" is satisfied,<sup>7)</sup> as in this model. Accordingly, the conditions with which the firm is confronted come down to the following two equations:

$$\begin{aligned} \text{IC-H (binding): } & R_H^{(2)} = h(Q_H - Q_L) - \frac{a(Q_H^2 - Q_L^2)}{2} + R_L^{(2)}, \text{ and} \\ \text{IR-L (binding): } & R_L^{(2)} = lQ_L - \frac{aQ_L^2}{2} \end{aligned} \quad (6)$$

Here the superscript (2) represents the 2nd-PD. The maximization problem and the constraints

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7) Concerning the single crossing property, see Laffont and Tirole (1993) and Wilson (1993).

under the 2nd-PD are formulated as follows:

$$\text{Max}_{\{Q_H, Q_L\}} PS^{(2)} = R_H^{(2)} + R_L^{(2)}; \text{ s.t. IC-H (binding), and IR-L (binding).} \quad (7)$$

The first-order conditions under the 2nd-PD are expressed as

$$Q_H^{(2)} = h/a, \text{ and } Q_L^{(2)} = \frac{2l-h}{a}. \quad (8)$$

For the quantity purchased in the L-market  $Q_L^{(2)}$  not to be negative, the parameter condition  $2l > h$  is assumed here. The equilibrium surpluses, such as the consumer surpluses of the H-market and the L-market, and the firm's profit under the 2nd-PD, are expressed as

$$CS_H^{(2)} = \frac{(h-1)(2l-h)}{a}, \quad CS_L^{(2)} = 0, \text{ and } PS^{(2)} = \frac{h^2 + (2l-h)^2}{2a}. \quad (9)$$

The third-degree price discrimination (3rd-PD), which charges different tariffs between the H-market and the L-market, is also modeled. Here the superscript (3) represents the 3rd-PD. The maximization problem under the 3rd-PD is formulated as follows:

$$\text{Max}_{\{Q_H, Q_L\}} PS^{(3)} = \square P_H D_H Q_H O + \square P_L D_L Q_L O. \quad (10)$$

The first-order conditions under the 3rd-PD are expressed as

$$Q_H^{(3)} = h/2a, \text{ and } Q_L^{(3)} = l/2a. \quad (11)$$

The equilibrium surpluses, such as the consumer surpluses of the H-market and the L-market, and the firm's profit under the 3rd-PD, are expressed as

$$CS_H^{(3)} = \frac{h^2}{8a}, \quad CS_L^{(3)} = \frac{l^2}{8a}, \text{ and } PS^{(3)} = \frac{h^2 + l^2}{4a}. \quad (12)$$

Finally, the uniform tariff (UT), which charges the same tariff between the H-market and the L-market, namely  $P_H = P_L$ , is modeled. Here the superscript (U) represents the UT. The maximization problem and the constraints under the UT are given as follows:

$$\text{Max}_{\{Q_H, Q_L\}} PS^{(U)} = \square P_H D_H Q_H O + \square P_L D_L Q_L O; \text{ s.t. } P_H = P_L. \quad (13)$$

The first-order conditions under the UT are expressed as

$$Q_H^{(U)} = \frac{3h-1}{4a}, \text{ and } Q_L^{(U)} = \frac{-h+3l}{4a}. \quad (14)$$

The equilibrium surpluses, such as the consumer surpluses of the H-market and the L-market, and the firm's profit under the UT, are expressed as

$$CS_H^{(U)} = \frac{(3h-1)^2}{32a}, \quad CS_L^{(U)} = \frac{(-h+3l)^2}{32a}, \quad \text{and} \quad PS^{(U)} = \frac{(h-l)^2}{8a}. \quad (15)$$

### III.2 The Results of the Models

Having established the models which produce the equilibrium surpluses under the three price discriminations and the uniform tariff, let us turn to examining the results: 1) the interests of the firm, the low-income consumers, and the high-income consumers sharply contradict each other; 2) the ranking of social welfare values of the three price discriminations and the uniform tariff cannot be determined without specifying the weights of social fairness; and 3) the low-income consumer surplus should be of greatest valued, the high-income consumer surplus the second, and the producer surplus the last.

In the first place, it is demonstrated that the advantages and disadvantages of the firm, the H-market, and the L-market sharply contradict each other. Since the equilibrium surpluses are expressed in (3), (9), (12), and (15), it is worthwhile examining the orders of preferences, concerning the three price discriminations and the uniform tariff, of the firm, the H-market, and the L-market respectively. Let us set that the preference  $a > b$  designates that  $a$  is preferred to  $b$ , and the preference  $ab$  designates that  $a$  is indifferent to  $b$ . The order of preference of the firm, concerning the three price discriminations and the uniform tariff, is indicated as follows:

$$PS^{(1)} > PS^{(2)} > PS^{(3)} > PS^{(U)}. \quad (16)$$

Similarly, the orders of preferences of the H-market and the L-market, concerning the price discriminations and the uniform tariff, are indicated as follows:

$$CS_H^{(U)} > CS_H^{(3)} > CS_H^{(2)} > CS_H^{(1)}, \quad (17)$$

$$CS_L^{(3)} > CS_L^{(U)} > CS_L^{(1)} \sim CS_L^{(2)}. \quad (18)$$

Let us take the 1st-PD, for example. It is rated first by the firm, last by the H-market, and third by the L-market. Then, let us consider the UT. It is rated last by the firm, first by the H-market, and second by the L-market. Thus, we can easily see that it is difficult to harmonize the diverse interests in the 1st-PD and the UT of the firm, the H-market, and the L-market because the preferences of the firm and the H-market are completely contradictory to each other and also because the preference between the 1st-PD and the UT of the L-market is different from those of the firm and the H-market.

Furthermore, it is worthwhile considering how to integrate the conflicting preferences of the firm, the H-market, and the L-market or how to obtain a social index, in other words a social welfare value, composed of the individual surpluses of the firm, the H-market, and the L-market. The most common way utilized in welfare economics is probably to adopt a weighted social welfare function, such as

$$W = \alpha PS + \beta CS_H + CS_L. \quad (19)$$

The term  $W$  denotes the social welfare function; the bigger the  $W$ , the higher the social welfare value. The terms  $\alpha$  and  $\beta$  denote weights for the producer surplus and the consumer surplus of the H-market respectively. If  $\alpha$  and  $\beta$  are less than one, the surplus of the L-market is valued more highly than those of the firm and the H-market. If  $\alpha$  is smaller than  $\beta$ , the surplus of the H-market is valued more highly than that of the firm. In this sense, a judgement about social fairness can be expressed in  $\alpha$  and  $\beta$ . However, an unsettled question remains as to how  $\alpha$  and  $\beta$  should be determined. Before turning to this question, it will be useful to exemplify various types of social welfare functions. First, in the case of  $\alpha = \beta = 1$ ,  $W$  is considered as the utilitarian social welfare function. Second, in the case of  $\alpha < 1$  and  $\beta = 1$ ,  $W$  is considered as the consumer highly weighted social welfare function. Especially in the case of  $\alpha = 0$  and  $\beta = 1$ ,  $W$  is considered as the consumer sovereignty social welfare function. Third, in the case of  $\alpha < 1$  and  $\beta < 1$ ,  $W$  is considered as the L-market highly weighted social welfare function. Especially in the case of  $\alpha = \beta = 0$ ,  $W$  is considered as the L-market sovereignty social welfare function. Fourth, in the case of  $W = \text{Max Min}[PS, CS_H, CS_L]$ ,  $W$  is considered as the max-min or Rawlsian social welfare function. As stated before, determination of  $\alpha$  and  $\beta$  is based upon our value judgements about the social fairness, and therefore we should not expect that there exists an absolutely adequate resolution to determine  $\alpha$  and  $\beta$ .

It will be useful, at this point, to offer some numerical examples which depict the social welfare values, depending upon weights, under the three price discriminations and the uniform tariff. Let us assume  $a=1$ ,  $h=10$ , and  $l=7$  and also the eight cases of weights following;  $\alpha = 1$  and  $\beta = 1$ ,  $\alpha = 0.6$  and  $\beta = 1$ ,  $\alpha = 0.3$  and  $\beta = 1$ ,  $\alpha = 0$  and  $\beta = 1$ ,  $\alpha = 0.6$  and  $\beta = 0.6$ ,  $\alpha = 0.3$  and  $\beta = 0.6$ ,  $\alpha = 0$  and  $\beta = 0.6$ , and  $\alpha = 0$  and  $\beta = 0$ . The social welfare values in these cases are given in table 1. Several interesting observations are obtained: 1) the rankings among the 1st-PD, the 2nd-PD, the 3rd-PD, and the UT change sharply depending upon the weights  $\alpha$  and  $\beta$ , therefore, it is difficult to determine the ranking of social welfare values of the three price discriminations and the uniform tariff without determining  $\alpha$  and  $\beta$  in advance; 2) to put it roughly, the 1st-PD is ranked highly when  $\alpha$  is high and  $\beta$  is low, and vice versa; 3) the 2nd-PD is ranked highly when  $\alpha$  and  $\beta$  are high; 4) the 3rd-PD is ranked highly when  $\alpha$  and  $\beta$  are low; and 5) the UT

Table 1. Numerical Example of Social Welfare Values under the Three Price Discriminations and the Uniform Tariff depending on the Weights  $\alpha$  and  $\beta$

|           | $\alpha=1,$<br>$\beta=1$ | $\alpha=0.6,$<br>$\beta=1$ | $\alpha=0.3,$<br>$\beta=1$ | $\alpha=0,$<br>$\beta=1$ | $\alpha=0.6,$<br>$\beta=0.6$ | $\alpha=0.3,$<br>$\beta=0.6$ | $\alpha=0,$<br>$\beta=0.6$ | $\alpha=0,$<br>$\beta=0$ |
|-----------|--------------------------|----------------------------|----------------------------|--------------------------|------------------------------|------------------------------|----------------------------|--------------------------|
| $W^{(1)}$ | 74.5<br>(1)              | 44.7<br>(2)                | 22.3<br>(4)                | 0<br>(4)                 | 44.7<br>(1)                  | 22.4<br>(4)                  | 0<br>(4)                   | 0<br>(3)                 |
| $W^{(2)}$ | 70.0<br>(2)              | 46.8<br>(1)                | 29.4<br>(3)                | 12.0<br>(3)              | 42.0<br>(2)                  | 24.6<br>(2)                  | 7.2<br>(3)                 | 0<br>(3)                 |
| $W^{(3)}$ | 55.9<br>(4)              | 41.0<br>(4)                | 29.8<br>(2)                | 18.6<br>(2)              | 36.0<br>(3)                  | 24.8<br>(1)                  | 13.6<br>(2)                | 6.1<br>(1)               |
| $W^{(L)}$ | 56.4<br>(3)              | 42.0<br>(3)                | 31.2<br>(1)                | 20.3<br>(1)              | 35.4<br>(4)                  | 24.5<br>(3)                  | 13.7<br>(1)                | 3.8<br>(2)               |

(Assume  $a=1$ ,  $h=10$ , and  $l=7$ . The numbers in parentheses display rankings of the three price discriminations and the uniform tariff.)

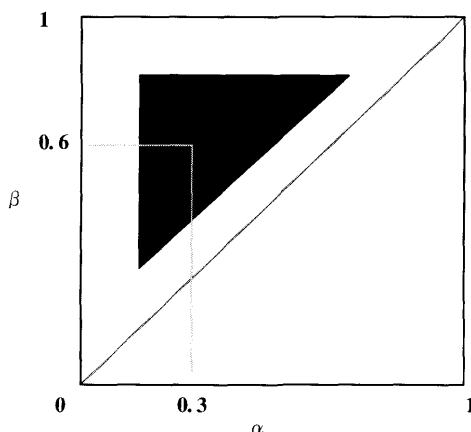


Figure 3. Zone of Weights which take Fairness into Consideration

is ranked highly when  $\alpha$  is low and  $\beta$  is high. The above observations are consistent with the expectations expressed in (16), (17), and (18).

Finally, it is necessary to clarify the value judgement advocated in the following paragraphs. It is assumed that the parameter conditions  $0 < \alpha < 1$ ,  $0 < \beta < 1$ , and  $\alpha < \beta$  always hold, where the surplus of the L-market is valued most, the H-market second, and the firm last. Figure 3 indicates the zone of weights which take fairness into consideration according to the assumptions above. The shaded area is the zone of weights which is advocated to be socially fair. In figure 3, the weights  $\alpha = 0.3$  and  $\beta = 0.6$  provide an example of the weights which belong to the shaded area. In the example of  $\alpha = 0.3$  and  $\beta = 0.6$ , it follows from table 1 that the rankings of social welfare values are given as the 3rd-PD, the 2nd-PD, the UT, and the 1st-PD from top to bottom although the differences among them are quite small. The main points that have been made here can be summarized as proposition 1.

**Proposition 1.** The advantages and disadvantages of the firm, the H-market, and the L-market sharply contradict each other when the social welfare values among the 1st-degree, the 2nd-degree, the 3rd-degree price discriminations and the uniform tariff are compared. It is possible to rank the social welfare values of the three price discriminations and the uniform tariff, as a whole, according to a weighted social welfare function. However, the ranking of social welfare values changes sharply depending upon the weights which take social fairness into consideration. It is necessary to determine the zone of weights, and the value judgment discussed here advocates that consumer surplus be valued more highly than the producer surplus and that the low-income consumer surplus be valued more highly than the high-income consumer surplus.

### III.3 An Extension of the Models: A New Pricing--Universal Service Support for Low-income Consumers

The purpose of this subsection is to develop an original pricing named "universal-service and self-selection price discrimination" (US-PD) and to demonstrate that the new pricing is

socially desirable in comparison with the other three price discriminations or the uniform tariff. The point is to incorporate universal support for the low-income consumers in a self-selection price discrimination.

It was discussed in the preceding sections that price discrimination has been legally regulated or prohibited by the government. In addition, price discrimination is problematic from the socially fair point of view. Let us now attempt to extend the models for a new pricing policy--US-PD, especially for the L-market. If a firm is not legally allowed to carry on price discrimination, the L-market could at least gain a surplus under the UT,  $CS_L^{(U)}$ , expressed in (15). In this respect,  $CS_L^{(U)}$  can be considered as the minimum surplus which the L-market could naturally gain. Therefore, let us modify the IR-L expressed in (5) and assume that the consumer surplus of the L-market under the 2nd-PD must be at least as high as that under the UT. The new condition, named the "universal-service condition " for the L-market (US-L), is expressed as

$$\text{US-L: } \int_0^{Q_L} P_L dQ - R_L \geq CS_L^{(U)}. \quad (20)$$

The new pricing is here called "the universal-service and self-selection price discrimination" (US-PD), where the firm tries to maximize its profit in the conditions of the US-L and the IC-H, both of which are to be binding. The maximization problem and the constraints under the US-PD are formulated as follows:

$$\text{Max}_{\{Q_H, Q_L\}} PS^{(US)} = R_H^{(US)} + R_L^{(US)}; \text{ s.t. US-L (binding), and IC-H (binding).} \quad (21)$$

Here the superscript (US) represents the US-PD. The first-order conditions under the US-PD are expressed as

$$Q_H^{(US)} = h/a, \text{ and } Q_L^{(US)} = \frac{2l-h}{a}. \quad (22)$$

The equilibrium surpluses, such as the consumer surpluses of the H-market and the L-market, and the firm's profit under the US-PD, are expressed as

$$\begin{aligned} CS_H^{(us)} &= \frac{(h-1)(2l-h)}{a} + \frac{(-h+3l)^2}{32a}, \quad CS_L^{(us)} = \frac{(-h+3l)^2}{32a}, \text{ and} \\ PS^{(US)} &= \frac{h^2 + (2l-h)^2}{2a} - \frac{(-h+3l)^2}{16a}. \end{aligned} \quad (23)$$

#### III.4 The social desirability of the US-PD

In this subsection, we will go on from the models above to the question of whether the US-PD is socially preferable to other pricings, such as the 1st-PD, the 2nd-PD, the 3rd-PD, and the UT. The main point discussed here is that the new pricing, namely the US-PD, is considerably more desirable than any other pricings with respect to social welfare values and is also easily implemented with a two-part tariff.

To begin with, it is helpful to extend the numerical example described in table 1. Table 1 displays the numerical examples of the social welfare values under the three price

Table 2. Numerical Example of Social Welfare Values of the US-PD depending on Weights  $\alpha$  and  $\beta$

|            | $\alpha=1,$<br>$\beta=1$ | $\alpha=0.6,$<br>$\beta=1$ | $\alpha=0.3,$<br>$\beta=1$ | $\alpha=0,$<br>$\beta=1$ | $\alpha=0.6,$<br>$\beta=0.6$ | $\alpha=0.3,$<br>$\beta=0.6$ | $\alpha=0,$<br>$\beta=0.6$ | $\alpha=0,$<br>$\beta=0$ |
|------------|--------------------------|----------------------------|----------------------------|--------------------------|------------------------------|------------------------------|----------------------------|--------------------------|
| $W^{(US)}$ | 70.0<br>(2)              | 49.8<br>(1)                | 34.7<br>(1)                | 19.6<br>(2)              | 43.5<br>(2)                  | 28.4<br>(1)                  | 13.3<br>(3)                | 3.8<br>(2)               |

(Assume  $a=1$ ,  $h=10$ , and  $l=7$ . Numbers in parentheses display rankings among four price discriminations, including the US-PD, and the uniform tariff.)

discriminations and the uniform tariff. Now, let us see table 2, which indicates the numerical example of social welfare values under the US-PD in the same conditions as in table 1. It seems reasonable to conclude that the social welfare values of the US-PD are relatively higher in comparison with other pricings since it is ranked first or second in almost cases. It is also concluded that the US-PD will be socially desirable under the zone of weights which take fairness into consideration, namely  $0 < \alpha < 1$ ,  $0 < \beta < 1$ , and  $\alpha < \beta$ , because the social welfare value of the US-PD in the example of  $\alpha=0.3$  and  $\beta=0.6$  is much higher than those of the other pricings.

Having discussed the numerical example, let us turn to a closer consideration of the social desirability of the US-PD. Let us at first compare the social welfare values of the US-PD with those of the 1st-PD, the 2nd-PD, the 3rd-PD, and the UT. The boundary conditions where the US-PD is better with respect to social welfare values than any other pricings are expressed as follows:

$$\begin{aligned}
 \text{(i)} \quad W^{(US)} \geq W^{(1)} &\Leftrightarrow (-14h^2 + 52hl - 30l^2)\alpha + (31h^2 - 90hl + 55l^2)\beta \\
 &\quad + (-h^2 + 6hl - 9l^2) \leq 0, \\
 \text{(ii)} \quad W^{(US)} \geq W^{(2)} &\Leftrightarrow 2\alpha - \beta - 1 \leq 0, \\
 \text{(iii)} \quad W^{(US)} \geq W^{(3)} &\Leftrightarrow (-22h^2 + 52hl - 38l^2)\alpha + (35h^2 - 90hl + 55l^2)\beta \\
 &\quad + (-h^2 + 6hl - 5l^2) \leq 0, \\
 \text{(iv)} \quad W^{(US)} \geq W^{(U)} &\Leftrightarrow (-13h^2 + 30hl - 21l^2)\alpha + (20h^2 - 48hl + 28l^2)\beta \leq 0.
 \end{aligned}$$

Especially, if we assume the preceding parameters condition,  $a=1$ ,  $\alpha=0.3$ ,  $\beta=0.6$ , and  $0 \leq l \leq h \leq 2l$ , the boundary conditions can be simplified as follows:

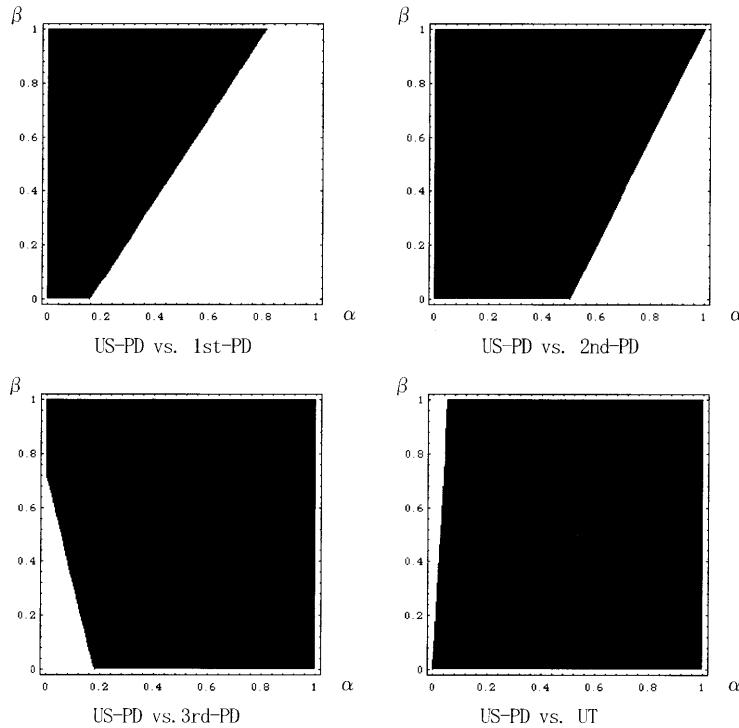
$$\begin{aligned}
 \text{(i)} \quad W^{(US)} \geq W^{(1)} &\Leftrightarrow 0.624l \leq h \leq 1.794l \\
 \text{(ii)} \quad W^{(US)} \geq W^{(2)} &\Leftrightarrow \forall h, 1, \\
 \text{(iii)} \quad W^{(US)} \geq W^{(3)} &\Leftrightarrow 0.737l \leq h \leq 1.681l, \\
 \text{(iv)} \quad W^{(US)} \geq W^{(U)} &\Leftrightarrow 0.778l \leq h \leq 1.667l.
 \end{aligned}$$

Therefore, it can be concluded that  $W^{(US)}$  is the highest ranked out of all the pricings, namely the US-PD is the most socially preferable, only given that  $l \leq h \leq 1.667l$ , which means that the economic difference between the H-market and the L-market is not too large.

Furthermore, let us consider the question from a different angle. At this point, we do not specify the weights  $\alpha$  and  $\beta$ , but instead we assume  $a=1$ ,  $h=10$ , and  $l=7$ , which certainly satisfies

$l \leq h \leq 1.667l$ . In this case, the boundary conditions where the US-PD is more socially preferable than any other pricings are expressed as follows:

- (i)  $W^{(US)} \geq W^{(1)} \Leftrightarrow 770\alpha - 505\beta - 121 \leq 0$ ,
- (ii)  $W^{(US)} \geq W^{(2)} \Leftrightarrow 2\alpha - \beta - 1 \leq 0$ ,
- (iii)  $W^{(US)} \geq W^{(3)} \Leftrightarrow 422\alpha - 105\beta - 75 \geq 0$ ,
- (iv)  $W^{(US)} \geq W^{(U)} \Leftrightarrow 229\alpha - 12\beta \geq 0$ .



(Assume  $a=1$ ,  $h=10$ , and  $l=7$ .)

Figure 4. Boundary Conditions where the US-PD is More Socially Preferable than any other Pricings

These inequalities are represented diagrammatically in figure 4. The four boundary conditions are depicted there, and the shaded areas mean the US-PD is more socially preferable than the 1st-PD, the 2nd-PD, the 3rd-PD, or the UT respectively. See figure 3 again, which depicts the zone of weights which take fairness into consideration. We can observe that the four shaded areas in figure 4, where  $W^{(US)} \geq W^{(1)}$ ,  $W^{(US)} \geq W^{(2)}$ ,  $W^{(US)} \geq W^{(3)}$ , and  $W^{(US)} \geq W^{(U)}$ , approximately cover the shaded area in figure 3, where  $0 < \alpha < 1$ ,  $0 < \beta < 1$ , and  $\alpha < \beta$ . Thus, the US-PD is the most preferable pricing out of all the pricings from the viewpoint of the fairness weighted social welfare function.



Next, let us examine the question of how a firm can actually implement self-selection price discriminations, such as the 2nd-PD and the US-PD. The pricing which consists of a fixed tariff and marginal tariff is called a "two-part tariff." It is here demonstrated that a firm can sort the types of markets, the H-market or the L-market, by means of two-part tariff. Let us assume that  $a=1$ ,  $h=10$ , and  $l=7$  again. The 2nd-PD can be implemented with the following two-part tariff:

$$Q_H^{(2)} = 10 \text{ and } R_H^{(2)} = 38; Q_L^{(2)} = 4 \text{ and } R_L^{(2)} = 20; \text{ and thus } R^{(2)} = 8 + 3Q^{(2)}. \tag{24}$$

That is to say, when the H-market and the L-market are charged with the two-part tariff,  $R^{(2)} = 8 + 3Q^{(2)}$ , by the firm, the former would self-select the bundle,  $Q_H^{(2)} = 10$  and  $R_H^{(2)} = 38$ , while the later would self-select the bundle,  $Q_L^{(2)} = 4$  and  $R_L^{(2)} = 20$ . On the other hand, the US-PD is implemented with the following two-part tariff:

$$Q_H^{(US)} = 10 \text{ and } R_H^{(US)} = 34.22; Q_L^{(US)} = 4 \text{ and } R_L^{(US)} = 16.22; \text{ and thus } R^{(U)} = 4.22 + 3Q^{(U)}. \tag{25}$$

That is to say, when the H-market and the L-market are charged with the two-part tariff,  $R^{(U)} = 4.22 + 3Q^{(U)}$ , by the firm, the former would self-select the bundle,  $Q_H^{(US)} = 10$  and  $R_H^{(US)} = 34.22$ , while the later would self-select the bundle,  $Q_L^{(US)} = 4$  and  $R_L^{(US)} = 16.22$ . Both two-part tariffs, (24) and (25), are displayed graphically in figure 5. The two-part tariff for implementing the 2nd-PD is made up of the fixed tariff of 8 and the marginal tariff of 3 whereas that for implementing the US-PD is made up of the fixed tariff of 4.22 and the marginal tariff of 3. It is important to note that the marginal tariff for implementing the 2nd-PD is equal to that for implementing the US-PD, but the fixed tariff of the former is higher than that of the latter. This is the effect of the universal-service condition, which means that the surplus of the L-market consumers must be at least as high as when any price discriminations are prohibited, and thereby, the both consumer surpluses are higher under the US-PD than under the 2nd-PD.

Finally, it is interesting to note the relationship between the US-PD and other similar pricing concepts, such as the Pareto-improving tariff and status-quo-fair pricing. The US-PD is

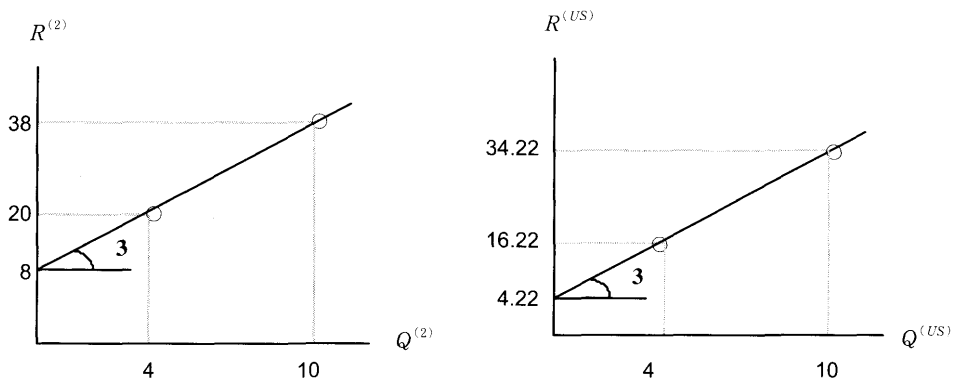


Figure 5. Two-Part Tariffs for implementing the 2nd-PD (left) and the US-PD (right)

a kind of Pareto-improving tariff. For any uniform price unequal to the marginal cost, there is a nonlinear tariff which is preferred by each consumer and which yields greater profits for the firm. An  $(n+1)$ -part tariff can be made Pareto-superior to an  $n$ -part tariff. Specifically, a supplier can offer an additional tariff as one option while keeping the old, existing tariffs as the other options. Each customer can choose whether to purchase at least the uniform tariff (small customers prefer this) or the nonlinear tariff schedule that offers quantity discounts (large customers prefer this). This policy assures that no customer is disadvantaged by the adoption of a nonlinear tariff. This applies to the US-PD. Further, the US-PD is also a kind of status-quo-fair tariff. Status quo fairness can refer to producers and/or consumers and would only allow tariff changes that are Pareto-improving. Fairness takes the form of a constraint on existing utility levels. This applies to the US-PD again. (See Willig 1978, 56; Mitchell and Vogelsang 1991, 33 and 96; Wilson 1993 for detail.) Thus, the main points that have been made here can be summarized as proposition 2.

**Proposition 2.** The self-selection price discrimination with the universal service condition is named the universal-service and self-selection price discrimination. Its social welfare value is relatively higher in comparison with other price discriminations or the uniform tariff. Furthermore, it is considerably higher in the case where weights are assumed to be socially fair. Finally, it is easily implemented with a two-part tariff whose fixed tariff is reduced to benefit consumers. Therefore, we can conclude that universal service support for low-income consumers is socially desirable.

#### **IV An Industrial Policy Discussion of the Japanese Telecommunications Industry**

The universal service support advocated in this paper is the integration between the 2nd-degree (namely self-selection) price discrimination and the financial support for low-income consumers. In this respect, the new discount service applied by Nippon Telegraph and Telecom (NTT) is investigated. The question here is whether the introduction of a new discount service into only a limited area is appropriate or not. The answer which this paper offers is that the new discount service itself is not so harmful but must be introduced throughout all areas of the market.

To begin with, it is useful to explain the trend of the Japanese telecommunications industry. NTT will be fully divested under a holding company system by 1999. This process is best summarized by Hatta (1997). The current structure of the Japanese telecommunications industry was mainly determined by the Telecommunications Reform in 1985, before which only Nippon Telegraph and Telecom Public Corporation (NTT-PC) provided inland services; NTT-PC was privatized in 1985, and entry into the long-distance market started in 1987.<sup>8)</sup> Nevertheless, of all the telephone companies, only NTT has substantially become an integrated firm which provides both long-distance and local telecommunications. In reviewing the history, it is noteworthy that

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8) International services was provided by Kokusai Denshin Denwa (KDD), the KDD Corporation Law (KCL) regulated the international services. Entry into the international market started in 1989.

there were many opinions requiring the divesting of NTT during those earlier days. There were three, main, influential discussions concerning the divesting. First, in 1982, the Second Administrative Reform Ad-hoc Council issued a report on NTT-PC. Their report was the first to propose a break-up plan: NTT should be divided into one long-distance carrier and several regional carriers. Second, in 1990, the Telecommunications Council's report proposed the vertical disintegration of NTT and the creation of one NTT local company, whose organizational structure would be reviewed afterwards. Third, and foremost, in 1996, the Telecommunications Council published the report which proposed the NTT break-up into one long distance and two regional companies, the latter serving the eastern and western parts of Japan. On the other hand, public opinion was fairly sympathetic towards the integrated NTT. The first reason was that the Japanese telecommunications industry was thought to be getting behind those of the United States and Europe despite the strong technological potential of NTT, and therefore NTT should remain a "flag carrier company." The second reason, which seemed to be more reasonable, was that there was no guarantee that competition would provide the answer, first, because competition was not expected everywhere and, second, because end-users would have to pay for the loss if NTT's investment failed to recover the cost. Finally, an agreement concerning the structure of NTT was reached in late 1996 by the Ministry of Post and Telecommunications and NTT. Accordingly, NTT was to be divested under a holding company system by 1999 into one holding company, two regional companies (east and west), and one long-distance company. The holding company would have a research and development obligation, and the regional companies would have a universal service obligation.

Additionally, it might be informative to explain why the NTT regional company was to be divested into two regional companies, namely NTT East and NTT West. The telecommunications Council (1996) described the principle of divestiture of NTT as follows: The future provision of telecommunication services must be ensured without lowering existing standards. If NTT is to be restructured, full consideration must be given to the financial basis of the resulting new firms in order to ensure the supply of such services. That is to say, the principle can be interpreted as meaning the maintenance of universal service in the Japanese telecommunications industry. Based on an overall assessment of a balanced scale for each company by the Council, it would be appropriate to establish two regional companies when NTT was to be reorganized (the Telecommunications Council 1996). See table 3, which indicates the financial outlook for companies created via the restructuring of NTT in 1999. The balance statements of all these companies are expected to be healthy. The assets and volume of sales for both regional telecom-

Table 3. Financial Outlook for Long-Distance NTT, NTT East, and NTT West

|                   | Gross assets | Net worth | No. of employees | Operating profit | Ordinary profit |
|-------------------|--------------|-----------|------------------|------------------|-----------------|
| Long-Distance NTT | 12,546       | 4,811     | 11,840           | 13,068           | 974             |
| NTT East          | 55,111       | 24,057    | 76,790           | 34,192           | 4,383           |
| NTT West          | 51,055       | 16,927    | 89,794           | 33,040           | 2,174           |

(Source: The Telecommunications Council (1996). Note: yen shown in units of 100 million.)

munications carriers will be virtually the same; the gross assets of NTT East is expected to be 5511.1 billion yen while that of NTT West, 5105.5 billion yen; and the operating profit of NTT East is expected to be 3419.2 billion yen while that of NTT West is expected to be 3304.0 billion yen.

The reconstruction of NTT will lead to new developments and competition in the Japanese local telecommunications industry. Here, let us take a new discount service applied by NTT, as an example. On January 20, 1998, NTT applied to the Minister of Post and Telecommunications for approval for a new discount service for local telephones, called Timeplus. The Timeplus service is such that if customers pay an additional fixed tariff of ¥200 per month, the rate for a local telephones call is discounted from ¥10/three-minutes to ¥10/five-minutes. The reason NTT began the new discount service was to compete with a cheap local telephone service of a new local common carrier, TNet, which does business only in the Tokyo metropolitan area. However, it became a subject of controversy whether the new discount service of NTT could be approved. At that time, NTT insisted that this discount service would be introduced only into the Tokyo metropolitan area because NTT's profit would decrease if it was introduced throughout Japan. Namely, NTT thought that this discount service would not infringe on its universal service obligation and that it was natural that tariff policies should be different depending on the degrees of competition between various areas. On the other hand, the Ministry of Post and Telecommunication emphasized that the limited introduction of the new discount service of NTT would infringe on the concept of universal service and that it had to be universally available throughout Japan. Furthermore, the Fair Trade Commission criticized NTT because the new discount service fell under a type of unfairly discriminational tariff. After two-weeks of controversy, on February 4, 1998, the Telecommunications Council submitted a report that the application of NTT could be approved on the condition that the discount service would be introduced throughout Japan within one year. Accordingly, the Ministry approved the application of NTT on that day, and NTT started the service in the middle of February.

Lastly, using the conclusions obtained in this paper so far, let us consider the new discount service of NTT. First of all, the discount service which NTT applied for corresponds to a form of the 2nd-degree price discrimination, which was fully examined in Section 3. As has already been discussed, the 2nd-degree price discrimination itself is not inferior from a viewpoint of social welfare because this makes it possible for consumers to self-select a preferred bundle depending upon their own preferences and because the purchased quantity of services is expected to increase. However, the introduction of the new discount service not into all areas but only into limited areas, as NTT planned at the beginning, should be criticized intensely with respect to economic theory. The limited introduction of the discount service contradicts the 2nd-degree price discrimination policy which offers the same menu to all customers in all areas. That kind of price discrimination which excludes specific customers from access to services, such as the 1st-degree or the 3rd-degree price discriminations do, should be strictly regulated by the government. Next, a problem of the 2nd-degree price discrimination policy is that the surpluses of the low-income consumers are restricted to low amounts. Therefore, this paper demonstrates that the new pricing policy called the universal-service and self-selection price discrimination, which integrates the 2nd-degree price discrimination and financial support for the low-income consumers, is desirable from the viewpoint of social welfare. Concretely, this new

pricing policy can be implemented through the two-part tariff which still allows consumers to choose a uniform tariff. In this sense, it is approximately equal to the Pareto-improving tariff or status-quo-fair tariff. In conclusion: 1) the new Japanese discount service itself is not so harmful; however, 2) it must be available to all consumers in all areas; and 3) the old tariff must still be available to consumers so that the surpluses of the low-income consumers might not decrease. This section seems to confirm that the conclusions obtained in this paper could provide an excellent guideline for an industrial policy discussion of universal service support in a broad spectrum of applications.

## V Conclusion

This paper theoretically analyzed universal service support, especially for low-income consumers. Several interesting conclusions were obtained. Let us here summarize the main propositions that have been stated. First, we compared the social welfare values among three price discrimination policies and the uniform tariff. Since the preferences concerning pricing for a firm, the high-income consumers, and the low-income consumers contradict each other, the ranking of the social welfare values depends upon the weights which represent social fairness. Second, we demonstrated the social desirability of universal service support for the low-income consumers. The new type of price discrimination called the universal-service and self-selection price discrimination (US-PD) is socially desirable in comparison with other pricings, especially in the case where weights are assumed to be socially fair. This new pricing is similar to the Pareto-improving tariff or status-quo-fair tariff.

Some points still remain to be considered. As space is limited, the relationship between price discrimination and competition has not been discussed sufficiently, but it does not mean that problem is less important. However, it is expected that the basic investigation developed in this paper can be applied to competitive circumstances. (See Wilson 1993, 10 and 281-312 for more discussion.) In perfect competitive markets, prices are driven downward equal to the marginal costs of production. This excludes the self-selection price discrimination policy except for a quantity discount based upon actual cost savings in production or delivery. However, the actual economy does not contain perfectly competitive markets but imperfect competitive markets in most cases. In monopolistic competitive markets, products are differentiated sufficiently so that each firm enjoys some monopolistic power for setting its price above the marginal costs. Similarly, in oligopolistic competitive markets, products are a close substitute, but the number of firms is sufficiently small to enable positive profits. Therefore, the self-selection price discrimination advocated in this paper is usually feasible even in imperfectly competitive markets.

The goals of universal service leading to advanced telecommunications services for all must be met by means that enhance rather than distort competition. This paper discusses the social desirability of universal service support through a developed economic model based on modern industrial organization theory. It is important for economists and policy makers to cooperate in developing a refined universal service support which is a new economic approach toward the tradeoff between efficiency and fairness.

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