ON FREQUENT FLYER PROGRAMS AND OTHER LOYALTY-INDUCING ECONOMIC ARRANGEMENTS

by

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Discussion Paper Number 1337
September 1987

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This paper grew out of a conversation with Steve Salop. We had useful discussions with Doug Bernheim, Jeremy Bulow, Paul Klemperer, Mike Whinston, and Jeff Zweibel. The current paper represents a drastic revision of an earlier paper circulated by the second author.

Frequent flyer plans are in the words of one airline executive "the strongest and most effective marketing program in place today." He explains "Airlines buy brand loyalty for a price. The price is the award." These programs have been overwhelmingly successful -- counting commuter carriers, more than 100 airlines including every major U.S. and European carrier is part of a frequent flyer plan. A typical journalistic account suggests some reasons why these plans have been so successful, "Depending on how they are implemented, they can ensure a frequent flyer's long-term loyalty, or be used to woo travelers from another airline. They can help protect an airline's existing traffic during a crisis or be an effective promotional tool when a carrier wants to attract business to a new route".[1]

Frequent flyer plans are only one example of what might be labelled as loyalty inducing economic arrangements. Other examples include airlines' practice of rewarding travel agents who concentrate bookings, stores and restaurants' common policy of doing special favors for repeat customers, landlords' practice of charging high rents to new tenants and lower rents to older tenants, firms' common policy of rewarding senior workers disproportionately to their productivity, and casinos' practice of laying on all sorts of special benefits for regular customers. Loyalty inducing arrangements have as their salient characteristic a commitment on the part of firms to charge lower effective prices to old than to new customers without any advance commitment as to the overall level of prices. While specific instances can be given idiosyncratic explanations, (e.g., frequent flyer programs may be viewed as a form of tax-free kickback to business travelers) the pervasiveness of loyalty-inducing arrangements suggests the need to look for non-idiosyncratic explanations.

Traditional models do not provide a convincing rationale for their existence. Loyalty-inducing arrangements differ fundamentally from quantity discounts or general non-linear pricing schemes where firms commit to a schedule of absolute prices for purchasers of different quantities. Nor is it easy to rationalize these arrangements on the basis of price discrimination arguments. Frequent flyers, ensconced tenants and regular shoppers almost certainly have less elastic product demands than do other customers so price discrimination arguments suggest that they should face high not low prices. Cremer (1984) suggests one possible rationale for favoring regular customers, involving goods with an "experience aspect" but this explanation is not very satisfactory for a homogeneous product like airline travel.

This paper presents a model of loyalty-inducing arrangements as collusion-facilitating devices. The basic intuition is simple. Inducing loyalty enables firms to split the market and so to charge higher prices. Price cutting becomes less attractive when customers' costs of switching between products is increased. Furthermore, firms may resist cutting prices and taking over whole markets in order to insure that their rivals have hostage customers in subsequent periods. We demonstrate in the context of a simple example that loyalty-inducing arrangements can arise as perfect equilibria of sequential games and that they can increase payoffs to all the participants in every period.

Our analysis is very closely related to the burgeoning literature on switching costs (see especially Klemperer (1987a,b), as well as Farrell

(1985), von Weizacker (1984), and Green and Scotchmer (1986)). Loyalty-inducing economic arrangements may be thought of as artificially generated switching costs. While the switching cost literature focuses on the pricing implications of the fact that switching between suppliers is costly to customers, our focus is on pricing policies which artificially make it expensive for customers to switch between suppliers. Our analysis supplements earlier studies by examining the considerations that determine the extent to which firms will artificially seek to lock in customers. We also add some empirical content by considering the evolution of frequent flyer plans in some detail.

Section I presents the basic two-period, two-firm model. Section II assesses the robustness of the conclusions with respect to changes in the number of periods and firms, and then considers issues relating to casual travelers and entry by new firms. Section III assesses the correspondence between the theoretical analysis and actual frequent flyer programs. Section IV concludes by discussing directions for future research.

I. The Model

The analysis is described in terms of competition between airlines for concreteness. It could be easily translated to other contexts.

The basic model embodies the following assumptions which we list and then discuss.

1. The game lasts for two periods.

2. There are two firms A and B which produce the same good at a marginal cost of 0. We assume that the firms chose their actions to maximize undiscounted expected profits over the two periods.

3. There are two types of competition between the firms:
   - Competition in prices
   - Competition in coupons offered to repeat customers (frequent flyers).

4. At the beginning of the first period, both firms simultaneously announce coupons c_2^A and $c_2^B \geq 0$, which are discounts on the price on period 2 available to customers who buy the firm's product in period 1 and buy again in period 2.

5. Once the coupons are set firms are involved in price competition in the price of the good for that period. The structure of competition is that one firm sets its price first and the other firm follows. In the first period the price leader is selected randomly. In the second period the firm which had a bigger market share in the first period leads. In the case where they both have exactly the same market shares the leader is selected randomly.

6. The same consumers participate in the market in both periods. The reservation demand of each consumer is 1 unit and the reservation price is 1. The consumer population is represented by the [0,1] continuum.

7. Consumers maximize lifetime utility given this period's price and the next period's expected price. The expected price in the second period is

a function of the proportion of consumers who buy from each firm in the first period. We assume that consumers are rational in the following sense:

a. Consumers in the 2nd period of their lives buy from the firm which has the cheaper effective price (price less disccunt).

b. First period consumers seek to maximize utility by choosing whether to purchase, and which firm to purchase from, on the basis of first period prices, P_1^A and P_1^B and expected second period prices. $\tilde{P}_2^A = f(\mu_1^A, \mu_1^B, C_2^A, C_2^B)$ and $\tilde{P}_2^B = f(\mu_1^B, \mu_1^A, C_2^B, C_2^A)$, where μ_1^j is the market share of firm j in period 1. We require that the market shares assumed by consumers in forecasting second period prices equal the market shares actually generated by first period decisions. This is a kind of rational expectations assumption.

8. If the consumer is indifferent, he chooses randomly between the firms.

9. We employ the following notation:

P_{jt}^i: prices set by firm i in the t^{th} period, t = 1,2, when firm j is the price leader.

C_2^A, C_2^B: coupons effective in the second period set in the first period.

μ_1^A, μ_1^B: share of A and B in the customers in the first period.

Π_{jt}^i: profits of firm i, in period t, when firm j is the price leader. We denote total profits of firm i by Π_j^i.

The restrictive but crucial assumption here concerns price-setting. We introduce sequential price-setting because it is well known that with switching costs and simultaneous price-setting, pure strategy equilibria may not exist (see Green and Scotchmer (1986) for example). Since mixed strategy equilibria have, at best, dubious claims to realism in the present context, we introduce sequential price-setting in order to avoid them.[2] Given sequential price-setting, the requirement that the firm with the larger market share is the price leader seems natural. The artificiality of our sequential price setting assumption is mitigated somewhat by the fact that coupons are set simultaneously in the first period prior to the selection of a price leader.

Analysis of the Model

We adopt the customary procedure of solving the two-period game by backward programming. This is complicated by the fact that the second period game depends both on the coupons selected in the first period and the market outcome in the first period. However, a significant simplification is provided by the fact that there are be only four ways the market could have been split in the first period -- A could have it all, $\mu_1^A = 1$ and $\mu_1^B = 0$; B could have it all, $\mu_1^A = 0$ and $\mu_1^B = 1$; they could split the market, $\mu_1^A = \frac{1}{2}$, and $\mu_1^B = \frac{1}{2}$; or they could both have no share at all, $\mu_1^A = \mu_1^B = 0$. (This is a consequence of our assumption of perfect substitution between the products of the firms and our assumption about consumer behavior.) The second period game depends only on μ_1^A and μ_1^B and the coupons announced by the firms in the first period C_2^A and C_2^B, so that we need only consider a manageable number of cases.

The Second Period Game

Case 1 $\mu_1^A = ½,\ \mu_1^B = ½$

This is the case where consumers have picked up coupons from either A or B (in equal proportions) in the first period and are now going to want to redeem them.

Since $\mu_1^A = 1/2$, leadership is determined by tossing a coin. Suppose the toss of the coin selects A. (The case where B is the leader is parallel.) First, suppose that A chooses $0 \leq P_2^A \leq 1$. Then, the only interesting options available to B and their results are as given below:

P_2^B	Π_{A2}^B	Π_{A2}^A
$P_2^A + C_2^B$	$1/2P_2^A$	$1/2(P_2^A - C_2^A)$
$P_2^A - C_2^A$	$P_2^A - C_2^A - 1/2C_2^B$	0

Now if A wants B to cooperate by not undercutting, it must set P_2^A such that

$$½P_2^A \geq P_2^A - C_2^A - ½C_2^B$$

or $\quad P_2^A \leq 2C_2^A + C_2^B.$

Now if $2C_2^A + C_2^B \leq 1$ then A sets $P_2^A = 2C_2^A + C_2^B$ and earns profits of $½(P_2^A - C_2^A) = 1/2(C_2^A + C_2^B) \geq 0$ (since we assume C_2^A and $C_2^B \geq 0$), so that it will want to enforce cooperation. In this case B will earn profits of $1/2P_2^A = C_2^A + C_2^B/2$.

As long as $2C_2^A + C_2^B < 1$, A will set $P_2^A \leq 1$ and hence will follow the strategy described above since setting $p_2^A > 1$ would result in B's undercutting and A not getting any profits. If $2C_2^A + C_2^B > 1$, the preceding discussion demonstrates that setting $P_2^A = 1$ dominates setting $p_2^A < 1$. Hence A's serious options involve setting $1 + C_2^A \geq p_2^A \geq 1$. (Setting $p_2^A > 1 + C_2^A$ yields 0 profits and is therefore uninteresting.) B's possible responses and the associated profits when $1 \leq p_2^A \leq 1 + C^A$ are:

P_2^B	Π_{A2}^B	Π_{A2}^A
$(1 + C_2^B)$	$\frac{1}{2}$	$\frac{1}{2}(P_2^A - C_2^A)$
$P_2^A - C_2^A$	$P_2^A - C_2^A - \frac{1}{2}C_2^B$	0

In order to enforce co-operation from B and earn positive profits, A will have to set P_2^A such that

$$\tfrac{1}{2} \geq P_2^A - C_2^A - \tfrac{1}{2}C_2^B$$

or $$P_2^A \leq \tfrac{1}{2} + C_2^A + \tfrac{1}{2}C_2^B$$

Now, since $C_2^A + \frac{1}{2}C_2^B > \frac{1}{2}$, the constraint that $P_2^A \geq 1$ does not prevent A from setting $P_2^A = \frac{1}{2} + C_2^A + \frac{1}{2}C_2^B$. The constraint $P_2^A \leq 1 + C_2^A$ may, however, limit P_2^A. Optimal strategy is therefore to set $P_2^A = \min(\frac{1}{2} + C_2^A + \frac{1}{2}C_2^B, 1 + C_2^A)$, Profits from this strategy will be $\min(\frac{1}{2}(\frac{1}{2} + \frac{1}{2}C_2^B), \frac{1}{2})$.

Summarizing the results obtained so far, we see that if $2C_2^A + C_2^B \leq 1$, then:

$$\Pi_{A2}^A = \frac{C_2^A + C_2^B}{2} \qquad \Pi_{A2}^B = C_2^A + \frac{C_2^B}{2} \quad ;$$

and if $2C_2^A + C_2^B > 1$, then:

$$\Pi_{A2}^A = \min(\tfrac{1}{2}(\tfrac{1}{2} + \tfrac{1}{2}C_2^B), \tfrac{1}{2}) \qquad \Pi_{A2}^B = \tfrac{1}{2}$$

Since the inequalities, $\frac{C_2^A + C_2^B}{2} \leqslant \frac{1 + C_2^B}{4}$ and $C_2^A + \frac{1}{2}C_2^B \leqslant \frac{1}{2}$ are satisfied if and only if $2C_2^A + C_2^B \leqslant 1$

it follows that:

<u>Proposition 1</u>: If $\mu_2^A = \frac{1}{2}$ and $\mu_2^B = \frac{1}{2}$, the profits from the second period equilibrium will be given by,

$$\Pi_{A2}^A(\tfrac{1}{2},\tfrac{1}{2}) = \min\left(\frac{C_2^A + C_2^B}{2}, \frac{1 + C_2^B}{4}, \tfrac{1}{2}\right)$$

$$\Pi_{A2}^B(\tfrac{1}{2},\tfrac{1}{2}) = \min(C_2^A + \tfrac{1}{2}C_2^B, \tfrac{1}{2})$$

$$\Pi_{B2}^A(\tfrac{1}{2},\tfrac{1}{2}) = \min(C_2^B + \tfrac{1}{2}C_2^A, \tfrac{1}{2})$$

$$\Pi_{B2}^A(\tfrac{1}{2},\tfrac{1}{2}) = \min\left(\frac{C_2^A + C_2^B}{2}, \frac{1 + C_2^A}{4}, \tfrac{1}{2}\right)$$

Proof: See above.

Notice that profits are an increasing function of coupon sizes. Large coupons serve to split the market and so allow more cooperative pricing. Given that their rivals have one-half of the incumbent customers, firms benefit from increases in their rival's coupon because this deters their rival from undercutting them. For sufficiently large coupons, (C_2^A and C_2^B greater than 1) the joint monopoly outcome where the firms split the market's unit profit is attainable. Further increases in coupons are then translated one for one into higher prices leaving net prices and profits unaffected.

Case 2 $\mu_1^A = 1,\ \mu_1^B = 0$, or $\mu_1^A = 0,\ \mu_1^B = 1$

Let us next consider the case when $\mu_1^A = 1$, i.e., A has captured the market. The case where $\mu_1^A = 0$ is parallel. The table of profits and responses is particularly simple in this case:

P_2^B	Π_{A2}^B	Π_{A2}^A
$P_2^A - C_2^A$	$\frac{1}{2}(P_2^A - C_2^A)$	$\frac{1}{2}(P_2^A - C_2^A)$
$P_2^A - C_2^A - \epsilon$	$(P_2^A - C_2^A)$	0

A has no incentive for setting $P_2^A - C_2^A < 0$ and, given this, B will always undercut and capture the whole market. Now it is obvious that A is indifferent between all non-negative values of $P_2^A - C_2^A$ and may set any one of the values. Thus, we conclude:

Proposition 2: $\Pi_{A2}^A(1,0) = 0$ $\qquad$ $\Pi_{B2}^A(0,1)\ \epsilon[0,\ 1]$

$\Pi_{A2}^B(1,0)\ \epsilon[0,1]$ $\qquad$ $\Pi_{B2}^A(0,1) = 0$

However, there are a number of reasons for focusing only on one of these equilibria; the one in which $\Pi_{A2}^B(1,0) = \Pi_{B2}^A(0,1) = 0$. First, this turns out to be the unique equilibrium of the corresponding game with players setting prices simultaneously. Second, this leads us to the equilibrium in which the leader in the last period uses his indifference most effectively (for more discussion of indifference as a threat see Dewatripont (1987)). Finally this turns out to be the unique outcome of an extension of our basic game in which in every period starting the second period there is a vanishing probability that the game will continue for another period (the actual outcome being known to the players only after they set prices for the relevant period). As a result, we will assume from now on that

$$\Pi^A_{A2}(1,0) = 0 \qquad \Pi^B_{A2}(1,0) = 0 \qquad \Pi^A_{B2}(0,1) = 0 \qquad \Pi^B_{B2}(0,1) = 0$$

The rather paradoxical consequence suggested by Proposition 2, that getting a very large share of the locked-in customers may be counterproductive, is similar to the result obtained in Klemperer (1987b) in a model with switching costs about there being "underinvestment in building a customer base." The intuition is simply that attached customers of rival firms serve as hostages and reduce their incentive to cut prices. In the case when one firm has no hostages there will be no such guarantee and a price war will result.[3] As we discuss below, the fact that a firm may prefer for its rival to have hostage customers raises the possibility that the introduction of coupons may reduce competition in the first as well as the second period.

<u>Case 3</u> $\mu^A_1 = 0,\ \mu^B_1 = 0$

In this case, the coupons do not come into play and so the zero profit Bertrand equilibrium is attained in the second period. That is:
$\Pi^A_{A2}(0,0) = \Pi^B_{A2}(0,0) = \Pi^A_{B2}(0,0) = \Pi^B_{B2}(0,0) = 0.$

The First Period Game

In discussing of the Period 2 game we implicitly used the definition of "Rational Consumer Behavior" introduced above. In the case where there is only one remaining period, it reduced to buying from the producer with the lower price. "Rational Consumer Behavior" in the first period is not quite so trivial since we have to consider prices in both periods. However, it turns out that buying from the lower priced seller is still "Rational" since if everyone were to purchase from the lower priced seller, everyone could rationally anticipate that both firms would charge a net price of zero in the second period, and no measurable subset of consumers could benefit by defecting to the higher priced firm.[4] Given this assumption, we are able to demonstrate:

Proposition 3: All equilibria of the Period 1 game involve $C_2^A \geqslant 1$,

$$C_2^B \geqslant 1 \text{ and } P_{A1}^A = P_{B1}^A = P_{A1}^B = P_{B1}^B = 1$$

Proof: Assume that coupons have been set and A has been chosen to be the leader. The case where B is the leader is symmetric

Suppose A sets $P_{A1}^A > 0$. If B undercuts this price it gets P_{A1}^A in first period profits and no second period profits, since we have already shown that if one firm starts with the whole of the market second period profits will be 0. If on the other hand B exactly matches this price it will share the first period market, and share in a cooperative outcome in the second period. Using Proposition 1, its expected profits will be:

$$\Pi^B_A = \tfrac{1}{2}P^A_{A1} + \tfrac{1}{2}\min(\tfrac{1}{2}C^A_2 + \tfrac{1}{2}C^B_2) + \tfrac{1}{2}\min(\tfrac{1}{2}, \frac{1 + C^A_2}{4}, \frac{C^A_2 + C^B_2}{2})$$

In order not to be undercut by B in period 1 and so earn zero profits in both periods, A must set

$$P^A_{A1} = \tfrac{1}{2}P^A_{A1} + \tfrac{1}{2}\min(\tfrac{1}{2}, C^A_2+\tfrac{1}{2}C^B_2) + \tfrac{1}{2}\min(\tfrac{1}{2}, \frac{1 + C^A_2}{4}, \frac{C^A_2 + C^B_2}{2})$$

or $$P^A_{A1} = \min(\tfrac{1}{2}, C^A_2+\tfrac{1}{2}C^B_2) + \min(\tfrac{1}{2}, \frac{1 + C^A_2}{4}, \frac{C^A_2 + C^B_2}{2}).$$

As a leader, A's expected first period profits will be:

$$\Pi^A_{A1} = \tfrac{1}{2}\min(\tfrac{1}{2}, C^A_2+\tfrac{1}{2}C^B_2) + \tfrac{1}{2}\min(\tfrac{1}{2}, \frac{1+C^A_2}{4}, \frac{C^A_2+C^B_2}{2}).$$

It is clear from the expressions for Π^A_{A1} and Π^B_{A1} and the expressions for second period profits in Proposition 1 that both firms gain in both periods from increases in either firm's coupon as long as C^A_2 or C^B_2 is less than 1. Hence the only equilibria of the first period game will have $C^A_2 > 1$ and $C^B_2 > 1$. For these coupon values, it is clear that:

$$P^A_{A1} = P^A_{B1} = P^B_{A1} = P^B_{B1} = 1$$

Proved.

Now to summarize the results of this two-period model:

$$C_2^A \geq 1, \; C_2^B \geq 1$$

$$P_{A1}^A = P_{B1}^A = P_{A1}^B = P_{B1}^B = 1$$

$$P_{A2}^A - C_2^A = P_{A2}^B - C_2^B = P_{B2}^A - C_2^A = P_{B2}^B - C_2^B = 1$$

$$\Pi_A^A = \Pi_A^B = \Pi_B^A = \Pi_B^B = 1$$

In the absence of coupons, firms would earn zero profits in both periods because of Bertrand competition, but the existence of loyalty-inducing arrangements makes it possible for both firms to attain the fully collusive outcome in both periods. The joint monopoly solution is attainable in the second period because the artificial switching costs eliminate competitive forces. One might expect that the possibility of locking in customers, who could be charged monopoly prices in the second period, would lead to especially sharp competition in the first period. The structure of our game, however, leads to the opposite conclusion because the maintenance of collusion in the second period requires that both firms have hostage customers. Indeed in the special case considered here, firms are able to attain the fully cooperative solution in the first as well as the second period.

II. Extensions

While solution of a general model with N firms and T periods becomes intractable, we are able to assess the robustness of these results along several dimensions. We consider in turn the effects of increasing the number of firms, allowing for more periods, recognizing that not all customers want to fly in all periods and allowing for entry.

A. More Firms

Consider the case where there are three firms, but the same two periods. One can easily check that all the definitions have natural extensions. Further, let us once again select the zero profit equilibrium if one of the players in the last period has no captive customers, and therefore moves last (this is, as before, the unique equilibrium with the agents moving simultaneously). In that case, the unique symmetric pareto optimal equilibrium has $C_1^A = C_1^B = C_1^C \geq 2$, $P_1^A = P_1^B = P_1^C = \frac{1}{2}$, and $P_2^A - C_1^A = P_2^B - C_1^B = P_2^C - C_1^C = 1$. As is is evident, this equilibrium involves the firms cooperating to split the market evenly but obtaining less than monopoly profits ($P_1^A = \frac{1}{2} < 1$) in the first period. The intuition for this is quite simple. If $P_1^A = P_1^B = 1$ and C was the last firm setting prices, it would always undercut since it gains 2/3 against the 1/3 it loses in the second period. So a lower price is necessary, if firms are not to have an incentive to cut prices in the first period.

It is also notable that the value of the coupons necessary to sustain the second period monopoly outcome is larger with three firms than it was with two. In equilibrium, when the firms split the market, the last firm's benefit from cutting its price to capture the whole market is 2/3 of the entire market as against only ½ of the entire market in the case where there are only two firms. The only way it could be induced to resist this temptation is by making its cost of price cutting larger, which requires it to have larger coupons.

B. More Periods

Our results may trivially be extended to the case where there are T>2 periods. Assume that firms only give out T period coupons, i.e., consumers have to consume from the same firm in T-1 periods before they can use the coupons. It should be clear that if any firm fails to attract consumers in any period there will not be cooperation in any subsequent period. This knife-edge property will enforce cooperation in all periods and so the outcome will be exactly parallel to the two-period model. As one might expect, increasing the number of periods makes it easier to sustain cooperation in the sense that smaller coupons are necessary.

C. New Customers

A major aspect of actual frequent flyer plans is that they discriminate between "frequent" and "infrequent" flyers. Our model in which individuals are identical does not permit us to address this aspect. It turns out, however, that allowing for some consumers to fly in the second period but not in the first has an important qualitative impact on our conclusions -- coupon size is no longer completely indeterminate but is instead determined by a tradeoff between the loyalty inducing effect of larger coupons and the adverse effects of higher gross coupon prices on sales to new customers.

Consider a model in which there is one cohort of consumers who enter the market in the first period, acquire coupons, use their coupons in the second period and leave the market, and another cohort who enter the market in the second period and use their coupons in the third period. If each of these cohorts are exactly the same as the one cohort in the two-period model there will be one unit of demand in the first and last period and two units in the second period. It turns out that there are several equilibria in this case some of which are actually pareto dominated from the point of view of the firms. The different equilibria allow positive profits to be made and there exist equilibria in which firms split the market in all periods.[5]

Monopoly profits are not obtained in any equilibrium. The intuition for this is quite straight-forward. There are two generations in the second period, one of which has a coupon and the other does not. It is easy to see that if monopoly profits are to be realized then the old in the second period have to have positive coupons (if not, then there are two generations of customers in the second period without coupons and if the leader sets the price at 1, the follower can gain 1 by undercutting the leader as against a maximum loss of ½ in third-period profits, so that a lower price must be set). But if the old have positive coupons, then the second period price must be set higher than 1 to extract full consumer surplus from them. This, however, would mean that the young will not buy at all. Thus, in every equilibrium total profits must be less than monopoly profits.

The same argument points to an important effect of allowing for overlapping generations. High coupons for the old in the second period (i.e., coupons given to the young in the first period) imply that the effective price charged to the old will be quite low if the price is set to keep the young in the market (i.e., if the price is not greater than one). Pricing the young out of the market is unattractive for firms because it reduces third as well as second period profits. Unlike in the two period model, it is costly for a firm to increase its coupon value. The conflicting interests of segmenting the market and trying to capture the young consumers determines coupon values.

To be more specific it can be shown that the pareto optimal symmetric equilibrium of the 3-period game will be characterized by:

$$P^A_{A3} - C^A_3 = P^B_{A3} - C^B_3 = P^A_{B3} - C^A_3 = P^B_{B3} - C^B_3 = 1$$

$$C^A_3 = C^B_3 \geq 1$$

$$P^A_{A2} = P^B_{A2} = P^A_{B2} = P^B_{B2} = 1$$

$$C^A_2 = C^B_2 = \frac{1}{4}$$

$$P^A_{A1} = P^B_{A1} = P^A_{B1} = P^B_{B1} = \frac{1}{4}$$

$$\Pi^A_A = \Pi^B_A = \Pi^A_B = \Pi^B_B = 1\frac{1}{2}$$

Notice the following characteristics of the solution which match with our discussion above. First, while C^A_3 and C^B_3 are indeterminate (as long as they are greater than 1) as in the two-period model, C^A_2 and C^B_2 are fully determinate and are equal to ¼. Second, monopoly profits in this industry would be 4 which is greater than total profits under duopoly with coupon setting which are 3. This is also unlike the two-period model. Finally, note that prices increase over the three periods. Indeed, flying in the first period is costless in the sense that the price is just equal to the coupon value.

D. Entry

The introduction of coupons generates positive profits in our otherwise competitive model. It is natural to ask whether this would induce entry.

While the details depend on exact timing assumptions, it generally turns out that the positive-profit equilibria sustained by coupons tends to be fragile to the possibility of entry in the sense that entry may cause a more than proportionate fall in prices and profits. This has the effect of deterring entry.

The simplest case to consider is one in which there is only one incumbent. It will obviously set a coupon of zero to prevent anybody from entering and benefitting from any potential cooperative outcome.

Analysis of the case where there are two incumbents and the entrant considers entering without captive customers in the second period is also straightforward. If incumbent firms assume the possibility of entry, Bertrand competition will drive all firms' profits to zero regardless of whether the entrant enters first, second, or last. This is because the entrant's situation is like that of an established firm with no customers. Hence, if there is a positive cost of entering the outcome must be that there is no entry.

The case where the entrant enters in the first period, when there are two incumbents, is more subtle. In order to build in some asymmetry between the firms, assume that the two incumbents set their coupons first. With two firms, the cooperative equilibrium can be attained if both firms set coupon values equal to 1. We demonstrated earlier that greater coupon values are needed to obtain full monopoly rents in the second period of a 3 firm game. The same kind of argument can be used to show that if two incumbents set their coupons at the value 1, full monopoly rents would not be extracted even if the entrant set his coupon at a very high value.

This allows us to suggest the following possibility for entry deterrence. Let the costs of entry be larger than the maximum profits that the entrant can extract given that the incumbents set their coupons at the value 1, but less than the profits in the 3-firm equilibrium in which everybody sets coupons optimally. Assuming that the entrant does not enter, there are two players so that setting coupons of 1 is optimal for each incumbent. But, given these coupons and our assumption about the costs of entry, the entrant will not enter even if three players can potentially be in the market and make enough profits to cover the cost of entering. The threat of entry like the entry of new customers in subsequent periods thus works to limit coupon sizes.

It is interesting to compare these results with the results obtained by Klemperer (1987b) in the context of switching costs and entry. One basic result that he obtains is also obtained in our analysis -- that having larger coupons may actually encourage entry by promising post-entry cooperative behavior by the incumbent. But, in his model it is always best to have very high switching costs even though medium range switching costs may be worse than very small switching costs. Our result is that very large coupons may turn out to be counterproductive and some medium range coupon will in fact be optimal. The reason for this difference is that, unlike Klemperer, we assume that entrants can acquire captive customers. Hence, the asymmetry between the entrant and the incumbents lies only in the fact that the incumbents can decide the size of their coupons before the entrant decides to enter.

III. Actual Frequent Flyer Programs

How relevant is this analysis to actual frequent flyer programs? Certainly the collusion facilitating effects stressed here are only one of the benefits that airlines have derived from their introduction. In addition to references to customer loyalty, journalistic analyses of frequent flyer programs invariably stress their kickback aspect. Clearly many aspects of frequent flyer programs, including some airlines' unwillingness to mail awards to business addresses and the frequent travel arranger plan for secretaries pioneered by one airline suggest that the kickback motive is an important aspect of frequent flyer plans. But some aspects of their structure suggest that the loyalty inducement effects stressed by our analysis are important as well. And there is weak evidence that frequent flyer plans have served to facilitate collusion and deter entry in at least some instances.

As Table 1 which indicates the market value of various awards makes clear, frequent flyer awards increase more than proportionately with mileage. For most of the airlines, an increase of 50% in the number of miles flown, leads to a doubling in the value of the travel award. At lower mileage levels, the increasing returns element in the reward structure appears to be even more pronounced. This pattern is exactly what would be predicted by the analysis in this paper. If awards were just proportional to the number of flights undertaken, they would not lock in any customers.

This point is clearly recognized by those who structure these programs. Brancatelli (1986) observes, "The accelerated award structure encourages members to take as many flights on American as possible in order to reach the better award levels." He then quotes American's vice president for sales as saying, "Our intention when we designed AAdvantage was to use it to maximize the number of trips a member would take on American. We know frequent flyers don't always use one airline, but we wanted to give them the incentive to use us all the travel they could."

The pure kickback theory provides no satisfactory explanation for why award structures are typically nonlinear. Indeed, the kickback motive would suggest that awards should be proportional to the number of trips taken so that even infrequent travelers could be attracted. One possible counter-argument would hold that forcing customers to accumulate mileage makes it more difficult for companies to appropriate their employees awards. This is questionable. An alternative approach to insuring non-appropriability would be to give gifts (e.g., Polaroid cameras) that employers would not be able to use.

Do nonlinear award structures actually facilitate collusion? One weak bit of evidence comes from the timing of their introduction. Frequent flyer were introduced soon after the advent of deregulation. Kickbacks were presumably profitable for airlines both before and after deregulation. The potential gains from deterring entry and facilitating collusion increased when the CAB stopped regulating prices and entry. More direct evidence comes from the universal tendency of airlines to raise mileage awards on hotly contested routes or when entry is threatened. If the kickback incentive were the whole story, the most generous awards would be offered on the least competitive routes where the marginal return to attracting extra customers was greatest. A final type of evidence indicating that frequent flyer plans are more than kickbacks is that competing airlines maintain separate plans even while honoring each other's tickets. Mutual restraint from going after rivals' incumbent customers is the essence of the collusion facilitation analyzed here.

In the formal analysis presented here, frequent flyer awards essentially took the form of cash gifts. The cost to firms of providing the award equalled the benefit to the recipients. A salient feature of actual programs is that free travel rather than cash is used as an inducement. Brancatelli (1986b) makes clear that this is no accident. Airline marketing executives do not want to pay cash for the gifts they give away. Presumably, this is for the same reason that stores prefer exchanging merchandise to giving refunds -- prices exceed marginal costs. The excess of ticket prices over marginal costs also explains why airlines have strenously fought the development of a market in frequent flyer awards. If price equalled marginal cost, it would be a matter of indifference to firms whether an award was used for discretionary travel or was instead sold to someone who would have travelled anyway. Excesses of price over marginal cost also probably explain why airlines, hotels and car rental firms can all benefit from cooperative award programs.

The observation that awards are given in kind rather than cash helps to rationalize a number of observations about frequent flyer plans made by Levine (1987) in his evaluation of airline deregulation. He argues that airlines without broad rule structures and without a frequent flyer base are at a competitive disadvantage. Large airlines that fly to attractive cities can offer awards worth a given amount to customers at lower cost than smaller carriers. Similarly, he suggests that since new entrants do not have a frequent flyer base, they are likely to find it more costly than incumbents to single out and reward business travelers.

The relative importance of the loyalty and kickback elements in accounting for the success of frequent flyer plans is of academic interest. However, both rationales for these plans imply that they are inimical to economic efficiency. Facilitating collusion almost certainly reduces welfare as well as transferring resources from consumers to producers. Exacerbating agency problems that firms have in dealing with their employees by offering bribes increases socially inefficient spending on monitoring as well as causing workers to make socially inefficient travel plans.

Given the absence of a salient efficiency argument for frequent flyer plans, it seems very likely that taxing award travel as the income it is would improve economic efficiency. For once the necessary record keeping would be a boon since it would help firms monitor employee travel.

IV. Conclusions

The analysis in this paper demonstrates that firms can achieve otherwise unattainable cooperative equilibria in finite period games by pursuing pricing policies that lock in consumers. While we have concentrated on the airline example, we suspect the analysis may have more widespread applicability to other market settings where repeat customers are favored. Examples include landlords' tendency to charge lower rents to new rather than old tenants, and firms' maintenance of a spread between the wages of junior and senior workers. As technology advances and it becomes easier for firms to track their regular customers, loyalty inducing arrangements are likely to proliferate. As an example, casino hotels now use electronic means to identify and reward frequent slot machine players. They claim to do this in order to prevent customers from shopping around different casinos. While high rollers have been "comped" for many years, tracking slot machine players would not have been feasible even a few years ago. This example is instructive because kickback elements are absent.

Economists have become increasingly interested in economic relationships governed by what Art Okun referred to as invisible handshakes rather than the invisible hand. The analysis here suggests that long term bilateral relationships may not always be a technological necessity. Instead they may be a byproduct of successful collusion facilitating strategies. These strategies may involve product design as well as the pricing strategies that have been our focus -- as when camera producers design cameras to be incompatible with standard film. Future work should concentrate on assessing the extent to which loyalty inducing arrangements facilitate collusion.

Footnotes

1. This paragraph is based on Brancatelli (1986b) which is typical of the numerous journalistic reports on frequent flyer programs that we examined.

2. Maskin and Tirole (1986) also make this assumption but they consider an infinitely repeated game and allow for endogenous timing of price changes by the two firms. Since we havé a two-period game and use a fixed rule to determine who sets prices our assumption is stronger than these they employ.

3. This idea of reciprocal hostages is reminiscent of the desirability of saving the adversary's cities at the early stages of a nuclear war.

4. Jeff Zwiebel has pointed out that if a measure zero subset of consumers defect from the low priced seller, they may benefit by receiving a negative net price in the second period. If any measurable subset defects, a partially collusive equilibrium will be obtained in the second period and those that defect will face a higher net price than they would following a purchase from the low cost seller. This issue would not arise if we assume there were a large finite number of customers, or rule out negative prices, or assume that only measurable subsets of consumers could take decisions.

5. A derivation of this result is available upon request.

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Table 1

Current Cash Value of Frequently Brokered Mileage Awards

Airline	Mileage Award	Broker Offers	Brokers Use Awards to Sell Customers:
United	75,000	$1000-$1200	2 first class tickets to Hawaii
United	125,000	$1500-$1900	2 business class tickets to the
United	150,000	$2000-$2800	2 first class tickets to the Orient
American	75,000	$1000-$1200	2 first class tickets to Hawaii
American	120,000	$1600-$1900	2 British Airways business class ticket
American	175,000	$2500-$3000	2 first class international tickets
Delta	70,000	$ 400-$ 600	2 domestic coach tickets
Delta	150,000	$1200-$1500	2 business class international tickets
TWA	60,000	$ 900-$1000	2 international coach tickets
TWA	90,000	$1800-$2400	2 first class international tickets
Northwest	80,000	$1000-$1300	2 business class tickets to Europe
Northwest	120,000	$2000-$2500	2 first class tickets to the Orient
Continental	90,000	$1000-$1100	2 coach tickets to Australia
Continental	110,000	$1500-$1700	2 business class tickets to Australia
Continental	150,000	$2000-$2500	2 first class tickets to Australia
Eastern	120,000	$ 900-$1100	2 TWA coach tickets to Europe
Eastern	170,000	$1500-$1600	2 TWA first class tickets to Europe
Western	75,000	$ 800-$ 900	2 first class tickets to Hawaii

Source: *Frequent Flyer*, June (1986, p.52).