The Political Economy of Pricing: Comparing the Efficiency Impacts of Flat Rate vs. Two-Part Tariffs

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■ Introduction

In recent years there has been much debate on the regulation of telecommunications pricing. Pricing is a major concern of users, suppliers and regulators. Trade-offs may exist not only between consumers and suppliers but also within each group. Users, for example, tend to choose a tariff that best benefits them. Their goal is to maximize the consumer surplus associated with the consumption of telecommunications service. Within the group of users, however, different interest groups may exist. For example, heavy users have quite different preferences from those of light users, preferring a quantity discount composed of a lower usage charge (while light users favor a quantity premium composed of a lower initial charge).

Suppliers, meanwhile, are apt to offer a tariff that yields improved profitability. An optimal pricing scheme tends to be one that maximizes supplier profitability. Supplier goals are not compatible with consumers' goals because the profit-maximizing price is much higher than that which maximizes consumer surplus, so long as market competition is imperfect. And since most telecommunications markets have an inherently monopolistic nature, such imperfection can be assumed. Furthermore, when more than one supplier exists in a market, supplier goals may diverge. An existing supplier may, for example, abuse monopoly power by setting an extremely low charge to deter the entry of new firms.

These trade-offs necessitate the existence of regulators. The role of regulators is to advance the market by coordinating conflicting interests among the parties involved. Their administrative guidance should be based

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on policies designed to achieve market efficiency at regional, national or international levels.

Alternative pricing schemes derive from different institutional and political perspectives. One pricing scheme may favor suppliers while another favors consumers. In a normative discussion, both can satisfy optimality conditions under certain circumstances. Since no superlative criterion exists, as implied by Arrow's impossibility theorem (ARROW, 1963), the choice takes the form of a political decision. We cannot rely solely on market mechanisms because greater inefficiency may result.

Hence, the implementation of a pricing scheme necessitates an institutional structure and political choice. No pricing scheme can come without an institutional structure, nor will it develop through an invisible market-efficiency mechanism. Choices must be made, and made by those involved in telecommunications policy.

From the consumer point of view, a flat-rate pricing scheme is often preferred to measured-rate systems such as the two-part tariff. Recently, flat rates have been seen as essential to promoting the use of the Internet, as Internet users tend to think that charges should be independent of the time of usage. In the United States, local phone companies have traditionally charged a fixed monthly fee for a phone line and allowed an unlimited number of local calls at no extra charge (TRAIN 1994, p. 208). In Japan, however, the two-part tariff has been in effect until quite recently, and flat rates have not been applied to local calls. It is often said that such a traffic-sensitive tariff is not suitable for dial-up connections and tends to inhibit use of the Internet (1). In addition, tariff structures affect the prospects of the e-commerce market. If people shy away from using the Internet because of high charges, e-commerce - especially in the B2C sector - will grow slowly.

For suppliers, however, the efficiency of a tariff depends upon its cost structure. Flat rates cannot be efficient as long as both traffic-sensitive and non-traffic-sensitive costs exist. Users will prefer a flat rate regardless of their own usage levels, while the supplier may hesitate in applying it because revenues may be reduced. Consequently, users and suppliers may conflict over pricing schemes. From the regulator's point of view, Coase's two-part tariff will deliver maximum economic welfare (COASE, 1946). Here, the unit usage charge is set at the marginal cost and the fixed charge covers

(1) US Department of Commerce (1999) quoted from a report of DSA Analytics stating, "Most Japanese Internet users note that the cost of local phone calls is a major disincentive to greater use."

the fixed cost. The supplier breaks even and the users' consumer surplus is maximized as a result of the use of marginal cost pricing.

This paper seeks to evaluate, through simulations, the impact on participants in the telecommunications market of a transition from one pricing scheme to another. By maximizing the objective function, optimality can be attained for each party (i.e., users and supplier(s)). The economic feasibility of adopting a flat rate in place of the optimal two-part tariff is examined in terms of supplier profit and social economic welfare. The result suggests that an institutional, political and non-market decision is necessary to evaluate alternative pricing schemes, because each pricing scheme necessarily includes some degree of inefficiency even if optimal for a certain objective.

■ Flat Rate vs. Two-part Tariff: A Simulation of Market Impacts

Summary of results and policy implications

An economic evaluation of flat rate vs. two-part tariff for an interactive telecommunications service was conducted. Results can be summarized as follows:

a) Flat rate increases consumer economic welfare and communication traffic.
b) Supplier profits drop dramatically, however, reducing the feasibility of this approach.
c) Even under flat rate, total surplus does not change drastically if it is optimal. Consequently, total economic efficiency remains steady because the flat rate has little impact on the total surplus. However, the surplus is composed of a larger consumer component and smaller profit than under the optimal two-part tariff.
d) The number of subscribers decreases under the optimal flat rate.
e) The flat rate has a negative impact on the supplier. As a result, a stable equilibrium subscriber set may not exist under profit maximization.

The simulation strongly suggests that users prefer flat rate because it delivers substantially greater benefits. However, the supplier suffers substantial losses and hence will seek to avoid flat rates. From a social benefits perspective, the flat rate contributes as much as the two-part tariff. If the regulator is neutral with respect to users and suppliers and the policy decision is based solely on social benefit, the way forward is not clear. Even for optimal solutions, some inefficiencies exist. For example, the optimal two-part tariff under total surplus maximization yields a negative profit for the supplier. In other words, optimality does not imply that a given pricing scheme is feasible; but rather, that the implementation of any pricing scheme necessitates a political, non-market choice. We should thus not be surprised to find that different countries choose different solutions -- different political economies are at work.

The model

It is difficult to compare the effect of adopting an alternative pricing system based on different institutions within a single context; indeed, there have been very few attempts to do so. MITOMO (1992) developed a model that describes a telecommunication market for interactive communications services and that takes account of multiple parties. In the model, both rates and subscription levels are optimized within the context of maximizing social economic welfare or supplier profitability. The former reflects the goals of a regulator who seeks to maximize social benefit and may coincide with benefits maximization for users. I utilize the model to evaluate the transition from two-part tariff to flat rate. (Details of the development of the model are given in Appendix A.)

Simulation

The optimal solutions for the two cases of original profit maximization (PM) and total surplus maximization (SM) are listed in table 1. In both cases, optimality holds under a two-part tariff. In addition, the optimal fixed charge is lower than the associated fixed cost, which can be an incentive to collect more users. A lower fixed charge will attract more users. Due to the existence of positive externalities, more users will generate more traffic, as seen under the PM case. Under the SM case, on the other hand, maximum social welfare can be attained by setting the usage charge equal to the marginal cost.

The optimal two-part tariffs *(m, C_0)* are (0.44, 2.80) in the PM case and (0.2, 2.49) in the SM case. Subscription levels are 60 per cent and 85 per cent respectively. Actual total communications, supplier profits, total consumer surplus and total surplus (= profits + total consumer surplus) are listed in the lower half of the tables.

Table 1: The optimal two-part tariff: profit maximization [PM] and total surplus maximization [SM]

	Profit Maximization [PM]	Total Surplus Maximization [SM]
Unit Usage Charge	0.44	0.2
Fixed Charge	2.80	2.49
Critical Mass	9.2%	8.4%
Equilibrium Subscription Level (Stable equilibrium)	60%	85%
Total Volume of Communication	10.50	20.31
Supplier's Profit	1.20	-2.13
Total Consumer Surplus	2.94	8.13
Total Surplus	2.46	3.88

In the presence of positive externalities, the supplier's profit is negative in the SM case. For the supplier then, the optimal two-part tariff is not feasible. However, the social economic efficiency of the tariff can be maximized.

Let us now examine the impact of introducing a flat rate. Numerous alternative flat rates exist, but here we consider two representative situations:

(a) Calculating the flat rate that keeps the subscription level constant.

(b) Solving a model with an additional constraint m=0 to derive the optimal flat rate.

In case (a), a feasible flat rate is sought to keep the number of subscribers, while in case (b) optimality is maintained even though the number of subscribers changes. In each case, the cost structure is held fixed.

Note that in the results below, the numerical values hold no meaning; only the direction of change of the indices is relevant.

(a) The flat rate, with subscription level held constant

Results are given in table 2. Here, subscription levels are held at 60% in the PM case and 85% in the SM case. The flat rates derived are 8.93 and

3.90 respectively. Figure 1 shows the change in the indices during the transition from the optimal two-part tariff to a flat rate, with the unit usage charge reduced by 10 per cent. The indices listed are flat rate (fixed charge), total consumer surplus, profit and total surplus. The indices from the optimal two-part tariff are placed at the left side of the diagram and those from the flat rate on the right. Under the PM case, profits decline as we move away from the optimal two-part tariff and become negative when the flat rate is reached. It is thus infeasible for the flat rate to retain subscriptions at the optimal level. Consumer surplus, on the other hand, increases as we move away from the monopoly profit-maximizing price. Total surplus increases initially but decreases as we approach the perfect flat rate, rising about 7% overall. This result suggests that changes to the pricing system may have little effect on social welfare.

Under the SM case, although the supplier's deficit has worsened, it is offset by the increase in the consumer surplus; hence, total surplus declines by some 13 %.

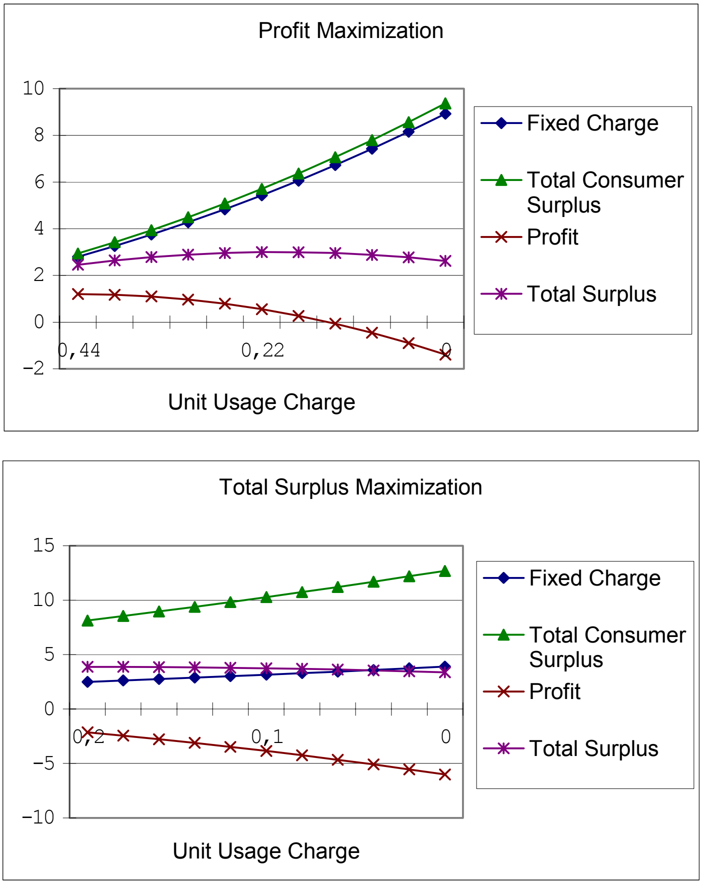
Total communications volume increases by 80% under the PM case and 25% under the SM case.

In each case, the introduction of flat rate increases consumer surplus and communications traffic while reducing supplier profitability dramatically. Consequently, this approach has limited feasibility in practice.

Table 2: Flat rate with subscription level held constant: the two cases of profit maximization [PM] and total surplus maximization [SM]

	Profit Maximization [PM]	Total Surplus Maximization [SM]
Unit Usage Charge	0	0
Fixed Charge	8.93	3.90
Critical Mass		
Equilibrium Subscription Level	(Fixed) 60%	(Fixed) 85%
Total Volume of Communication	18.75	25.39
Supplier's Profit	-1.39	-6.02
Total Consumer Surplus	9.37	12.70
Total Surplus	2.63	3.37

Figure 1: Changes in indices:
transition from the optimal two-part tariff to a flat rate



(b) The optimal flat rate

The solution to the new problem of optimizing flat rate is shown in table 3. In the model, the unit usage charge is set at zero and the cost structure remains unchanged. Unit usage charge is simply an instrument variable used to solve the maximization problem. The unimodal curve in figure 2 represents the benefit to the smallest subscriber at each subscription level. Figure 3 shows the change in the maximized profit at each subscription level.

Table 3: Optimal flat rate and other indices

	Profit maximization		Surplus Maximization
Subscription Level	33% Profit Maximized at critical mass	52% Stable equilibrium subscription level corresponding to critical mass	84%
Unit Usage Charge	0	0	0
Fixed Charge	9.82	9.82	4.17
Total Demand	8.11	15.74	25.22
Total Consumer Surplus	4.06	7.87	12.61
Profit	0.0	-0.64	-5.74
Total Surplus	0.78	2.12	3.37

Figure 2: The benefit to the smallest subscribers under the flat rate

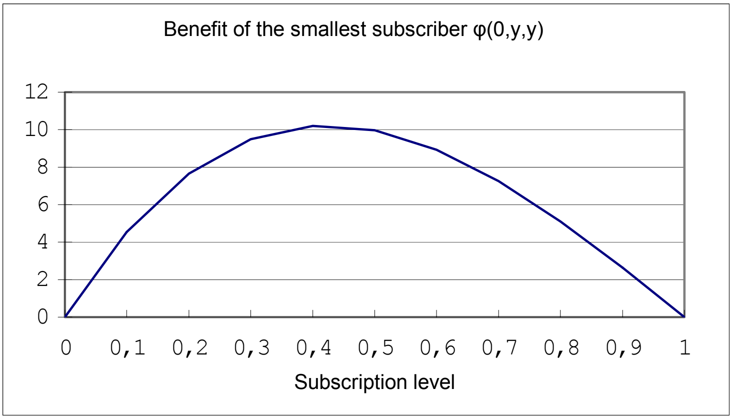
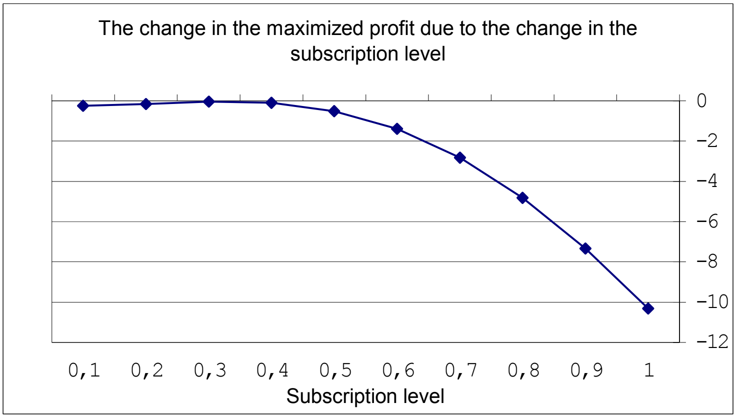


Figure 3: Change in the profit (the case of profit maximization)



As figure 3 shows, the profit-maximizing subscription level is 33%, or about half that of the two-part tariff. At this subscription level, the smallest subscriber's benefit curve is upward sloping (see figure 2), so that the equilibrium attained is unstable. The stable equilibrium subscription level corresponding to the critical mass 33%(y=0.33) is 52%(y=0.52). If the actual subscription level exceeds the critical mass, away from the optimal level, it will approach the stable equilibrium and supplier profit will further decline. It is much harder to demonstrate supplier feasibility at the stable point.

Under the SM case, both the subscription level and the total surplus show a slight decrease. When the consumer surplus increases and the profit decreases, they offset each other. Total communication traffic decreases under the PM case, but increases by 24% under the SM case.

As the above findings confirm, the introduction of a flat rate changes the relative shares of consumer surplus and producer profit within the total surplus, with the former rising and latter declining. Consumers favor the flat rate because it produces a favorable shift in surplus for them.

■ Conclusion

This paper takes some first steps toward examining the impact of a change from a two-part tariff to flat rate on users, suppliers and the overall telecommunications market. An optimal tariff was derived for both parties.

Within any country, designated interest groups exist to serve consumers and suppliers. Conflict between these groups will reflect the trade-off between those political economies conducive to a flat rate and those conducive to a two-part tariff. The optimal two-part tariff can be applied in countries favoring such a tariff, and the optimal flat rate in countries favoring flat rate. Both the two-part tariff and flat rate are optimal, but each is inefficient for different reasons. Different countries must pursue different solutions based on their prevailing social, economic and political climates. Consequently, policy intervention is necessary in pricing. Although each pricing scheme may include some degree of intrinsic inefficiency, policy choices must take into account which inefficiencies are relatively more desirable.

The general public tends to be in favor of flat rates, especially in the use of the Internet. However, our simulation shows that the flat rate entails inefficiencies even if derived from an optimal solution. If this inefficiency is more favorable than that present in other pricing schemes, or if users and suppliers agree to accept it, a policy in favor of flat rates should be pursued. In some cases, however, the two-part tariff may remain more favorable and if so, current policies in support of such tariffs should remain. These choices can be made with reference to existing conditions and political economies.

Since the success of the Internet depends on its flat-rate nature, it is plausible that the political economy of telecommunications is shifting toward users, at least where the Internet is concerned. Indeed, support for flat rate is gaining momentum in other areas of telecommunications as well. As new information technologies gain penetration, flat rates seem inevitable. However, we should remain cautious of introducing such rates because they can act as a disincentive for suppliers to provide services - even though their merit to consumers is apparent.

The results outlined above depend entirely upon the nature of the model and type of simulation conducted. Although our model satisfies the general properties of interactive communications, the results are not necessarily applicable to telecommunications involving content providers, i.e., one-way delivery of information such as broadcasting, WWW content, etc. They should be applied only to markets involving telephone, facsimile, e-mail, etc. Analysis of content-provider markets remains a topic for future study.

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Appendix A: Formulation of the model

We restrict our analysis to an interactive communication service such as telephone, fax and e-mail, excluding one-way services such as broadcasting and database. Interactive communication has a distinctive feature of network externalities or more precisely, demand (or consumption) externalities of telecommunications. Due to this feature, subscriber benefit depends upon the number of subscribers. Therefore, an interactive communication service requires a more specific analytical framework.

Let us consider a complete set of users and potential users of a service. Assume that they distribute continuously and uniformly within the interval [0, 1]. Each user is identified with some unique index ξ.The index $\xi = 0$ denotes the user with the maximum demand and $\xi = 1$ the user with the minimum demand. All users are ranked between $\xi = 0$ and $\xi = 1$ according to the size of potential demand. If the subscription level is *y* $(0 \le y \le 1)$, users with indices between zero and y subscribe to the service and users with indices between *y* and 1 do not. To formulate network externalities explicitly, each user's individual demand function is assumed to have the form $D(m, \xi, y)$. This means that the demand of the user ξ depends on the unit usage charge and the number of subscribers (equivalent to the subscription level in this case).

We assume a monopoly supplier whose costs are composed of variable and fixed components. These are subdivided into a marginal cost per volume of communication *r* and a fixed cost per subscriber *k*. In other words, fixed cost depends upon the number of subscribers. In such a case, a two-part tariff is usually applied:

m : a unit usage charge, C_0 : a fixed charge.

Let the subset [0, y] represent the set of subscribers. For a subscriber ξ, the realizable potential communication is given by:

$$V(\xi, y) = \int_0^y v(\xi, \eta) d\eta ,$$

and the total realizable potential communication is represented by

$$Vr = \int_0^y V(\xi, y) d\eta = \int_0^y \int_0^y v(\xi, \eta) d\eta d\xi .$$

Demand by the subscriber ξ is assumed to depend upon the usage charge *m* and his/her realizable potential communication $V(\xi, y)$, so that:

$v=D(m, \xi, y)=D(m, V(\xi, y))$.

If the demand for communication is regarded as derived demand, it should be finite even if the usage charge is zero. Consequently, $V(\xi, y)$ can be interpreted as demand under a costless environment:

$D(0, \xi, y) = V(\xi, y)$.

Let $B(m, \xi, y)$ denote the gross consumer surplus. Under a two-part tariff, subscriber outlay is:

$C = mD(m, \xi, y) + C_0$ where m : a unit usage charge and C_0: a fixed charge.

The net benefit NB left to the subscriber is:

$NB(m, \xi, y) = B(m, \xi, y) - [mD(m, \xi, y) + C_0]$.

If for the smallest subscriber $\xi = y$ in the subscriber set,

$NB(m, y, y) = 0$

holds, the set $[0, y]$ is in equilibrium. If the net consumer surplus is represented by $\psi(m, \xi, y)$, for the subscriber with index y=y* so that $NB(m, y^*, y^*) = 0$,

$\psi(m, y^*, y^*) - C0 = 0$

holds. The above equation defines a necessary condition for [0, y*] to be in equilibrium. The profit maximization problem for the supplier and the surplus maximization problem for a policymaker can be formulated as follows:

[Profit Maximization (PM) Problem]

$$Max.R = (C_0 - k)y + (m - r)\int_0^y D\ (m, \xi, y)d\xi$$

subject to $\varphi(m, y, y) = C_0$

[Total Surplus Maximization (SM) Problem]

$$Max.W = \left[\int_0^y \varphi(m, \xi, y)d\xi - yC_0\right] + \left[(C_0 - k)y + (m - r)\int_0^y D(m, \xi, y)d\xi\right]$$

subject to $\varphi(p, y, y) = C_0$

The constraint is necessary for the optimal y to be in equilibrium. The optimal solutions to the problems are as follows (see MITOMO, 1992):

[Optimal Solution to PM]

$$m = \frac{re_m}{e_m - 1 + v_y / \bar{v}} \text{ where } e_m = -\frac{\partial D^T(m,y)}{\partial m} \frac{m}{D^T(m,y)}, \quad D^T = \int_0^y D(m,\xi,y) d\xi$$

$$v_y = D(m,y,y), \ \bar{v} = D^T(m,y)/y$$

$$C_0 = \frac{k - (m-r)\partial D^T / \partial y}{1 - e_y} \text{ where } e_y = \frac{\partial \varphi(m,y,y)}{\partial y} \frac{y}{\varphi(m,y,y)}$$

[Optimal Solution to SM]

$p = r$

$$C_0 = k - \int_0^y \frac{\partial}{\partial y} \varphi(p,\xi,y) d\xi$$

For profit maximization, the optimal usage charge is set higher than the marginal cost and the optimal fixed charge diverges from the fixed cost due to the two opponent factors. For social welfare maximization, the marginal-cost pricing principle holds, but the fixed charge is set lower than the fixed cost due to the positive network externalities. If network externalities do not exist, the fixed charge is apparently equal to the fixed cost (an outcome known as Coase's two-part tariff).

Appendix B: Model specifications for simulation

Let $v(\xi, \eta)=\alpha(1-\xi)(1-\eta)$ denote the communication between two subscribers ξ and η, where $\alpha(>0)$ is a constant.

Assuming a uniform and continuous distribution of subscribers, the realizable communication for ξ can be derived by integrating $v(\xi, \eta)$ with respect to η in the interval [0, y]:

$$V(\xi, y)=\alpha(1-\xi)(2-y)y/2$$

We also assume that the demand function is a linear function in m:

$$D(m,\xi,y)=(1-m)\,V(\xi, y).$$

Then, the demand function can be written as

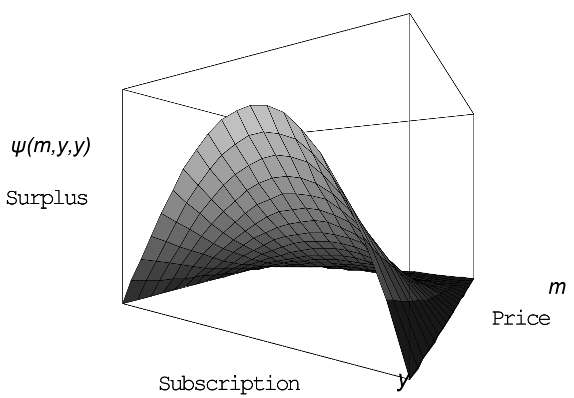
$$D(m,\xi,y)=\alpha(1-m)(1-\xi)(2-y)y/2.$$

The net consumer surplus is

$$\psi(m,\xi,y)=\alpha(1-m)^2(1-\xi)(2-y)y/4.$$

Figure 4 illustrates the net consumer surplus function in the m - y and $\psi(m,y,y)$ space. This is an extension of Rohlfs' famous diagram of network externalities to the two-part tariff case (see ROHLFS, 1974). The two-dimensional parabolic line in Rohlfs' diagram is the section by the plane composed of the subscription level axis and the surplus axis. In the diagram of this section, a line parallel with the axis of subscription level denotes a fixed charge.

Figure 4: The smallest subscriber 's benefit function



Exogenous parameters such as the cost structure of the supplier are given in table 4. These values are given only for convenience of calculation.

Table 4: Parameters

r: Constant marginal cost	0.2
k: Fixed cost per subscriber	5.0
α : Constant for communication function	106.3