Loss Leading as an Exploitative Practice[*]

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November 13, 2009

Abstract

Loss-leading pricing is often viewed as an advertising strategy that allows retailers to attract consumers by subsidizing some products and making profits from other items; in this way, below-cost pricing may improve consumer welfare by compensating consumers for lack of information. This paper shows that, without efficiency justification in terms of distribution cost or advertising, larger retailers can use loss leading as an exploitative device to the detriment of smaller retailers. We further show that banning below-cost pricing can then increase consumer surplus and social welfare, as well as smaller retailers' profits.

JEL Classification: L11, L41

Keywords: loss leading, rent extraction, exploitative practice

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[*]We are grateful to Georg Goetz, Bruno Jullien, John Vickers for their valuable comments, as well as seminar participants in the University of Amsterdam, the Shanghai University of Finance and Economics, the Toulouse School of Economics, and the Oxford University. Zhijun Chen is also grateful to the Economic and Social Research Council, UK for its financial support.

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1 Introduction

The last three decades have seen the emergence of large retailers, such as Wal-Mart and Carrefour, that provide a full line of groceries and allow consumers to fill their baskets in a single stop. The growing market power of these large retailers has caused serious concerns, not only because of its impact on relations with suppliers, but also because of the risk of distorted competition with small retailers, such as discount stores, specialist grocery retailers and convenience stores.[1]

One particular concern is the adoption of so-called loss-leading strategies, which consist of pricing selected "leader" products below cost,[2] in order to attract customers to the outlet and make profit on the other items sold therein. Such strategies have not been much studied in the economic literature and are subject to conflicting views in practice. In *American Drugs vs. Wal-Mart Stores (1993)*, for example, Wal-Mart was sued under Arkansas' *Unfair Practice Act* for below-cost pricing on certain pharmaceuticals. Wal-Mart lost the initial trial, the court finding that intent to injure competitors and destroy competition could be inferred from circumstances such as the number and extent of below-cost sales. Wal-Mart, however, successfully appealed before the Supreme Court of Arkansas, which found that "the loss-leader strategy employed by Conway Wal-Mart is readily justifiable as a tool to foster competition and to gain a competitive edge as opposed to simply being viewed as a stratagem to eliminate rivals all together."[3] Yet in *Star Fuel Marts v. Murphy Oil (2003)*, a preliminary injunction was granted under Oklahoma's Unfair Sales Act, prohibiting below-cost sales of gasoline by Sam's East, a Wal-Mart subsidiary selling groceries in a wholesale club format. The court ruled that pricing below cost was prima facie evidence of intent to harm competitors, as well as of a tendency to dampen competition.[4]

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[1] See for example the reports of the US Federal Trade Commission (2001, 2003), the proceedings of the FTC conference held on May 24, 2007, available at http://www.ftc.gov/be/grocery/index.shtm, or the groceries market enquiries of the UK Competition Commission (2000, 2008) recommending the adoption of codes of practices. In France, in 1996, these concerns motivated two legal acts aimed at curbing the expansion of large retailers, as well as the exploitation of their market power. Dobson and Waterson (1999) provide an excellent survey on retail power.

[2] In its recent report on the grocery market, the UK Competition Commission notes, for example, that most large retailers were engaged in below-cost selling, concentrated in two to three product lines but representing up to 3% of a retailer's total revenue. See Competition Commission (2008) at p. 94.

[3] See Boudreaux (1996) for details.

[4] Star Fuel Marts, LLC. v. Murphy Oil, Inc., No. CIV-02-2002-F (W.D. Okla.2003) (order granting preliminary injunction).

A similar discrepancy appears in the differential treatment of below-cost retail pricing among European national laws. Legal restrictions on below-cost resale have, for example, been adopted in Belgium, France, Ireland, Portugal, and Spain, but not in Denmark, Germany, or Italy, although a few cases have centered on this practice there as well.[5]

In the absence of specific regulations, practitioners tend to tackle loss leading with predatory-pricing tests.[6] However, in most cases, establishing recoupment would be a challenge, making predation scenarios unlikely. In its recent report, the UK Competition Commission, for example, concluded: "We find that the pattern of below-cost selling that we observed by large grocery retailers does not represent behavior that was predatory in relation to other grocery retailers."[7] Moreover, there is no solid economic analysis that relates loss-leading strategies to predatory pricing. Loss leading has instead been viewed as an optimal pricing strategy by a multi-product firm, with cross-subsidies resulting from differences in demand elasticities;[8] it has also been identified as a featuring or advertising strategy,[9] suggesting that below-cost pricing may compensate consumers for their imperfect information and thereby improve consumer surplus.[10]

This paper shows that loss leading could be used by large retailers as an effective exploitative device, at the detriment of smaller rivals and consumers. We consider a simple setting, where a large retailer enjoys a monopoly position for some products but faces competition from one or several more efficient small retailers on other goods — a common feature in antitrust cases mentioned above. In order to set aside advertising and cross-subsidizing effects, consumers are supposed to be fully informed about prices and homogeneous in their valuations of the goods;

[5] For instance, in 2000 the German Cartel Office ordered Wal-Mart, Aldi, and Lidl to stop selling below cost such staples as milk or butter, arguing that this could impair competition and force smaller retailers out of the market.

[6] See e.g., Bolton, Brodley and Riordan (2000) and Eckert and West (2003) for detailed discussions of how such tests should be designed.

[7] See Competition Commission (2008) at page 98. Noting that predatory-pricing tests would not only require that the practice harms smaller retailers, but also that the large retailer has sufficient market power to recoup the losses incurred during the predation phase, the Competition Commission finds that both conditions are unlikely to be met in loss-leading cases.

[8] See Bliss (1988).

[9] Lal and Matutes (1994) consider, for example, a situation where multi-product firms compete for consumers who are initially unaware of prices, and find that in equilibrium firms may indeed choose to advertise a few loss leaders in order to increase store traffic.

[10] Walsh and Whelan (1999) show that in the presence of imperfect information, loss leading can generate the same long-run equilibrium outcomes as those observed under a laissez-faire full information scenario.

however, they vary in their perceived cost of shopping: consumers who face higher shopping cost, e.g., because of tighter time constraints or lower taste for shopping, have a stronger preference for one-stop shopping. In the absence of a rival, the large retailer would charge monopoly prices, exploiting the demand derived from one-stop shopping. When the large retailer competes instead with rivals who can distribute some of the goods more efficiently (and could, thus, offer consumers more value), consumers with lower shopping cost prefer to buy the competitive goods from the smaller store, while still purchasing the monopolized goods at the larger store. As long as the large retailer enjoys some competitive advantage, it can also keep attracting those consumers who prefer to patronize a single store. Pricing the competitive products below cost while raising the prices for the monopolized products so as to keep the overall assortment price constant actually allows the larger retailer to obtain the same monopoly profit as before from one-stop shoppers, while extracting some additional rents from multi-stop shoppers, who only purchase the monopolized products; in this way, the larger retailer is able to make even more profit than in the absence of a rival.

Thus, loss leading allows the larger retailer to discriminate multi-stop shoppers, who only buy the monopolized goods from the larger retailer, from one-stop shoppers, who also purchase the competitive goods from the larger store, and exploit extra rents from multi-stop shoppers. While loss leading increases the large retailer's profit, it is achieved at the expense of the rival retailers:[11] it reduces their market share and limits the profit margins that they would otherwise obtain. Our analysis validates the often-voiced concern that the market power of large retailers distorts retail competition and harms smaller rival retailers. However, this appears as a by-product of a consumer discrimination strategy instead of as a result of predation. As the large retailer makes more profit than in the case of pure monopoly, it actually has no incentive to exclude the more efficient small retailers; it prefers to have them around, but at the same time its optimal discrimination strategy tends to squeeze their profits.[12] In other words, loss leading appears here as an exploitative device rather than as an exclusionary practice. Noting that the small retailers remain active should not lead to the conclusion that loss leading is an innocuous strategy, however. A ban on loss leading would hurt the large retailer but benefit consumers, as

[11] The loss leading strategy increases the large retailer's profit, even in the absence of any impact of the other retailers' strategies — e.g., when facing a fringe on competitive smaller retailers.

[12] Marx and Shaffer (1999) label such below-cost pricing practice as predatory accommodation without exclusion. They study a rent-shifting setting à la Aghion-Bolton (1987), in which a retailer negotiates sequentially with the suppliers of substitute products; below-cost pricing by one supplier allows the retailer to extract rents from the remaining suppliers. In this context, the welfare effect of below-cost pricing is ambiguous.

well as the small rivals, and as a result, would increase social welfare.[13]

This paper is closely related to the literature on competitive pricing by multi-product firms in the presence of consumer shopping cost. Armstrong and Vickers (2009) consider, for example, a symmetric duopoly à la Hotelling in which consumers have heterogeneous and elastic demands for two products and incur an additional shopping cost when dealing with both suppliers; they show the existence of an equilibrium in which firms price all products above (or equal to) their costs but offer conditional discounts (mixed bundling). Ambrus and Weinstein (2008) study Bertrand competition among symmetric firms competing for one-stop shoppers. They first show that loss leading cannot occur when consumers have inelastic demand. When demand is elastic, loss leading can occur but only under rather specific forms of demand complementarity; in particular, loss leading cannot arise when consumer demand is sufficiently diverse. In contrast to these papers, we focus on asymmetric competition between multi-product and single-product firms; loss leading then emerges as an effective way to discriminate one-stop shoppers from multi-stop shoppers.

Stahl (1982) also develops a simple model of consumer behavior in which, owing to a non-convexity in the transportation cost of obtaining the desired commodity bundle, consumers are attracted to marketplaces offering a large variety of products, and then studies impacts on sellers' equilibrium locations and pricing strategies. While sellers have asymmetric product ranges, loss leading does not arise in equilibrium, since all consumers are one-stop shoppers.

The rest of the paper is organized as follows. Section 2 develops a simple model for retail competition between a large retailer and smaller retailers in the presence of heterogeneous shopping costs. Section 3 shows that loss leading arises in equilibrium whenever the large retailer enjoys a competitive advantage over a fringe of smaller retailers; section 4 then studies the welfare impact of a ban on loss leading. Section 5 shows that loss leading still provides an exploitative device when the large retailer competes with a strategic smaller retailer; it also discusses the implications for bans on loss leading, as well as the strategic use of loss leading when the large retailer benefits from a first-mover advantage or faces uncertain entry. Finally, we conclude in section 6.

[13] Allain and Chambolle (2005) show instead that manufacturers can take advantage of below-cost pricing laws to maintain higher prices and profits; banning loss leaders may then have a perverse effect on consumer welfare.

2 The model

2.1 Market structure and consumer choice

A large retailer (denoted by L) and small retailers (denoted by S) compete in a local retailing market. The large retailer offers a broad range of products, while small ones provide a narrower range of products but are more efficient in distributing these products. For the sake of exposition, we simply assume that there are two products (or categories), A and B: product A is only distributed by the large retailer, while product B is distributed by all retailers; the two types of retailers could offer differentiated varieties of product B, which we denote respectively by B_L and B_S. The large retailer incurs a marginal cost c_A for distributing A, as well as a marginal cost c_L for B_L, while the small retailers face a marginal cost c_S for B_S.

Each consumer is willing to buy at most one unit of A and one unit of B. We assume that consumers have homogeneous valuations for A, B_L and B_S; this allows us to avoid cross-subsidization stemming from differences in demand elasticities, as studied by Bliss (1988). We respectively denote by u_A and u_i (for $i = L, S$) the utility obtained from consuming A and B_i on a stand-alone basis, and by $u_{Ai} \leq u_A + u_i$ the utility derived from consuming both A and B_i.[14]

We will denote by $w_A \equiv u_A - c_A$, $w_L \equiv u_L - c_L$, and $w_S \equiv u_S - c_S$ the social value respectively generated by A, B_L and B_S, and by $w_{Ai} \equiv u_{Ai} - c_A - c_i$ the total welfare generated by A and B_i. We assume that it is efficient for L to supply both products rather than one: $w_{AL} > w_A, w_L$; it is thus *a fortiori* efficient for L to supply either product rather than none: $w_A, w_L > 0$.[15] We are moreover interested in the case where the small retailers are more efficient in distributing B,[16] and will assume $w_S - w_L = w_{AS} - w_{AL} = \beta > 0$. Its broader range of products however enables L to bring an additional value $\alpha = w_{AL} - w_L > 0$ on product A.[17]

Finally, we build on Armstrong and Vickers (2009) and assume that consumers incur a shopping cost for visiting a store. This shopping cost may reflect the opportunity cost of the

[14] This formulation allows for some substitution between A and B; the two products are independent when $u_{Ai} = u_A + u_i$.

[15] These conditions indeed imply $c_A < u_{AL} - u_L \leq u_A$ and $c_L < u_{AL} - u_A \leq u_L$.

[16] For instance, the small retailers could be discount stores with lower distribution costs, or specialist stores bringing higher value for B.

[17] This is in line with the observation that hard discounters, such as Aldi and Lidl in Europe, often offer much fewer categories of groceries than large supermarkets, and less than 10% of total categories provided by these supermarkets. See Cleeren, Verboven, Dekimpe and Gielens (2008) for a detailed report.

time spent in traffic, parking, selecting products and checking out, and so forth; it may also account for the consumer's taste for shopping. To reflect the fact that consumers may be more or less time-constrained, or value the shopping experience in different ways, we assume that this shopping cost, denoted by t, varies across consumers and is distributed according to a cumulative distribution function $F(\cdot)$, with density function $f(\cdot)$; we assume that the inverse hazard rate, $h(\cdot) \equiv F(\cdot)/f(\cdot)$, is strictly increasing.

In principle, L might offer three prices: one for A, one for B_L and one for the bundle; in practice, however, L will sell A to all the consumers who visit its store, so that only two prices matter: the price p_A when buying A only, and the total price p_{AL} when buying both A and B_L. If A and B are not closely substitutes, these prices can alternatively be implemented through stand-alone prices, p_A for A and $p_L \equiv p_{AL} - p_A$ for B_L; in case of closely substitutes, however, L will favor mixed bundling since the "stand-alone" price p_L might exceed the added value $w_{AL} - w_A$. In what follows, we will therefore follow that approach and interpret p_L as the price differential $p_{AL} - p_A$ rather than as the actual stand-alone price for B_L.

We will model retail competition as follows: (i) L and S simultaneously set their prices; (ii) consumers observe all prices and then make shopping decisions. When making these decisions, consumers are thus fully aware of all retail prices but take into account the value of the proposed assortments as well as transactional conveniences relating to shopping time. We will successively consider two scenarios. In the first scenario, product B is competitively supplied by a fringe of small retailers, who thus offer the variety B_S at cost; this scenario allows us to develop our main insight in the simplest way. In the second scenario, a single small retailer acts also as a strategic player. This scenario will allow us to show the robustness of the main insight and to discuss margin squeeze issues. Before considering these two scenarios, we conclude this section with the benchmark case in which L faces no competition from any rival.

2.2 Benchmark: monopoly

We suppose here that L is a monopolist for both products. By assumption, it is more profitable to sell both products rather than one,[18] and a consumer will buy as long as $t \leq v_{AL} = u_{AL} - p_{AL} = w_{AL} - r_{AL}$, where $r_{AL} \equiv p_{AL} - c_A - c_L$ denotes L's total margin; the monopolist retailer thus

[18]Since consumers have homogeneous valuations, all active consumers behave in the same way. Suppose that they buy B only (that is, $p_A \geq u_{AL} - u_A$, or $r_A \geq w_{AL} - w_A = \alpha$); then reducing the margin on A slightly below α would ensure that the same consumers buy A as well, bringing an additional revenue (almost) equal to α from each of them; a similar reasoning applies to the case where active consumers would only buy A.

faces a demand $F(v_{AL})$ and makes a profit

$$r_{AL}F\left(v_{AL}\right)=r_{AL}F\left(w_{AL}-r_{AL}\right).$$

This profit function is quasi-concave in r_{AL} (see Appendix A) and the first-order condition is written as:

$$r_{AL}=h(v_{AL}). \tag{1}$$

That is, the monopoly total margin r_{AL}^m and the corresponding value v_{AL}^m are such that $r_{AL}^m \equiv h\left(v_{AL}^m\right)$ and, using $v_{AL}^m = w_{AL} - r_{AL}^m = w_{AL} - h(v_{AL}^m)$, v_{AL}^m is uniquely characterized by:

$$v_{AL}^m \equiv l^{-1}\left(w_{AL}\right), \tag{2}$$

where $l(t) \equiv t + h(t)$ is increasing in t. L's monopoly profit is then given by

$$\Pi_{AL}^m \equiv F(v_{AL}^m)h(v_{AL}^m). \tag{3}$$

3 Loss leading as an exploitative device

We suppose in this section that a competitive fringe of small retailers supplies B_S at cost. One-stop shoppers can thus obtain a value equal to w_S by patronizing the small retailers, or $v_{AL} \equiv w_{AL} - r_{AL}$ by buying both products from L.

If one-stop shoppers favor L ($v_{AL} > w_S$), which we will refer to as "regime L", small retailers can only attract multi-stop shoppers, who buy A from L and B_S from them. Doing so doubles their shopping costs but gives them a net value $v_{AS} \equiv u_{AS} - p_A - c_S = w_{AS} - r_A$, where r_A denotes L's margin on A; consumers will therefore favor multi-stop shopping if $v_{AS}-2t \geq v_{AL}-t$, that is, if the extra gain from multi-stop shopping offsets the additional shopping cost:

$$t \leq \tau \equiv v_{AS} - v_{AL} = \beta + r_L,$$

where $r_L \equiv r_{AL} - r_A$ denotes L's (implicit) margin on B. Thus, in regime L consumers are willing to visit L if $t \leq v_{AL}$, but prefer patronizing both stores if $t \leq \tau$. In addition, without loss of generality, we can focus on $\tau \in [0, v_{AL}]$:

- If $\tau > v_{AL}$ (i.e., $\beta + r_L > w_{AL} - r_{AL}$, or $r_L > r_L' = \left(w_{AL} - r_A - \beta\right)/2$), there is no one-stop shoppers: active consumers buy A from L and B_S from S, and do so as long as long as $t < v_{AS}/2$, where $v_{AS} = w_{AS} - r_A = w_{AL} + \beta - r_A$; but then, keeping r_A constant and decreasing r_L to r_L' would satisfy $\tau' = v_{AL}'$ and affect neither the number of active consumers (that is, $v_{AS}' = v_{AS}$) nor their behavior (they would still visit both types of stores).

- If instead $\tau < 0$ (i.e., $r_L < -\beta$), there is no multi-stop shoppers: active consumers only visit L, and do so as long as $t < v_{AL}$; but then, keeping r_{AL} constant and increasing r_L to $r'_L = -\beta$ would yield $\tau' = 0$ without affecting consumers' behavior.

Conversely, in the range $\tau \in [0, v_{AL}]$, L attracts a demand $F(v_{AL}) - F(\tau)$ for both products from one-stop shoppers, and an additional demand $F(\tau)$ for product A from multi-stop shoppers; it thus obtains a profit equal to:

$$\Pi_L = r_{AL}\left(F\left(v_{AL}\right) - F\left(\tau\right)\right) + r_A F(\tau) = r_{AL} F\left(v_{AL}\right) - r_L F\left(\tau\right),$$

that is:

$$\Pi_L = r_{AL} F\left(w_{AL} - r_{AL}\right) - r_L F\left(\beta + r_L\right), \tag{4}$$

which is quasi-concave in r_{AL} and r_L (see Appendix A); the first-order conditions yield:

$$r_{AL} = h(v_{AL}), \tag{5}$$

$$r_L = -h(\tau). \tag{6}$$

In the absence of any restriction L would therefore charge again the monopoly margin for the bundle: (5) coincides with (1), yielding $r_{AL} = r_{AL}^m$; it can do as long as this does not discourage one-stop shoppers, i.e., as long as $v_{AL}^m \geq w_S$. But L would also set a *negative* margin for B_L, characterized by: $r_L^* = -h(\beta + r_L^*)$. The intuition for using B_L as a loss leader can be understood as follows. All combinations of r_A and r_L satisfying $r_A + r_L = r_{AL}^m$ generate the monopoly profit from one-stop shoppers, but yield different profits from multi-stop shoppers. Subsidizing B_L (that is, $r_L < 0$) then allows L to increase its margin on A above the monopolistic level ($r_A > r_{AL}^m$); in this way, L reaps a higher profit from multi-stop shoppers, who only buy A from it. Subsidizing B_L however reduces the population of multi-stop shoppers (that is, it decreases τ), generating a trade-off that is reflected in the above first-order condition.

The optimal threshold τ^* satisfies:

$$\tau^* = \beta + r_L^* = \beta - h(\tau^*),$$

or

$$\tau^* \equiv l^{-1}(\beta). \tag{7}$$

This threshold is indeed such that $\tau^* > 0$ (since $l(\cdot)$ is increasing and satisfies $l(0) = 0$) and $\tau^* \leq v_{AL}^m$ whenever $w_{AL} \geq w_S$.[19]

[19] It suffices to note that $v = v_{AL}^m$ maximizes $(w_{AL} - v) F(v)$, whereas $v = \tau^*$ maximizes $(\beta - v) F(v)$; a simple revealed argument then yields $\tau^* \leq v_{AL}^m$ whenever $w_{AL} \geq w_S$ ($\geq \beta = w_S - w_L$).

While mixed bundling (namely, offering only A and the bundle $A + B_L$) removes any acceptability restriction on the implicit margin r_L, L's offering must ensure that prospective multi-stop shoppers are willing to buy A on a stand-alone basis; but this is the case whenever $r_A < \alpha = w_{AL} - w_L$, which by construction is satisfied in regime L: $v_{AL} = w_{AL} - r_A - r_L > w_S$ implies $\alpha - r_A > w_S - (w_L - r_L) = \tau > 0$.

When $v_{AL}^m < w_S$, in order to attract one-stop shoppers L must make a better offer. Given the quasi-concavity of the profit function, it is then optimal for L to match the value offered by the competitive fringe: $\tilde{v}_{AL}^* = w_S$, or $\tilde{r}_{AL}^* = w_{AL} - w_S$.[20] This does not affect the optimality condition for r_L, however: L therefore still uses B_L as a loss leader and sets $r_L^* = -h(\tau^*)$; the margin on A is thus equal to:

$$\tilde{r}_A^* = \tilde{r}_{AL}^* - r_L^* = w_{AL} - w_S - r_L^* = \alpha - \tau^*.$$

Alternatively, L may choose to offer $v_{AL} < w_S$, in which case one-stop shoppers favor small retailers (regime S); L then only sells to multi-stop shoppers, who buy B_S from small retailers and A from L. Consumers are indeed willing to do so as long as the value from buying A, $v_A = w_{AL} - w_L - r_A = \alpha - r_A$, exceeds the extra shopping cost t that they must incur to visit L as well. L's profit is thus equal to:

$$\Pi_L = r_A F(v_A) = r_A F(\alpha - r_A).$$

It is then optimal for L to adopt the monopoly margin r_A^m which, together with the corresponding value $v_A^m = \alpha - r_A^m$, is characterized by:

$$r_A^m = h(v_A^m), v_A^m = l^{-1}(\alpha).$$

The loss-leading strategy is clearly preferable as long as $v_{AL}^m \geq w_S$, since in that case it gives L a profit:

$$\Pi_L^* = r_{AL}^m F(v_{AL}^m) - r_L^* F(\tau^*) = \Pi_{AL}^m + h(\tau^*) F(\tau^*),$$

which exceeds the monopolistic profit Π_{AL}^m: in effect, L captures an extra rent $-r_L^* F(\tau^*) = h(\tau^*) F(\tau^*)$ from multi-stop shoppers. Suppose now that $v_{AL}^m < w_S$. The loss-leading strategy then yields a profit equal to:

$$\tilde{\Pi}_L^* \equiv (w_{AL} - w_S) F(w_S) + h(\tau^*) F(\tau^*).$$

[20] If needed, L can make a slightly better offer, to ensure that it attracts all one-stop shoppers.

That is, L reduces the total margin charged to one-stop shoppers below the monopoly level, so as to reflect its competitive advantage ($r_{AL} = w_{AL} - w_S$); L therefore makes less profit from one-stop shoppers, and all the more so as its competitive advantage further decreases. Yet, adopting a loss-leading strategy still allows L to charge a higher margin to multi-stop shoppers; the extra margin and the resulting number of one-stop shoppers remains the same as before, allowing L to obtain an additional rent equal to $-r_L^* F(\tau^*) = h(\tau^*) F(\tau^*)$. Focussing instead on multi-stop shoppers and monopolizing product A gives L a profit:

$$\Pi_A^m \equiv r_A^m F(v_A^m).$$

We now show that the loss-leading strategy remains preferable as long as $w_{AL} \geq w_S$. To see this, note first that, keeping $r_{AL} = r_A + r_L$ constant so as to maintain $v_{AL} = w_S$, varying r_A (and thus adjusting r_L to $w_{AL} - w_S - r_A$) yields

$$\tau = \beta + r_L = \alpha - r_A.$$

We then have:

$$\begin{aligned}
\tilde{\Pi}_L^* &= \tilde{r}_{AL}^* \left(F\left(\tilde{v}_{AL}^*\right) - F\left(\tau^*\right)\right) + \tilde{r}_A^* F\left(\tau^*\right) \\
&= \left(w_{AL} - w_S\right)\left(F\left(w_S\right) - F\left(\alpha - \tilde{r}_A^*\right)\right) + \tilde{r}_A^* F\left(\alpha - \tilde{r}_A^*\right) \\
&= \max_{r_A} \left(w_{AL} - w_S\right)\left(F\left(w_S\right) - F\left(\alpha - r_A\right)\right) + r_A F\left(\alpha - r_A\right) \\
&\geq \left(w_{AL} - w_S\right)\left(F\left(w_S\right) - F\left(\alpha - r_A^m\right)\right) + r_A^m F\left(\alpha - r_A^m\right) \\
&= \left(w_{AL} - w_S\right)\left(F\left(w_S\right) - F(v_A^m)\right) + \Pi_A^m.
\end{aligned}$$

Using $w_S > v_{AL}^m = l^{-1}(w_{AL}) > l^{-1}(w_{AL} - w_L) = v_A^m$, it follows that $\tilde{\Pi}_L^* \geq \Pi_A^m$ whenever $w_{AL} \geq w_S$. Conversely, when $w_{AL} < w_S$, we have:

$$\begin{aligned}
\tilde{\Pi}_L^* &= \left(w_{AL} - w_S\right)\left(F\left(w_S\right) - F\left(\tau^*\right)\right) + \tilde{r}_A^* F\left(\alpha - \tilde{r}_A^*\right) \\
&< \tilde{r}_A^* F\left(\alpha - \tilde{r}_A^*\right) \\
&\leq \Pi_A^m,
\end{aligned}$$

where the first inequality stems from $w_S > w_{AL}$ and $w_S > \tau^* = w_S - (w_L - r_L^*)$.[21]

[21] In the limit case $w_{AL} = w_S$ (or $\beta = \alpha$), using B as a loss leader amounts to monopolizing A. The margin on A must then reflect the subsidy on B: offering $v_{AL} = w_S$ requires $r_{AL} = 0$, or $r_A = s \equiv -r_L$; the optimal subsidy maximizes $sF(\tau) = sF(\beta - s)$, which amounts to maximizing $r_A F(\alpha - r_A)$ when $\beta = \alpha$. Consumers are also indifferent between the two strategies: in both cases they face the same price for A, and while the loss leading strategy may yield a lower price for B_L (in the monopolization scenario, L may actually stop carrying B_L), this does not affect multi-stop shoppers (who do not buy B_L from L) whereas one-stop shoppers are indifferent between buying A and B_L from L or B_S only from a smaller rival.

The following proposition summarizes this analysis:

Proposition 1 *Suppose that the large retailer, L, faces a competitive fringe of small retailers. Then:*

- *When L enjoys a competitive advantage (i.e., $w_{AL} > w_S$), its unique optimal strategy consists in using the competitive product, B, as a loss leader and pricing it below cost. In addition, when its competitive advantage is particularly significant (namely, when $v_{AL}^m \geq w_S$), L keeps the total price for the two products at the monopoly level – and earns more profit than in the absence of any rival; otherwise L simply charges a total price reflecting its competitive advantage, $r_{AL} = w_{AL} - w_S$.*

- *When instead L faces a competitive disadvantage (i.e., $w_{AL} < w_S$), its unique optimal strategy consists in monopolizing product A and leaving the market of the competitive product to the small retailers.*

Loss leading thus provides an effective exploitative device, which allows L to discriminate multi-stop shoppers (i.e., those consumers who face lower shopping costs) from one-stop shoppers: by using the most competitive good as a loss leader, L keeps attracting one-stop shoppers, and at the same time can increase the price it charges to multi-stop shoppers on the less competitive segment. This strategy appears profitable as long as L enjoys a net comparative advantage, that is, as long as the added value from its broader range more than offsets the efficiency gain that smaller retailers have on the competitive segment.

Illustration: Uniform density of shopping costs

To illustrate our analysis, suppose that the shopping cost is uniformly distributed, so that $F(t) = t$. The first-order conditions then boil down to

$$r_L = -\tau \text{ and } r_{AL} = v_{AL},$$

which, using $v_{AL} = w_{AL} - r_{AL}$ and $\tau = \beta + r_L$, yield

$$r_{AL}^m = v_{AL}^m = \frac{w_{AL}}{2} \text{ and } \tau^* = -r_L^* = \frac{\beta}{2}.$$

For the sake of exposition, let us fix w_L and $\alpha = w_{AL} - w_L$ such that $\alpha > w_L$, and vary the small rivals' efficiency gain, $\beta = w_S - w_L$. The condition $v_{AL}^m > w_S$ is then satisfied as long as $\beta < \hat{\beta} \equiv (\alpha - w_L)/2$, in which case L uses B_L as a loss leader ($r_L = -\beta/2$) and charges the monopoly margin $r^m_{AL} = (w_L + \alpha)/2$ for the bundle (or $r_A = (w_L + \alpha + \beta)/2$ for A); in this way, L obtains

$$\Pi^*_L = \Pi^m_{AL} + \frac{\beta^2}{4} = \frac{(w_L + \alpha)^2}{4} + \frac{\beta^2}{4},$$

which thus increases with β: L benefits from its rivals' more attractive offers, since they expand the demand from multi-stop shoppers, and it takes advantage of this by raising its margin on A.

When instead $\beta \in \left[\hat{\beta}, \alpha\right]$, then $v^m_{AL} \leq w_S \leq w_{AL}$ and L maintains the same subsidy on B but charges $\tilde{r}^*_{AL} = \alpha - \beta$, or $\tilde{r}^*_A = \alpha - \tau^* = \alpha - \beta/2$. Its profit then reduces to:

$$\tilde{\Pi}^*_L = (\alpha - \beta)(w_L + \beta) + \frac{\beta^2}{4}.$$

As β increases in this range, L's profit first still increase but then decrease: the smaller rivals' efficiency gain exerts a competitive pressure on L which reduces its margins (on the bundle as well as on A), and this effect dominates the former one when $\beta > 2(\alpha - w_L)/3$.[22] This profit coincides with

$$\Pi^m_A = \frac{\alpha^2}{4}$$

when $\beta = \alpha$ and, whenever $\beta > \alpha$, L leaves the competitive segment to its smaller rivals and exploit its monopoly power on A only.

4 Banning loss leading

We now show that the profitability of the loss-leading strategy is obtained at the expense of consumer surplus and social welfare. To see this, we focus here on the case $w_{AL} > w_S$ and suppose that L is not allowed to set prices below cost. From the profit expression (4), it follows that L then optimally sets $r_L = 0$ and obtains a profit $r_{AL}F(v_{AL})$.

If L enjoys a significant competitive advantage (i.e., $v^m_{AL} \geq w_S$), it can still earn the monopoly profit Π^m_{AL} by charging $r_A = r^m_{AL}$. Otherwise (i.e., if $v^m_{AL} < w_S$), it simply charges $r_A = w_{AL} - w_S$ and earns $(w_{AL} - w_S) F(w_S)$. This remains preferable to leaving the competitive segment to the smaller retailers and monopolizing the noncompetitive segment whenever $(w_{AL} - w_S) F(w_S) > \Pi^m_A = r^m_A F(v^m_A)$.

As long as L keeps attracting one-stop shoppers, banning loss leading does not affect them: L keeps charging the same total margin, r_{AL}, with or without a ban. A ban on loss leading however

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$$\frac{\partial \tilde{\Pi}^*_L}{\partial \beta} = -(w_L + \beta) + \alpha - \beta + \frac{\beta}{2} = \alpha - w_L - \frac{3\beta}{2}.$$

benefits multi-stop shoppers, since it prevents L from overcharging for A, by an amount equal to the subsidy $s^* \equiv -r_L^* > 0$ it offers on B_L. As a result, those consumers that would visit both types of stores benefit from a reduction in prices (they obtain w_S from patronizing small retailers, and also benefit from a reduction of p_A by s^*). In addition, some consumers that would visit only L will now prefer to visit another store as well. Indeed, banning loss leading forces L to compete "on the merits", which induces those consumers with a shopping cost lower than $\beta = w_S - w_L$ to patronize both types of stores; in contrast, subsidizing B_L (and overcharging A by the same amount) allows L to discourage those consumers whose shopping cost exceeds $\tau^* = \beta - s^* (< \beta)$ from visiting the smaller retailers, in spite of the higher price on A. More precisely, in the absence of a ban on loss leading, total consumer surplus is equal to

$$\begin{aligned} CS^* &= \int_{\tau^*}^{v_{AL}} (v_{AL} - t)\, dF(t) + \int_0^{\tau^*} (\alpha + w_S - (r_{AL} + s^*) - 2t) dF(t) \\ &= \int_0^{v_{AL}} (v_{AL} - t)\, dF(t) + \int_0^{\tau^*} (\tau^* - t)\, dF(t), \end{aligned}$$

where, in the first line, the two terms correspond respectively to one-stop and multi-stop shoppers; the second line follows from noting that, by construction, multi-stop shoppers (those with $t < \tau^*$) gain an additional surplus equal to $\tau^* - t$. Using the same logic, a ban on loss leading (which, as noted, does not affect neither r_{AL} nor v_{AL}) yields

$$\begin{aligned} CS^b &= \int_{\beta}^{v_{AL}} (v_{AL} - t)\, dF(t) + \int_0^{\beta} (\alpha + w_S - r_{AL} - 2t) dF(t) \\ &= \int_0^{v_{AL}} (v_{AL} - t)\, dF(t) + \int_0^{\beta} (\beta - t)\, dF(t). \end{aligned}$$

Using $\tau^* = \beta - s^*$, a ban on loss leading thus increases total consumer surplus by an amount equal to

$$s^* F(\tau^*) + \int_{\tau^*}^{\beta} (\beta - t)\, dt.$$

Forcing L to compete in the merits for B also improves efficiency, by allowing those consumers whose shopping cost lies between τ^* and β to take advantage of the small retailers' better offering. In the absence of a ban, social welfare is equal to

$$\begin{aligned} W^* &= \int_{\tau^*}^{v_{AL}} (w_{AL} - t) dF(t) + \int_0^{\tau*} (w_{AL} + \beta - 2t) dF(t) \\ &= \int_0^{v_{AL}} (w_{AL} - t) dF(t) + \int_0^{\tau} (\beta - t) dF(t), \end{aligned}$$

whereas a ban of loss leading yields

$$W^b = \int_0^{v_{AL}} (w_{AL} - t) dF(t) + \int_0^{\beta} (\beta - t) dF(t).$$

As a result, banning loss leading increase social welfare by an amount equal to

$$\int_{\tau^*}^{\beta} (\beta - t) dF(t),$$

corresponding to the improved efficiency in the distribution of B for those consumers whose shopping cost lies between τ^* and β.

The above findings are summarized in the following proposition:

Proposition 2 *Assume below-cost pricing is banned. As long as L keeps attracting one-stop shoppers (which is the case as long as $(w_{AL} - w_S) F(w_S) \geq \Pi_A^m$), it then maintains the same total margin as before but sells the competitive good at cost. As a result, consumer surplus and social welfare are both higher than when loss leading is allowed.*

While most countries have laws equipped to deal with predatory pricing by a multiproduct retailer, competition authorities have been reluctant to apply them to loss leading. For instance, in its 1997 report, the UK Office of Fair Trading argues that in the analysis of alleged predation in retailing cases, a price-cost comparison is of little use, since pricing below cost on individual items may be profitable without being predatory. In its 2000 and 2008 reports, the UK Competition Commission similarly argues that the necessary conditions for an alleged predation are unlikely to be met in loss leading cases. Our analysis however shows that a dominant retailer can use loss leading as an exploitative device, so as to extract rents from multi-stop shoppers, rather than as an exclusionary or predatory practice aimed at foreclosing the market; banning loss leading can then increase consumer surplus and social welfare. These findings may thus put the evaluation of anticompetitive effects in loss leading cases on firmer grounds.

5 Margin squeeze

By focusing on the case of a competitive fringe, the above analysis highlights the role of loss leading as a pure exploitative device, which allows a large retailer to obtain greater profits at the expense of (multi-stop) consumers. In this framework, loss leading has no impact whatsoever on smaller rivals, since competition among them dissipate their margins anyway. However, in many antitrust cases, small retailers complained that their profit were squeezed as a result of large retailers' loss leading strategies. To analyze this concern, we consider in this section the case where the large retailer L competes against a single, smaller but more efficient rival S. As we will see, the large retailer can still adopt a loss-leading strategy to exploit rents from consumers, and this practice then hurts the smaller rival as well as consumers.

5.1 Loss leading when competing with strategic rivals

In response to its rival's price, the large retailer behaves qualitatively as above, replacing the competitive value w_S with the net value $v_S = w_S - r_S$ now offered by the small retailer, given its margin r_S. Since we are interested in the role of loss leading, we will focus here on regime L, in which L attracts one-stop shoppers by offering more value than its rival: $v_{AL} > v_S$. S thus only attracts multi-stop shoppers, who keep buying A from L but are willing to buy B_S from S as long as:

$$t \leq \hat{\tau} \equiv v_{AS} - v_{AL} = \beta + r_L - r_S. \tag{8}$$

Without loss of generality, we can again focus on $\hat{\tau} \in [0, v_{AL}]$ and, in this range, L attracts a demand $F(v_{AL}) - F(\hat{\tau})$ for both products from one-stop shoppers, and an additional demand $F(\hat{\tau})$ for product A from multi-stop shoppers. Its profit is thus equal to:

$$\Pi_L = r_{AL} F\left(v_{AL}\right) - r_L F\left(\hat{\tau}\right),$$

which, using $w_{AL} - r_{AL}$ and (8), leads to the first-order conditions:

$$r_{AL} = h(v_{AL}), r_L = -h(\hat{\tau}).$$

Since S only attracts multi-stop shoppers, its profit is equal to

$$\Pi_S = r_S F(\hat{\tau}) = r_S F(\beta + r_L - r_S),$$

which leads to the first-order condition:

$$r_S = h(\hat{\tau}).$$

These first-order conditions yield a candidate equilibrium in which L: (i) charges the monopoly retail margin for the bundle of products ($\hat{r}^*_{AL} = r^m_{AL}$); and (ii) prices the competitive good below cost: $\hat{r}^*_L = -\hat{r}^*_S = -\hat{r}^*$. The equilibrium margin $\hat{r}^*$ and the resulting threshold $\hat{\tau}^*$ satisfy:

$$\hat{\tau}^* = \beta + \hat{r}^*_L - \hat{r}^*_S = \beta - 2\hat{r}^* = \beta - 2h(\hat{\tau}^*),$$

or

$$\hat{\tau}^* \equiv j^{-1}(\beta), \tag{9}$$

where $j(t) \equiv t + 2h(t)$ is strictly increasing. It follows that in equilibrium S earns a profit

$$\hat{\Pi}^*_S \equiv h\left(\hat{\tau}^*\right) F\left(\hat{\tau}^*\right),$$

while L obtains

$$\hat{\Pi}_L^* \equiv \Pi_{AL}^m + h(\hat{\tau}^*) F(\hat{\tau}^*).$$

Since $\hat{\tau}^* = j^{-1}(\beta) < l^{-1}(\beta) = \tau^*$, L's profit is lower than when facing a competitive fringe of small retailers.

For the above margins to form an equilibrium, two conditions must be satisfied: First, L must indeed attract one-stop shoppers, that is:[23]

$$v_{AL}^m \geq \hat{v}_S^* = w_S - \hat{r}^*. \tag{10}$$

Second, while L has no incentive to exclude its rival, since it earns more profit than a pure monopoly, S may want to attract one-stop shoppers by offering more than v_{AL}^m. S's profit then becomes $r_S F(w_S - r_S)$, which is quasi-concave in r_S and maximal for a margin already exceeding the equilibrium level,[24] it is then optimal for S to offer precisely $v_S^d = v_{AL}^m$, by charging $r_S^d = w_S - v_{AL}^m$, which gives S a profit equal to $\Pi_S^d = r_S^d F(v_S^d) = (w_S - v_{AL}^m) F(v_{AL}^m)$. S cannot benefit from such a deviation if $\hat{\Pi}_S^* \geq \Pi_S^d$, or:

$$\hat{r}^* F(\hat{\tau}^*) \geq (w_S - v_{AL}^m) F(v_{AL}^m). \tag{11}$$

Since $v_{AL}^m > \hat{\tau}^*$ and $F(.)$ is increasing, this constraint is more stringent than (10), and is thus the only relevant equilibrium condition; it is shown in Appendix B that it amounts to $\beta \leq \hat{\beta}(\alpha; w_L)$, where the threshold $\hat{\beta}$ increases with α. Loss leading thus constitutes an equilibrium strategy as long as L enjoys a significant competitive advantage over S (that is, $\alpha = w_{AL} - w_S$ is large and/or $\beta = w_S - w_L$ is small).

Appendix B also shows that no other equilibrium exists under this condition; therefore:

Proposition 3 *Suppose that the large retailer, L, faces a single smaller rival, S, and enjoys a significant competitive advantage (namely, $\beta \leq \hat{\beta}(\alpha; w_L)$, where $\hat{\beta}$ increases with α). Then, in the unique equilibrium L adopts a loss-leading strategy: it sells the competitive product B below-cost, while keeping the total price for both products at the monopoly level; as a result, L earns more profit than in the absence of the rival.*

[23] As before, this amounts to $\alpha - \hat{r}_A^* > \hat{v}_S^* - \hat{v}_L^* = \hat{\tau}^* (> 0)$, implying that multi-stop shoppers are indeed willing to buy A when visiting L.

[24] $r_S F(w_S - r_S)$ is maximal for $r_S^m = h(v_S^m)$, where $v_S^m = l^{-1}(w_S)$. In contrast, the equilibrium margin satisfies $\hat{r}_S^* = h(\tau^*)$, where the equilibrium threshold derives from S's best response and thus satisfies $\hat{\tau}^* = l^{-1}(\beta + \hat{r}_S^*) < l^{-1}(w_S)$ since $\hat{r}_S^* < 0$ and $\beta = w_S - w_L < w_S$.

Proof. See Appendix B. ∎

Loss leading thus constitutes a robust exploitative device, which L can use to discriminate multi-stop from one-stop shoppers even when competing with a strategic smaller rival. As before, through this strategy L can earn even more profit than a pure monopolist if its comparative advantage is large enough. Interestingly, loss leading is now adopted in (pure strategy) equilibrium only when it allows L to charge the full monopoly margin to one-stop shoppers, but it does so in a broader range of circumstances: in the case of a competitive fringe, L can charge the monopoly margin only when its comparative advantage exceeds it (i.e., $v^m_{AM} \geq w_S$), a more stringent requirement than the equilibrium condition (11).[25]

Compared with the previous case of a competitive fringe of small retailers, whose profits could not be affected by L's behavior, the additional gains for L now come at the expense of S as well as of multi-stop shoppers. Indeed, pricing the competitive good below cost:

- Allows L to keep one-stop shoppers and yet charge a higher price (on the monopolized good) to multi-stop shoppers; this constitutes the "exploitative" motivation already stressed in the previous sections.
- But also exerts a competitive pressure on the small retailer, reducing its market share and squeezing its margin.

To see this, note that L' profit is of the form

$$\max_r \Pi_S(r; r_L) = r_S F(\beta + r_L - r),$$

which thus decreases when r_L decreases. A simple revealed argument moreover shows that a reduction in r_L reduces S's market share $\hat{\tau}(r_L) = \arg\max_\tau (\beta + r_L - \tau) F(\tau)$; since the best response $\hat{r}(r_L) = \arg\max_r \Pi_S(r; r_L)$ satisfies $\hat{r}(r_L) = h(\hat{\tau}(r_L))$, it follows that a reduction in r_L also reduces S's margin. Yet, while the loss-leading strategy squeezes the rival's profit (and may thus deter efficient entry, as we will see below), it appears more as a side effect of the exploitative motive than as the result of exclusionary motive. In particular, foreclosing the market through strategic tying or (pure) bundling could not be profitable here, since the large retailer could not obtain more than the monopoly profit in case of exclusion.

[25] It suffices to note that in $v^m_{AL} \geq w_S$ implies (11). Note however that this condition is more stringent than $w_{AL} \geq w_S$ (see Appendix B).

5.2 Banning loss leading

To get a better sense of the impact of L's loss-leading strategy, suppose that retailers are prevented to sell below cost. Whenever L would have wished to use B_L as a loss-leader, constraining L's subsidy leads it to sell B_L at cost ($r_L = 0$) and charge $r_A = r_{AL}^m$ for A, so as to earn the monopoly profit Π_{AL}^m. Conversely, S maximizes its profit by charging $r_S = h(\tau) = h(\beta - r_S)$. The equilibrium threshold for the shopping cost is then:

$$\tau^* = l^{-1}(\beta) > j^{-1}(\beta) = \hat{\tau}^*.$$

S, facing higher demand from multi-stop shoppers, thus makes more profit: it increases both its market share (from $\hat{\tau}^*$ to τ^*) and its margin (from $\hat{r}_S^* = h\left(\hat{\tau}^*\right)$ to $\hat{r}_S^b \equiv h\left(\tau^*\right)$); as a result, it obtains $\hat{\Pi}_S^b \equiv h(\tau^*)F\left(\tau^*\right) > h(\hat{\tau}^*)F\left(\hat{\tau}^*\right) = \hat{\Pi}_S^*$.

While one-stop shoppers face the same monopoly price as before, multi-stop shoppers benefit again from a ban of below-cost pricing since

$$v_{AS}^* \equiv v_{AL}^m + \tau^* > v_{AL}^m + \hat{\tau}^* = \hat{v}_{AS}^*.$$

It follows that banning loss leading not only raises S's profit but also increases total consumer surplus.

Finally, the increase in the number of multi-stop shoppers also enhances total welfare, since more consumers benefit from a better distribution of B. The gain in social welfare is here equal to:

$$\int_{\hat{\tau}^*}^{\tau^*} (\beta - t) dF(t),$$

which is indeed positive since $\hat{\tau}^* < \tau^* < \beta$. Finally, it is check in Appendix C that this equilibrium prevails whenever L would have offered B_L as a loss leader in the absence of a ban. Therefore, we have:

Proposition 4 *Suppose that the large retailer, L, faces a single small rival, S. Whenever L would otherwise adopt a loss-leading strategy, a ban on loss leading leads L to maintain the same total margin and sell the competitive good at cost. As a result, consumer surplus and social welfare are both higher than when loss leading is allowed.*

Proof. See Appendix C. ■

Illustration: Uniform density of shopping costs

Suppose that the shopping cost is uniformly distributed: $(F(t) = t)$. When loss leading is allowed, the equilibrium margins are given by:

$$r_{AL}^m = \frac{w_{AL}}{2}, \hat{r}_S^* = -\hat{r}_L^* = \frac{\beta}{3}.$$

S's efficiency gain, β, is thus equally shared by the two retailers and the multi-stop shoppers: compared with the monopoly benchmark, in which L obtains Π_{AL}^m and consumers whose shopping cost lies below v_{AL}^m obtain this value from patronizing L's store: (i) S charges a margin equal to one-third of β; (ii) L charges multi-stop shoppers an additional margin which is also equal to one-third of β (that is, $\hat{r}_A^* = r_{AL}^m + \beta/3$); and (iii) these multi-stop shoppers obtain an additional value which, gross of their shopping costs, corresponds to the remaining one-third of β.[26]

When loss leading are banned, S's efficiency gain is instead divided equally by S and multi-stop shoppers: S's margin equals $\beta/2$, while multi-stop shoppers obtain the other half of β.

5.3 Strategic margin squeeze

While margin squeeze appears here as a by-product of an exploitative device, the large retailer would have an incentive to manipulate its rival's prices. On the one hand, the lower its rival's price, the more it can extract from one-stop shoppers. As we will see, this leads L to decrease further its own price it can move first and act as a Stackelberg leader. On the other hand, L benefits from the presence of a smaller retailer; therefore, if entry is uncertain, L may want to limit its loss-leading strategy so as to preserve this presence. We consider these two aspects in turn.

Stackelberg leadership. Suppose that L benefits from a first-mover advantage: it sets its prices first, and then, having observed these prices, S sets its own price. Retail prices are often strategic complements, and it is indeed the case here for S in the B segment: as noted above, S's best response, $\hat{r}(r_L)$, increases with r_L. If L was competing in the usual way in the B segment, it would therefore exploit its first-mover advantage by *increasing* its price r_L, so as to encourage its rival to increase its own price and relax in this way the competitive pressure in that segment. In contrast, here L has an incentive to *decrease* even further its price for B_L (i.e., to increase

[26] This equilibrium exists (that is, condition (11) holds) whenever $r_{AL}^m = w_{AL}/2 < w_{AL} - w_L$, or $w_{AL} > 2w_L$, and

$$\beta \leq \hat{\beta} \equiv \frac{9w_{AL}}{4}\left(1 - \sqrt{\frac{5w_{AL} + 8w_L}{9w_{AL}}}\right).$$

further the subsidy it offers for that product): this leads S to decrease its own price, and allows L to raise the price it charges for A to one-stop shoppers. To see this, note that L's Stackelberg profit from a loss-leading strategy can be written as:

$$\Pi_L^S(r_L) = \Pi_{AL}^m - r_L F(\hat{\tau}(r_L)) = \Pi_{AL}^m - r_L F(\beta + r_L - \hat{r}(r_L)).$$

Letting r_L^S denote the optimal Stackelberg margin, and using $\hat{r}(\hat{r}_L^*) = \hat{r}_S^*$, we have:

$$\begin{aligned} -r_L^S F\left(\beta + r_L^S - \hat{r}\left(r_L^S\right)\right) &\geq -\hat{r}_L^* F\left(\beta + \hat{r}_L^* - \hat{r}_S^*\right) \\ &\geq -r_L^S F\left(\beta + r_L^S - \hat{r}_S^*\right), \end{aligned}$$

where the second inequality stems from the fact that $\hat{r}_L^*$ constitutes L's best response to r_S^*. Since $-r_L^S > 0$ and $F(\cdot)$ and $\hat{r}(\cdot)$ are both increasing, this in turn implies $r_L^S \leq \hat{r}_L^*$. This inequality is moreover strict, since (using $\hat{\tau}(\hat{r}_L^*) = \hat{\tau}^*$):

$$\left(\Pi_L^S\right)'(\hat{r}_L^*) = -F(\hat{\tau}^*) - \hat{r}_L^* f(\hat{\tau}^*)\left(1 - \hat{r}'(\hat{r}_L^*)\right) = \hat{r}_L^* f(\hat{\tau}^*)\,\hat{r}'(\hat{r}_L^*) < 0.$$

This leads to:

Proposition 5 *Suppose that L and S compete as Stackelberg leader and follower. Then, whenever L's competitive advantage leads it to adopt a loss-leading strategy, it sells the competitive product B further below-cost, compared with what it would do in the absence of a first-mover advantage: $r_L^S < \hat{r}_L^*$.*

The adoption of loss leading thus appears to change drastically the nature of the strategic interaction between the two retailers.

Entry accommodation. Suppose now that the presence of S is uncertain. To capture this possibility, we will assume that S must incur a fixed cost of entry, γ, which is ex ante distributed according to a cumulative distribution function $G(\cdot)$.

Consider first the following timing:

- In stage 1, the entry cost is realized and S chooses whether to enter;
- In stage 2, if S enters it competes with L as above; otherwise L enjoys a monopoly position.

In case of entry, S's profit is limited by L's loss-leading strategy. In particular, $\hat{\Pi}_S^b > \hat{\Pi}_S^*$ implies that a ban on loss leading will foster entry, which will occur with probability $G\left(\hat{\Pi}_S^b\right)$

rather than $G\left(\hat{\Pi}_S^*\right)$. Banning loss leading will thus improve further consumer surplus and social welfare, by allowing multi-stop shoppers to benefit with greater probability from S's more efficient distribution of B.

While it is profitable for L to adopt a loss-leading strategy in case of entry, this strategy actually backfires by reducing the likelihood of entry, and thus the prospect of extracting additional rents from multi-stop shoppers. Although L would not gain from committing itself to never adopt a loss-leading strategy (since then it would extract no additional rent from multi-stop shoppers), it would benefit from limit its extent.

To see this, suppose that L benefits again from a first-mover advantage and consider the following timing:

- In stage 1, L chooses its prices.
- In stage 2, the entry cost is realized and S chooses whether to enter; if it enters, it then sets its own price.

If entry were certain, maximizing its Stackelberg profit would lead L to adopt r_L^S. But now, L's ex ante profit can be written as:

$$\hat{\Pi}_L^S\left(r_L\right)=\Pi_{AL}^m+G\left(\hat{\Pi}\left(r_L\right)\right)\Pi_L^S\left(r_L\right).$$

The optimal margin, $\hat{r}_L^S$, thus satisfies:

$$G\left(\hat{\Pi}\left(\hat{r}_L^S\right)\right)\Pi_L^S\left(\hat{r}_L^S\right)\geq G\left(\hat{\Pi}\left(r_L^S\right)\right)\Pi_L^S\left(r_L^S\right)\geq G\left(\hat{\Pi}\left(r_L^S\right)\right)\Pi_L^S\left(\hat{r}_L^S\right),$$

which implies:

$$G\left(\hat{\Pi}\left(\hat{r}_L^S\right)\right)\geq G\left(\hat{\Pi}\left(r_L^S\right)\right).$$

Since $G(\cdot)$ and S's best response profit, $\hat{\Pi}\left(r_L\right)$, are both increasing in r_L, it follows that $\hat{r}_L^S\geq r_L^S$. This inequality is moreover strict, since:

$$\begin{aligned}\left(\hat{\Pi}_L^S\right)'\left(r_L^S\right) &= g\left(\hat{\Pi}\left(r_L^S\right)\right)\Pi_L^S\left(r_L^S\right)+G\left(\hat{\Pi}\left(r_L^S\right)\right)\left(\Pi_L^S\right)'\left(r_L^S\right)\\ &= g\left(\hat{\Pi}\left(r_L^S\right)\right)\Pi_L^S\left(r_L^S\right)>0.\end{aligned}$$

Therefore, we have:

Proposition 6 *Suppose that L and S compete as Stackelberg leader and follower, and that the entry of S depends on the realization of a random entry cost. Then, when L's competitive advantage leads it to adopt a loss-leading strategy, it limits the subsidy offered on B so as to increase the likelihood of entry: $\hat{r}_L^S>r_L^S$.*

6 Conclusion

This paper shows that large multi-product retailers can use loss leading as an exploitative device at the detriment of consumers and smaller retailers, without any efficiency justification in terms of distribution cost or advertising. We further show that banning below-cost pricing can then increase consumer surplus and social welfare, as well as smaller retailers' profits.

Our analysis also underlies some of the key ingredients for loss leading to be used as such an exploitative device. In particular, a retailer must offer a range of products that is sufficiently valuable to offset any efficiency gains that its smaller but more focused rivals may enjoy, thus de facto conferring a leading position in the market.

Finally, while our analysis sheds a first light on the possible exploitative use of loss leading, it does so within the confines of a rather stylized framework, in which the large retailer enjoys a monopoly situation on some of the goods offered to consumers. The extent to which the analysis carries over to different situations, where the large retailer faces (imperfect) competition on these goods, either from other large retailers or from alternative smaller outlets that focus on these goods, remains an avenue for further research.

Appendices

Appendix A: Quasi-concavity of Profit Functions

We check here the quasi-concavity of the profit functions. In the monopoly case, it is optimal for L to charge $r_{AL} < w_{AL}$ (otherwise, it would make no profit) and it obtains in this way

$$\Pi\left(r_{AL}\right) = r_{AL} F(w_{AL} - r_{AL}).$$

Differentiating with respect to r_{AL} yields:

$$\Pi'\left(r_{AL}\right) = f(w_{AL} - r_{AL})\left(h(w_{AL} - r_{AL}) - r_{AL}\right).$$

The first-order condition thus boils down to

$$\phi\left(r_{AL}\right) \equiv h(w_{AL} - r_{AL}) - r_{AL} = 0,$$

which has a unique solution r_{AL}^m, since ϕ is strictly decreasing. This solution is moreover a global maximum since:

$$\Pi''\left(r_{AL}^m\right) = -f(w_{AL} - r_{AL}^m)\left(h'(w_{AL} - r_{AL}^m) + 1\right) < 0.$$

In regime L, as long as $\tau = \beta + r_L - r_S$ lies between 0 and $v_{AL} = w_{AL} - r_{AL}$, L's profit is equal to:

$$\Pi_L(r_{AL}, r_L) = r_{AL}F(w_{AL} - r_{AL}) - r_L F(\beta + r_L - r_S),$$

which is thus additively separable with respect to r_{AL} and r_L. Using the same argument as above, the terms $r_{AL}F(w_{AL} - r_{AL})$ and $-r_L F(\beta + r_L - r_S)$ are moreover quasi-concave in, respectively, r_{AL} and $-r_L$. It follows that the unique local optimum, given by $r_{AL}^m = h(w_{AL} - r_{AL}^m)$ and $r_L^* = -h(\beta + r_L^* - r_S)$, is also a global maximum and therefore constitute L's unique best response to r_S. Similarly, when the small retailer is a strategic player, its best response, which maximizes $\Pi_S = r_S F(\beta + r_L - r_S)$, is quasi-concave in r_S and the unique best response is characterized by $r_S = h(\beta + r_L - r_S)$. A similar reasoning applies to regime S.

Appendix B: Proof of Proposition 3

We first characterize the condition under which the candidate loss leading equilibrium ($r_{AL} = r_{AL}^m$, $\hat{r}_L^* = -\hat{r}_S^* = -\hat{r}^*$) does not encourage S to deviate and attract one-stop shoppers, before turning to regime S as well as to the boundary case $v_{AL} = v_S$.

The candidate loss leading equilibrium resists S's deviation to regime S as long as (11) holds, namely:

$$h(\hat{\tau}^*) F(\hat{\tau}^*) \geq (w_L + \beta - v_{AL}^m) F(v_{AL}^m), \tag{12}$$

This condition requires $w_{AL} > w_S$: when $w_{AL} = w_S$, the deviation profit is equal to $(w_S - v_{AL}^m) F(v_{AL}^m) = (w_{AL} - v_{AL}^m) F(v_{AL}^m) = \Pi_{AL}^m$, which thus dominates the competitive profit $h(\hat{\tau}^*) F(\hat{\tau}^*)$ since S faces a residual demand of the form $\beta + \hat{r}_L^* - r_S < w_S - r_S = w_{AL} - r_S$.

Using $\hat{\tau}^*(\beta) \equiv j^{-1}(\beta)$, this condition can be rewritten as:

$$\Psi(\beta; v_{AL}^m) \equiv \beta - \frac{h(\hat{\tau}^*(\beta))F(\hat{\tau}^*(\beta))}{F(v_{AL}^m)} \leq v_{AL}^m - w_L, \tag{13}$$

Using

$$\hat{\tau}^{*\prime}(\beta) = \frac{1}{1 + 2h'(\hat{\tau}^*(\beta))},$$

we have:

$$\begin{aligned} \frac{\partial \Psi}{\partial \beta}(\beta; v_{AL}^m) &= 1 - \frac{h'(\hat{\tau}^*(\beta)) F(\hat{\tau}^*(\beta)) + h(\hat{\tau}^*(\beta)) f(\hat{\tau}^*(\beta))}{(1 + 2h'(\hat{\tau}^*(\beta))) F\left(v_{AL}^m\right)} \\ &= 1 - \frac{1 + h'(\hat{\tau}^*(\beta))}{1 + 2h'(\hat{\tau}^*(\beta))} \frac{F(\hat{\tau}^*(\beta))}{F\left(v_{AL}^m\right)}. \end{aligned}$$

Since $\hat{\tau}^* < v_{AL}^m$ in regime L, $\Psi(\cdot)$ strictly increases with β in the relevant range (in particular, this holds whenever $w_{AL} > w_S$). The equilibrium condition can be written as $\beta \leq \hat{\beta}(\alpha; w_L) \equiv$

$\Psi^{-1}(v_{AL}^m - w_L; w_L)$. To show that this threshold increases with α, note that (12) depends on α only through the impact of $v_{AL}^m(w_{AL}) = v_{AL}^m(w_L + \alpha) = l^{-1}(w_L + \alpha)$ on the right-hand side, $(w_L + \beta - v_{AL}^m) F(v_{AL}^m)$, and:

$$\begin{aligned} \frac{\partial}{\partial \alpha}\left((w_L + \beta - v_{AL}^m) F(v_{AL}^m)\right) &= \left((w_L + \beta - v_{AL}^m) f(v_{AL}^m) - F(v_{AL}^m)\right) \frac{\partial v_{AL}^m}{\partial \alpha} \\ &= \left((w_S - v_{AL}^m) - (w_{AL} - v_{AL}^m)\right) f(v_{AL}^m) \frac{\partial v_{AL}^m}{\partial \alpha} \\ &= -(w_{AL} - w_S) f(v_{AL}^m) \frac{\partial v_{AL}^m}{\partial \alpha}, \end{aligned}$$

and is thus negative whenever $w_{AL} > w_S$.

We now turn to regime S, in which one-stop shoppers patronize the small retailer ($v_{AL} < v_S$) and show that there is no such equilibrium when $w_{AL} > w_S$. In this regime, L faces only a demand $F(v_A)$ for A from multi-stop shoppers, where $v_A = \alpha - r_A$, and thus makes a profit equal to $r_A F(v_A)$. L could however deviate and attract one-stop shoppers by reducing r_L (keeping r_A and thus v_A constant) so as to offer $v_{AL}' = v_S$ (or slightly above v_S). This does not change the number of multi-stop shoppers since $\tau' = v_S - v_L' = v_{AL}' - v_L' = v_A' = v_A$, and on those consumers L obtains the same margin, r_A, as before. But it now attracts one-stop shoppers (those for which $v_A \leq t \leq v_{AL} = v_S$) on which its margin is $r_{AL}' = w_{AL} - v_{AL}' = w_{AL} - v_S = w_{AL} - w_S + r_S$. Since any candidate equilibrium would require $r_S \geq 0$, the deviation would be profitable when $w_{AL} > w_S$.

Finally, consider the boundary between the two regimes, in which one-stop shoppers would be indifferent between visiting L or S ($v_{AL} = v_S$). Note first that there must exist some active consumers, since either retailer can profitably attract consumers by charging a small positive margin. We must therefore have $v_{AL} = v_S > 0$. Suppose now that all consumers are multi-stop shoppers, in which case L only sells A while S sells B_S to all consumers; this requires $v_{AL} = v_S \leq \tau$, where τ denotes the shopping cost threshold below which consumers favor multi-stop shopping. This also implies that one-stop shoppers would buy at least A when patronizing L. Assume first that these one-stop shoppers would only buy A. In that case, $v_{AL} = w_A - r_A$ and $\tau = v_{AS} - v_{AL} = (w_{AS} - r_A - r_S) - (w_A - r_A) = v_S - \theta$, where by assumption $\theta \equiv w_A + w_S - w_{AS} \, (= w_A + w_L - w_{AL}) \geq 0$. The condition $v_S \leq \tau$ then imposes $\theta = 0$ and $\tau = v_S$. If instead one-stop shoppers would buy both products from L, then $\tau = v_S - v_L \geq v_S$ implies $v_L = 0$ and thus again $\theta = 0$ (otherwise, one-stop shoppers would not buy B from L) and $v_{AL} = w_A - r_A$. In both cases, it is profitable for L to transform some multi-stop shoppers into one-stop shoppers by reducing its margin on B_L to $r_L' = w_L - \varepsilon > 0$, increasing r_A by ε so as to keep v_{AL} constant: this does not affect the total number of consumers, but transforms those whose shopping cost lies between $\tau' = v_S - v'_L = \tau - \varepsilon$ and τ into one-stop shoppers; and while L obtains the same margin on them (since $r'_{AL} = r_A$), it now obtains a higher margin $r'_A < r_A$ on the remaining multi-stop shoppers.

Some consumers must therefore visit a single store, and by assumption they are indifferent between visiting either store ($v_{AL} = v_S$). Suppose now some one-stop shoppers visit S. Since S can avoid making losses, we must then have $r_S \geq 0$; but then, $v_{AL} = v_S$ implies $r_{AL} = r_S + w_{AL} - w_S > 0$, and thus it would be profitable for L to reduce slightly r_{AL} so as to attract all one-stop shoppers. Therefore, all one-stop shoppers must go to L. Conversely, we must have $r_S \leq 0$, otherwise S would benefit from slightly reducing so as to attract all one-stop shoppers. Therefore, in any candidate equilibrium such that $v_{AL} = v_S$, either:

- There are some multi-stop shoppers (i.e. $\tau > 0$) and thus $r_S = 0$; but then slightly increasing r_S would allow S to keep attracting some multi-stop shoppers and obtain a positive profit, a contradiction.
- Or all consumers buy both products from L, which requires $r_L \leq r_S - \beta \leq -\beta < 0$. But then increasing r_L to $r'_L = r_S - \beta + \varepsilon$ while reducing r_A by the same amount (so as to keep r_{AL} constant) would lead those consumers with $t < \tau' = \varepsilon$ to buy B_S from S, allowing L to avoid a subsidy r_L for them.

It follows that there is no equilibrium such that $v_{AL} = v_S$.

Appendix C: Proof of Proposition 4

We characterize here the conditions under which S cannot gain by deviating from regime L. Its optimal margin in regime S would again be $r_S^m = h\left(v_S^m\right)$, which exceeds the equilibrium level $\hat{r}_S^b = h\left(\tau^*\right)$, since $\tau^* = l^{-1}\left(\beta\right) < l^{-1}\left(w_S\right) = v_S^m$; the optimal deviation is achieved at the boundary of the two regimes. The equilibrium condition is thus:

$$h\left(\tau^*\right) F\left(\tau^*\right) \geq \left(w_L + \beta - v_{AL}^m\right) F(v_{AL}^m),$$

which is less stringent than in the absence of a ban, since the profit is higher than before $\left(\hat{\Pi}_S^b \equiv h(\tau^*) F\left(\tau^*\right) > h(\hat{\tau}^*) F\left(\hat{\tau}^*\right) = \hat{\Pi}_S^*\right)$. Therefore, the equilibrium prevail whenever L would have adopted a loss-leading strategy in the absence of a ban on below-cost pricing.

Applying the same logic as before, the equilibrium exists if $\beta \leq \tilde{\beta}\left(\alpha; w_L\right) \equiv \tilde{\Psi}^{-1}(v_{AL}^m - w_L; w_L)$, where

$$\tilde{\Psi}\left(\beta; v_{AL}^m\right) \equiv \beta - \frac{h(\tau^*(\beta)) F(\tau^*(\beta))}{F(v_{AL}^m)}$$

is indeed increasing: using

$$\tau^{*\prime}(\beta) = \frac{1}{1 + h'(\tau^*(\beta))},$$

we have:

$$\frac{\partial \tilde{\Psi}}{\partial \beta}(\beta; v_{AL}^m) = 1 - \frac{F(\tau^*(\beta))}{F(v_{AL}^m)} > 0.$$

As already noted, $\tau^* > \hat{\tau}^*$ implies $\tilde{\beta}(\alpha; w_L) > \hat{\beta}(\alpha; w_L)$.

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