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Imperfect Competition, Clubs, and Two-Part Tariffs*

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ABSTRACT: Oligopolistic firms providing clubs charge two-part tariffs: the variable part equals marginal cost and the fixed part depends on the market power of a firm. The market equilibrium is efficient. These results suggest a close analogy between oligopolistic clubs and a monopolist selling a private good who uses a two-part tariff. The mechanisms however differ completely.

KEYWORDS: imperfect competition, clubs, two-part tariff

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TIIVISTELMÄ: Oligopolistisilla markkinoilla toimivat, klubeja (ruuhkautuvaa julkista hyödykettä) tuottavat yritykset perivät asiakkailtaan kaksiosaisen hinnan: muuttuva osa on rajakustannuksen suuruinen ja kiinteän osan suuruus riippuu yrityksen markkinavoimasta. Markkinatasapaino on tehokas. Nämä tulokset viittaavat siihen, että klubeja tuottavien oligopoliyritysten sekä yksityistä hyödykettä tuottavan ja kaksiosaista hintaa perivän monopoliyrityksen välillä olisi läheinen analogia. Tilanteissa vaikuttavat mekanismit ovat kuitenkin täysin erilaisia.

ASIASANAT: epätäydellinen kilpailu, klubit, kaksiosainen hinta

1 Introduction

The theory of clubs analyzes institutions where the *per capita* cost of providing a service declines with the number of persons served, but where congestion reduces each consumer's welfare as the number of users increases. The theory of clubs does not apply only to such facilities as beaches or golf courses. It also applies more extensively: to local governments (Wildasin 1986), macroeconomics (Barro and Romer 1987), schools (Stiglitz 1974), or roads (Newbery 1988). The last three papers rediscovered the theory of clubs.[1]

The properties of clubs in competitive markets and under free entry are well known, and are reported by several authors. In particular, when visits to club are variable the basic result says that a typical firm does not charge a membership fee: the only charge is a visit price equal to marginal cost. Moreover, the market equilibrium is efficient. [2]

Clubs in imperfectly competitive markets are less thoroughly examined. Oligopolistic clubs are studied by Scotchmer (1985a, 1985b).[3] She shows that oligopolistic firms providing clubs charge prices higher than marginal cost and yet the market equlibrium is efficient.[4] In particular, when visits to club are variable, this result means that firms charge a two-part tariff: a visit price equal to marginal cost and a membership fee.

But, perhaps because of the technical difficulty of Scotchmer's papers and because of the novel approaches they use, these important results are not widely known. Also, the relationship between these results and the well-known results in industrial organization literature on a discriminating monopolist charging a two-part tariff seems to be somewhat blurred.

Our paper reanalyzes oligopolistic clubs. We build on the Scotchmer works cited, deriving the central results more intuitively, and more thoroughly discussing the intuition behind them. We also carefully relate the results to the standard industrial organization literature.

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[1]See Cowen and Glazer (1991). For recent summary articles on the theory of clubs and its applications, see Scotchmer (1994) and Glazer, Niskanen and Scotchmer (1995).

[2]The seminal article for competitive clubs is Berglas (1976). Other important works include Boadway (1980), Berglas and Pines (1981), Scotchmer and Wooders (1987), Brueckner and Lee (1989), and Scotchmer (1994).

[3]See also Scotchmer (1994). For analyses of a monopoly firm providing clubs, see Kennedy (1990), and Brueckner and Lee (1991).

[4]Efficiency is here defined for a given number of firms (clubs). When the number of firms is endogenous there will typically in equilibrium be excess entry as compared to social optimum.

2 Assumptions

Consider an economy consisting of N identical persons. Each uses his endowed income I, which he can spend on a private (composite) good and a club good. The private good has a price of 1 per unit; its consumption is x. To consume the club good a consumer must join a club, paying a membership fee F, and a price p for each of his v visits. Each person is a member of one and only one club. The physical size of a club is G. The total number of visits at a club with n members is $T = nv$.

Each consumer's utility function is $u(x, v, G, T)$. The partial derivatives are assumed to satisfy $u_x, u_v, u_G > 0$; $u_T < 0$; $u_{xv}, u_{vG} > 0$; $u_{xx}, u_{vv}, u_{vT}, u_{GT} < 0$; and $u_{xG} = u_{xT} = 0$. The consumer choo ses x and v to maximize utility subject to his budget constraint $x + F + pv = I$.

Each consumer takes as exogenous his income I, congestion (as determined by T), and the values of F, p and G. Solving the consumer's problem yields the first-order condition

$$-u_x p + u_v = 0. \tag{1}$$

The number of clubs in the economy is fixed; we denote this number by k. Each club's cost function is $c(G, nv) = c(G, T)$, with $c_G > 0$ and $c_T > 0$. Each club is a profit-maximizing firm, which chooses F, p, and G. A typical firm takes the choices of F, p, and G by other firms as given. Because of congestion, the firm faces a downward sloping demand curve. A typical firm also considers the effect of its behavior on consumers' utility at other firms: a club which entices more customers reduces congestion at other clubs and increases the utility of customers at these other clubs for given values of F, p, and G.

We shall restrict attention to symmetric equilibria. The population size, N, is supposed to be sufficiently large relative to k so that the number of members, n, in each club can be treated as an integer.

3 Fixed visits by each consumer

We begin the analysis by considering a market where each consumer makes a fixed number of visits at a club, so that v is a constant. For simplicity, we set $v = 1$. A firm's pricing decisions can thus be viewed as setting the membership fee, with the price of visit being zero. The next section considers variable visits.

In a symmetric Nash equilibrium let each of k firms choose the same membership fee F and the same capacity G. Suppose tentatively that firm i sets a fee F^i, physical size G^i, and attracts n^i users. The number of users at each other club is $(N-n^i)/(k-1)$. Since no consumer will use a club that gives him less utility than some other club, in equilibrium consumers will be so distributed as to have the same utility at all clubs.[5]

The equilibrium condition is

$$u(I-F^i,G^i,n^i)=u\left(I-F,G,\frac{N-n^i}{k-1}\right). \tag{2}$$

Solve this equation for n^i as a function of F^i and G^i to find the demand function faced by firm i:

$$n^i=n(F^i,G^i;F,G,k). \tag{3}$$

The partial derivatives of this function are

$$\frac{\partial n^i}{\partial F^i}=\frac{u_x^i}{u_T^i+u_T/(k-1)}<0 \tag{4}$$

$$\frac{\partial n^i}{\partial G^i}=\frac{u_G^i}{u_T^i+u_T/(k-1)}>0. \tag{5}$$

The partial derivatives u_x^i, u_T^i and u_G^i are evaluated at $(I-F^i,G^i,n^i)$. The partial u_T refers to all firms other than i, and is evaluated at $(I-F,G,(N-n^i)/(k-1))$.

The ith firm chooses F^i and G^i to maximize

$$\pi^i=F^in^i-c(G^i,n^i) \tag{6}$$

with n^i given in (3). The first-order conditions are

$$\frac{\partial \pi^i}{\partial F^i}=n^i+(F^i-c_T^i)\frac{\partial n^i}{\partial F^i}=0 \tag{7}$$

$$\frac{\partial \pi^i}{\partial G^i}=(F^i-c_T^i)\frac{\partial n^i}{\partial G^i}-c_G^i=0. \tag{8}$$

[5]Originally, the model is investigated in Scotchmer (1985a).

In equilibrium all firms choose the same values of F, G, and n, so that the superscript i can be dropped. Substitute equations (4)-(5) into (7)-(8) and write N/k for n to obtain the equilibrium conditions

$$\frac{N}{k} + (F - c_T)\frac{u_x}{u_T + u_T/(k-1)} = 0 \tag{9}$$

$$-(F - c_T)\frac{u_G}{u_T + u_T/(k-1)} = c_G. \tag{10}$$

Condition (9) determines the profit-maximizing membership fee:

$$\begin{aligned} F &= -\tfrac{N}{k-1}\tfrac{u_T}{u_x} + c_T \\ &= -\tfrac{N}{k}\tfrac{u_T}{u_x} - \tfrac{N}{k(k-1)}\tfrac{u_T}{u_x} + c_T. \end{aligned} \tag{11}$$

Substituting (11) into (10) gives a condition for the physical size chosen by each club:

$$\frac{N}{k}\frac{u_G}{u_x} = c_G. \tag{12}$$

3.1 Efficiency of equilibrium

Equation (12) is the familiar Samuelson condition for the efficient level of capacity. Equation (11) shows that the membership fee is greater than the sum of the marginal resource cost, c_T and the marginal congestion cost $(-N/k)u_T/u_x$.

Why does the fee exceed marginal cost? The intuition is as follows. A firm which attracts a new member reduces congestion at other clubs, and thereby increases utility at the other clubs.[6] The firm with the additional customer can therefore retain its existing customers only by lowering the fee it charges them. The fee charged the new member must cover this loss.

Is the solution efficient?[7] The excess of the membership fee over the marginal cost of serving an additional customer suggests inefficiency. How-

[6] Recall our assumption that in a Nash equilibrium other firms do not react when one firm changes capacity or prices.

[7] We consider here short-run efficiency where the number of clubs is taken as fixed. The question of long-run efficiency, where the number of clubs is endogenous, is addressed by Scotchmer (1985a).

ever, the fact that the Samuelson condition for capacity is satisfied suggests efficiency.

The true efficiency conditions are obtained by maximizing social welfare, or by maximizing

$$nku(x, G, n) - kc(G, n). \tag{13}$$

Examination of the corresponding first-order conditions shows them to be identical to equations (11)-(12), showing that the market equilibrium is efficient.

The equilibrium is efficient because neither the total number of members in the clubs nor their allocation among the clubs is affected by the price.[8] Indeed, any other arbitrary membership fee, with the restriction or condition that the consumers would be willing to pay for it, would yield an equally efficient solution. The excess of price over marginal cost thus affects only income distribution between the firms' customers and the firms' owners.

4 Variable visits by each consumer

We now extend the analysis to consider clubs with variable visits. As before, we consider a symmetric equilibrium with k firms. Now the equilibrium determines prices F and p and capacity G.[9]

To characterize the equilibrium, suppose tentatively that a representative firm, firm i, chooses values F^i, G^i, and p^i, for given values of F, G, p, n and v at the other firms. The utility-maximizing choices of consumers determine unique equilibrium values of *per capita* visits v^i and membership size n^i in club i.

The first-order conditions for a consumer are:

$$u_x(I - F^i - p^i v^i, v^i, G^i, n^i v^i)p^i + u_v(I - F^i - p^i v^i, v^i, G^i, n^i v^i) = 0 \tag{14}$$

$$-u_x(I - F - pv, v, G, nv)p + u_v(I - F - pv, v, G, nv) = 0. \tag{15}$$

The third equilibrium condition requires that consumers are indifferent between joining club i and joining other clubs:

[8] Only if the number of firms were endogenous could the allocation of members be affected. But here too the total number of members would be fixed by assumption.

[9] The same model is considered in Scotchmer (1985b), with the distinction that she treats capacity as fixed.

$$u(I - F^i - p^i v^i, v^i, G^i, n^i v^i) = u(I - F - pv, v, G, nv). \tag{16}$$

The final equilibrium condition defines the number of members at the other clubs:

$$n = \frac{N - n^i}{k - 1}. \tag{17}$$

These equations can be solved to determine v^i (the demand function for *per capita* visits at firm i) and n^i (the number of users at firm i):

$$v^i = v(F^i, p^i, G^i; F, p, G, k) \tag{18}$$

$$n^i = n(F^i, p^i, G^i; F, p, G, k). \tag{19}$$

For tractability we henceforth assume utility is transferable: $u = x + h(v, G, T)$. Then equations (14)-(17) reduce to

$$-p^i + h_v(v^i, G^i, n^i v^i) = 0 \tag{20}$$

$$-p + h_v\left(v, G, \frac{N - n^i}{k - 1} v\right) = 0 \tag{21}$$

$$h(v^i, G^i, n^i v^i) - F^i - p^i v^i - h\left(v, G, \frac{N - n^i}{k - 1} v\right) + F + pv = 0. \tag{22}$$

These equations can be used to determine the partial derivatives of v^i and n^i with respect to F^i, p^i and G^i. For example,

$$\frac{\partial v^i}{\partial F^i} = \frac{1}{|J|} v^i h^i_{vT} M \tag{23}$$

where

$$M = h_{vv} + \frac{N - n^i}{k - 1} h_{vT}, \tag{24}$$

and the Jacobian is

$$|J| = -v^i h^i_T h^i_{vv} M - \frac{v}{k - 1} h_T h_{vv} \left(h^i_{vv} + n^i h^i_{vT}\right). \tag{25}$$

The superscript in h^i means that the expression is evaluated at (v^i, G^i, n^i); the derivatives without the i superscript are evaluated at (v, G, n).

Firm i chooses F^i, p^i and G^i to maximize its profit

$$\pi^i = F^i n^i + p^i n^i v^i - c(G^i, n^i v^i), \tag{26}$$

where v^i and n^i are given in (18) and (19). The first order conditions are:

$$\frac{\partial \pi^i}{\partial F^i} = n^i + F^i \frac{\partial n^i}{\partial F^i} + (p^i - c_T)\left(v^i \frac{\partial n^i}{\partial F^i} + n^i \frac{\partial v^i}{\partial F^i}\right) = 0 \tag{27}$$

$$\frac{\partial \pi^i}{\partial p^i} = F^i \frac{\partial n^i}{\partial p^i} + n^i v^i + (p^i - c_T)\left(v^i \frac{\partial n^i}{\partial p^i} + n^i \frac{\partial v^i}{\partial p^i}\right) = 0 \tag{28}$$

$$\frac{\partial \pi^i}{\partial G^i} = F^i \frac{\partial n^i}{\partial G^i} + (p^i - c_T)\left(v^i \frac{\partial n^i}{\partial G^i} + n^i \frac{\partial v^i}{\partial G^i}\right) - c_G = 0. \tag{29}$$

Drop superscript i and substitute expressions for the partial derivatives $\partial v^i/\partial F$ and so on to obtain the equilibrium conditions:

$$\frac{N}{k}\frac{k}{k-1} v h_T h_{vv} + FL + (p - c_T) v h_{vv} = 0 \tag{30}$$

$$\begin{array}{l} \left[F(vL - \frac{N}{k}h_T) + \frac{N}{k}\frac{k}{k-1}v^2 h_T h_{vv}\right] L \\ +(p - c_T) v h_{vv}(vL + \frac{N}{k}\frac{1}{k-1}h_T) = 0 \end{array} \tag{31}$$

$$\begin{array}{c} F\left(h_G L - \frac{N}{k}h_T h_{vG}\right) L + \\ (p - c_T)* \\ \left[v(h_G L - \frac{N}{k}h_T h_{vG})L + \frac{N}{k}\left(\frac{1}{k-1}v h_T h_{vG} h_{vv} + v(h_T h_{vG} - h_G h_{vT})L\right)\right] \\ +\frac{k}{k-1}c_G v h_T h_{vv} L = 0 \end{array} \tag{32}$$

where $L = h_{vv} + \frac{N}{k}h_{vT}$.

Solve (30) and (31) for F and p to find the profit-maximizing prices

$$F = -\frac{N}{k}\frac{1}{k-1}\frac{v h_T}{1 + (N/k)(h_{vT}/h_{vv})} \tag{33}$$

$$p = -\frac{N}{k}h_T + c_T. \tag{34}$$

Substitute expressions (33) and (34) to find the first-order condition for the profit-maximizing capacity:

$$\frac{N}{k}h_G = c_G. \tag{35}$$

4.1 Efficiency of equilibrium

The familiar Samuelson condition for the efficient level of capacity is again satisfied by equation (35). Equations (33) and (34) show that profit-maximizing firms charge both a membership fee, F, and a visit price, p. The visit price exactly covers the marginal cost of a visit.[10]

The visit price equals marginal cost because an oligopolistic firm selling a homogeneous product which tried to charge a higher visit price would lose all its customers to other firms. The positive membership fee charged a new customer equals the revenue loss that a firm with an additional customer suffers from the reduced fees it must charge existing customers to continue attracting them.

The market solution is efficient, both in the number of visits by each consumer and in the allocation of consumers among clubs (firms). Each consumer makes an efficient number of visits because the visit price exactly covers marginal cost. The allocation of consumers among clubs is efficient (despite the membership fee) because this fee does not affect any allocation of resources: we consider here the symmetric allocation of a given number of identical consumers among a given number of identical clubs.[11]

5 Two-part tariffs in oligopolistic clubs and in a discriminating monopoly

Well-known results in the industrial organization literature say that a perfectly discriminating monopolist producing a homogeneous private good charges a two-part tariff: the unit price equals the marginal cost of producing the

[10]Recall that for the transferable utility function $u_T = h_T$ and $u_x = 1$.

[11]Recall that we consider short-run efficiency, for a given number of firms. Scotchmer (1985b) shows that the long-run equilibrium, where the number of firms is endogenous, may be inefficient: the rents earned by each firm can induce excessive entry.

good; the fixed price extracts the consumers surplus.[12]

The results for clubs at first appear the same. Scotchmer (1985b, p. 461), for example, stresses the similarities. We think this analogy is wrong. First, in contrast to a perfectly discriminating monopolist, an oligopolistic club does not extract all consumer surplus. Instead, the membership fee equals the loss that the firm incurs on its inframarginal members when attracting an additional one. Indeed, the size of the membership fee is not linked to the size of consumer surplus.[13]

Second, the equality of price and marginal cost arises from different causes in the two different markets. An oligopolistic club in equilibrium charges a visit price equal to marginal cost because if charged a higher price it would lose all its customers. A perfectly discriminating monopolist charges a visit price equal to marginal cost because it thereby maximizes the consumers surplus it extracts.

These considerations also show that, though the equilibria are efficient in both markets, the mechanisms leading to efficiency completely differ.

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[12] A classic paper is Oi (1971); Calem and Spulber (1984) extend the argument to oligopolistic firms with product differentiation. See also Tirole (1988, ch. 3) and references therein.

[13] Here consumer surplus refers to a consumer's benefit compared to not having the service at all; it does not refer to the benefit at one club compared to another. In equilibrium consumers get the same consumer surplus at all clubs, so it is uninteresting to speak of one club extracting consumer surplus in the second sense.

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6 Notation

$c(G, T)$ Cost function of club

F Membership fee at club

G Physical size of club

I Income

k Number of clubs

n Number of members at club

N Number of consumers

p Price of visit at club

T Total number of visits at club

$u(x, v, G, T)$ Utility function

v Number of visits at club by each member

x Consumption of private good

$x + h(v, G, T)$ Separable utility function