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LOSS LEADER PRICING AND RAIN CHECK POLICY

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Loss leader pricing and rain check policies are common in retail markets, yet research on these topics is surprisingly scarce. In this paper, we study the effects of leader pricing and rain check policy on stores' profits and market outcomes. Suppose stores can accurately predict demand. Might they still run out of stock? We investigate whether such a result is plausible when stores can offer rain checks. The paper also helps resolve an issue that has recently attracted much attention: Should the FTC repeal its rule prohibiting stock outs of advertised sale items?
(Pricing; Loss Leaders; Rain Checks; Featuring)

1. Introduction

Leader pricing is a pricing strategy in which retailers set very low prices, sometimes below cost, for some products to lure customers into stores. The idea is that while customers are in the store to get this good (the leader product), they buy other goods that generate higher profits. This phenomenon is also referred to as "featuring" (Nelson and Hilke 1986). When a featured brand is sold at a loss, stores try to avoid selling large quantities of the loss leader product and want to sell other goods with larger markups. As a result, some stores limit purchases of leader items to one per customer, while others run out of the leader products and offer rain checks to frustrated customers. A rain check is a promise to provide the items at the reduced price sometime in the future.

In this paper, we study the effects of leader pricing and rain check policy on stores' profits and market outcomes. Suppose stores can accurately predict demand. Might they still run out of stock? We investigate whether such a result is plausible when stores can offer rain checks.

Other research on leader pricing and rain check policy is scarce. In one empirical study, Hendon (1976) found that stock outs of sale items were common in his sample of three interstate chain stores. We have conducted a short empirical investigation in two general merchandise stores and also found that stock outs occurred more often for products on sale than for similar products not on sale. In this study, 35 frequently purchased products were preselected for each store. When the two stores advertised sales on similar products, 35 sale items with substantial discounts were selected for each store. We compared the percentages of stock outs for each group in each store one day before the end of the sale. The sales lasted three days. Table 1 shows the percentages of

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TABLE 1

Stock Out Percentages by Store and Product Group

Store	35 Advertised Sale Items	35 Non-sale Items
1	22.9	8.6
2	37.1	5.7

stock outs for sale and nonsale products. As can be seen, the percentages of stock outs for sale items are significantly higher (at the 5% level).

It is hard to explain these results as inventory misjudgements: Why should errors be more frequent for featured items? Furthermore, these stock outs occurred despite a 1971 ruling of the Federal Trade Commission that makes it illegal for stores to advertise sale items not available in sufficient quantities. The stores cannot comply with the law simply by offering rain checks in such circumstances; they must carry sufficient inventories to satisfy customers.

In a recent article in the *Wall Street Journal* (Saddler 1985), it was reported that the FTC is considering repeal of the rule that "requires stores to have enough stock on hand so that the last shopper on the last day of the sale can purchase every time. More than 3000 people have written to the agency in recent months about the proposal; most opposed repeal."

The issue of concern to the retailers and to the FTC is that the rule imposes an inventory burden on retailers that is eventually passed on to consumers. Repealing the rule and allowing stores to offer rain checks to compensate consumers for inventory mistakes could be plausible. The point we make in this paper is that the FTC is ignoring a different aspect of leader pricing and rain checks; the opportunity of using rain checks can actually induce retailers to run out of stock deliberately even when they can accurately predict demand. We investigate a fully informed model of profit-maximizing firms that consciously plan on running out of stock of advertised goods and offering rain checks to those customers who do not find the goods on the shelf. Rain checks are offered to induce customers to come to the store a second time and buy other products. This behavior imposes inefficiencies on the economy.

Leader pricing is not the only reason for "price deals" by stores. Other possibilities are:

(a) Price differentiation: Stores might find it profitable to price discriminate between well-informed and ill-informed consumers (Salop 1977, Shilony 1977 and Varian 1980), or between consumers with high and low transaction costs (Narasimhan 1984, Gerstner and Holthausen 1986, Gerstner and Hess 1987a), or between consumers with high and low willingness to pay (Conlisk et al. 1984, Sobel 1984 and Lazear 1986).

(b) Forward buying: Price dealing can help stores increase profits by inducing consumers to purchase for future consumption (Salop and Stiglitz 1982 and Jeuland and Narasimhan 1985).

(c) Peak load pricing: By offering different prices in different periods, sellers profitably motivate consumers to spread their buying across time periods (Gerstner 1986).

(d) Introductory offers of new products: Effective market penetration can be achieved when sellers offer new products at a special low price (Bass 1980, Jeuland 1981, Jeuland and Dolan 1982 and Kalish 1983).

Most of these papers examine sales strategies by assuming that the retailer sells only one product. Therefore they do not consider multiproduct marketing strategies that rely on substitutability or complementarity relationships that exist in shopping. In this paper we consider complementarity; shoppers who visit a store to buy one product also buy complementary products to reduce the number of future shopping trips or to satisfy urgent needs. In another paper (Gerstner and Hess 1987b) we consider substitutability; when visiting a store consumers are exposed to substitute brands and they may choose to buy these rather than the brand originally on their shopping list.

Interesting questions that are not addressed in our paper are the following: Why do retailers usually feature a relatively small subset of their products? And, why are only particular brands featured and others not? Limited advertising budgets or industry traditions are possible reasons. Different explanations are offered in Holton (1957, p. 20) and Nagle and Novak (1985). First, buyers can more easily remember prices of frequently purchased items. Therefore these items are more likely to be featured. Second, featuring might be a way of price differentiation; stores are more likely to feature brands that are more frequently purchased by price sensitive customers. Nagle and Novak tested these two hypotheses and found them to be supported by the evidence.

Finally, leader pricing can be interpreted as a "bundling strategy" in which stores bundle impulse goods with leader products. Bundling might be used to sort consumers into groups among which a monopolist can profitably price discriminate (Stigler 1963, Adams and Yellen 1976). In this paper, the bundling is a device designed to compete for customers. The purpose is to bring customers to the store with the low-priced leader product, for once they are in the store, the cost of going to another store gives the seller monopoly power over impulse goods.

2. The Model

Consumer Behavior

We will construct a two-period model with N identical consumers. Stores sell a selection of "impulse goods" (products bought on sight without price comparisons across stores)[1] and only one shopping good as a leader product. Each consumer visits only one store in each period (because of high transaction costs) and is willing to spend R dollars on impulse goods each visit but buys only one unit of the leader product either in period 1 or period 2. When the customer finds the leader product on the shelf in period 1, the product has a current reservation value of V to the consumer. If, however, the customer does not find it, the customer gets a rain check and the value is reduced to $\beta V - T$. Here T is the transaction cost to customers of using a rain check (for example, spending time at the service desk, remembering to bring it back to the store, etc.) and β is the discount factor common to sellers and buyers, $0 < \beta < 1$. A rain check guarantees that a frustrated customer will get one unit of the leader product at the current price when the customer visits the same store again in the second period.

Consumers are informed about the leader price and rain check policy and rational by assumption. They compare stores' policies concerning the leader products and each period choose the store that provides them with the highest utility. We simplify notation by distinguishing only between a representative store and all other stores. Small letters describe the behavior of the representative store, and capital letters describe the common behavior of each of the other stores. Let x be the number of customers who visit the representative store in period 1, let q be the quantity of leader product sold in period 1, and let p be the leader product price. The equivalent magnitudes for all other stores are X, Q, and P, respectively.

The number of rain check offers by the representative store is $x - q$, and the fraction of customers who will not find the leader product on the shelf and will use rain checks is

[1] Impulse buying is an important aspect of buyer behavior, and it has been investigated in numerous studies. (See, for example, Stern 1962, Cox 1964, Kollat and Willett 1967, D'Antoni and Shenson 1973.) A most recent large-scale study by Point-of-Purchase Advertising Institution, Inc. shows that roughly 60 percent of all products bought in supermarkets are unplanned purchases (*Marketing News*, March 27, 1987). A high incidence of unplanned buying also occurs in drugstores and in general merchandise stores (Prasad 1975).

$$\alpha = (x - q)/x = 1 - q/x. \tag{1}$$

The transaction cost of frustrated customers, T, is likely to increase with the proportion of customers seeking rain checks because of longer lines at the service counter. For simplicity, assume that T is proportional to α, $T = t\alpha$, $t > 0$, and that all consumers take advantage of rain check offers (consumer heterogeneity will be considered in §6). That is, we assume all consumers have the same transaction costs and that t is not so high that the surplus, $\beta V - \beta p - t\alpha$, obtained when using a rain check is negative. This requires

$$t \leq \beta(V - p)/\alpha. \tag{2}$$

Noting that α is the probability of a stock outage, the consumer's expected surplus from buying the leader product at the representative store equals

$$u = (1 - \alpha)(V - p) + \alpha[\beta(V - p) - t\alpha]. \tag{3}$$

Figure 1 shows three different indifference curves: u_0, u^*, and u_1 derived from (3) when varying p and α. Expression (3) and the indifference curves imply the following: (a) indifference curves closer to the origin represent higher utility; (b) if the probability

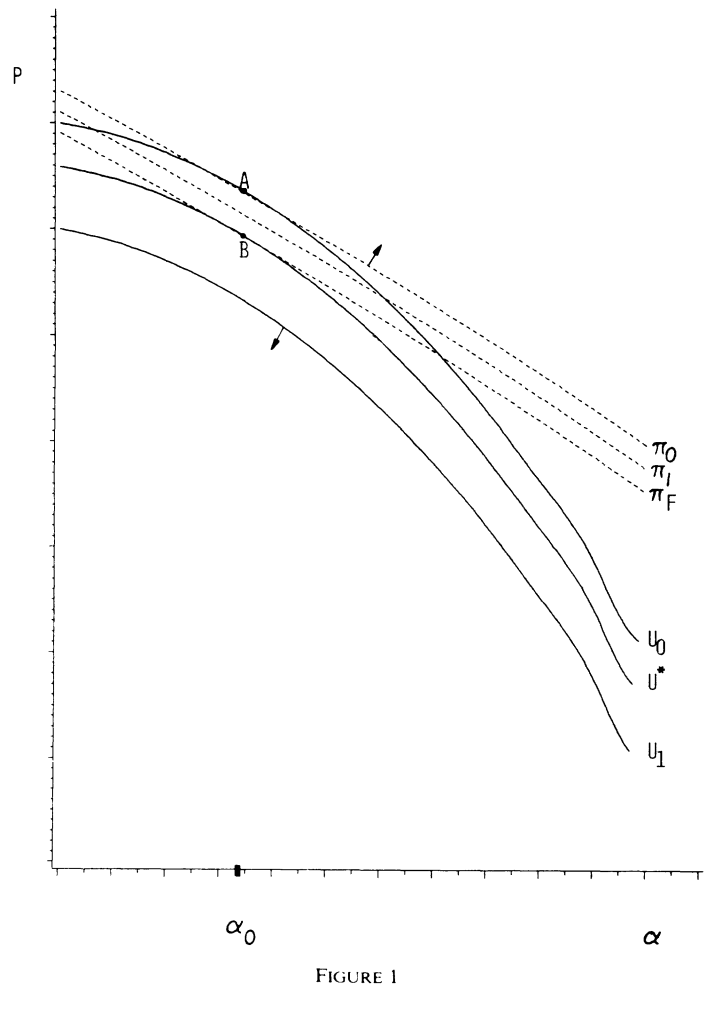

FIGURE 1

of stock out is increased, the price of the leader product must be lowered to keep utility constant; (c) larger price decreases are required as the probability approaches one.

Seller Behavior

There are n profit-maximizing stores in the market. The representative store chooses a price for the impulse good, a price for the leader product, and the fraction of customers who receive rain checks to maximize the present value of profits. Following in the Bertrand (1882) tradition, the store with the best offer attracts *all* consumers.[2] Stores compete by giving better and better offers until they reach a point where the leader product is so inexpensive that leader pricing and rain checks are no longer profitable.

The pricing of impulse goods is straightforward. Consumers decide to buy these products while at the store and do not visit other stores, so each store has complete monopoly power with respect to these goods. The store extracts all consumer surplus from each customer: each customer will spend R dollars and obtain zero surplus from the impulse goods.

Pricing of leader products is more competitive. Consumers compare expected surplus obtained from the leader product (see equation (3)) before selecting a store in the first period. To attract customers, the representative store must offer consumers nonnegative expected surplus, and this surplus cannot be below the expected surplus, U, offered by other stores. Specifically, if $u < U$, no customers visit the representative store in the first period, whereas when $u > U$, all N consumers visit the representative store in the first period. Finally, if $u = U$, N/n consumers visit the store. Therefore, the demand at the representative store is

$$x = \begin{cases} 0 & \text{if} \quad u < U, \\ N/n & \text{if} \quad u = U, \\ N & \text{if} \quad u > U. \end{cases} \tag{4}$$

The profit function of the representative store can now be specified. Start by calculating the store's revenue. When x customers visit the store in the first period, each customer contributes R dollars to revenue by purchasing impulse goods. Of these customers, $(1 - \alpha)x$ also finds the leader product on the shelf and each purchase contributes p dollars. Therefore, the first-period revenue is $Rx + (1 - \alpha)xp$. What is the present value of the second-period revenue? Since αx customers receive rain checks, they come back to the store in the second period for the leader product. Their contribution to revenue's present value, including purchase of impulse goods, is $\beta(R + p)\alpha x$. Some customers shop at the store in the second period without a rain check and just buy the impulse good; these are the consumers who found the leader product on the shelf and had no need for a rain check. There are $(1 - \alpha)x$ customers who purchased the leader product from the representative store in the first period and $(n - 1)(1 - A)X$ consumers who purchased the leader product from other stores in the first period (A is the probability of stock outages at other stores). Since they have already purchased the leader product, these consumers choose a store randomly in the second period and, on average, $[(1 - \alpha)x + (n - 1)(1 - A)X]/n$ customers visit the representative store, each one contributing βR dollars to the present value of revenue.

Considering costs, a store incurs a constant marginal cost, C, to supply the leader product, and the costs of supplying impulse goods and handling rain checks are as-

[2] In the Bertrand oligopoly model firms choose prices rather than quantities, and the firm with the lowest price attracts all the customers for the homogeneous product. The Bertrand equilibrium outcome is competitive in that price equals marginal cost.

sumed for simplicity to be zero. Some leader products are provided in the first period at a unit cost of C and some are provided in the second period at a present value cost of βC. Combining the revenue and cost, the present value of profits is

$$\pi(p, \alpha, x) = x\{R + p(1 - \alpha) + \beta(R + p)\alpha\} + \beta R[(1 - \alpha)x + (n - 1)(1 - A)X]/n - (1 - \alpha)Cx - \alpha\beta Cx. \quad (5)$$

Figure 1 shows three different iso-profit curves π_0, π_1, and π_F derived from (5) when p and α are varied. Expression (5) and the iso-profit curves imply the following: (a) iso-profit curves farther from the origin represent higher profits; (b) if the probability of stock out is increased, the price of the leader product must be decreased to keep the profit constant; (c) for $p < C$, larger price decreases are required as the probability approaches one.

3. The Symmetric Bertrand-Nash Equilibrium

The symmetric Bertrand-Nash equilibrium is defined as a set of values (p^*, P^*, α^*, A^*) that satisfy the following conditions. The values (p^*, α^*) maximize the representative store's profits subject to demand (4), given (P^*, A^*). In equilibrium the magnitudes satisfy the symmetry conditions

$$p^* = P^*, \qquad \alpha^* = A^*. \quad (6)$$

To find the symmetric Nash equilibrium, imagine that all other stores offer a leader price and rain check policy (P, A). This offer provides consumers with expected surplus U. The representative store would contemplate a leader price and rain check policy combination (p, α) that provides consumers with a slightly higher surplus $u_0 = U + \epsilon$. Under the Nash assumption that other sellers leave their prices and rain check policies unchanged, this will attract *all* N consumers to the representative store, increasing its profits. What combination (p_0, α_0) maximizes the representative store's profit for the given u_0? Since the representative store obtains all consumers when u_0 is offered, we substitute $x = N$ and $X = 0$ in the profit expression (5). This gives

$$\pi(p, \alpha) = RN + pN(1 - \alpha) + \beta(R + p)N\alpha + \beta R(1 - \alpha)N/n - (1 - \alpha)CN - \alpha\beta CN. \quad (7)$$

To find the optimal combination (p_0, α_0), first use the surplus formula (3) to solve for p as a function of α. Second, substitute p into the profit formula (7) and maximize the profit function with respect to α. This gives[3]

$$\alpha_0 = [\beta R(n - 1)/n - (1 - \beta)(V - C)]/(2t). \quad (8)$$

Finally, substitute α_0 back into p to get

$$p_0 = V - [u_0 + t\alpha_0^2]/[1 - \alpha_0 + \beta\alpha_0]. \quad (9)$$

The combination (p_0, α_0) is illustrated by the tangency between iso-profit π_0 and the indifference curve u_0 in Figure 1 at point A. It is interesting to note from (8) and (9) that only p_0 depends on u_0. Therefore, the most profitable way the deviant store could offer customer higher utility would be by reducing price, leaving α_0 unchanged.

The combination (p_0, α_0) is not the market equilibrium. The other stores lose all their customers to this offer. To regain customers, these stores will offer expected surplus slightly higher than u_0. One can imagine stores successively undercutting each other in frustrating attempts to build a larger market share. (During this process α_0 remains constant.) When will the process stop?

[3] Second order conditions are satisfied as long as $t > 0$. A necessary and sufficient condition for α_0 to be in the interval [0, 1] is

$$C + \frac{\beta}{1-\beta}\frac{n-1}{n}R - \frac{2}{1-\beta}t \le V \le C + \frac{\beta}{1-\beta}\frac{n-1}{n}R.$$

TABLE 2

Parameter Values						
$t = 2.895$,	$R = 3$,	$V = 15$,	$\beta = 0.9$,	$C = 10$,	$N = 100$,	$n = 10$
Solution Values						
$\alpha^* = A^* = 0.33$,	$p^* = P^* = 5.97$,	$x^* = X^* = 10$,	$\pi^* = 18$,	$u^* = 8.41$		

The process of price cutting will stop and an equilibrium will be reached before loss leader pricing and rain checks become unprofitable. A deviant store can always choose not to use leader pricing. If all other stores continue to use leader pricing with rain checks, all N consumers visit the other stores in the first period. Of these, $(1 - \alpha_0)N$ find the leader product on the shelf. Since these consumers choose a store randomly in the second period, on average the deviant store expects $(1 - \alpha_0)N/n$ second-period customers and can guarantee profit of $(1 - \alpha_0)(N/n)\beta R$ by not selling the leader product. Equilibrium will be reached when the profit obtained under leader pricing and rain checks equals this profit floor,

$$\pi(p, \alpha_0) = \pi_F \equiv (1 - \alpha_0)(N/n)\beta R. \tag{10}$$

In Figure 1 the iso-profit curve that takes on the value of the profit floor is labelled π_F. The equilibrium price can be obtained by substituting $\pi(p, \alpha)$ from (5) into (10), solving for p using the symmetry conditions (6):

$$p_0^* = C - R\frac{1 + \alpha_0\beta}{1 + \alpha_0\beta - \alpha_0}. \tag{11}$$

At this point, a substantial part of monopoly profits from selling impulse goods is wiped out by the leader product being sold at a loss, so stores are indifferent between using leader pricing and selling only impulse goods in the second period. The leader product is sold below its unit cost and the markdown is larger than R when $\alpha_0 > 0$. (Recall that the cost of producing impulse goods is assumed to be zero and, therefore, R is the profit per customer per period from selling impulse goods.)

The unique symmetric Bertrand-Nash equilibrium has now been derived:

$$\alpha^* = A^* = \alpha_0, \qquad p^* = P^* = p_0^*, \qquad x^* = X^* = N/n. \tag{12}$$

Substituting (12) in (5) and (3) gives the equilibrium profits earned by each store and the equilibrium surplus provided to the typical consumer:

$$\pi^* = (1 - \alpha^*)\beta RN/n, \tag{13}$$

$$u^* = V + R - C + \alpha^*\beta R/n + t\alpha^{*2}. \tag{14}$$

The equilibrium is illustrated in Figure 1 at point B where the iso-profit curve π_F is tangent to the indifference curve u^*. The representative store cannot increase profit by using leader pricing without rain checks[4] or by selling only impulse goods in the second period. The price war resulting from the rain check policy has increased the surplus other stores provide customers. These other strategies would reduce customer satisfaction and the representative store would lose all its customers in the first period. Furthermore, if the transaction cost of using rain checks is not too high, the store cannot increase profit by offering the leader product only in the second period (see Appendix).

Table 2 provides a numerical example of a symmetric Bertrand-Nash equilibrium with stock outages and rain checks. The proportion of stock outages in this example

[4] When the representative store uses leader pricing without rain checks, $\alpha = 0$. Setting $\alpha = \alpha^*$, however, would yield higher profit since α^* maximizes the store's profit.

resembles the actual proportions in our sample (see Table 1) and the leader product is sold at 40 percent below costs.

4. The Effect of a Law Eliminating Rain Checks

As shown, leader pricing together with rain check policy gives stores incentives to run out of stock. In this model stock outs occur for no other reason, such as unanticipated demand. What is the effect of a law that prohibits stores from offering rain checks? We will compare the equilibrium and welfare resulting when leader pricing is used with rain check policy to the equilibrium and welfare resulting when leader pricing is used but rain checks are not allowed. Two types of inefficiencies could prevail: inefficiency resulting from sale of loss leaders and inefficiency resulting from stock outages. If V is smaller than C, consumers would not buy the leader product at cost, so the industry would be inefficient when the leader is sold. Yet, stores may sell the leader product below cost to attract impulsive customers. Another inefficiency can be attributed only to stock outages, not to cross subsidization of the leader product by the impulse good. Because we want to concentrate on the inefficiency created by stock outs, it will be assumed that $V > C$.

First, let's calculate the total welfare under a law that forbids rain checks. In this case, stores face a legal constraint $\alpha = 0$. Substituting this in surplus (3) and profit (5) yields

$$u = V - p, \tag{15}$$

$$\pi = (R + p)x + \beta Rx - Cx. \tag{16}$$

The representative store maximizes (16) subject to (15) and demand (4), given U. What is the equilibrium?

When all other stores sell the leader product at P, they provide consumers with surplus U. The representative store can lower its price slightly below P, provide consumers with surplus higher than U, and gain all N consumers. Successive price cutting by all stores would take place until first period profits, $(R + p)x - Cx$, are driven to zero. Sales of impulse goods guarantee that the second-period expected profit is βRx; this will not be eroded by price competition, since stores can always shut down in the first period if the leader price drops too low. Using the symmetry condition (6), equilibrium profit equals

$$\pi^{**} = \beta R(N/n). \tag{17}$$

The equilibrium price is determined by setting first-period profits to zero:

$$p^{**} = C - R. \tag{18}$$

The surplus obtained by each consumer is

$$u^{**} = V - p^{**} = V + R - C. \tag{19}$$

By summing all profits and utilities, the total welfare in the economy is obtained:

$$\begin{aligned} W^{**} = Nu^{**} + n\pi^{**} &= N(V - C + R) + \beta R(N/n)n \\ &= N[V + (1 + \beta)R - C]. \end{aligned} \tag{20}$$

Now consider repeal of the law prohibiting rain checks. What is the total welfare when rain check policy α can be adjusted by stores? From the previous section, we know that stock outages can occur. Sum the profits and utilities given in (13) and (14) to obtain

$$W^* = Nu^* + n\pi^* = W^{**} - \alpha^*[(1 - \beta)V + t\alpha^*]N. \tag{21}$$

$W^{**} - W^*$ measures the relative inefficiency of an economy with and without a law prohibiting stock outs and rain checks.

Comparing the equilibria with and without such a law, the following results are evident:

(A) The price of the leader product is lower when rain checks can be used. (Compare (11) with (18).)

(B) Stores earn lower profits when rain checks can be used. (Compare (13) with (17).)

(C) Consumers obtain higher surplus when rain checks can be used. (Compare (14) and (19).)

(D) The total welfare in the economy is higher with a law that eliminates rain checks. (Compare (20) and (21).)

The results are surprising. The explanation is as follows. Consider first result (A). When the law to eliminate rain checks is in effect, leader pricing is used only to increase first-period sales of impulse products, but when rain checks can be used, stores combine rain checks with leader pricing to gain both first- and second-period sales of impulse goods. Each store has an incentive to lower the leader price further to augment these second-period sales. Therefore, the leader product price is lower without the law.

Now examine result (B). When rain checks may not be used, every store can guarantee the expected profits given in (17) by selling only impulse goods in the second period. Allowing stores to use rain checks opens new marketing opportunities. By offering rain checks, a representative store can dramatically increase from $1/n$ to 1, the probability that a first-period customer will return to the store in period two, so the store anticipates greater profits from offering rain checks to some consumers.[5] To attract customers to the store in the first place, the price of the leader product is reduced. However, this is not the equilibrium outcome. Since all the stores will use this opportunity, profits will be driven below the profit level that would result under the law prohibiting rain checks. The situation is similar to the prisoner's dilemma (Luce and Raiffa 1957, Axelrod 1984). The rain check policy is profitable to the representative store as long as the other stores are not using this strategy. This behavior, however, is myopic; when all stores adopt rain checks, they all lose profits. Stores are better off with the law that eliminates rain checks.

Next consider result (C). Since rain checks enhance competition, consumers can buy the leader product at a lower price. The price decrease must be large enough to compensate for transaction costs incurred when using the rain checks, since the seller must induce the customers to its store. Therefore, consumers are better off with a law that allows rain checks and stock outages.

Finally, result (D) says the economy is more efficient with a law eliminating rain checks. Rain checks do not increase total sales[6] but do introduce transaction costs. The last term in (21) reflects net costs to society of delayed consumption and transaction costs associated with rain checks.[7]

We conclude that laws that limit the scope of "competitive" marketing practices can be economically efficient. How can a law preventing voluntary competitive behavior by firms and individuals be beneficial? An essential ingredient in the model developed here is that the number of customers who buy the product is not increased by the marketing strategy of rain checks and loss leaders. The entrepreneur who first offers rainchecks gains customers from other stores, not expanding the size of the market. Because the policy imposes costs on the customers, it is not efficient. If the total number of customers depends on the offers made by the firms (for example, due to consumer hetero-

[5] In reality, not all customers use rain checks. Consumer heterogeneity is discussed in §6.

[6] Note that in our model the rain checks do not increase sales of impulse products in the market. They only help divert sales from one store to another.

[7] If stores had positive costs of processing rain checks, the last term in (21) would include these costs, but α^* would be smaller.

geneity), the results could be less determinate, as is the case for monopolistic price discrimination (Chiang and Spatt 1982, Varian 1985, and Gerstner and Hess 1987).

5. Sensitivity Analysis

This model of retail marketing leads to some sharp testable hypotheses. Table 3 shows how small increases in the parameters of the economy affect leader pricing, rain check policy and efficiency. The responses of α^* and p^* to parameter changes can be obtained from expressions (8) and (11). The inefficiency created by stock outages is studied by comparing (20) and (21). The results have an intuitive appeal as explained below.

Increased Competition

Column 1 shows how an increase in the number of competitors affects leader pricing and rain check policy. Without a rain check, the probability that a given customer will visit the store in period two is $1/n$. This probability approaches zero when n increases. The store can improve this probability to 1.0 by giving a rain check to the customer. Therefore, when the number of rivals is larger, rain checks are more productive, so α^* increases. Since α^* is larger, the leader price p^* falls to compensate customers for more frequent stock outages and to keep profits from rising above the equilibrium level (10). Surprisingly, greater competition for a fixed number of customers increases the inefficiency of the industry. To prevent loss of customers in the more competitive situation, stock outs are more prevalent, imposing greater transaction costs on the consumers.

Increased Cost

When the cost of the leader product increases, rain checks are more attractive to the store because the cost of the leader product can be delayed: α^* increases when C increases. The impact of a cost increase on price is ambiguous. On the one hand, the increase in stock outages forces price down to compensate customers, but on the other hand, the price must reflect the increased cost of the leader product if profit levels are to be maintained. More frequent stock outs cause greater inefficiencies.

Increased Willingness-to-Pay

When the amount spent on the impulse goods, R, increases, leader pricing and rain checks both are more profitable to stores because of the higher returns from each customer who visits the store. When R increases, p^* is reduced to draw customers to the store and α^* is raised to induce them to return. In the case of larger R, the more frequent stock outages add to inefficiency.

When consumers value the leader product more, any delay in its consumption is more costly. Therefore, α^* decreases when V increases. The decrease in stock outages

TABLE 3

	Store Parameters				Consumer Parameters	
			Demand Values			
	No. Firms n	Cost C	R	V	Transact. Cost t	Discount Rate β
p^*	$-$	?	$-$	$+$	$-$	$-$
α^*	$+$	$+$	$+$	$-$	$-$	$+$
$W^{**} - W^*$	$+$	$+$	$+$	$-$	$-$	?

improves customer satisfaction so the leader price can be raised. The reduction in stock outages mitigates the inefficiency of the economy.

Increased Transaction Costs

Transaction costs, t, affects p^* and α^* in a way similar to that of V. Rain checks are less attractive when the transaction cost of using them increases, so α^* decreases when t increases. The leader price can then be increased without loss of customers.

Increased Discount Rate

An increase in the common discount factor β has a similar effect to that of increased value of impulse goods because consumer willingness to purchase the leader product in the second period increases and the seller is more willing to postpone sales. Again, leader pricing and rain checks are more attractive. An increase in β, however, has an indeterminate effect on efficiency because it makes delayed consumption less detrimental, even though the increased stock outs increase the incidence of delays.

6. Consumer Heterogeneity

In the analysis above, it was assumed that all consumers take advantage of loss leader pricing and rain check policy. In this section we will relax these assumptions. In reality, not all consumers take advantage of loss leaders and rain checks. Research shows that there are different segments among shoppers (Gabor and Granger 1961, Brown 1968, William et al. 1978). Some buyers choose a store based more on its location and services than on its price. Other buyers compare stores' pricing policies more carefully and choose a store accordingly. To model consumer heterogeneity, we will assume that a fraction μ of the N customers do not respond to loss leader pricing and/or rain checks. These customers, called the nonresponsive segment, choose stores randomly. The assumption that consumers in the nonresponsive segment choose stores randomly might look restrictive. However, the results obtained below would still be valid under circumstances in which nonresponsive customers select stores based on location or services, but no store has a location or service advantage; all stores obtain the same share of nonresponsive customers. The following cases will be considered:

(a) The nonresponsive segment responds neither to advertised loss leader pricing nor to rain check offers.

(b) The nonresponsive segment does not respond to advertised loss leader pricing but will use rain checks.

To study these cases we will assume that the other parameters, V, R, β, are still the same for all consumers.

Case (a): *Heterogeneity in response to both loss leader pricing and rain check use.* Suppose that all the consumers in the nonresponsive segment have the same high cost of time. As a result, they do not become informed about the leader price and rain check policy and choose a store randomly. Furthermore, these customers buy the leader product only if it is available at the store in the first period. If the product is out of stock, they do not take the time to get a rain check and choose a store randomly again in the second period (condition (2) does not hold for these customers).

To find the Bertrand-Nash equilibrium for this case, it is useful to note that any store that is not using loss leader pricing and rain checks can guarantee a profit of

$$\pi_F = \mu(R + V - C + \beta R)N/n + (1 - \mu)(1 - A)\beta RN/n. \tag{22}$$

To see this, notice that when leader pricing and rain checks are used by other stores but not by a deviant store, only the nonresponsive consumers visit the deviant store in the first period, $\mu N/n$ on the average. Since these consumers do not learn the price before choosing a store, each is willing to pay the reservation value V for the leader product, and R for the impulse products. In the second period, the deviant store expects not only the $\mu N/n$ nonresponsive customers but also its fair share $(1 - \mu)(1 - A)N/n$ of the responsive consumers who found the leader product on the shelf (and did not need a rain check). Each of these customers buys impulse goods at value R. Therefore each store is guaranteed the profit floor (22).

The representative store can choose to use loss leader pricing and rain checks. Its profit function is then given by

$$\hat{\pi}(p, \alpha, x) = (1 - \mu)\pi(p, \alpha, x) + \mu[R + \beta R + (1 - \alpha)(p - C)]N/n. \tag{23}$$

To see this, note that the profit from the responsive segment is obtained by multiplying $\pi(p, \alpha, x)$ from equation (5) by the proportion $1 - \mu$; the response of these consumers to loss leader pricing and rain checks remains the same. The profit from the nonresponsive segment is computed as follows: there are $\mu N/n$ nonresponsive customers who visit the store at random in the first period. Of these $(1 - \alpha)\mu N/n$ also find the product on the shelf and purchase it at a price p. The first-period expected revenue from the nonresponsive segment is $\mu RN/n + \mu(1 - \alpha)pN/n$. In the second period the nonresponsive customers choose a store for the impulse good only, so revenue is $\mu\beta RN/n$. The expected cost of selling the leader product to these customers is $\mu(1 - \alpha)CN/n$. The combined profit function of the representative store is given by (23).

When all the other stores use loss leader pricing and rain checks, the representative store can also use this strategy but gain all the responsive customers by offering them a utility slightly higher than that offered by the other stores. The combination of (p, α) that maximizes the store's profit is obtained by substituting $x = N$ in the profit function (23) and maximizing with respect to p and α.

A symmetric equilibrium with significant stock outages (similar to the one derived for the case of homogeneous consumers) would exist if the segment of responsive consumers is large relative to the nonresponsive segment. In this case the stores compete for responsive consumers, offering (p, α) combinations with higher and higher expected surplus. The process stops and equilibrium is reached when the profit obtained under loss leader pricing and rain checks just equals the profit floor (22). Table 4 provides a numerical example for the symmetric Bertrand-Nash equilibrium, using the same parameter values as in the example of Table 2 but with various values of μ.

The following results can be observed from the numerical example:

(E) As the proportion of nonresponsive customers, μ, increases, the equilibrium price of the leader product, p^*, increases.

(F) As the proportion of nonresponsive customers, μ, increases, the probability of a stock outage, α, first increases and then decreases.

It can be shown that these results hold in general.

Result (E) is clear. As the size of the nonresponsive segment increases, fewer con-

TABLE 4

Parameter Values

$t = 2.895$, $R = 3$, $V = 15$, $\beta = 0.9$, $C = 10$, $N = 100$, $n = 10$

	$\mu =$ 0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
p^*	6.0	6.0	6.1	6.3	6.4	6.8	7.0	7.5	8.5	10.9	15.0
α^*	0.333	0.337	0.342	0.347	0.352	0.358	0.363	0.359	0.315	0.098	0.000
π^*	18.0	26.8	35.6	44.5	53.3	62.1	71.1	80.1	89.3	98.7	107
u^*	8.41	8.33	8.23	8.09	7.93	7.70	7.38	6.88	6.00	4.25	0.0

sumers compare prices before choosing a store. Therefore the stores can increase their profits by raising the price of the leader product.

To understand result (F), recall that the nonresponsive segment will not use rain checks, but it does take advantage of the leader product if it is available. Loss leader pricing does not influence these customers; they choose a store at random. Therefore, when the leader product is sold at a significant loss, stores prefer not to sell the leader product to the nonresponsive consumers. Since the store cannot distinguish responsive from nonresponsive customers, the only way the store can discourage sales to the nonresponsive segment is to increase stock outs. As the size of the nonresponsive segment continues to increase, however, the price of the leader product increases, so selling the leader product to all customers becomes more and more profitable. To attract responsive customers and to induce the nonresponsive customers to buy the leader product, stock outages must decrease. Therefore, α^* increases for small values of μ and decreases for larger values of μ.

Case (b): *Heterogeneity in response to loss leader pricing only.* The analysis of this case is not much different from that of Case (a). Consumers in the nonresponsive segment still choose stores randomly in the first period, but they will use rain checks when they do not find the leader product on the shelf. Therefore, the profit floor and the profit function under leader pricing and rain checks must be revised.

If loss leader pricing is used by other stores but not by a deviant store, only nonresponsive consumers visit the store in the first period, $\mu N/n$ on average. These uninformed customers are willing to buy the leader product if it is available and will accept a rain check if it is out of stock. In either case they will spend R on the impulse goods. In the second period, responsive and nonresponsive customers who took rain checks from other stores will not visit the deviant store. The deviant store expects its fair share of those customers who did not need rain checks. The profit floor is

$$\pi_F = \mu\{R + (1-\alpha)p + \alpha\beta(R+p) + \beta R[(1-\alpha) + (n-1)(1-A)]/n - (1-\alpha)C - \alpha\beta C\}N/n + (1-\mu)(1-A)\beta RN/n. \quad (24)$$

It turns out that the profit floor is maximized either by choosing zero stock outs, $\alpha = 0$, and setting the price of the leader item equal to the reservation value, V, or choosing to always have stock outs, $\alpha = 1$, and setting the price equal to $\beta V - t$, the highest price that a consumer would pay for a rain check when he is in the store. For the parameter values used in the examples the optimal strategy involves setting α equal to zero in the profit floor (24).

If all the stores use leader pricing and rain checks, the profit function of the representative store is given by:

$$\hat{\pi}(p, \alpha) = (1-\mu)\pi(p, \alpha) + \mu\{R + (1-\alpha)p + \alpha\beta(R+p) + \beta R[(1-\alpha) + (n-1)(1-A)]/n - (1-\alpha)C - \alpha\beta C\}N/n. \quad (25)$$

As in case (a), the profit from the responsive segment is obtained by multiplying $\pi(p, \alpha)$ from equation (7) by the proportion $1 - \mu$. The nonresponsive segment visits stores randomly in the first period, buying impulse goods and, if possible, the leader product. Their second period behavior is different. In this case nonresponsive customers do take advantage of rain checks. Therefore, the representative store expects $\mu\alpha N/n$ nonresponsive customers to use their rain checks, in addition to its fair share of customers who did obtain the leader product in the first period.

Table 5 provides a numerical example of the equilibrium, using the same parameter values as in the example of Table 2 with various values of μ. The following results can be observed:

TABLE 5

	Parameter Values $t = 2.895$, $R = 3$, $V = 15$, $\beta = 0.9$, $C = 10$, $N = 100$, $n = 10$ $\mu =$										
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
p^*	6.0	6.1	6.2	6.3	6.5	6.7	7.0	7.5	8.3	9.9	15.0
α^*	0.333	0.333	0.333	0.333	0.333	0.333	0.333	0.333	0.333	0.333	0.000
π^*	18	26	34	42	50	58	67	75	83	91	107
u^*	8.41	8.32	8.21	8.08	7.91	7.67	7.36	6.88	6.10	4.58	0.00

(G) As the proportion of nonresponsive customers, μ, increases, the equilibrium price of the leader product, p^*, increases.

(H) If there is heterogeneity, the probability of a stock outage, α^*, is independent of the proportion of nonresponsive customers, μ.

It can be shown that these results hold in general.

The intuition for result (G) is the same as for result (E), case (a). To explain result (H), recall that the nonresponsive consumers do not respond to leader pricing, but do take advantage of rain checks. Since all consumers respond in the same way to rain checks, returning to the store in the second period, α does not change when the proportion of the population that is nonresponsive changes.

7. Conclusions

Loss leader pricing and rain check policy are used by retailers in markets where impulse goods are sold. Loss leader pricing draws customers to the store, where they also buy highly profitable impulse goods. Rain checks are introduced to enhance the effect of the loss leader. By running out of the leader item and offering rain checks, sellers bring the customers to their store a second time. The market equilibrium derived above is used to study the effect of changes in marketing parameters on the store's profits and market outcomes. The FTC law that prohibits the use of stock outs and rain checks is also analyzed.

The model generates interesting results. An entrepreneur who introduces rain checks to a market with loss leader pricing initially can earn higher profit. However, should other sellers follow suit, they all would prefer a law that prohibits use of rain checks. Stores benefit from the current FTC regulation as it mitigates this "prisoner's dilemma." On the other hand, one consumer who opposed the repeal of the 1971 ruling forbidding stock outages wrote: "Do you remember how much it costs to make all those trips to a store on the other side of town only to be told they're all out? I bet my costs are a lot higher in gas, time, and trouble and temper" (Saddler 1985). This consumer has not considered the full consequences of repeal. In our model all consumers take advantage of rain checks, but the personal benefit from the reduced prices that rain checks generate exceeds the transaction costs associated with them. Therefore, consumers are better off without the FTC rule. From the social perspective, however, the rule is desirable because it promotes efficiency by reducing transaction costs and delayed consumption.

There appear to be four key elements in the model. First, consumers do not plan purchases of impulse goods and buy only one unit of the leader product. Second, they visit only one store each period (the cost of visiting other stores is too high and exceeds the cost of using rain checks). Third, the number of consumers in the market is fixed and independent of prices that are below the reservation prices. Fourth, all agents are informed and rational. (Stores accurately predict demand and consumers accurately predict stock outs.)

Some of the model's results prevail under weaker assumptions. Leader pricing and rain checks may occur even when customers do not buy impulsively. A typical grocery, general merchandise or drug store carries thousands of products and only a small portion of the products are advertised, since advertising is costly. Consumers may plan consumption of unadvertised goods whose exact prices are not discovered until the consumer is at the store (see, for example, Feichtinger et al. 1987). This gives stores some monopoly power and they can apply higher markups to unadvertised products.

Stores will still have incentives to use rain checks even if consumers would like to purchase leader products every period, or if some consumers would like to purchase only leader products. Even if other leader products are sold every period, rain checks may still be offered. Using rain checks, an entrepreneur can increase the probability that some customers will come back to the store, and in turn, increase profits. If some consumers buy only the loss leader item, sellers could impose a "minimum purchase" requirement that requires buyers of the loss leader item to purchase a certain value of other products to get the leader product at a reduced price. This bundling strategy mitigates this problem of "cherry picking" and does not affect consumers who would purchase more than the minimum anyway.

The economic inefficiencies that occur in our model are due to transaction costs and delayed consumption that result from stock outages (expression (21)). These inefficiencies would still prevail if we assumed that consumers have continuous demand for impulse products and obtain positive utility from consuming them. Another type of inefficiency would result if the cost of producing and selling the loss leader exceeds consumer willingness to pay for the product. Kemp (1955) discusses additional sources of inefficiencies created by leader pricing.

In our model consumers do not punish stores for stock outages. Consumers know about rain check policy, so they anticipate the possibility of a stock out. They accept rain checks as partial compensation, if their transaction costs of using rain checks are not too high. It would be interesting to explore loss leader pricing and rain check policy in a framework where uninformed customers are so frustrated by unexpected stock outs, that they never return to an offending store. This and the limitations just discussed provide areas of exploration for future research.

Finally, loss leaders with rain checks is not the only way to entice customers to return to a seller. Airlines' frequent flyer programs are designed to attract customers back to a particular airline for the next trip. And recently, a fast food restaurant offered a sweepstakes game in which every customer was a winner of a soft drink, sandwich, or french fries. However, the prize could only be redeemed on the next visit to the restaurant![8]

[8] This paper was received in April 1986 and has been with the authors for 2 revisions.

Appendix

If the transaction cost of using rain checks is not too high, the representative store is better off selling the leader product with rain checks in the first period, since every buyer who gets a rain check buys impulse goods twice: in the first period and in the second. If, however, the transaction cost of using rain checks is high, consumers who do not find the leader product on the shelf would pay a significantly higher price for the leader product in the second period to avoid the costs of rain checks. Therefore, when all other stores offer rain checks, a deviant store can increase profit by shutting down in the first period and offering the leader product only in the second period.

The following condition guarantees that a deviant store cannot increase profit by offering the leader product only in the second period:

$$t < \beta(2 - \beta)R/(1 + \alpha_0\beta - \alpha_0). \tag{i}$$

Suppose the leader product is offered only in the second period by a deviant store. Consumers who do not find the leader product on the shelf at the other stores in the first period will prefer to not take a rain check and buy the product from the representative store if its price, p, satisfied $p \leq p_0 + \alpha t/\beta$. That is, p does not exceed the price at the other stores plus the delayed value of the transaction cost customers incur when using rain checks.

Let $\tilde{p} = p_0 + \alpha t/\beta$ be the highest price the representative store can charge for the leader product in the second period. Selling the leader product in the second period is not profitable when $C - \tilde{p} > R$; that is, the loss per customer from selling the leader product exceeds the gain from sales of impulse goods. Condition (i) is obtained by substituting p_0 from (11) in the relation $\tilde{p} = p_0 + \alpha t/\beta < C - R$ and rearranging.

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