Loss Leading and Price Intervention in Multiproduct Retailing: Welfare Outcomes in a Second-Best World

PATRICK PAUL WALSH

Trinity College, Dublin, Ireland and LICOS, Katholieke Universiteit Leuven, Belgium
E-mail: ppwalsh@tcd.ie

and

CIARA WHELAN

The Economics of Industry Group, London School of Economics, London, UK, and LICOS, Katholieke Universiteit Leuven, Belgium

We examine whether loss leading pricing strategies in multiproduct retailing should be a target of antitrust policy. Loss leading is modeled in the presence of imperfect competition and consumer information in a stage game framework. We show that price constraints, used as a second-best instrument, targeted at loss leading can interact with market imperfections to create distortions that can only reduce welfare ex post. Imperfections in the market are moving targets in relation to intervention. Only first-best policy instruments aimed at factors creating endogenous price imperfections can move welfare closer to the bliss point. © 1999 by Elsevier Science Inc.

I. Introduction

We examine whether loss-leading pricing strategies in multiproduct retailing should be a target of antitrust policy. Holton (1957) first formulated the problem with reference to supermarkets or chain stores. In the framework of Coase (1947), he modeled monopoly retail pricing in the presence of interrelated costs and demands. Holton (1957) presents an argument for defining the retail product sold by supermarkets as a basket of goods bought as a package. As a result, the crossprice elasticities of demand are negative among countless combinations of goods, food and nonfood product lines alike, in a supermarket. In supermarket retailing, one cannot charge consumers different prices for the same product, but it is possible to price discriminate across the range

We are grateful to Frank Barry, Jozef Konings, Francis O’Toole, Michael Waterson, and anonymous referees for their comments.

© 1999 by Elsevier Science Inc.
655 Avenue of the Americas, New York, NY 10010
0144-8188/99/$-see front matter
PII S0144-8188(99)00015-0
of products. Products that are more important to the consumer, such as staples or frequently purchased items, can be used as “traffic builders,” as consumers tend to be attracted to an outlet by the pricing of this core subset of products. This creates incentives for multiproduct retailers to price close to or below cost on such Known-Value-Items (KVIs) to attract consumers into their outlet, with the intention of extracting rents on other items sold therein. In the case of a monopoly store, loss leading on KVIs can be considered a form of monopolistic price discrimination that reduces welfare. Holton (1957) does not formally model the impact of retail competition on this outcome, but felt that his results were robust to such. This unjustly brought upon him a wave of criticism for issues not explicitly modeled. Bliss (1988) indicates that the monopoly scenario does not carry over in the presence of retailer competition and full consumer information. Under the assumption of full consumer information, loss leading is not an equilibrium outcome that one should expect.

Yet, loss leading is an observed phenomenon of multiproduct retail pricing that is not confined to supermarket retailing. In restaurants, the main meal can be good value but the extras can be expensive. This can also be observed in the sale of cars—the basic car model can be priced competitively, but the extras can be expensive. Retailers seem to compete on core products and try to earn rents on the additional products or extras they provide. The question is whether this is an equilibrium outcome that can be modeled, and if so, is it an outcome that is welfare reducing. The dilemma facing antitrust authorities in dealing with such loss-leading strategies in retailing is evident in the differential treatment of below-cost retail pricing under European Member State competition laws. Restrictions on below-cost selling are legislated in Ireland, Belgium, France, Luxembourg, and Portugal, but not in Denmark, Germany, Spain, or Italy.1

Compared with Bliss (1988), we model competition between retail stores explicitly. Rather than just using a value for money constraint, we model price and nonprice competition between retailers over the consumer using the Salop (1979) location model. As in Bliss (1988), we do not find loss leading to be an equilibrium outcome under perfect consumer information. However, in multiproduct retailing there are significant information costs to the consumer in finding out prices for the large range of goods sold. Location convenience and the lack of information on the prices of fringe products, non-KVIs, in other stores may give retailers some localized monopoly power in pricing. This paper confirms that loss leading can be an equilibrium outcome observed under conditions of imperfect competition between firms and imperfect consumer information over products. The pertinent issue is whether loss leading on KVIs justifies intervention in the form of price controls. Is it a form of predatory pricing or price discrimination that reduces long-run welfare, or is it an outcome driven by strategic competition between rivals that leaves welfare outcomes at their full information levels? We consider these issues within the second-best world of imperfect competition and consumer information.

Corden’s (1974) distinction between welfare reducing distortions and divergences in the market, with reference to trade policy, can be applied in the context of competition policy. Distortions are the by-products of intervention affecting endogenous outcomes such as welfare, which are created by restraints on price or quantity movements in the market. Divergences are created from the presence of imperfections in the market that produce a gap between social and private net benefits in laissez faire. Under imperfect

---

1For a specific case study of the legislation in the Irish retail grocery market, see Walsh and Whelan (1999b).
competition, the ability to sustain prices above marginal cost in the presence of either horizontal or vertical product differentiation creates endogenous divergences. Resultant welfare under *laissez faire* is not a first-best outcome. In this paper we focus attention on the role of price intervention in the presence of defined endogenous price divergences. The central issue is whether price constraints that target loss leading can move us closer to the first-best welfare outcome, or whether the interaction of price constraints with endogenous divergences lead to distortions that move us even further away from first-best and on to third-best outcomes.

Price constraints in multiproduct retailing are implemented based on the rationale that loss leading involving below-cost selling is a predatory option created by imperfect consumer information that reduces long run welfare. This policy instrument is designed to push welfare towards the first best outcome. A literature review in Section II overviews the role of predatory options in imperfectly competitive pricing. In particular, it indicates that predatory options can be competitive in effect and improve welfare, although not to the level of first best. The market can be self-correcting in the presence of predatory options, as rivals can discipline each other through strategic interactions.

In section III we formally model the role of loss leading, or predatory price options, and price constraints in the presence of imperfect competition and consumer information. We do this within a three-stage game in which we derive the welfare outcome under full consumer information. Welfare outcomes of this benchmark case are compared with those generated in the loss-leading case under imperfect consumer information and in the interventionist case where there is ban on below-cost selling.

Our results show that predatory options created by the presence of imperfect information, in the guise of loss leading, generate the same long-run equilibrium outcomes as those observed under the *laissez faire* full information scenario. Price intervention is not justified. The use of price constraints in this environment of imperfect information as a policy instrument targeted at loss leading is shown to interact with the endogenous divergences and create distortions that reduce welfare compared with *laissez faire* outcomes.

The main contribution of the paper is to show how imperfections in the market are moving targets in relation to intervention. Policy makers have to anticipate how the strategic reaction of rivals in a market to intervention will effect welfare *ex post*. The paper shows that price controls, a second-best policy instrument, and their interactions with imperfections in a second-best world can be expected to reduce welfare *ex post*. First-best policy instruments aimed at the factors that create endogenous price divergences would be more likely to move welfare closer to the bliss point.

**II. Predatory Options and Price Discrimination in Imperfectly Competitive Pricing: Implications for Antitrust Authorities**

Predatory pricing is defined as the use of a temporary price reduction by a firm with the intent of altering the evolution of market structure to increase longer term profits. This is achieved through inducing exit, deterring entry, or restricting rivals to relatively small market shares. The conventional, and in antitrust cases the most prevalent, test of the existence predatory pricing was developed by Areeda and Turner (1975). Accordingly, prices below marginal cost (usually proxied by average variable cost) indicate predatory pricing. This test is clearly motivated by Pareto efficiency considerations and competitive equilibrium analysis. As highlighted in McGee (1980), however, in a competitive equilibrium analysis where there is free entry, exit, and full information, a theoretical
rationale for optimal predatory pricing is difficult to derive. The search for an economic theory justifying the use of pricing as an instrument for manipulating market structure subsequently moved towards a game-theoretic framework in which important intertemporal and strategic issues could be modeled.

The new game-theoretic models provide valuable lessons for antitrust authorities. They conclude no simple rule for the detection of predatory pricing. Pricing below cost in imperfectly competitive markets to exploit endogenous learning economies can be beneficial to welfare [Cabral and Riordan (1994)]. Pricing above cost in the presence of imperfect capital markets can allow a prey with a financial advantage to successfully predate through manipulating this imperfection [Bolton and Scharfstein (1988)]. The incentives for predatory practices when firms can create endogenous intertemporal demand linkages through technological incompatibility is highlighted in Farrell and Saloner (1986) and Katz and Shapiro (1986). They illustrate the general point that while endogenous barriers to entry drive a more concentrated structure per se, firms may strategically price to manipulate entry barriers and the long-run evolution of market structure without violation of the Areeda-Turner rule.

New theories on predatory pricing also indicate that predatory options created by imperfect information may be socially desirable in imperfectly competitive markets as the threat of predation induces more competition to the market via strategic reactions of rivals. In signaling models, a firm has an informational advantage via informational asymmetries relating to costs of production [Milgrom and Roberts (1982a)] or prevailing demand conditions [Roberts (1986); Saloner (1987)], giving it the option of manipulating existing or potential rivals’ perceptions of the market using price as a signal. In the reputation models [Kreps and Wilson (1982); Milgrom and Roberts (1982b)], a firm operating in many markets with asymmetric information has the option of using price as an instrument to establish a reputation of toughness. Informational asymmetries thus present a firm with the option of using low prices as an instrument to influence entry, exit, and merger decisions in the market. However, the equilibrium properties of the asymmetric information models suggest that firms can not exploit informational advantages if observed price changes are interpreted as attempts to manipulate perceptions in the market. The optimal response of rivals, incumbents, and potential entrants, is to interpret and set price on just this basis. These strategic rival reactions, in turn, force the firm with the predatory option to set the lower prices and increase the toughness of short-run price competition in the market, even in the knowledge that this fails to manipulate rivals perceptions. Predatory options under informational asymmetries do not allow successful manipulation of this imperfection, and in equilibrium can be socially beneficial. In such a case no intervention in the form of price controls is warranted.

A ban on below-cost pricing may be implemented on the basis of violation of the Areeda-Turner rule and the possible predatory effects that this may have for the market. Yet we have seen it is possible that activities that are considered anticompetitive or in violation of the Areeda-Turner rule in a traditional framework may be welfare enhancing in imperfectly competitive markets when we take into account the strategic interactions between firms. Allowing for the fact that firms can defend against predatory action induces markets to be self-correcting.

As argued by Klevorick (1993), this is one of the primary reasons why new game-theoretic models on predatory pricing have had to little impact on the development of antitrust in the United States.
The presence of imperfect consumer information in multiproduct retailing may create a predatory option for retailers to profitably engage in loss leading that involves below-cost pricing on KVIs to attract a consumer base and subsequent higher mark-ups on non-KVIs. Without taking into account the role of strategic price responses from rival firms, loss leading could be modeled as a form of monopolistic price discrimination as in Holton (1957). In contrast to the traditional school, new theories emphasizing strategic interaction in imperfectly competitive markets illustrate a possible role for competitive price discrimination reflecting heterogeneities in crossprice elasticities. In that case, the ability and willingness of consumers to switch between alternative retailers in the market dominate pricing strategies, and this induces price discrimination favoring more crossprice elastic consumers to protect market share. It can, thus, be argued that multiproduct retailers in the presence of imperfect information may loss lead on a subset of crossprice elastic items, KVIs, to protect market share and not to extract rent.

The central issue surrounding the desirability or otherwise of loss leading, which may involve below-cost selling, is whether such a strategy distorts price competition, influences market structure, and reduces welfare in the long run. Only if the equilibrium loss-leading long-run welfare outcome under imperfect information diverges from that obtained in the full information framework with no loss leading, is there a rationale for intervention through price controls in the market. In light of the lessons derived from the new game-theoretic models on predatory options and competitive price discrimination, the following sections formally model loss leading in multiproduct retail pricing. We begin in Section III by modeling optimal multiproduct retail pricing for the full information benchmark case, against which we compare equilibrium outcomes derived for the loss-leading imperfect information and the interventionist case.

### III. Optimal Multiproduct Retailing

In this section it is assumed that consumers select retail outlets on the basis of location, value for money of the basket of goods, and the levels of services offered. The provision of services, such as parking or crèche facilities and aesthetic surroundings, enhances consumer utility and involves an endogenous sunk cost outlay by the retailer. Retail outlets are horizontally differentiated by location and vertically differentiated by services. We incorporate these factors into our model of multiproduct retailer behavior under perfect information in the benchmark case, imperfect information in the loss-leading case, and price constraints in the interventionist case.

### The Benchmark Case

In the benchmark case we model the *laissez faire* outcomes of multiproduct retailing where consumers are assumed to have full price information on the range of products sold when choosing an outlet. We adopt Sutton’s (1991) three-stage framework in which subgame perfect equilibrium solutions are derived in a process of backward induction. In the third and final stage of the game we model price competition between outlets for a predetermined level of services and a given number of outlets in the market using an application of Salop’s (1979) circular road model. In the second stage of the

---

3Borenstein (1985) and Holmes (1989) outline the potential importance of both “Monopoly-Type” and “Competitive-Type” discrimination in imperfectly competitive markets. For an empirical distinction, see Borenstein and Rose (1994), Giulietti and Waterson (1997), Walsh and Whelan (1999b), and for more on the role of switching costs in resale pricing see Katz (1984), Borenstein (1991), and Shephard (1991).
game we derive the equilibrium level of services and the associated endogenous sunk cost outlays for a given number of outlets in the market and in full anticipation of the price competition that takes place in stage three. The first stage of the game models the entry decision of potential entrants to the market with perfect foresight regarding the total irrecoverable set up costs and postentry profits.

In the final stage of the game retailers select the price for their bundle of goods taking the number of outlets and predetermined service levels as given. We assume that $N$ identical multiproduct retailers each sell $M$ different products. Although the individual prices of these $M$ goods may differ, they have an average price $P$ for the basket of goods. Consumers are located uniformly on a circle with a circumference equal to one where the density of consumers is assumed to be unitary around the circle. The outlets are located symmetrically around the circle, and the corresponding distance between outlets is thus equal to $1/N$. Consumers are modeled to have a transport cost, $t$, per unit of distance traveled, $d$, to each outlet located on the circle. Once a customer has selected an outlet they commit to purchasing one unit of each of the $M$ goods sold. The consumer also derives utility from services $S$ provided by an outlet. The utility of the representative consumer is given by,

$$ U = \bar{C} - PM - td + S. \quad (1) $$

This describes the marginal utility per basket of goods net of expenditure and transport costs, where $\bar{C}$ plus $S$ is the consumer reservation expenditure for the basket of goods, inclusive of services. A utility maximizing consumer with full information chooses an outlet based on the relative levels of these factors. The consumer becomes indifferent in her/his choice of outlet when the sum of these factors are equal for alternative outlets either side of their location on the circle. The equation of the indifferent consumer is thus given by,

$$ P_i M + td - \bar{C} - S_i = PM + \left\{ \frac{1}{N} - d \right\} - \bar{C} - S \quad (2) $$

From this equation we can solve for the number of consumers $E_i$ that enter a representative outlet, which include all consumers located close to an outlet up to the indifferent consumer on either side of the outlet, $2d$. We write down the demand function facing each retail outlet as follows,

$$ 2d = E_i = \frac{1}{N} + M \left( \frac{P - P_i}{t} \right) - \left( \frac{S - S_i}{t} \right) \quad (3) $$

In the final stage of the game, retailers select prices for a predetermined level of services involving $\sigma^*$ endogenous sunk cost outlays, and a given number of outlets in the market. We set the variable cost of production equal to zero for the representative retailer. Retailer surplus, $R$, is defined as profit net of exogenous, $\sigma$, and endogenous, $\sigma^*$, sunk cost outlays,

$$ R_i = MP_i E_i - \sigma - \sigma^*; \quad \sigma > 0; \quad \sigma^* > 0 \quad (4) $$

Price setting takes places in all outlets on the circle simultaneously using a Bertrand strategy. Given predetermined values of $S$ and $S_i$ and holding the average price $P$ in all other stores constant, the retailer selects $P_i$ to maximize (4). In a symmetric equilibrium
where \( P_i = P \) and \( S_i = S \), the solution function for the average price charged for each of the \( M \) goods from the first-order condition is thus,\(^4\)

\[
P_i^0 = \left( \frac{t}{N} \right) \frac{1}{M}
\]

(5)

Hence, total expenditure on the basket of \( M \) goods is equivalent to \( t/N \). Because \( N \) identical outlets are located symmetrically on the circle, the average price-cost mark-up on each of the \( M \) goods is the same in every outlet, and each outlet has an equal share of the consumer base, \( 1/N \). We, therefore, solve for equilibrium profit as the following,

\[
\pi_i^0 = \left( \frac{t}{N^2} \right)
\]

(6)

A critical point is that total consumer expenditure on the entire basket of \( M \) goods is equivalent to the switching cost of moving from one outlet to another. Bertrand competition for market share induces aggressive price undercutting by retail outlets. This competitive process prevents retailers from extracting a premium above consumer willingness to pay for locational convenience as determined by the proximity, and hence the number, of outlets on the circle and transport costs per unit of distance traveled. In this model of full information the total transport cost in moving from one outlet to another, \( t/N \), defines the level of switching costs for the consumer and, hence, the total premium that may be extracted from each consumer in equilibrium. This, in turn, is allocated between the \( M \) goods. The overall rent that can be earned from the \( 1/N \) consumers in each outlet, as shown by Equation (6), is thus independent of the number of products sold.

In the second stage of the game we model service competition, assuming forward-looking outlets with full information on the nature of competition in stage three. It is assumed that a fixed outlay, \( \sigma^* \), is sunk by outlets in providing services, and that the cost of services increase at an increasing rate with service levels. The relationship between the level of services and associated sunk cost expenditure is represented by the following function,

\[
\sigma_i^* = aS_i^2
\]

(7)

The marginal benefit of augmenting services is derived by examining the additional profits obtained by increasing services by one unit in stage three of the game, given a constant level of services for all other identical outlets. Outlet, is the deviant retailer that considers setting its service levels above other outlets in an endeavor to attract market share. Using the profit maximizing first-order condition in pricing, we can reexpress the outlets rent function to illustrate the payoff received in the final stage of the game by the deviant retailer where \( P = P_i \) and \( S_i > S \).

\[
\pi_i = \left( \frac{t}{N} - (S - S_i) \right) \frac{1}{M} \left( \frac{1}{N} - \frac{(S - S_i)}{t} \right)
\]

(8)

\(^4\)It is possible that the individual mark-up on each of the \( M \) goods can vary. Under perfect information, Bliss (1988) predicts that constrained price discrimination based on Ramsey pricing rules determine pricing. This paper does not concern itself with this issue, but models explicitly what is an exogenous value for money constraint in Bliss’s paper.
Taking the derivatives of Equations (7) and (8) with respect to \( S \) gives the marginal costs and benefits, respectively, to the deviant retailer of increasing services in excess of rivals. Equating these allows us to solve for the privately optimal level of services in a symmetric equilibrium, where \( S = S_e \), and the associated endogenous sunk cost outlays given the cost function in (7),

\[
S^0 = \frac{1}{aN} \Rightarrow \sigma^* = \left( \frac{1}{aN^2} \right)
\]  

(9)

If the deviant retailer finds a departure from current service levels profitable, then all retailers in the market have an equal incentive to increase service expenditure until no further profitable deviation exists and \( S = S_e \). Expenditure on services is a defensive mechanism that retailers are forced to adopt to protect their market share.

In the first stage of the game we solve for the equilibrium number of outlets in full anticipation of the outcomes derived for later stages. The last entrant to the market will be indifferent between entering and not, and so postentry profits will just equal to total sunk costs of entry, \( \sigma \) plus \( \sigma^* \). Given this condition, and expected profits and endogenous sunk cost outlays in (6) and (9), respectively, we solve for the long-run equilibrium number of outlets in the market as,

\[
N^* = \sqrt{\frac{t - \frac{1}{a}}{\sigma}}
\]  

(10)

For the industry to exist it must hold that \( t > 1/a \). The larger the per-unit transport cost, \( t \), the more postentry equilibrium profit and, hence, the more fragmented the industry becomes over the long run. The exogenous sunk cost, \( \sigma \), acts as a barrier to entry in the market. The presence of service competition drives a more concentrated market structure. This is attributable to the higher costs of entry that includes an endogenous sunk cost due to the provision of services. Lower values of \( a \) indicate less expensive services, resulting in a more concentrated industry. As a result of this more concentrated structure, equilibrium prices as well as consumer transport costs will be higher. Transport costs, exogenous, and endogenous barriers to entry allow equilibrium price divergences from marginal cost (zero) to be sustained in the long run.

Long-run welfare resulting from this industry is equal to the sum of retailer and consumer surplus aggregated over each of the \( N \) outlets in equilibrium. Total expenditure on the basket of \( M \) goods from (5) is equal to \( t/N \) in equilibrium. Outlets are located symmetrically around the circle and charge the same price per basket of goods. The distance traveled by indifferent consumers, \( x \) and \( y \), either side of an outlet is \( 1/2N \). Total welfare for the representative outlet, \( O_o \), in equilibrium can, thus, be depicted as in Figure 1.

Outlet, captures all consumers located up to the indifferent consumers, \( x \) and \( y \), on either side of the location. Total retailer surplus is given by area \( A \) net of the sunk costs of entry. Net consumer surplus is represented by the sum of areas \( D, E, \) and \( F \). This illustrates total consumer surplus net of transport cost areas, \( B \) plus \( C \). In equilibrium, the welfare for an individual outlet as given by Expressions (1) plus (4) can be written as the following,
Total net welfare is equal to the sum of retailer and consumer surplus, as defined in equation (11), times the number of outlets in the market in equilibrium as in (10). Multiplying equation (11) by $N$ and substituting from equation (10) that expresses $N$ in terms of $t$, $s$ and $1/a$, we solve for overall welfare as follows:

$$W = C - 1.25 \sqrt{\sigma} \Omega; \text{ where } \Omega = \begin{bmatrix} t \frac{1}{a} \\ t - \frac{1}{a} \end{bmatrix}^{1/2}$$

Imperfections in the market induce a gap between social and private net benefits in laissez faire retailing. Transport costs, exogenous, and endogenous barriers to entry result in equilibrium price divergences from marginal cost being sustained in the long run. These factors reduce welfare. In the absence of these factors total consumer surplus on the circle is $C$, which defines our bliss point or first best outcome in terms of total long-run welfare. As service costs, $a$, decline significantly, the welfare outcome tends to zero. Higher transport and exogenous sunk costs also push welfare outcomes to zero.

We now examine how our defined price divergence interacts with imperfect consumer information under laissez faire. We show that the market is self-correcting in laissez faire where loss leading under imperfect consumer information is an equilibrium outcome that leaves welfare as defined in (12) derived under full consumer information. We then model the interventionist case in this second-best world to document the distortions created by price constraints that push welfare to a third-best outcome.
**The Loss-Leading Case**

In the above game there was an explicit assumption that consumers had full information, so that all goods are KVIs, on the value of the basket of $M$ goods sold in each store when selecting their preferred outlet. We now examine the *laissez faire* equilibrium outcomes for optimal multiproduct retailing when consumers are assumed to have imperfect information on the prices of the basket of $M$ goods in making an outlet choice.

In the final stage of the game, $N$ identical retailers sell $M$ different products that may be segmented into KVIs and non-KVIs. Of the $M$ goods, a fraction, $\Phi$, are classified as KVIs and are sold at an average price $P$. All remaining goods, $(1 - \Phi)$, are non-KVIs, sold at an average price of $P^*$. We assume that the value of $\Phi$ is predetermined by factors such as the frequency of purchase and, hence, is exogenous in our model. Because the consumer has no information on non-KVIs before entering a store, it is assumed that expenditure on KVIs, as well as transport and utility from services, determines their choice of outlet. We assume that once a customer commits to an outlet they will buy one unit of each of the $M$ goods, including non-KVIs, providing total expenditure does not exceed their reservation expenditure for the basket of goods. Another way of thinking of this is that finding out information on non-KVIs in alternative outlets incurs information costs and transport costs that exceed reservation expenditure. Switching outlets and incurring information costs is not a feasible option for the consumer in this scenario. We modify this assumption in the next section. The retailer, as an extreme assumption, is handed localized monopoly power over the pricing of non-KVIs. The question is whether the retailer is able to extract maximum rents up to the reservation expenditure for the basket of goods from his consumer base, $C/N$?

We show that irrespective of the rent earned on non-KVIs, competition over the consumer base with KVIs will ensure that the rent earned from the basket of $M$ goods remains equal to the transport cost of moving from one outlet to another as in the full information benchmark case. Retailers cannot exploit the lack of information on non-KVIs when there is no restriction on price competition between KVIs.

Under conditions of imperfect information, consumers choose outlets based upon relative levels of expenditure on KVIs, transport costs, and service levels. The equation of the indifferent consumer may be written accordingly,

$$P_i \Phi M + td - S_i - \bar{C} = P \Phi M + t \left( \frac{1}{N} - d \right) - S - \bar{C}$$

Solving for the number of consumers, $E_i = 2d$, that enter the representative outlet, and assuming zero variable costs for simplicity, the payoff for outlet, can be decomposed into revenue from KVIs and non-KVIs and retailer surplus, $R$, can thus be written as follows,

$$R_i = P_i \Phi ME_i + P_i^* (1 - \Phi) ME_i - \sigma - \sigma^*$$

The average price of KVIs is simultaneously determined in all outlets on the circle. An outlet chooses $P_i$ to maximize (14), taking the price of its non-KVIs and all other outlets prices as given. In a symmetric equilibrium, all outlets will provide the same predetermined level of services, $S = S_0$, charge the same prices, $P = P_0$ and $P_i^* = P^*$, and attract equal market share, $1/N$. The solution function from the first-order condition for the
average price for each KVI is a mark-down on the average price charged for non-KVIs, which can be expressed as follows,

$$P_i^0 = \left( \frac{t}{N} - (1 - \Phi) MP_i^* \right) \frac{1}{\Phi M}$$  \hspace{1cm} (15)

Total expenditure on the basket of $M$ goods, $P_i^0 \Phi M + P_i^* (1 - \Phi) M$, is thus equal to $t/N$. Because $N$ identical outlets are located symmetrically on the circle, the average price–cost mark-up on the basket of $M$ goods is the same in every outlet, each has an equal share of consumers, $1/N$, and the rent that goes to each firm remains as in (6). Thus, we observe that for any combination of $P^*$ and $P$ the total rent earned by each outlet remains at the full information benchmark level. Firms do not earn premiums above the transport cost that each consumer incurs in moving from one outlet to another. Moreover, loss leading on KVIs may involve below-cost pricing. This is due to the opportunity that the retailer has to recuperate these losses through higher pricing on a vast range of non-KVIs in the store. The average price of KVIs will be less than marginal cost providing total expenditure on non-KVIs exceeds that on KVIs.

Because the overall rent earned in stage three under imperfect consumer information remains equal to the benchmark case, the corresponding equilibrium outcomes for services, and the number of outlets in Equations (9) and (10), respectively, remain the same. Hence, retailer and consumer surplus remain unchanged, and total welfare remains at the full information 	extit{laissez faire} levels in (12). This provides our first proposition:

**Proposition 1:** Optimal multiproduct retailing under conditions of imperfect consumer information and imperfect competition between retailers induces loss leading on a subset of products that protects market share leaving retailer surplus, welfare, and market structure at 	extit{laissez faire} full consumer information levels in the long run.

At first sight, the structure of our game and the assumption that once a consumer commits to an outlet there is no incentive to switch because the information and transport costs of such exceed reservation expenditure appears to give retailers an opportunity to extract consumer reservation expenditure in equilibrium. However, as in the new game-theoretic models on predatory options, the option to utilize price to manipulate imperfect information on the price of non-KVIs induces a strategic rival response from retailers that, in turn, increases short-run price competition on KVIs and leaves welfare outcomes unchanged. Loss leading under conditions of imperfect information acts as a signaling device that is interpreted by the consumer as an indication of the overall value for money to be obtained from the total basket of $M$ goods in an outlet.\(^5\) This forces all outlets to set prices on just this basis. With the objective of maintaining market share, Bertrand price competition induces aggressive price undercutting strategies on KVIs. This ensures that any additional premiums generated on non-KVIs are fully dissipated by price cuts on KVIs in equilibrium, which may or may not

\(^5\)An alternative mechanism available to process information involves the conversion of non-KVIs to KVIs through expenditure on promotions, coupons, or advertising. This would lead to an increase in sunk costs and a more concentrated market structure in the long run. The equilibrium outcome in the final stage of the game would be unaffected however, as profits remain equal to (6) for any value of $\Phi$. Because loss leading can achieve the same outcome at no additional cost to the retailer, the conversion of non-KVIs to KVIs by retailers would not be an equilibrium outcome.
result in pricing below cost on these items. Once again, consumers only pay a premium equivalent to switching costs in the full information case. In this sense, the strategic response of rivals makes the *laissez faire* outcome self-correcting. Intervention in the form of price controls is not justified on the basis of improving welfare to *laissez faire* full information levels. We now consider a blanket prohibition on below-cost selling to document the repercussions for equilibrium profits, services, corresponding concentration, and welfare.

*The Interventionist Case*

In the final stage of the game, our analysis is augmented by restricting the multiproduct retailer to pricing KVIs at or above marginal cost. The price of non-KVIIs is now endogenized to explicitly incorporate the information costs of finding out the true value of the basket of goods in each outlet. Switching costs now include both transport and information costs. We assume that information costs are proportional to the transport cost of moving from one outlet to another. In contrast to the loss-leading scenario, it is now assumed that information plus transport costs do not exceed consumer reservation expenditure \( C \). Once a consumer enters an outlet they have the option of switching to alternative stores if total expenditure exceeds the costs of switching, transport, plus information costs. Overall switching costs are represented by \( \delta(t/N) \) where \( \delta > 1 \). Higher values of \( \delta \) reflect greater information costs for the consumer. If \( \delta = 1 \), there are no informational costs to the consumer, and switching costs are equivalent to those in the benchmark case. The total rent earned from consumer expenditure in a symmetric equilibrium with each outlet charging the same price and attracting an equal market share of \( 1/N \) is equal to the total switching costs of consumers in equilibrium and is, thus, expressed as,

\[
\pi_i^0 = \left( \delta - \frac{t}{N^2} \right); \quad \delta > 1
\] (16)

Restricting retailers to pricing KVIs at or above marginal cost prevents the additional rents earned on non-KVIIs from being dissipated fully by price cuts on KVIs. Rather than allowing competition on KVIs as a mechanism to disperse information to the consumer, consumers now have to incur information costs. Restricting competition on KVIs allows rents for imperfect consumer information to be extracted, resulting in higher equilibrium payoffs.

In stage two the optimal level of services is determined in full anticipation of the outcome in stage three. The additional benefit from increasing services given the service levels of all other outlets is now higher due to the higher profits reflected in (16). Following the procedure used in the benchmark case, we define the marginal cost and new marginal benefit of the deviant retailer increasing services in excess of rivals, and solve for the equilibrium level of services in the symmetric equilibrium and the associated sunk costs as follows,

\[
S_i^* = \frac{(1 + \delta)}{2aN} \Rightarrow \sigma_i^* = \frac{(1 + \delta)^2}{4aN^2}
\] (17)

The level of services increases with a prohibition on loss leading. Higher information costs, \( \delta \), result in higher levels of services. The inability to compete aggressively on KVIs and the higher profits reaped by retailers due to information costs sunk by consumers
stimulates competition in services, a nonprice incentive, to attract consumers into the outlet.

In the first stage of the game we solve for the equilibrium number of outlets where the entry decision is made in full anticipation of the ex post entry expenditure on services and profit received. Using (16) and (17), we can solve for the equilibrium number of outlets,

\[
N^* = \sqrt{\frac{\delta t - (1 + \delta)^2}{4a}}
\]  

(18)

To ensure the existence of the industry, it is necessary that

\[
t > \frac{(1 + \delta)^2}{4a\delta}.
\]

Thus, for values of \( \delta > 1 \) the market will evolve to a more concentrated structure. The number of outlets declines at an increasing rate with \( \delta \), \( N_0 < 0 \) and \( N_{0\delta} > 0 \). Hence, equilibrium services, prices, and consumer transport costs will rise at an increasing rate with information costs.

We examine the impact that a ban on below-cost pricing has for overall welfare using Figure 1 and our new equilibrium outcome values.

Welfare = \( CS + RS = \left( t - \frac{\tilde{C}}{4N^2} \right) \left( \frac{(\delta + 0.5) t}{N^2} + \frac{(1 + \delta)}{2aN^2} \right) + \left( \frac{\delta t - (1 + \delta)^2}{4aN^2} - \sigma \right) \)

(19)

Total welfare aggregated over outlets is equal to the sum of retailer and consumer surplus in each outlet times the number of outlets in equilibrium as defined in Equation (18). Substituting in for \( N \), we solve for total welfare on the circle,

\[
W = \tilde{C} - (\delta + .25) \sqrt{\sigma.\Omega^*}, \text{ where } \Omega^* = \left[ \left( t - \frac{(1 + \delta)}{\delta(\delta + .25)2a} \right)^{1/2} \right]
\]

(20)

Thus, welfare under the interventionist case where restrictions are imposed on price competition declines at an increasing rate towards zero with \( \delta \). In one limiting case welfare is zero. Switching costs between outlets just equal consumer’s reservation expenditure. In the other limiting case, \( \delta = 1 \), we get the same expression for welfare as in (12), the benchmark or imperfect information loss-leading welfare outcomes. Welfare is a third-best outcome compared to the bliss point and the outcome in (12). With restrictions on price competition on KVIs, consumers can no longer use prices on KVIs as an indicator of value for money. Information costs and the ban on loss leading allow retailers to extract more of the consumers reservation expenditure rather than just their transport costs. One interesting observation is the shift in focus away from price to service competition induced by price controls. Price controls induce an escalation in endogenous sunk costs or service competition, which is greater for lower values
of a. This shift in focus away from price to service competition can have a large detrimental effect on welfare.

**Proposition 2:** Compared with the laissez faire outcomes, the prohibition of below-cost selling in multiproduct retailing under imperfect consumer information and imperfect competition between retailers ensures that welfare declines to a third-best outcome in the long run.

Price intervention has the effect of imposing a distortion on the market that alters market structure and long-run welfare and produces a third-best outcome. Contrary to the objectives of antitrust policy, implementing price restraints under imperfect information actually reduces overall welfare compared with laissez faire full information and loss-leading outcomes, rather than pushing outcomes toward first best levels.

The fall in welfare depends on the magnitude of the distortions created by the ex post intervention interaction of price constraints with the endogenous price divergence in the market. Depending on how we model the ex ante price divergence, the distortions can vary in their effect. In our model, the presence of service competition ex ante and its escalation ex post can be very detrimental to overall welfare. Hence, the ex ante presence of nonprice competition and its interaction with price controls is a worthwhile consideration before deciding on policy instruments in a second-best world.

### III. Conclusions

Antitrust policies should only target retailing practices that reduce social welfare. Price constraints in multiproduct retailing tend to be implemented on the basis that loss leading involving below-cost selling is predatory in effect and reduces long-run welfare. In this paper we formally model multiproduct retail pricing in imperfectly competitive markets with full consumer information. This creates long-run endogenous price divergences, or the ability to sustain prices above marginal cost. Hence, under conditions of laissez faire retailing and imperfect competition between retailers the welfare outcomes that are generated are second best. Predatory options, in the guise of loss leading, materialize when we assume the presence of imperfect consumer information. However, these predatory options are shown not to be predatory in effect. Strategic responses from rival retailers ensure that the market is self-correcting. Long-run welfare and equilibrium concentration outcomes remain equivalent to laissez faire full consumer information levels. Thus, price controls are not justified as a means of improving welfare to laissez faire full-information levels. The use of price constraints as a second-best policy instrument actually creates distortions that reduce welfare to a third-best outcome.

A blanket prohibition of below-cost pricing in multiproduct retailing that is motivated by the Areeda-Turner pricing rule is clearly undesirable in imperfectly competitive markets with imperfect information. Price intervention imposes a distortion on the market that adversely alters long-run structure and welfare. One should not use price controls unless one understands how this instrument will interact with the imperfections of the second-best world.

### References


