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ABSTRACT

The Manufacturers' Suggested Retail Price*

Based on arguments of the 'reference-dependent' theory of consumer choice, we assume that a retailer's discount of a manufacturer's suggested retail price changes consumers' demand. We can show that the producer benefits from suggesting a retail price. If consumers are additionally sufficiently 'loss averse', e.g. consumers' disappointment from higher-than-suggested retail prices is sufficiently high, the producer can force the retailer to take the suggested price in equilibrium and thus capture some of the retailer's profits. A producer always benefits from investing into an advertising campaign with suggested retail prices.

JEL Classification: D10, D40, L10, L20 and M37
Keywords: advertising, loss aversion, manufacturer's suggested retail price, reference dependence and vertical product differentiation

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1 Introduction

Several examples indicate that manufacturers frequently publicly suggest retail prices even though they may not have any direct influence on the retailer's obedience. Car manufacturers, as Mitsubishi and Hyundai, software manufacturers as Microsoft, manufacturers of Swiss watches as Swatch or Jaeger leCoutre, as well as the manufacturers of cosmetics as Vichy or Claire Fisher or even of chocolate brands, as Lindt, advertise in magazines or other media with a *manufacturer's suggested retail price* (MSRP).

In many countries retail price maintenance as a direct vertical restraint is per se prohibited by antitrust laws. In Canada, for example, any attempt to influence upwards the price at which any other person, and thus a downstream retailer, offers or supplies a product is prohibited by s61(1) of the Competition Act. Suggested retail prices are not prohibited provided that it is made clear to the retailer that he is "under no obligation to accept the suggestion and would not suffer in his business relations (...) if he failed to accept the suggestion" and s61(3) "unless the price is so expressed as to make it clear to any person to whose attention the advertisement comes that the product may be sold at a lower price." In Germany, §23 GWB says that suggested retail prices are "allowed for branded products if it is made clear that the price is suggested and that it is neither a price ceiling nor a minimum price, and that it corresponds to the expected price of a majority of customers." It may not be too high as to make a costumer believe that the majority expects a significantly higher price than the effective retail price.

In fact, advertised suggested retail prices - either on the product's package, or on brochures or even by an advertisement campaign - often are a manufacturer's only possibility to influence the retail price in the absence of certain narrowly defined competitive conditions or agency relationships or when the good is not sold on consignment.[1] But how should the suggested retail price be set such that a retailer in fact accepts this price? Is a price suggestion a profitable strategy for the manufacturer? How do consumers respond to a suggested retail price?

Economic theory explains the fact that retailers accept suggested prices by either collusive arguments or by assuming that the manufacturer has other possibilities to pressure retailers.[2] The retailer cartel hypothesis is based on the assumption that the suggested retail price serves as a coordination device for retailers and serves as an entry bar-

[1] This is one exception of the per se illegality of resale price maintainance in the US under the General Electric doctrine.

[2] See Bernheim and Whinston (1985) and Matthewson and Winter (1998).

rier against low-price, large volume outlets.[3] The conditions for this hypothesis are the following: The retailers invested substantial assets in traditional low-volume outlets and entry of a discount chain store threatens the quasi rents earned by these outlets. The cartel must involve a number of retailers for substitute products with only one manufacturer and their common interest is to maximize joint profits irrespective of how profits are divided among them. If the cartelization is successful, entry may be blocked or at least delayed. The problem with this hypothesis is that it only is valid if the manufacturer agrees to foreclose the discount sector. Once the potential market share of this sector is growing the manufacturer's gain from the cartel at the suggested retail price would be overcompensated by the cost of foreclosing the discount sector even if the traditional retailers had prevented cheating.[4] Alternatively, the cartel hypothesis can be based on arguments from the agency literature which suggests that the manufacturer acts as a common marketing agency for the retailers and thereby facilitates collusion.[5] The second explanation for suggested retail prices is grounded in the idea that a monopolistic manufacturer can effectively threaten his retailers to quit or alter the business relation in case they do not follow the recommendation even if this behavior is illegal, because detection is rather difficult. This argument is conditioned on the assumption that no retailer has enough market power as for example a large discounter may have.

In this paper a different line of argument is used to explain the prevalence of suggested retail prices and the observation that retailers in fact often price the products according to the suggested price. The argument is based on the hypothesis that a suggested retail price serves as a 'reference point' and thus manipulates consumers' willingness-to-pay: A number of psychological experiments point at the important role of reference points in individual choice. "The location of a reference point affects the coding of outcomes as gains and losses. This coding, in turn, affects preferences because of characteristic differences in the evaluation of positive and negative outcomes."[6] Kahneman and Tversky (1979, 1984) emphasized in prospect theory that the value function is not only reference dependent but also loss averse and therefore steeper in the do-

[3] See Matthewson and Winter (1998) for a discussion of the hypothesis to explain retail price maintainance.

[4] On the french book market recommended prices, which were met by the retailers, were common until FNAC and Leclerc entered the market as large discount retailers. Thereafter a severe price war started which finally in 1981 induced a change in law, and RPM was allowed for printed products. See Monopolkommission (2000).

[5] See Bernheim and Whinston (1985) for this line of argument.

[6] See Kahneman (1992), p.297.

main of losses than in the domain of gains. The concept used in this analysis will be in line with the concepts of reference dependence and loss aversion in the context of riskless choice which has been formalized by Tversky and Kahneman (1991) or Kahneman, Knetsch and Thaler (1991). We assume that in responds to the suggested retail price consumers' willingness to pay is increased if they are confronted with a lower than suggested retail price while it is decreased if the retail price is above the suggested retail price.[7]

For simplicity, we restrict the analysis to the case of a single and monopolistic manufacturer and a single and monopolistic retailer. In this respect the analysis is only a starting point, suggesting that most results from the literature on vertical strategic interactions are probably adjustable to the analyzed demand features. Furthermore we model (without loss of generality) heterogeneous consumers and restrict ourselves to the case in which they buy only one unit, which seems to be reasonable when talking about luxurious or durable branded products. Our main findings are that the manufacturer always benefits from suggesting a retail price and would thus always invest into price suggesting advertisement. Considering only reference dependence in the sense that consumers' satisfaction about negative deviations is as large as their disappointment in case of positive price deviations, we find that the suggested retail price corresponds to a price ceiling and the retailer will always undercut this suggested retail price. Both the retailer and the manufacturer benefit in this situation. If consumers' loss aversion is sufficiently strong (consumers' disappointment is sufficiently larger than their satisfaction), the manufacturer can and will 'force' the retailer to choose the suggested retail price in equilibrium and profits are shifted from the retailer to the manufacturer.

To the best of my knowledge there is no literature on the issue of suggested retail prices as characterized above. The effect of announced list prices is analyzed in the context of auctions as for example by Horowitz (1992) for the housing market. The effects of advance notification of list price changes was analyzed together with best-price policies by Holt and Scheffman (1987) for the market of lead-based gasoline to comment on the FTC Ethyl-Case. Best-price policies are analyzed separately by Schnitzer (1994) in a more general setting. In contrast to the scenario we have in mind, in both these approaches there is no vertical structure as the auctioneer or the retailer/seller is the one who announces the list prices. The auction literature focuses on the impact of announcements

[7] We abstract from a third characteristic of individuals' value function proposed by prospect theory, as we do not assume that the marginal value of both gains and losses decreases with their size in the sense of 'diminishing sensitivity'.

on the demand in an incomplete information framework while the literature on special pricing policies focuses on the competitive aspects of those practices. Bester (1995) investigates the role of price advertising in a market in which consumers are imperfectly informed about prices. He finds that the monopolistic seller adopts a random advertising strategy which allows him to also adopt a random pricing strategy. Also Bester's approach lacks the vertical structure that we have in mind with the manufacturer's suggested retail pricing behavior..

The marketing literature analyzes phenomenons which seem to be related to the above mentioned psychological observations. Anderson and Simester (1998) find that sale signs increase demand and Dhar et al. (1999) show that advertised price claims are a major promotional tool to attract consumers. Rao and Syam (2001) analyze the effect of communicated price discounts and unadvertised specials on consumers' store choice. Although the marketing models propose a certain indirect relationship between price announcements and consumers' demand they neglect the possibility that the manufacturer of a good may also influence demand strategically.

The paper is organized as follows. In the next section we present the main assumptions of the basic demand model and in section 3 we present two reference cases for the interaction between manufacturer and retailer. The impact of a suggested retail price on demand as well as strategic decisions of retailer and manufacturer are presented in section 4. In section 5 we analyze the manufacturer's incentive to invest into advertising and in the last section we summarize our findings and close with some concluding remarks.

2 The model

A single supplier produces an intermediate good at a constant costs c,which he sells to a single downstream firm, called the retailer. The retailer resells the product and for simplicity he has no retailing costs. The quantity bought by the retailer corresponds also to the final consumption of the good. We assume that the manufacturer chooses his wholesale price p_w and the suggested price p_s first, anticipating the retailer's reaction perfectly, and then the retailer chooses the retail price p_r, taking the manufacturer's prices as given.

The good is characterized by a quality index s. All final consumers buy at most one unit of the good and agree over the most preferred quality s, and therefore also over the preference ordering. Thus the product space is characterized by vertical differentiation. In the present model a very simple example of a vertical differentiation model, based on Tirole's (1989) version of the analysis by Shaked and Sutton (1982), is used to describe consumers' preferences:[8]

$$u = \begin{cases} \theta s - p_r & \text{if he buys the good with quality } s \text{ at a retail price } p_r, \\ 0 & \text{if he does not buy.} \end{cases}$$

The utility u is separable in price and quality and corresponds to the surplus derived from consumption. The retail price is given by $p_r > 0$ and quality $s > 0$ is a positive real number, as well as consumers' taste, given by θ. Although all consumers rank the product quality equally, a consumer with high θ is more willing to pay for it. For simplicity it is assumed that across the population of relevant consumers θ is distributed uniformly between 0 and 1 such that the density is constant and given by $f(\theta) = 1$.

A consumer will purchase the good if $\theta s - p_r \geq 0 \Leftrightarrow \theta \geq \frac{p_r}{s}$. Hence, demand will be given as:

$$D(p_r) = \int_{\frac{p_r}{s}}^{1} dx = \left(1 - \frac{p_r}{s}\right).$$

Note that demand is constantly decreasing by $-\frac{1}{s}$ and that for $p_r = s$ there is no demand left, while for $p_r = 0$ all consumers purchase the good. Furthermore, all parties are perfectly informed about demand, prices as well as quality.

3 The reference cases

For later reference let us assume for the moment, that the manufacturer *cannot* use the instrument of suggesting a retail price. Instead, he can only choose the wholesale price p_w, anticipating the retailer's subsequent action perfectly. Furthermore, let us distinguish two situations: In the first, retail price maintenance is allowed. This corresponds to the case in which the manufacturer acts as a monopolist on the market. In the second situation we assume that price maintenance is not allowed. The retailer can choose his retail price independently, and the manufacturer acts like a von Stackelberg leader.

3.1 Retail price maintenance

If retail price maintenance is allowed, the manufacturer can dictate the choice of the retail price to the retailer. He will choose a wholesale

[8] The qualitative results of the following analysis do not depend on this specific description of consumers' preferences but apply also to the standard linear demand function given as $D(r) = a - br$. Since we consider heterogeneous products or preferences to be a more realistic description we chose the presented approach.

price p_w which maximizes his profit and then write a provision into the contract that the retailer chooses $p_r = p_w$. The manufacturer solves

$$\max_{p_w} \Pi_M^{RPM} = (p_w - c) D(p_r).$$

It is straightforward to show that he chooses the monopoly price as in absence of the vertical structure and thus realizes monopoly profits, while the retailer makes zero profits.

$p_r = p_w$	Π_R^{RPM}	Π_M^{RPM}
$\frac{s+c}{2}$	0	$\frac{(s-c)^2}{4s}$

The manufacturer's profit under price maintenance corresponds to the vertically integrated profit.

3.2 Double marginalization

Ignoring any other vertical restraints, we can analyze the manufacturer's choice if he can only choose a linear wholesale tariff p_w, very much in line with Spengler (1950). Assume that the manufacturer chooses the wholesale price p_w first and the retailer chooses the final retail price p_r second and that he is himself a monopolist in his retail market. For simplicity assume that the retailer has no further costs. The retailer's optimization problem is given as:

$$\max_{p_r} (p_r - p_w) \left(1 - \frac{p_r}{s}\right),$$

which leads to $p_r(p_w) = \frac{1}{2}s + \frac{1}{2}p_w$. At the first stage, the manufacturer incurs production costs c and chooses:

$$\max_{p_w} (p_w - c) \left(1 - \frac{p_r(p_w)}{s}\right).$$

The equilibrium prices and profits will then be given by[9]:

p_w	p_r	Π_R^{DM}	Π_P^{DM}
$\frac{s+c}{2}$	$\frac{3s+c}{4}$	$\frac{(s-c)^2}{16s}$	$\frac{(s-c)^2}{8s}$

[9] In the following, superscripts denote the pricing regime while subscripts M and R stand for 'manufacturer' and 'retailer', respectively.

Any decision made by the retailer that increases his demand for the good by one unit generates an incremental profit of $p_w - c$ units for the manufacturer. Since the retailer does only take his own incremental profit into account he chooses a retail price that leads to a too low consumption of the good from the manufacturer's perspective. This vertical externality causes the aggregate profits to be lower than the vertically integrated profits. For later reference take the manufacturer's profit under double marginalization as a lower benchmark and the profit under retail price maintenance as the upper benchmark. In the following sections the question will be analyzed if a retail price suggestion via a more or less widely spread advertising campaign addressed at final consumers is an adequate tool to raise manufacturer's profit if retail price maintenance is illegal.

4 The impact of a suggested price on demand

Assume now that the manufacturer advertises a suggested retail price $p_s \in [0, s]$ to the final consumers. We assume that those consumers who were reached by the advertisement take this suggested retail price p_s as a reference point when they enter the retailer's store. Given that the retailer chooses any retail price p_r consumers can be confronted with $p_r < p_s, p_r = p_s$ or $p_r > p_s$. The concept used in this analysis will be in line with the concepts of reference dependence and loss aversion in the context of riskless choice and 'constant loss aversion' formalized by Tversky and Kahneman (1991). Consumers who observe $p_r \leq p_s$ enjoy additional utility of $\varepsilon (p_s - p_r)$, while if they observe $p_r > p_s$ their utility is reduced by $\gamma (p_s - p_r)$. Both, γ as well as ε are positive real numbers in the interval $[0, 1]$. To formalize loss aversion we assume $\gamma > \varepsilon$. A consumer's utility from buying the final good can be written as:

$$u = \begin{cases} \theta s - p_r + \varepsilon (p_s - p_r) & p_r \leq p_s \\ \theta s - p_r + \gamma (p_s - p_r) & p_r > p_s \end{cases}$$

which leads to a demand function of[10]

$$\overline{D}(p_s, p_r) = \begin{cases} 1 & p_r \leq \frac{\varepsilon p_s}{\varepsilon + 1} \\ 1 - \frac{p_r - \varepsilon(p_s - p_r)}{s} & \frac{\varepsilon p}{\varepsilon + 1} < p_r \leq p_s \\ 1 - \frac{p_r - \gamma(p_s - p_r)}{s} & p_s < p_r < \frac{s + \gamma p_s}{1 + \gamma} \\ 0 & \frac{s + \gamma p_s}{1 + \gamma} \leq p_r \end{cases}$$

[10]Note that a suggested retail price of $p_s < s$ does not increase all consumers' willingness to pay but only of those at the lower end of the distribution, while for consumers at the upper end the willingness to pay is decreased.

At some point the retailer cannot convince any additional consumers to purchase the product by further reducing his retail price p_r, since for some low p_r all consumers already purchase the good. This is the case if $p_r = \frac{\varepsilon p_s}{\varepsilon+1}$. Obviously for a given suggested retail price p_s this lowest price is strictly positive. On the other hand, if the retailer chooses p_r sufficiently high there will be no consumer left to buy his product. This price is reached for $p_r = \frac{s+\gamma p_s}{1+\gamma}$. Due to consumers' loss aversion γ this reservation price is lower if there is a suggested retail price p_s.

Given that only a fraction λ of all consumers is reached by the advertisement, there will still be some fraction $(1-\lambda)$ of the consumers without a reference point whose' demand function can be characterized as before by $D(p_r) = 1 - \frac{p_r}{s}$.[11] Hence, the combined demand for the good is given by $\lambda \overline{D}(p_s, p_r) + (1-\lambda)D(p_r)$ and can be written as:

$$\widehat{D}(p_s, p_r, \lambda) = \begin{cases} \lambda \max\left\{1 - \frac{p_r - \varepsilon(p_s - p_r)}{s}, 0\right\} + (1-\lambda)\max\{1 - \frac{p_r}{s}, 0\} \text{ if } p_r \leq p_s \\ \lambda \max\left\{1 - \frac{p_r - \gamma(p_s - p_r)}{s}, 0\right\} + (1-\lambda)\max\{1 - \frac{p_r}{s}, 0\} \text{ if } p_r > p_s \end{cases}$$

which leads to:

$$\widehat{D}(p_r, p_s, \lambda) = \begin{cases} 0 & s \leq p_r \\ (1-\lambda)(1 - \frac{p_r}{s}) & \frac{s+\gamma p_s}{1+\gamma} < p_r < s \\ 1 + \frac{\lambda\gamma(p_s - p_r)}{s} - \frac{p_r}{s} & p_s < p_r \leq \frac{s+\gamma p_s}{1+\gamma} \\ 1 + \frac{\lambda\varepsilon(p_s - p_r)}{s} - \frac{p_r}{s} & \frac{\varepsilon p_s}{1+\varepsilon} < p_r \leq p_s \\ \lambda 1 + (1-\lambda)(1 - \frac{p_r}{s}) & p_r \leq \frac{\varepsilon p_s}{1+\varepsilon} \end{cases}$$

The impact of a suggested retail price on consumers' demand is twofold: If 'loss aversion' is neglected 'reference dependence' implies that the negative impact γ is equal to the positive impact ε. A suggested retail price would just turn the demand function downwards around the reference point of the suggested retail price. At $p_r = \frac{\varepsilon p_s}{1+\varepsilon}$ and at $p_r = \frac{s+\gamma p_s}{1+\gamma}$ the demand function is kinked. If on the other hand $\gamma > \varepsilon$, as 'loss aversion' will be assumed in this analysis, the demand function is also kinked at $p_r = p_s$, decreasing more rapidly with a rate of $-\frac{\lambda\gamma+1}{s}$ for $p_r > p_s$, and more slowly with $-\frac{\lambda\varepsilon+1}{s}$ for $p_r < p_s$.

[insert Figure 1 here]

[11] The literature distinguishes between "persuasive" and "informative" advertising. Informative advertising conveys information about existence of products, prices and location of stores, and so on, and as e.g. Grossman and Shapiro (1984) assume, consumers cannot purchase a good without recieving an ad. In contrast, persuasive advertising directly influences consumer preferences. This model falls into the latter category, in line with e.g. Dixit and Norman (1978).

Now that demand is completely characterized for a given amount of informed consumers, the optimal strategies of the retailer and the manufacturer can be analyzed. Henceforth it is assumed that the manufacturer can only offer a linear tariff, but that additionally he can choose a suggested retail price which he will advertise to the final consumers.

4.1 The retailer's strategy

The retailer's optimization problem can be written as

$$\max_{p_r} \Pi_R = (p_r - p_w)\, \widehat{D}\,(p_r, p_s, \lambda)\,.$$

As he has to take into account the consumers' reaction, he now has several options: He can choose p_r such that demand is given by any of the above characterized four subfunctions. His choice depends on the manufacturer's combination of p_s and p_w and can be characterized by the following lemma:

Lemma 1 *The retailer chooses a retail price p_r, depending on p_w and p_s, such that:*

$$p_r = \begin{cases} p_r^* \equiv \frac{s+\lambda\varepsilon p_s+p_w\lambda\varepsilon+p_w}{2\lambda\varepsilon+2} < p_s & for \quad 0 < p_w < f_1(p_s), \\ p_s & for \quad p_w \in [f_1(p_s), f_2(p_s)], \\ p_r^{**} \equiv \frac{s+\lambda\gamma p_s+p_w(1+\lambda\gamma)}{2+2\lambda\gamma} > p_s & for \quad f_2(p_s) < p_w < f_3(p_s), \\ p_r^{***} \equiv \frac{1}{2}s + \frac{1}{2}p_w > p_r^{**} & for \quad f_3(p_s) \leq p_w < s, \end{cases}$$

$$with \qquad \begin{array}{l} f_1(p_s) \equiv \frac{(2+\lambda\varepsilon)p_s-s}{1+\lambda\varepsilon} \\ f_2(p_s) \equiv \frac{(2+\lambda\gamma)p_s-s}{1+\lambda\gamma} \\ f_3(p_s) \equiv \frac{s+\gamma p_s-(s-p_s)\gamma\sqrt{\frac{1-\lambda}{1+\lambda\gamma}}}{\gamma+1} \end{array}.$$

Proof. See the Appendix. ■

The retailer's reaction can be visualized by the following graphic, which depicts the retailers' iso-p_r-curves:

[insert Figure 2 here]

The retailer will always add his own price-cost margin to the wholesale price, as this maximizes his profit. If the wholesale price p_w is sufficiently low, the retailer chooses a price p_r which is below the suggested retail price p_s as this increases demand of the fraction λ of the consumers by $\varepsilon(p_s - p_r)$. For any $p_w \in [\frac{(2+\lambda\varepsilon)p_s-s}{1+\lambda\varepsilon}, \frac{(2+\lambda\gamma)p_s-s}{1+\lambda\gamma}]$ the optimal response of the retailer is given by p_s, because $p_r^* > p_s$ as well as $p_r^{**} < p_s$

are not feasible. It is immediately clear that the manufacturer can only possibly "force" the retailer to choose the suggested retail price if $\varepsilon < \gamma$, as otherwise the region for $p_r = p_s$ does not exist.[12] If, and under which conditions, this is a profitable strategy for the manufacturer will be analyzed in the next section, under the assumption that $\varepsilon < \gamma < 1$. Finally, if the wholesale price is sufficiently high, the retailer chooses a price above the suggested retail price and thus reduces demand of the informed consumers by $\gamma(p_s - p_r)$. For an even higher wholesale price he chooses to sell only to the uninformed consumers. In the next section it becomes clear that the last two situations cannot be profitable for the manufacturer.

4.2 The manufacturer's choice

Given the retailer's reaction, the manufacturer's optimization problem can be written as

$$\max_{p_s, p_w} \Pi_M = (p_w - c)\, \widehat{D}\left(p_r(p_w, p_s), p_s, \lambda\right),$$

as he has to take into account the retailer's response. From the manufacturer's perspective the retailer's price is too high and demand therefore too low. Integrated profits would be maximized at a lower retail price. Given this restriction the manufacturer has to choose between several possible combinations of a wholesale and a suggested retail price leading to the different reactions by the retailer as characterized above. Which strategy is optimal can be summarized in the following proposition:

Proposition 2 *The manufacturer sets a wholesale price of* $p_w = \frac{1}{2}c + \frac{1}{2}s$.

(i) If consumers are sufficiently loss averse, i.e. $\gamma \geq \frac{2\varepsilon}{1-\varepsilon\lambda}$, *the manufacturer sets a suggested retail price of* $p_s = \frac{s(3+\lambda\gamma)+c(1+\lambda\gamma)}{4+2\lambda\gamma}$ *and induces the retailer to choose the suggested price as the retail price* $p_r = p_s$ *[suggested retail price equilibrium].*

(ii) If $\gamma < \frac{2\varepsilon}{1-\varepsilon\lambda}$, *the manufacturer chooses the suggested retail price* $p_s = s$ *as a price ceiling, while the retailer chooses* $p_r = \frac{3}{4}s + \frac{1}{4}c < p_s$ *[price ceiling equilibrium].*

Proof. See the Appendix. ■

A high suggested retail price expands demand and thus profits of both parties increase. Opposed to this effect, the manufacturer can also

[12] The intervall $\left[\frac{(2+\lambda\varepsilon)p_s - s}{\lambda\varepsilon+1}, \frac{(2+\lambda\gamma)p_s - s}{1+\lambda\gamma}\right]$ exists for all $\gamma > \varepsilon$, since $\frac{\partial \frac{(2+k)p_s - s}{k+1}}{\partial k} = \frac{s-p_s}{(k+1)^2} > 0$.

benefit from a lowered retail price as more units of his product are sold compared to the double marginalization case. By the choice of a suggested retail price the manufacturer can induce the retailer to choose a lower retail price which meets exactly the suggested retail price, as any higher retail price reduces consumer's willingness to pay. If consumers' additional utility measured by ε is rather high, a high suggested retail price shifts the demand upwards and thus increases the profits of both, the manufacturer and the retailer. If on the other hand, consumers are sufficiently loss averse, a price suggestion will help the manufacturer to punish the retailer for higher retail prices and thus to capture a larger piece of the (smaller) pie by reducing the retailer's share.[13] Which of the two effects is dominant, in the sense of more profitable for the manufacturer, depends on the relative magnitude of γ and ε. Figure (3) and (4) visualize these effects.

[insert Figure (3) and (4) here]

It is straightforward to show that any strategy which induces the retailer to choose a retail price above the suggested retail price is dominated by the strategy to induce him to choose exactly $p_r = p_s$ as this minimizes demand reduction. On the other hand, any strategy with $p_s < s$ which leads to a lower than suggested retail price is dominated by setting $p_s = s$ as this maximizes demand increases.

We can conclude that choosing a perfectly tailored suggested retail price is the better strategy whenever consumers' satisfaction from a lower than suggested retail price is significantly lower than their loss aversion in case of a higher than suggested retail price. If we assume that it is not allowed to advertise suggested retail prices that are too high ('Mondpreise'), it is straightforward to conclude that the suggested retail price equilibrium becomes more attractive for even smaller values of $\gamma - \varepsilon$.

On the other hand, it is clear that whatever is the equilibrium outcome, the manufacturer will in any case make higher profits with a suggested retail price than without, since:[14]

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[13] The sum of profits under double marginalization is $\frac{3}{16}\frac{(s-c)^2}{s}$, while in the equilibrium with $p_r = p_s$ the sum of profits is $\frac{3}{16}\frac{(s-c)^2}{s}\frac{4(1+\lambda\gamma)}{(2+\lambda\gamma)^2}$. It is easy to check that $\frac{4(1+\lambda\gamma)}{(2+\lambda\gamma)^2} < 1$ holds.

[14] The superscript SRP indicates the manufacturer's profit with a retail price corresponding to the 'suggested retail price' while PC stands for the 'price ceiling'.

$$\Pi_M^{SRP} = \frac{(s-c)^2 (1+\lambda\gamma)}{4(2+\lambda\gamma)s} = \Pi_M^{DM} \frac{2(1+\lambda\gamma)}{2+\lambda\gamma} \text{ and } \frac{2(1+\lambda\gamma)}{2+\lambda\gamma} > 1,$$
$$\Pi_M^{PC} = \frac{(s-c)^2(\lambda\varepsilon+1)}{8s} = \Pi_M^{DM}(\lambda\varepsilon+1) > \Pi_M^{DM}$$

as long as $\lambda\gamma$ or $\lambda\varepsilon$ are positive. On the other hand, even in the suggested retail price equilibrium it is not possible for the manufacturer to reduce the retailer's profit to zero as he does under retail price maintenance, since the wholesale price, which is the same in both scenarios, is always lower than the (suggested) retail price:

$$p_w = \frac{s+c}{2} < p_s = \frac{s(3+\lambda\gamma)+c(1+\lambda\gamma)}{4+2\lambda\gamma} \;\forall\; \lambda\gamma \geq 0$$

In the price ceiling equilibrium the ratio of the retailer's margin over the manufacturer's margin is still $\frac{1}{2}$ as it is in the case of double marginalization. In the suggested retail price equilibrium the ratio is lower than $\frac{1}{2}$. Following Breshnahan and Reiss (1985) this result is due to the fact that if the manufacturer chooses a suggested retail price $p_s < s$ the demand function becomes a concave function (which gives the manufacturer more power).

4.2.1 A symmetric impact on demand

Assume for the moment that $\gamma = \varepsilon$, such that consumers' reaction towards a lower than suggested retail price is symmetric to their reaction towards a higher than suggested retail price. The demand function in this special case represents 'reference dependence' but neglects 'loss aversion'. It has no kink at the suggested retail price but is just shifted upwards around this price. The retailer's maximization problem is given by:[15]

$$\max_{p_r} \;(p_r - p_w)(1 + \frac{\lambda\varepsilon(p_s - p_r)}{s} - \frac{p_r}{s})$$

and leads to a retail price of:

$$p_r^{++}(p_w, p_s) = \frac{s + \lambda\varepsilon p_s + p_w(1+\lambda\varepsilon)}{2+2\lambda\varepsilon}$$

As $\frac{\varepsilon p_s}{1+\varepsilon} < p_r^{++}(p_w, p_s) < \frac{s+\varepsilon p_s}{1+\varepsilon}$ has to hold, the following relation has to be satisfied:

$$\frac{p_s\varepsilon(\lambda\varepsilon+2-\lambda) - s(1+\varepsilon)}{(1+\varepsilon)(1+\lambda\varepsilon)} < p_w < \frac{p_s\varepsilon(\lambda\varepsilon+2-\lambda) + s(1-\varepsilon+2\lambda\varepsilon)}{(1+\varepsilon)(1+\lambda\varepsilon)}.$$

[15] See the proof of Lemma 1 part a) to make sure that it is not optimal for the retailer to choose $p_r < \frac{\varepsilon p_s}{1+\varepsilon}$. Part d) of the proof together with the proof of Proposition 2 establish that there is no equilibium in $p_r > \frac{1+\varepsilon p_s}{1+\varepsilon}$.

Anticipating the retailer's strategy, the manufacturer chooses p_w and p_s to maximize his profit. Obviously

$$\frac{\partial(p_w - c)(1 + \frac{\lambda\varepsilon(p_s - p_r)}{s} - \frac{p_r^{++}}{s})}{\partial p_s} > 0$$

such that the highest possible $p_s = s$ is optimal. Differentiation with respect to p_w leads to $p_w = \frac{\lambda\varepsilon p_s + c\lambda\varepsilon + s + c}{2\lambda\varepsilon + 2}$.[16] Substituting for p_s yields $p_w = \frac{1}{2}s + \frac{1}{2}c$. The retail price is then given as $p_r = \frac{3}{4}s + \frac{1}{4}c$ and the firms' profits are given as

$$\Pi_P = \frac{(s-c)^2(\lambda\varepsilon + 1)}{8s},$$
$$\Pi_R = \frac{(s-c)^2(\lambda\varepsilon + 1)}{16s}.$$

A comparison to the profits in Table 2 in the Appendix reveals that this corresponds to the price ceiling equilibrium. If we assume a completely symmetric positive and negative proportional impact on demand we cannot explain why any retailer should in fact stick to a suggested retail price. If additionally suggested retail prices are not allowed to be higher than a given level we would expect the profits to be lower, without any change in the firms' equilibrium behavior.

These results imply that a manufacturer should have an incentive to invest into an advertising campaign which informs final consumers about the price of the good, if he expects the consumers to adjust their demand accordingly. Here it is assumed that advertising does not increase total demand by reaching additional consumers. Of course, this is a different tool, which was not analyzed in this context. In the following section it is analyzed in which equilibrium the manufacturer realizes higher rates of return for a given investment into a price suggesting advertising campaign.

5 Advertising

As assumed earlier, consumers' surplus - and thus demand - depends on whether they are reached by the manufacturer's advertisement campaign. Recall that λ is the probability of contact with the advertisement. The manufacturer can therefore choose λ optimally, and of course, if there are no costs for advertising, he would choose $\lambda = 1$, as his profit is increasing. In fact, it seems more plausible to assume convex advertising costs, $R(\lambda)$ with $R'(\lambda) > 0$, $R''(0) > 0$ and $R'(0) = 0, R'(1) = \infty$,

[16] It is easy to verify that for $p_s = s$ the solution for p_w is in the relevant interval if $0 < p_w < s$ holds.

meaning that to reach a larger fraction of the population the manufacturer has to spend more resources on advertising and that a complete coverage ($\lambda = 1$) is prohibitively expensive. The question addressed in this section is whether and how the manufacturer's advertising decision is affected by the previously derived pricing options.

As derived in the previous section, the critical value for deciding between the one or the other equilibrium, $\gamma \gtreqless \frac{2\varepsilon}{1-\varepsilon\lambda}$, depends on λ. Note that rearranging leads to $\lambda \gtreqless \frac{\gamma-2\varepsilon}{\gamma\varepsilon} \equiv \widetilde{\lambda}$ and that $0 \leq \widetilde{\lambda} \leq 1$ for $2\varepsilon \leq \gamma \leq \frac{2\varepsilon}{1-\varepsilon}$. This means that if γ is sufficiently large, $\gamma > \frac{2\varepsilon}{1-\varepsilon}$, the manufacturer will always choose the suggested retail price strategy and invest according to

$$\lambda = \arg\max \left(\Pi_M^{RP}(\lambda) - R(\lambda)\right)$$

which leads to

$$R'(\lambda) = \frac{(s-c)^2}{8s}\frac{2\gamma}{(2+\lambda\gamma)^2}. \tag{1}$$

On the other hand, if γ is sufficiently low $\varepsilon < \gamma < 2\varepsilon$, the manufacturer will always choose the price ceiling strategy and invest according to

$$\lambda = \arg\max \left(\Pi_M^{PC}(\lambda) - R(\lambda)\right)$$

and thus

$$R'(\lambda) = \frac{(s-c)^2}{8s}\varepsilon. \tag{2}$$

For an intermediate interval $\gamma \in (2\varepsilon, \frac{2\varepsilon}{1-\varepsilon})$ the manufacturer can choose λ such that either a suggested retail price or a price ceiling is more profitable for him. We find that the marginal return of advertisement investment in the suggested retail price equilibrium is larger if the following relation holds:

$$\frac{2\gamma}{\varepsilon(2+\lambda\gamma)^2} > 1 \Leftrightarrow \lambda < \frac{\sqrt{2}\sqrt{\varepsilon}\sqrt{\gamma} - 2\varepsilon}{\gamma\varepsilon} \equiv \overline{\lambda}.$$

Note that $\widetilde{\lambda} > \overline{\lambda}$ for $\varepsilon < \frac{\gamma}{2}$, as also the following figures show.

[insert Figure (5) and (6) here]

Based on these observations it is straightforward to conclude the following:

Proposition 3 *(i) If* $\frac{2\varepsilon}{1-\varepsilon} \leq \gamma$ *the manufacturer will always choose the suggested retail price strategy and invest into advertising according to (1).*

(ii) If $\gamma \leq 2\varepsilon$ *the manufacturer will always choose the price ceiling strategy and invest into advertising according to (2).*

(iii) If $\gamma \in [2\varepsilon, \frac{2\varepsilon}{1-\varepsilon}]$ *and advertisement costs are strongly (weakly) increasing, such that low (large) values of* λ *are chosen, the manufacturer will choose the suggested retail price (price ceiling) strategy.*

(iv) For advertising cost functions with an intermediate slope, $\frac{(s-c)^2}{8s}\frac{2\varepsilon^2}{\gamma} < R(\widetilde{\lambda}) < \frac{(s-c)^2}{8s}\varepsilon$*, predictions depend on the absolute values of concrete functions. In fact, two equilibria may exist: a suggested retail price equilibrium with low values of* $\lambda < \widetilde{\lambda}$ *and a price ceiling equilibrium with higher values of* $\lambda > \widetilde{\lambda}$*.*

Proof. See the above arguments. ■

Obviously, only if $\gamma \in [2\varepsilon, \frac{2\varepsilon}{1-\varepsilon}]$, the choice of λ determines which pricing strategy is more profitable for the manufacturer. If in this situation advertising is expensive such that only a low fraction λ of consumers is reached by the advertisement, demand cannot be sufficiently increased via the positive effect of ε in the price ceiling equilibrium. It is more profitable for the manufacturer to 'force' the retailer to charge a lower retail price in the suggested price equilibrium.

Part (iv) of the proposition is shown in the Figure (7). As the manufacturer's optimization problem may have two local maxima for an advertising costs function with an intermediate slope, the manufacturer will, of course, choose the strategy which generates the higher absolute profit in the sense of a global maximum. Although more of technical interest, this situation may also lead to indifference on behalf of the manufacturer if both strategies generate the same profit.

[insert Figure (7) here]

The analysis of comparative static properties of the optimal advertising investment with respect to the product's quality reveals that an increase in quality increases marginal returns on advertising investment in both price equilibria. In the case of the suggested retail price equilibrium marginal returns change according to:

$$\frac{\partial R'(\lambda)}{\partial s} = \frac{(s-c)(s+c)}{8s^2}\frac{2\gamma}{(2+\lambda\gamma)^2} > 0$$

while in the price ceiling equilibrium the change is given by:

$$\frac{\partial R'(\lambda)}{\partial s} = \frac{(s-c)(s+c)}{8s^2}\varepsilon > 0.$$

The higher the quality of the product the more is the manufacturer willing to spend on advertising, independently of the specific pricing equilibrium he chooses. It is easy to verify that if the marginal return to advertising is higher in the suggested retail price equilibrium, then the positive effect of a higher quality is also larger in that equilibrium.

6 Conclusions

This analysis has shown that a suggested retail price as a strategic device to increase manufacturer's profits can be explained in a simple model of two vertically related monopoly markets. According to the 'reference-dependent' theory of consumer choice I assumed that a suggested retail price serves as a 'reference point' and that consumers are 'loss averse': Due to some additional utility their willingness to pay is increased if they are confronted with a lower than suggested retail price while it decreases due to loss aversion if the retail price is above the suggested retail price. The main findings are that the manufacturer always benefits from a price suggestion and would thus always invest into a retail price suggesting advertisement. If consumers are only reference-dependent but not loss averse, as their satisfaction about negative deviations is as large as their disappointment in case of positive price deviations, the suggested retail price corresponds to a price ceiling and the retailer will always undercut this suggested retail price. Both the retailer and the manufacturer benefit in this situation. If consumers are sufficiently loss averse, in the subgame-perfect equilibrium the retailer complies with the suggested price and profits are shifted from the retailer to the manufacturer.

In this analysis I assumed heterogenous consumers of the final product but it easily checked that all results carry over to the case of homogenous consumers and a common a linear demand function.

7 Appendix

Proof of Lemma 1. Being confronted with the four intervals of the demand function $\widehat{D}(p_r, p_s, \lambda)$, the retailer chooses the optimal $p_r(p_w, p_s, \lambda)$ for any given p_w, p_s, λ of the manufacturer.

a) For $p_r < \frac{\varepsilon p_s}{1+\varepsilon}$ the retailer's maximization problem is:

$$\max_{p_r} \ (p_r - p_w)(\lambda + (1-\lambda)(1 - \frac{p_r}{s}))$$

which leads to:

$$p_r(p_w) = \frac{s + p_w(1-\lambda)}{2(1-\lambda)}$$

The solution is in the relevant interval if $0 < p_r < \frac{\varepsilon p_s}{1+\varepsilon}$ holds, which is the case if:

$$p_w < \frac{s\,(1+\varepsilon) + 2\varepsilon p_s\,(\lambda - 1)}{(\lambda-1)\,(1+\varepsilon)}.$$

For $p_s < s$ this can never be satisfied, since

$$\frac{s\,(1+\varepsilon) + 2\varepsilon p_s\,(\lambda - 1)}{(\lambda-1)\,(1+\varepsilon)} < 0 \text{ for } p_s < \frac{s\,(1+\varepsilon)}{2\varepsilon\,(1-\lambda)}$$

and $\frac{(1+\varepsilon)}{2\varepsilon(1-\lambda)} > 1 \Leftrightarrow (1+\varepsilon) > 2\varepsilon\,(1-\lambda) \Leftrightarrow 1-\varepsilon > -2\varepsilon\lambda$. Hence, for positive values of p_w the retailer will not choose a price p_r in this interval.
b) For $\frac{\varepsilon p_s}{1+\varepsilon} < p_r \leq p_s$ the retailer's maximization problem is:

$$\max_{p_r}\ (p_r - p_w)(1 + \frac{\lambda\varepsilon(p_s - p_r)}{s} - \frac{p_r}{s})$$

which leads to

$$p_r^*(p_w, p_s) = \frac{s + \lambda\varepsilon p_s + p_w(1+\lambda\varepsilon)}{2 + 2\lambda\varepsilon}.$$

This is in the relevant region as long as $\frac{\varepsilon p_s}{1+\varepsilon} < p_r^*(p_w, p_s) \leq p_s$ holds, which is the case if:[17]

$$0 < p_w \leq f_1(p_s) \equiv \frac{(2+\lambda\varepsilon)p_s - s}{\varepsilon\lambda + 1}.$$

c) For $p_s < p_r \leq \frac{s+\gamma p_s}{1+\gamma}$ the retailer's maximization problem is:

$$\max_{p_r}(p_r - p_w)(1 + \frac{\lambda\gamma(p_s - p_r)}{s} - \frac{p_r}{s})$$

[17] We find $\frac{\varepsilon p}{1+\varepsilon} < r^* < p$ if

$$\frac{s\,(1+\varepsilon) - p\varepsilon(\varepsilon\lambda - 1) - p\varepsilon(3-\lambda)}{(1+\varepsilon)\,(\varepsilon\lambda - 1)} < p_w < -\frac{s - p\varepsilon\lambda - 2p}{\varepsilon\lambda + 1}.$$

Taking into account that $\varepsilon\lambda < 1$, the LHS is negative for

$$s\frac{(1+\varepsilon)}{\varepsilon\,(\varepsilon\lambda + 2 - \lambda)} > p.$$

Obviously, $\frac{(1+\varepsilon)}{\varepsilon(\varepsilon\lambda+2-\lambda)} > 1 \Leftrightarrow 1-\varepsilon > \varepsilon\lambda\,(\varepsilon - 1)$ which is always satisfied for $\varepsilon < 1$. Therefore, the lower bound for p_w is 0.

and leads to a retail price of:

$$p_r^{**}(p_w, p_s) = \frac{s + \lambda\gamma p_s + p_w(1+\lambda\gamma)}{2 + 2\lambda\gamma}.$$

This solution is in the relevant region as long as $p_s < p_r^{**}(p_w, p_s) \leq \frac{s+\gamma p_s}{1+\gamma}$ holds, which is the case if:[18]

$$\frac{(2+\lambda\gamma)p_s - s}{\lambda\gamma + 1} \equiv f_2(p_s) < p_w \leq \frac{s(1-\gamma) + p_s\gamma(2-\lambda) + \lambda\gamma(\gamma p_s + 2s)}{(1+\lambda\gamma)(1+\gamma)}.$$

d) Since we assume $\varepsilon < \gamma$, the analysis under c) and b) reveals that there exists an interval $p_w \in [f_1(p_s), f_2(p_s)]$ for which $p_r = p_s$ is a corner solution to the retailer's optimization problem.
e) For $\frac{s+\gamma p_s}{1+\gamma} < p_r \leq s$ the retailer's maximization problem is:

$$\max_{p_r} \; (p_r - p_w)\left((1-\lambda)(1 - \frac{p_r}{s})\right)$$

and leads to a retail price of:

$$p_r^{***}(p_w) = \frac{1}{2}s + \frac{1}{2}p_w$$

This is in the relevant region as long as $\frac{s+\gamma p_s}{1+\gamma} < p_r^{***}(p_w) \leq s$ holds, which is the case if:

$$\frac{s(1-\gamma) + 2\gamma p_s}{1+\gamma} < p_w < s.$$

Note that for the upper bound for p_w in case c) and the lower bound for p_w in case e) the following relation holds:

$$\frac{s(1-\gamma) + p_s\gamma(1+\lambda\gamma) + p_s\gamma(1-\lambda) + 2s\lambda\gamma}{(1+\lambda\gamma)(1+\gamma)} > \frac{s(1-\gamma) + 2\gamma p_s}{1+\gamma} \Leftrightarrow p_s < s.$$

Obviously there is an interval for p_w in which $p_r^{**}(p_w, p_s)$ and $p_r^{***}(p_w)$ are both interior solutions. the retailer's best interior solution is the one which leads to higher profits. A comparison of the retailer's profits in that region shows that [19]

$$\Pi_R(p_r^{***}(p_w), p_w) - \Pi_R(p_r^{**}(p_w, p_s), p_w, p_s) \geq 0 \Leftrightarrow$$

[18] Note that for the RHS the following relation holds: $\frac{s(1-\gamma)+p\gamma(2-\lambda)+\lambda\gamma(\gamma p+2s)}{(1+\lambda\gamma)(1+\gamma)} < s \Leftrightarrow p < s$.

[19] Solving the inequality for p_w leads to two solutions: $p_w < s + \gamma p + (s-p)\left(\frac{\gamma}{\gamma+1}\sqrt{\frac{1-\lambda}{1+\lambda\gamma}}\right)$ and $s + \gamma p - (s-p)\left(\frac{\gamma}{\gamma+1}\sqrt{\frac{1-\lambda}{1+\lambda\gamma}}\right) < p_w$. Since $r^{***}(p_w)$ maximizes the retailer's profit in $[\frac{s+\gamma p}{1+\gamma}, s]$ it must be the case that the second solution is relevant.

$$\left(\frac{1}{4s}\left(s-p_w\right)^2\left(1-\lambda\right)\right)-\left(\frac{1}{4s}\frac{\left(s-p_w+\lambda\gamma\left(p_s-p_w\right)\right)^2}{\left(1+\lambda\gamma\right)}\right)\geq 0\Leftrightarrow$$

$$\frac{s+\gamma p_s-\left(s-p_s\right)\gamma\sqrt{\frac{1-\lambda}{1+\lambda\gamma}}}{\gamma+1}\equiv f_3(p_s)\leq p_w<s.$$

Hence, the interior solution is p_r^{**} for $p_w \in [f_2(p_s), f_3(p_s))$, and it is p_r^{***} for $p_w \in [f_3(p_s), s]$.

f) Now that all interior solutions are calculated, we have to compare the profits associated with those solutions to the retailer's profits if he chooses a retail price at the corner of the intervals. It is straightforward to exclude $p_r = 0$ and $p_r = s$ as optimal retail prices for any combination (p_w, p_s) of the manufacturer because both lead to zero profits for the retailer.

Next consider $p_r^*(p_w, p_s)$. This is an interior solution to the retailer 's maximization problem if $0 < p_w \leq f_1(p_s)$, excluding $p_r = \frac{\varepsilon p_s}{1+\varepsilon}$ as well as $p_r = p_s$ as possible candidates for corner solutions. Hence, only $p_r = \frac{s+\gamma p_s}{1+\gamma}$ is a candidate for a corner solution. A comparison of profits reveals that $\Pi_R(p_r^*) - \Pi_R(p_r = \frac{s+\gamma p_s}{1+\gamma})$ has a minimum at

$$p_w=\frac{2s}{\lambda\varepsilon+1}\left(\frac{(s+\lambda\varepsilon p_s)}{2s}-\frac{(s\gamma-s\lambda\gamma-\gamma p_s+\lambda\gamma p_s)}{s+s\gamma}\right)$$

and that at this minimum $\Pi_R(p_r^*) - \Pi_R(p_r = \frac{s+\gamma p_s}{1+\gamma}) > 0$ holds. Hence, if $0 < p_w \leq f_1(p_s)$ the retailer chooses $p_r^*(p_w, p_s)$.

Next consider $p_r = p_s$. This a corner solution to the retailer 's maximization problem if $f_1(p_s) < p_w < f_2(p_s)$. Since $p_r = 0$ and $p_r = s$ are not optimal retail prices for any combination of (p_w, p_s) it is enough to exclude $p_r = \frac{\varepsilon p_s}{1+\varepsilon}$ as well as $p_r = \frac{s+\gamma p_s}{1+\gamma}$ as possible candidates for corner solutions. Note that $\Pi_R(p_s) - \Pi_R(p_r = \frac{\varepsilon p_s}{1+\varepsilon})$ is increasing in p_w and that it is zero for

$$p_w=\frac{(p_s(1+2\varepsilon+\lambda\varepsilon^2)-s(1+\varepsilon))}{\left(\varepsilon+1\right)\left(\lambda\varepsilon+1\right)}<f_1(p_s).$$

Furthermore, $\Pi_R(p_s) - \Pi_R(p_r = \frac{s+\gamma p_s}{1+\gamma})$ is decreasing in p_w and is it zero for

$$p_w=\frac{(p_s(1+2\gamma+\lambda\gamma^2)-\gamma s(1-\lambda))}{\left(\gamma+1\right)\left(\lambda\gamma+1\right)}>f_2(p_s).$$

Hence, if $f_1(p_s) < p_w < f_2(p_s)$ the retailer chooses $p_r = p_s$.

Next consider $p_r^{**}(p_w, p_s)$. This is an interior solution to the retailer 's maximization problem if $f_2(p_s) \leq p_w < f_3(p_s)$, excluding $p_r = p_s$ as well as $p_r = \frac{s+\gamma p_s}{1+\gamma}$. Hence, only $p_r = \frac{\varepsilon p_s}{1+\varepsilon}$ is a candidate for a corner solution. A comparison of profits reveals that $\Pi_R(p_r^{**}) - \Pi_R(p_r = \frac{\varepsilon p_s}{1+\varepsilon})$ has a minimum at

$$p_w = \frac{2s}{\lambda\gamma + 1}\left(\frac{(s + \lambda\gamma p_s)}{2s} - \frac{(s + s\varepsilon - \varepsilon p_s + \lambda\varepsilon p_s)}{s + s\varepsilon}\right)$$

and that at this minimum $\Pi_R(p_r^{**}) - \Pi_R(p_r = \frac{\varepsilon p_s}{1+\varepsilon}) > 0$ holds. Hence, if $f_2(p_s) \leq p_w < f_3(p_s)$ the retailer chooses $p_r^{**}(p_w, p_s)$.

Next consider $p_r^{***}(p_w)$. This is an interior solution to the retailer 's maximization problem if $f_3(p_s) < p_w \leq s$, excluding $p_r = \frac{s+\gamma p_s}{1+\gamma}$ as well as $p_r = s$. Hence, $p_r = p_s$ as well as $p_r = \frac{\varepsilon p_s}{1+\varepsilon}$ are possible candidates for corner solutions. A comparison of profits reveals that $\Pi_R(p_r^{***}) - \Pi_R(p_s)$ has a minimum at

$$p_w = \frac{(2p_s - s(1 + \lambda))}{1 - \lambda} < p_s.$$

It is easy to check that $f_3(p_s) > p_s$ holds and that at $p_r = p_s$ the difference is positive. On the other hand, a comparison of profits reveals that $\Pi_R(p_r^{***}) - \Pi_R(p_r = \frac{\varepsilon p_s}{1+\varepsilon})$ has a minimum at

$$p_w = \frac{2s}{1 - \lambda}\left(\frac{s(1 - \lambda)}{2s} - \frac{(s + s\varepsilon - \varepsilon p_s + \lambda\varepsilon p_s)}{s + s\varepsilon}\right) < \frac{\varepsilon p_s}{1 + \varepsilon}$$

and that at $p_r = \frac{\varepsilon p_s}{1+\varepsilon} < p_s$ the difference is positive. Hence, if $f_3(p_s) < p_w \leq s$ the retailer chooses $p_r^{***}(p_w, p_s)$. ■

Proof of Proposition 2.

The retailer's best response function as characterized in Lemma **1** divides the p_w, p_s- space into four regions as depicted in Figure 2. The manufacturer chooses the optimal combination of p_w and p_s for each region.

a) In region **A** with $0 < p_w < \frac{(2+\lambda\varepsilon)p_s - s}{1+\lambda\varepsilon}$, the retailer's strategy is given by: $p_r^*(p_w, p_s) = \frac{s+\lambda\varepsilon p_s + p_w\lambda\varepsilon + p_w}{2\lambda\varepsilon+2} < p_s$ and the manufacturer's profit is:

$$\Pi_M = (p_w - c)(1 + \frac{\lambda\varepsilon(p_s - p_r^*(p_w, p_s))}{s} - \frac{p_r^*(p_w, p_s)}{s}).$$

It is straightforward to verify that the profit is strictly increasing in p_s. Optimization with respect to p_w and then finding the highest feasible p_s leads to:

$$p_w = \frac{\lambda\varepsilon(p_s + c) + s + c}{2\lambda\varepsilon + 2}.$$

This solution has to satisfy the condition $0 < p_w < \frac{1}{\lambda\varepsilon+1}((2 + \lambda\varepsilon)p_s - s)$, which it does for all

$$\frac{3s + c(1 + \lambda\varepsilon)}{\lambda\varepsilon + 4} < p_s.$$

Note that $\frac{3s+c(\lambda\varepsilon+1)}{\lambda\varepsilon+4} < s$ is satisfied for all $c < s$. Since the profit is increasing in p_s the manufacturer will choose a suggested retail price of $p_s^* = s$ which leads to $p_w^* = \frac{1}{2}s + \frac{1}{2}c$ and $p_r^* = \frac{3}{4}s + \frac{1}{4}c$. This results in a profit of:

$$\Pi_M = \frac{(s-c)^2(1+\lambda\varepsilon)}{8s}$$

b) If the manufacturer wants to induce the retailer to choose the suggested retail price, $p_r = p_s$, he has to choose p_w, p_s in region **B,** such that $p_w \in [\frac{(2+\lambda\varepsilon)p_s - s}{1+\lambda\varepsilon}, \frac{(2+\lambda\gamma)p_s - s}{1+\lambda\gamma}]$. His optimization problem is:

$$\max_{p_s, p_w} (p_w - c)(1 - \frac{p_s}{s}).$$

It is easy to see that the profit is strictly increasing in p_w for any $p_s < s$ and strictly decreasing in p_s for any $p_w > c$. The manufacturer chooses $p_w = \frac{(2+\lambda\gamma)p_s - s}{1+\lambda\gamma}$ as large as possible in the relevant region, and then optimizes with respect to p_s. This leads to a suggested retail price of:

$$p_s = \frac{s(3+\lambda\gamma) + c(1+\lambda\gamma)}{4+2\lambda\gamma}.$$

Substitution into the upper bound for p_w yields:[20]

$$p_w = \frac{1}{2}s + \frac{1}{2}c.$$

His profit is then

$$\Pi_M = \frac{(s-c)^2(1+\lambda\gamma)}{4s\,(2+\lambda\gamma)}.$$

c) If the manufacturer wants to induce the retailer to choose a price above the suggested retail price, he has to choose p_w, p_s in region **C,** such that $\frac{(2+\lambda\gamma)p_s - s}{1+\lambda\gamma} < p_w < \frac{s+\gamma p_s - \gamma\sqrt{\left((s-p_s)^2 \frac{1-\lambda}{1+\lambda\gamma}\right)}}{\gamma+1}$. If the manufacturer chooses p_w

[20] This suggested retail price is lower than the suggested retail price in case a) if $\varepsilon < \frac{2\gamma}{3+\lambda\gamma}$, as then

$$\begin{aligned} &\frac{s(3+\lambda\gamma)+c(1+\lambda\gamma)}{4+2\lambda\gamma} - \frac{3s+c(1+\lambda\varepsilon)}{\lambda\varepsilon+4} \\ = &\frac{1}{2}\lambda\frac{(s-c)(3\varepsilon-2\gamma+\lambda\gamma\varepsilon)}{(2+\lambda\gamma)(\lambda\varepsilon+4)} < 0 \end{aligned}$$

holds.

and p_s accordingly, the retail price will be $p_r^{**}(p_w, p_s) = \frac{s+\lambda\gamma p_s+p_w(1+\lambda\gamma)}{2+2\lambda\gamma}$ and the manufacturer's optimization problem is:

$$p_w, p_s \arg\max \left((p_w - c)(1 + \frac{\lambda\gamma(p_s - p_r^{**}(p_w, p_s))}{s} - \frac{p_r^{**}(p_w, p_s)}{s}) \right)$$

Maximization with respect to p_s shows that the profit is increasing in p_s for any $p_w > \dot{c}$. Maximization with respect to p_w leads to

$$p_w = \frac{\lambda\gamma(p_s + c) + s + c}{2\lambda\gamma + 2}$$

It is easy to check that this wholesale price is larger than c for any $p_s > \frac{c(1+\lambda\gamma)-s}{\lambda\gamma}$ and that the profit is at its minimum for $p_s = \frac{c(1+\lambda\gamma)-s}{\lambda\gamma}$. Hence, the manufacturer chooses the optimal suggested retail price p_s as large as possible, given the optimal solution for p_w, under the restriction that the retail price is larger than the suggested price p_s. Substituting $p_w(p_s)$ into $p_r{}^{**}(p_w(p_s), p_s)$ leads to:

$$p_r^{**}(p_w(p_s), p_s) = \frac{1}{4}\frac{3s + 3\lambda\gamma p_s + c\lambda\gamma + c}{1 + \lambda\gamma}$$

This retail price is larger than the suggested price, $p_r^{**}(p_w(p_s), p_s) > p_s$ if:

$$p_s < \frac{c\lambda\gamma + 3s + c}{4 + \lambda\gamma}.$$

Since the manufacturer optimally chooses p_s as large as possible, in this region he chooses the corner solution $p_s = \frac{c\lambda\gamma+3s+c}{4+\lambda\gamma}$. But for this suggested price, the retailer's best responds is to choose $p_r = p_s$. Anticipating this response, the manufacturer choose p_w and p_s as under b). Hence, the manufacturer will not choose p_w and p_s such that the retailer's best response is in region **C** in which the retailer chooses $p_r^{**}(p_w(p_s), p_s) > p_s$.

d) If the manufacturer wants to induce the retailer to choose a price corresponding to the price under double marginalization $p_r^{***}(p_w) = \frac{1}{2}s + \frac{1}{2}p_w$ he has to choose p_w, p_s in region **D,** such that $\frac{s+\gamma p_s - \gamma\sqrt{\left((s-p_s)^2 \frac{1-\lambda}{1+\lambda\gamma}\right)}}{\gamma+1} < p_w < s$. His maximization problem is thus given as:

$$p_w \text{ argmax } (p_w - c)\left((1 - \lambda)(1 - \frac{p_r^{***}(p_w)}{s})\right)$$

which leads to:

$$p_w^{***} = \frac{1}{2}s + \frac{1}{2}c$$

This wholesale price p_w is in the relevant region **D** if the following holds:

$$\frac{s+\gamma p_s-\gamma\sqrt{\left((s-p_s)^2\,\frac{1-\lambda}{1+\lambda\gamma}\right)}}{\gamma+1}<\frac{1}{2}s+\frac{1}{2}c\Leftrightarrow$$

$$s+\gamma p_s-\gamma(s-p_s)\sqrt{\left(\frac{1-\lambda}{1+\lambda\gamma}\right)}<(\gamma+1)\left(\frac{1}{2}s+\frac{1}{2}c\right)$$

For this inequality to hold, the manufacturer has to choose

$$p_s^{***}<\frac{s\left(2\gamma\sqrt{\left(\frac{1-\lambda}{1+\lambda\gamma}\right)}-1+\gamma\right)+c(1+\gamma)}{2\gamma\sqrt{\left(\frac{1-\lambda}{1+\lambda\gamma}\right)}+2\gamma}$$

The retail price is thus $p_r^{***}=\frac{3}{4}s+\frac{1}{4}c$ as under double marginalization and the manufacturer's profit is given by:

$$\Pi_M=(1-\lambda)\,\frac{(s-c)^2}{8s}$$

Thus we can summarize the following strategies for the manufacturer

(and the retailer) in the different regions. A comparison of the resulting profits helps to decide which region the manufacturer will prefer.

p_w	p_s	p_r	Π_R	Π_M	region
$\frac{1}{2}s+\frac{1}{2}c$	s	$\frac{3}{4}s+\frac{1}{4}c$	$\frac{(s-c)^2(1+\lambda\varepsilon)}{16s}$	$\frac{(s-c)^2(1+\lambda\varepsilon)}{8s}$	A
$\frac{1}{2}s+\frac{1}{2}c$	$\frac{s(3+\lambda\gamma)+c(1+\lambda\gamma)}{4+2\lambda\gamma}$	$\frac{s(3+\lambda\gamma)+c(1+\lambda\gamma)}{4+2\lambda\gamma}$	$\frac{(s-c)^2(1+\lambda\gamma)}{4s(2+\lambda\gamma)^2}$	$\frac{(s-c)^2(1+\lambda\gamma)}{4s(2+\lambda\gamma)}$	B,C
$\frac{1}{2}s+\frac{1}{2}c$	$[0,\frac{s\left(2\gamma\sqrt{\left(\frac{1-\lambda}{1+\lambda\gamma}\right)}-1+\gamma\right)+c(1+\gamma)}{2\gamma\left(\sqrt{\left(\frac{1-\lambda}{1+\lambda\gamma}\right)}+1\right)}]$	$\frac{3}{4}s+\frac{1}{4}c$	$\frac{(1-\lambda)(s-c)^2}{16s}$	$\frac{(1-\lambda)(s-c)^2}{8s}$	D

Table 2

Now that the possible profits associated with any pair of (p_w,p_s) are characterized it can be derived which strategy the manufacturer chooses in equilibrium. Note first that the optimal actions for the regions B and C coincide in the sense that the manufacturer chooses a pair of (p_e,p_s) on the boundary of the two regions. The manufacturer induces the retailer to comply with the suggested retail price and to choose $p_r=p_s$.

Second, note that the strategy in region A for which the manufacturer sets a "price ceiling" $p_s=s$ and a wholesale price such that the retailer chooses $\frac{\varepsilon s}{1+\varepsilon} < p_r < p_s$ dominates the strategy in region D under which the manufacturer is indifferent between any sufficiently low suggested retail price. Although the same retail price is induced in both situations, in region D only the non-informed consumers are served while the informed consumers retain from buying. See Figure 8 for a visualization of these results:

[Insert Figure (8) here]

Obviously, the manufacturer has to choose between two strategies: Either he chooses a strategy in region A and advertises a price ceiling, knowing that the retailer chooses a retail price lower than the suggested retail price. Or he chooses a strategy in region B, a suggested retail price together with an adjusted wholesale price such that the retailer will choose exactly this suggested retail price. Which of the two strategies is optimal depends on the parameters:[21]

$$\frac{(s-c)^2(1+\lambda\gamma)}{4(2+\lambda\gamma)s} - \frac{(s-c)^2(\lambda\varepsilon+1)}{8s} > 0$$

$$\text{for } \varepsilon < \frac{\gamma}{2+\lambda\gamma} \quad \Leftrightarrow \quad \gamma > \widehat{\gamma} \equiv \frac{2\varepsilon}{1-\lambda\varepsilon}.$$

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[21] Note that for the price suggestion situation to be feasible the parameter of consumers' additional utility had to be restricted to $\varepsilon < \frac{2\gamma}{3+\lambda\gamma}$. The following condition is stronger, since $\frac{\lambda\gamma}{2+\lambda\gamma} < \frac{2\gamma}{3+\lambda\gamma}$ for all $\lambda < 1$

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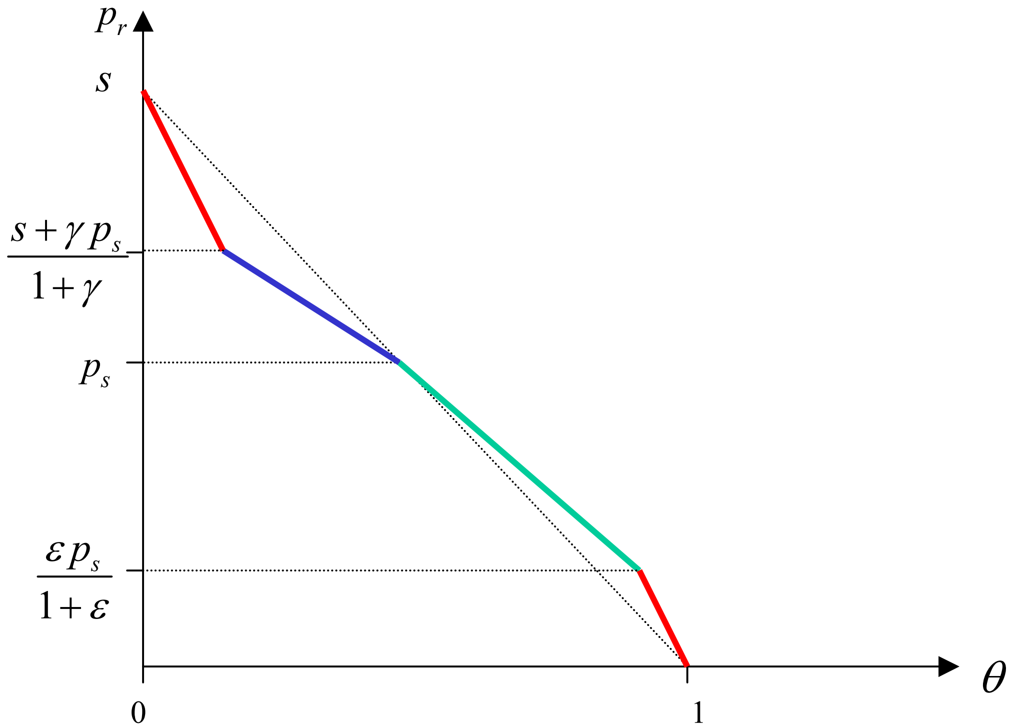

Figure 1: The demand function

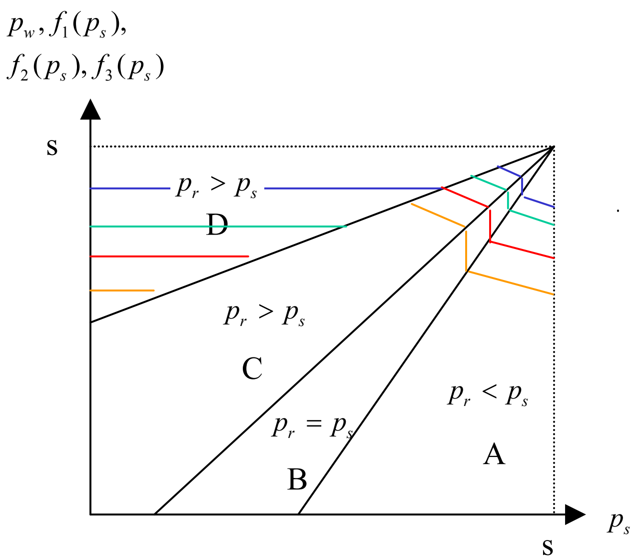

Figure 2: The iso - p_r - lines

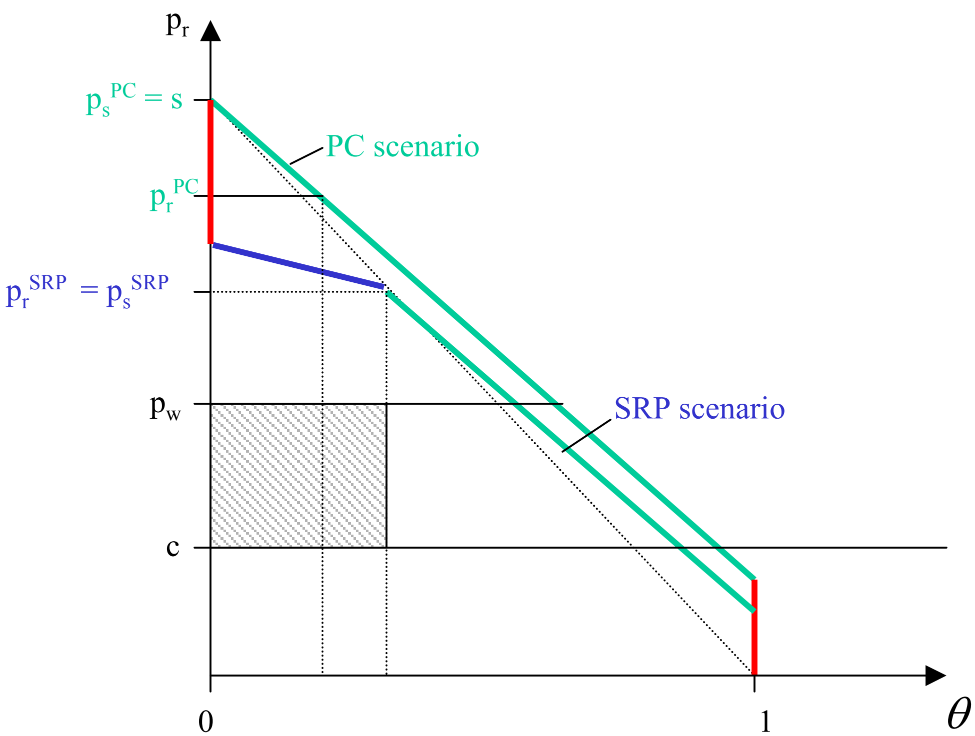

Figure 3: Manufacturer's payoff for small γ

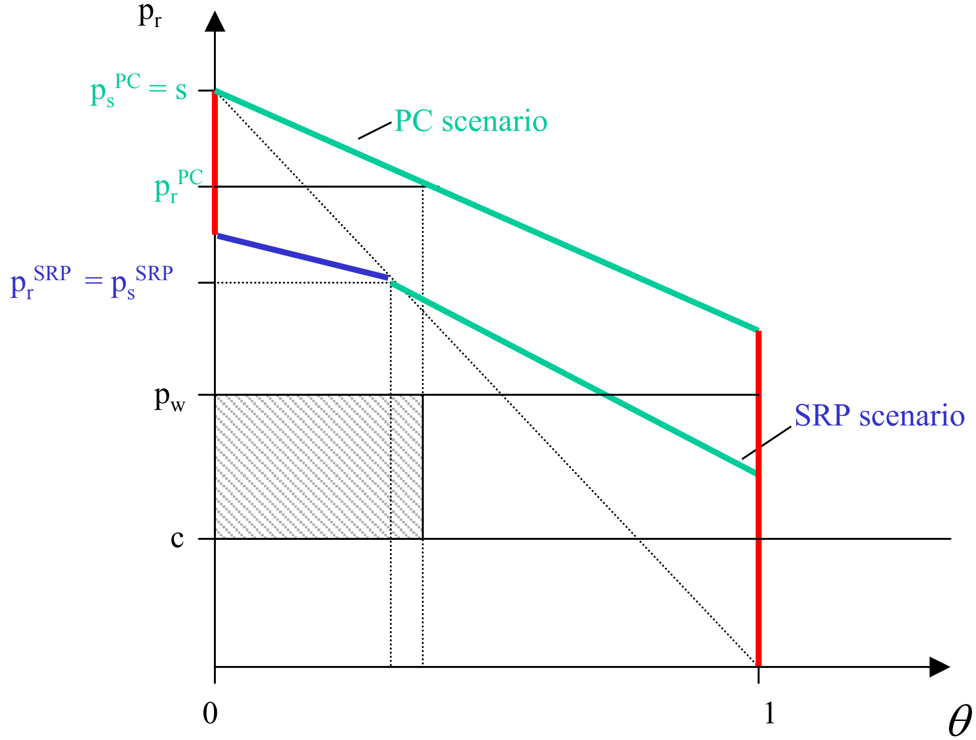

Figure 4: Manufacturer's payoff for large γ

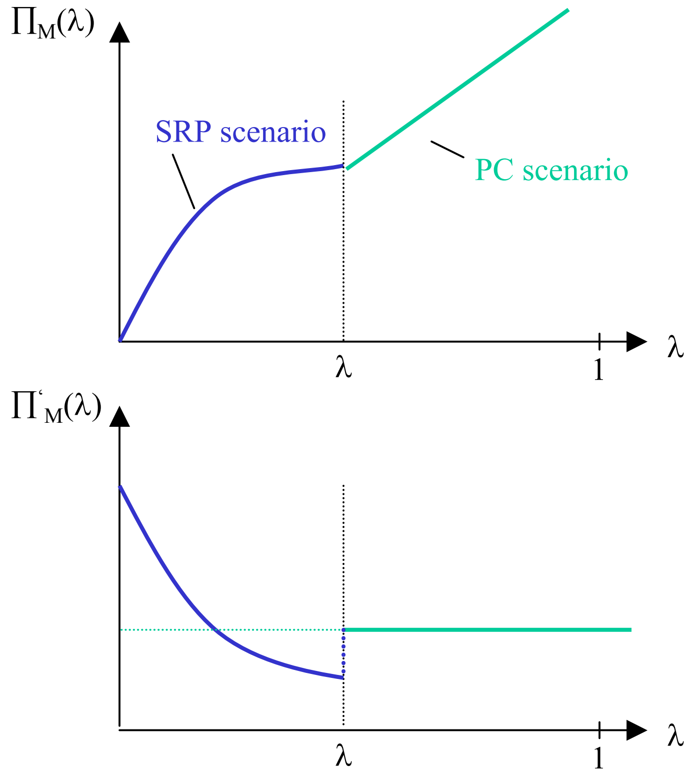

Figure 5 and 6

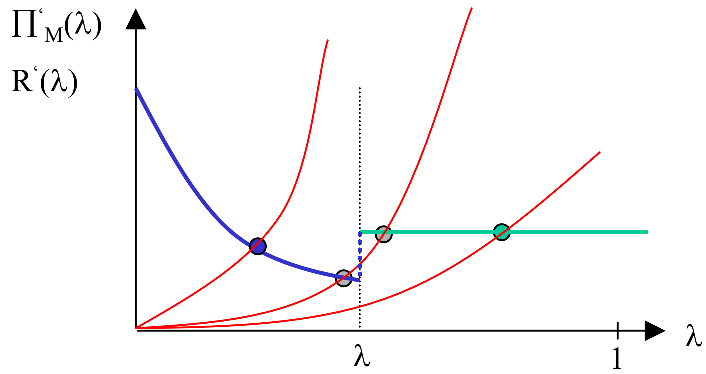

Figure 7: Different marginal advertising costs functions

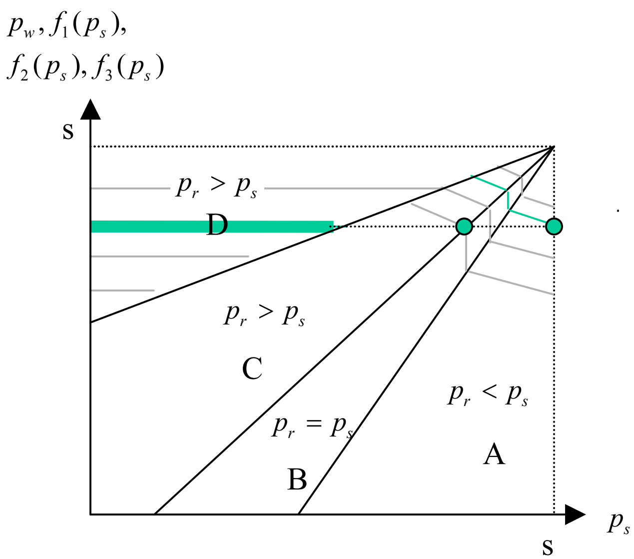

Figure 8: The manufacturer's optimal actions