Corporate Social Responsibility and Profit Maximizing Behaviour[1]

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ABSTRACT

We examine the behavior of a profit maximizing monopolist in a horizontal differentiation model in which consumers differ in their degree of social responsibility (SR) and consumers SR is dynamically influenced by habit persistence. The model outlines parametric conditions under which (consumer driven) corporate social responsibility is an optimal choice compatible with profit maximizing behavior.

1 Introduction

The ongoing integration of labour and product markets has increased interdependence among countries and concerns for the problem of the insufficient provision of global public goods. The novelty in this scenario is that global problems are becoming increasingly correlated with individual well being, with environmental degradation affecting personal health and North-South per capita income and labour cost divide fuelling illegal immigration and endangering welfare of workers in the North. This may be one of the reasons why the sensitiveness of the public opinion toward social responsibility is growing.

The increased sensitivity of individuals and the consequent growing attention of corporate behaviour toward social responsibility (hereafter also SR) is confirmed by widespread statistical evidence[3].

Regardless to the way we judge this phenomenon, the challenge of the economic literature is to incorporate this new feature into its theoretical framework.

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[3] The 2003 Report on Socially Responsible Investing Trends documents that the industry of ethically managed mutual fund assets accounted in 2003 for 2.16 trillion dollars in the United States when including all US private and institutional ethically screened portfolios. According to this figures one out of nine dollars under professional management in the United States was part of a socially responsible portfolio. The same Report illustrates that, from 1995 to 2003 the rate of growth of assets involved in social investing, through screening of retail and institutional funds, shareholder advocacy, and community investing has been 40 percent higher than all professionally managed investment assets in the U.S (240 against 174 percent).

This extended theoretical framework will help to evaluate the reaction of producers' behaviour to this specific component of consumers' preferences and the equilibrium levels of prices and social responsibility which will result from the interaction of consumers "concerns" for social responsibility and producers profit maximizing behaviour.

Our paper aims to perform this task and is divided into five sections (including introduction and conclusions). Section two outlines the main features of the model of horizontal product differentiation in presence of SR consumers and discusses and justifies its basic assumptions. Section three solves the intertemporal maximization problem of the profit maximizing monopolist in presence of consumers with heterogeneous and time varying tastes for SR. In this section we demonstrate the validity of a proposition which fixes parametric intervals discriminating among three different optimal strategies (permanent, temporary or no corporate SR), of the profit maximizing monopolist. Section four qualifies and discusses consequences of these three different strategies. In the fifth and final section we provide a parametric example to explain which of the three strategies will be chosen by the PMP under reasonable parametric values.

2 The model

To analyze the role of social responsibility in product markets we adopt a horizontal differentiation model in which the traditional unit segment measures consumers' tastes about social responsibility instead of geographical distance. We choose a segment instead of a circle because in SR extremes do not touch, differently from what happens for geographical distance in the circumference of circular spaces. We model product competition in presence of consumers SR with horizontal instead[4] of vertical differentiation because values and social preferences are extremely subjective and heterogeneous across individuals as several empirical papers demonstrate[5].

In the model a monopolist transforms a good with unit costs w paid to a subcontractee and maximizes his profit by selling at the price P_A to consumers with inelastic, unit demands. For simplicity, we assume that his SR consists

[4] For a reference to the traditional literature on horizontal product differentiation see Hotelling, 1929; Anderson, 1987; D'Aspremont, Gabsewicz and Thisse, 1979; Economides, 1984; Dasgupta and Maskin, 1986.

[5] This heterogeneity violates a fundamental element of vertical product differentiation models in which more of a given product feature is better for everyone. Empirical support for our hypothesis on the heterogeneity of individual attitudes toward social responsibility is confirmed by descriptive evidence from the World Value Survey database - 65,660 (15,443) individuals interviewed between 1980 and 1990 (1990 and 2000) in representative samples of 30 (7) different countries-. In both surveys around 45 (49) percent of sample respondents declare that they are not willing to pay in excess for environmentally responsible features of a product. The same survey documents that the share of those arguing that the poor are to be blamed is around 29 percent in both surveys. This simple evidence confirms heterogeneity in the willingness to pay for social and environmental responsibility, rejecting the assumption that more of SR may be better for all individuals.

of paying something above w to his subcontractee. This formalization stylizes a quite general element of SR which often consists of a wealth transfer from shareholders to stakeholders[6]. The model may therefore be considered as a generalization of different cases such as the adoption of a more costly and more environmentally sustainable production process, an improvement of wage and non wage benefits of firm workers or subcontractees, and increase in job security, etc.[7].

Consumers are uniformly distributed across the line segment $[0, 1]$, according to their sensitivity to social responsibility, and have a "conditional" reservation price R_p, that is, the maximum price they are willing to pay in case of zero costs of ethical distance. Consistently with the specific features of the SR model, we assume that costs of ethical distance are asymmetric, i.e. distance costs are positive only for consumers moving from the right to the left, because they buy a product whose ethical standards are inferior to their benefits. On the contrary, moving from the left to the right is never costly for consumers, by assuming that their preferences are not affected when they buy a product whose standards are above their beliefs[8]. Corporate SR consists of paying a portion $a \in [0, 1]$ of a premium s over the cost w of the intermediate output. As a consequence, total costs for the producers are given by market cost and transfers to subcontractee according to the profit maximizing producer (hereafter also PMP) location on the segment: $w(1 + as)$.

The goal of this basic version of the model is to analyze what is the effect of the presence of SR consumers on the behaviour of the profit maximizing monopolist and, therefore, what kind of effects the existence of SR consumers may generate on PMP price and SR.

To solve the problem we consider the following condition for the consumer indifferent between buying or not the product:

[6] By taking for instance criteria for affiliation to the Domini stock index, which is one of the most well known benchmarks in social responsibility in the US, we find that, on about 80 different SR items, almost all involve actions which transfer wealth from shareholders to stakeholders, such as improved workers' wage and non wage benefits, commitment for the environment, transparency on overseas sourcing disclosure and monitoring, care for human rights in relationship with subcontractors, etc.

[7] In case of producers selling transformed goods to final consumers and being monopsonistic or oligopolistic buyers of raw material products from subcontractees, the mark-up above the cost w does not need to be a market failure, but may be a solution to it when, in the monopsony, w is below the marginal value of the intermediate product. Moreover, the monopolist's decision of selling a SR good may be viewed as the creation of a new variety of product (a bundle of physical and SR characteristics) which improves welfare of consumers with SR preferences (Adriani and Becchetti, 2005).

[8] Empirical findings discussed in footnote 5 clearly evidence that a nonzero share of consumers which are not willing to pay extra money for the social or environmental features of the product exists. These consumers are either indifferent (asymmetric distance) or even find a disutility in buying a product above their ethical standards (i.e., they may believe that this money is waisted) (symmetric distance). Even though we believe that the asymmetric distance hypothesis is the most faithful representation of consumers' preferences on SR, the simmetry/asymmetry of distance costs may be open to debate.

$$\begin{cases} P_A + f(x-a) = R_p & \text{if } x-a \geq 0 \\ P_A = R_p & \text{if } x-a < 0 \end{cases} \tag{1}$$

where x is consumer location on the segment and f is the marginal psychological cost of the distance between consumer and producer locations in the SR space. The cost of ethical distance has a clear monetary counterpart. When the producer is located at the right of the consumer this cost represents the distance in monetary terms between the transfer, which is considered fair by the consumer (indicated by his location on the segment) and the transfer provided by the producer (indicated by producer's location on the segment). The coefficient f maps this objective measure into consumers preferences indicating whether its impact on consumers' utility is proportional ($f = 1$), more than proportional ($f > 1$) or less than proportional ($f < 1$) than its amount in monetary terms. We may conveniently define consumers as "SR neutral", "SR lovers" or "SR averse", respectively, under the three cases.

Eq. (1) shows that $P_A \leq R_p$ is a necessary condition for a positive monopolist's market share. On the other hand, if $P_A > R_p - f(x-a)$, the generic consumer located in x does not buy the product. More generally, if $P_A = R_p - f(x-a)$, the PMP's market share is:

$$x = \left(\frac{R_p - P_A}{f} + a \right) \tag{2}$$

A final feature of our model is the assumption that consumers' tastes on SR are not time invariant. Recent empirical findings support this hardly disputable assumption showing that habit persistence reinforces socially responsible preferences of consumers. A recent empirical investigation on the willingness to pay for SR, on a sample of around 1,000 consumers in Italy, shows that the willingness to pay is positively related to the length of SR consumer habits[9]. To formalize this point we devise the following law of motion:

$$\begin{cases} f'(t) = -\theta f(t) + a(t) \left(\frac{R_p - P_A(t)}{f(t)} + a(t) \right) \\ f(0) = f_0 > 0 \end{cases} \tag{3}$$

where consumers' marginal cost of ethical distance "depreciates" at the rate θ and is enhanced at any period in proportion of the SR "commitment" of the monopolist, weighted for his market share.

Based on these model features, in the following sections we will describe PMP's reactions to the existence of SR consumers by analyzing his optimal strategy conditional to values of initial parameters which crucially affect his choice.

[9] See Becchetti and Rosati, 2004.

3 The reaction of the profit maximizing monopolist to social responsibility

In this section we investigate under which conditions consumers' sensitiveness to social and environmental issues may affect producers PMP equilibrium prices and SR. The PMP chooses price and location by solving the following dynamic problem:

$$\begin{aligned}
&\max_{\{a(\cdot),P_A(\cdot)\}} \int_0^\infty e^{-\rho t}[P_A(t) - w(1 + a(t)s)] \left(\frac{R_p - P_A(t)}{f(t)} + a(t) \right) dt \\
&s.t. \begin{cases} f'(t) = -\theta f(t) + a(t) \left(\frac{R_p - P_A(t)}{f(t)} + a(t) \right) \\ f(0) = f_0 > 0 \end{cases} ; \quad t > 0; \\
&a \in [0, 1], \quad P_A \in [w, R_p]
\end{aligned} \tag{4}$$

where ρ is the monopolist's discount rate, t is the time variable, θ measures consumers' "loss of ethical memory"[10] and f_0 is the initial value of consumer cost of ethical distance. f is the state variable in the model and the differential equation on f is the law of motion, which explains how the variation in consumers' social responsibility depends, positively, on the current consumption of socially responsible products given by the ethical portion of PMP's market share and, negatively, on the "loss of ethical memory". Finally, $a : [0, +\infty[\to [0, 1]$ and $P_A : [0, +\infty[\to [w, R_p]$ are the two control variables. To solve problem (4) we must take into account the critical condition in (1) because, anytime $x - a \leq 0$ holds, the PMP will choose $P_A = R_p$ and problem (4) does not exist anymore, since PMP's market share would be equal to 1.

By defining $\lambda(t)$ as the costate variable of the problem, and by analyzing PMP's optimal location on the ethical segment in our stylized model, we obtain the following result.

Proposition 1. The monopolist PMP, fully informed on the distribution of consumer tastes along the ethical segment, has three possible location strategies, conditional on the observed values of some crucial model parameters :

1) *(no SR stance)the PMP always chooses to locate at the extreme left of the segment fixing a price $P_A = (R_p + w)/2$ $\forall t$;*

2) *(temporary SR stance) there exists a finite $t = \bar{t} \in]0; +\infty[$ such that, on $[\bar{t}, +\infty[$ the PMP always chooses to locate at the extreme left of the segment fixing a price $P_A = (R_p + w)/2$ $\forall t$ and, on $[0, \bar{t}[$, the PMP chooses to fix a price $P_A = R_p$ and a location different from zero such that*

$$a(t) = \begin{cases} \frac{R_p - w}{2(sw - \lambda(t))} = a^*(t) & \text{if } \lambda(t) < sw - \frac{R_p - w}{2} \\ 1 & \text{if } \lambda(t) > sw - \frac{R_p - w}{2} \end{cases} ;$$

[10] Consider that, for admissible values, the $\theta < \rho$ condition needs to be respected.

3) *(permanent SR stance) the PMP chooses a location a positive, constant and given by the following*

$$a(t) = \begin{cases} \frac{R_p - w}{2sw} = a^* & \text{if } \frac{R_p - w}{2sw} < 1 \\ 1 & \text{if } \frac{R_p - w}{2sw} \geq 1 \end{cases} \quad \forall t.$$

Proof:
The Current Value Hamiltonian function of problem (4) is

$$\begin{aligned} H(t, f, a, P_A, \lambda) &= (P_A - w(1 + as)) \left(\frac{R_p - P_A}{f} + a \right) + \\ &+ \lambda \left(-\theta f + a \left(\frac{R_p - P_A}{f} + a \right) \right) \end{aligned} \tag{5}$$

The costate variable $\lambda(t)$ can be interpreted as the marginal cost for the PMP arising from the variation in consumers' social responsibility. The constraint of the problem has a negative impact on the value function. For this reason we expect $\lambda(t)$ to be negative, as we will show in Appendix A.1.

By maximizing H with respect to control variables (a, P_A) we obtain the following first order conditions:

$$\begin{aligned} \frac{\partial H}{\partial P_A} &= \frac{R_p - P_A}{f} + a - \frac{1}{f}(P_A - w(1 + as)) - \frac{a\lambda}{f} = 0; \\ \frac{\partial H}{\partial a} &= -sw \left(\frac{R_p - P_A}{f} + a \right) + (P_A - w(1 + as)) + \\ &+ \frac{R_p - P_A}{f}\lambda + 2a\lambda = 0; \end{aligned} \tag{6}$$

We check second order conditions by evaluating the Hessian matrix of the Hamiltonian function and its determinant:

$$H_S = \begin{bmatrix} 2(\lambda - sw) & \frac{sw}{f} + 1 - \frac{\lambda}{f} \\ \frac{sw}{f} + 1 - \frac{\lambda}{f} & -\frac{2}{f} \end{bmatrix} \tag{7}$$

$$\det H_S = - \left[\frac{sw - \lambda}{f} - 1 \right]^2 < 0$$

This result implies that, even when we find a stationary point of problem (4), we obtain a saddle point and therefore our Hamiltonian function is not maximized in it.

Therefore, to find the optimal control of the problem, we need to consider the corner solutions (a, P_A) belonging to the boundary of the set $[0, 1] \times [w, R_p]$.

i) First of all we analyze what happens when $P_A = w$. It is easy to see that, for any admissible value of a, the profit is always negative:

$$\pi_{P_A=w} = \int_0^{\infty} e^{-\theta t} \left[-asw\right] \left[\frac{R_p - w}{f} + a\right] dt < 0 \tag{8}$$

Hence we will not consider this corner solution.

ii) Maximizing with respect to P_A along $a = 0$ we obtain $P_A^* = \frac{R_p+w}{2}$. We can easily verify that $P_A^* \in [w, R_p]$. By evaluating the Hamiltonian function in $(0, P_A^*)$ we have:

$$H|_{(0,P_A^*)} = \left(\frac{R_p - w}{2}\right)^2 \frac{1}{f} - \theta\lambda f \tag{9}$$

Eq. (9) will be compared with the Hamiltonian values obtained by considering the corner solutions left.

iii) When $P_A = R_p$, the optimal control for PMP's location is $a^*(t) = \frac{R_p-w}{2(sw-\lambda(t))}$. Since $a^*(t)$ depends on λ, we do not know yet whether it is within the unit segment. So we have to consider this solution $(a^*(t), R_p)$ as a possible optimal control for problem (4) if

$$\lambda(t) < sw - \frac{R_p - w}{2} \tag{10}$$

If condition (10) does not hold, then $a(t) = 1$. Finally, the optimal location will be

$$a(t) = \begin{cases} \frac{R_p-w}{2(sw-\lambda(t))} = a^*(t) & \text{if } \lambda(t) < sw - \frac{R_p-w}{2} \\ 1 & \text{if } \lambda(t) > sw - \frac{R_p-w}{2} \end{cases} \tag{11}$$

In (a^*, R_p) the Hamiltonian function is:

$$H|_{(a^*,R_p)} = \left(\frac{R_p - w}{2}\right)^2 \frac{1}{sw - \lambda} - \theta\lambda f \tag{12}$$

iv) The last side of the corner solution to analyze is $a = 1$. In this case the PMP's market share becomes $x = \frac{R_p-P_A}{f} + 1 \geq 1$. In such situation the PMP would conquer the whole market ($x = 1$) because his product is fully "ethical" and bought also by the most socially responsible consumers in the market.

Consequently, it makes no sense to analyze problem (4) along $a = 1$, because it is always $x - a = 0$ and, from equation (1), PMP's price is $P_A = R_p$. This happens because a market share equal to 1 leads the PMP to fix the maximum price he can. This corner solution can be seen as a particular case of corner solution along the boundary $P_A = R_p$.

The two possible solutions of problem (4) are therefore controls $(0, P_A^*)$ and $(a^*(t), R_p)$, the latter under condition (10). To choose the best solution among them we need to compare equations (9) and (12). By doing this we find that the PMP chooses as optimal control $(0, P_A^*)$ when

$$f(t) < sw - \lambda(t) \tag{13}$$

while he chooses the corner solution $(a^*(t), R_p)$ otherwise.

The inequality (13) provides an interesting insight on the role of $\lambda(t)$. Since the costate variable is negative, as we will show in Appendix A.1, the higher is $\lambda(t)$ (the lower in absolute value), the more PMP choice of partial SR is likely to occur. A high value of $\lambda(t)$ implies lower PMP costs from positive changes in consumers SR, so that the PMP is less reluctant to move from the left extreme of the ethical segment.

To discriminate between these two choices and solve the problem of the unknown value of $\lambda(t)$ we formulate two alternative hypotheses on limit values of the critical condition stated above as far as t approaches infinity and explore their consequences in terms of the PMP's behaviour.

In fact, it is possible that condition (13) holds only for some time intervals. In this case we would have the so called bang-bang controls. However, since $\lambda(t)$ is unknown, we can not establish when the condition is verified or not. Moreover, we do not know the value of $\lambda(t)$ because it depends on which is the optimal corner solution. To solve this puzzle we may start from the following differential equation

$$\begin{aligned}
\lambda'(t) &= \rho t - \frac{\partial H(t, f(t), a(t), P_A(t), \lambda(t))}{\partial f} = \\
&= (\theta + \rho)\lambda(t) + \frac{R_p - w}{f(t)^2}\left[P_A - w(1 + a(t)s) + \lambda(t)a(t)\right] \qquad (14)
\end{aligned}$$

for which we do not have an initial value for the costate variable.

Nevertheless, we can derive a terminal condition on $\lambda(t)$ by considering the transversality condition on the Hamiltonian (5)[11]:

$$\lim_{t \to \infty} He^{-\rho t} = 0 \tag{15}$$

For this reason we formulate two alternative hypotheses on condition (13) starting by infinity. In this way we are able to evaluate $\lambda(t)$ and to use it to calculate $f(t)$, which depends on $\lambda(t)$ itself[12]. At this point all variables in the law of motion are well-known and, given the initial value f_0, it is easy to solve the Cauchy problem to find $f(t)$. The solution of the problem following the outlined approach yields what stated in *Proposition 1*. Details on the solution are provided in Appendix 1.

[11] See Michel, 1982.

[12] Actually, $f(t)$ depends on $a(t)$, which *could* depend on $\lambda(t)$, when $f(t) > sw - \lambda(t)$.

4 Observations about the three cases

In this section we analyze characteristics and consequences of the three cases outlined by *Proposition 1.*

4.1 Case 1. The monopolist PMP does not choose SR

Under CASE 1 the PMP does not care about consumers' ethical sensitiveness and locates at the extreme left of the segment. The equations for state and costate variables are the following

$$f(t) = f_0 e^{-\theta t} \tag{16}$$

$$\lambda(t) = e^{2\theta t} \frac{1}{\theta - \rho} \left(\frac{R_p - w}{2f_0} \right)^2 \tag{17}$$

Under this case PMP's products do not incorporate ethical features and consumers' sensitiveness to SR (the psychological cost of ethical distance), without consumption habit reinforcement, will progressively depreciate and go to zero. The existence of SR consumers, however, is not without consequences. In fact, it will create a downward pressure on prices because "concerned" consumers accept to buy non SR products only if their price, adjusted for the cost of ethical distance, is smaller than their "conditional" reservation price R_p. In such circumstances, if the PMP fixes $P_A = R_p$, his market share $x = \left(\frac{R_p - P_A}{f}\right)$ would be equal to zero. Consequently, he chooses his price as to maximize the Hamiltonian (9) obtaining a constant value: $P_A^* = \frac{R_p + w}{2}$.

It is important to note that, given equation (16), we have $\lim_{t \to \infty} f(t) = 0$. This means that, going to infinity, we can not consider any longer the maximum problem stated by (4), because PMP's market share can not be written as it is in equation (2). However, for $f \to 0, P_A \to R_p$ and consumers' sensitivity to SR vanishes, as we observe from the indifference condition (1). In this way PMP's market share will be equal to 1 when $t \to \infty$.

Actually the PMP will reach the whole market ($x = 1$) very much before, when $x = \frac{R_p - w}{2f_0 e^{-\theta t}} = 1$, that is when

$$t = t_1 = -\frac{1}{\theta} \log \left(\frac{R_p - w}{2f_0} \right) \tag{18}$$

However, the optimal price will be always P_A^*, because consumers would never agree to pay the "conditional" reservation price for a non ethical product and would accept to buy those products only if their price is sufficiently low. When $t \to \infty$, $f \to 0$ and they pay $P_A = R_p$, letting the PMP gain a profit equal to $\frac{R_p - w}{\rho}$.

We also note that, for some values of f_0, t_1 is negative, thereby implying that the PMP conquers the whole market since $t = 0$, with a price P_A^*.

Consider also that CASE 1 needs inequality $f(t) < sw - \lambda(t)$ to hold for every $t \in [0;\infty[$. This shows that CASE 1 will occur for very low values of f_0, as we will see in Appendix 2.

4.2 Case 2. The monopolist PMP chooses partial SR until consumers' sensitiveness fades

We defined CASE 2 as the situation in which there is a positive $\bar{t}$ such that, for $t < \bar{t}$ ($t > \bar{t}$), the PMP will (will not) incorporate ethical features in the product. Evaluating $\bar{t}$ actually is not so easy. $\overline{f}$ is such that $\overline{f} = sw - \overline{\lambda} = sw - \frac{1}{\theta-\rho}\left(\frac{R_p-w}{2\overline{f}}\right)^2$,which is a third order equation in $\overline{f}$ always giving only one real and positive solution, according to Cartesio's theorem.

For $t < \bar{t}$ we have the following differential equations

$$
\begin{aligned}
f'(t) &= -\theta f(t) + a^{*2}(t) && (19)\\
\lambda'(t) &= (\rho+\theta)\lambda(t) && (20)
\end{aligned}
$$

For $\lambda(t)$ the final condition is given by $\lambda(\bar{t}) = \overline{\lambda}$ and, for $f(t)$, the usual initial condition is $f(0) = f_0$. We can find $\bar{t}$ evaluating the solution of the Cauchy problem for $f(t)$ in $\bar{t}$ and setting it equal to $\overline{f}$:

$$
\begin{aligned}
f(t) &= e^{-\theta(t-\bar{t})}\left[\left(\frac{R_p-w}{2}\right)^2 \int_0^t \frac{e^{\theta r}}{\left(sw-\overline{\lambda}e^{(\theta+\rho)(r-\bar{t})}\right)^2}dr + f_0\right] = \\
&= \left[\left(\frac{R_p-w}{2}\right)^2 \int_0^{\bar{t}} \frac{e^{\theta r}}{\left(sw-\overline{\lambda}e^{(\theta+\rho)(r-\bar{t})}\right)^2}dr + f_0\right] = \overline{f} \qquad (21)
\end{aligned}
$$

A solution for $\bar{t}$ does not always exist, because the right hand side is increasing in $\bar{t}$ and has a horizontal asymptote that can be also lower than $\overline{f}$. When this happens CASE 2 does not occur, as we will see better in the parametric example provided in Section 5.

CASE 2 indicates the possibility for the PMP to choose partial SR just for an initial finite period. This choice is crucially influenced by the high initial consumer sensitiveness for social responsibility. The PMP adapts himself to new consumers' tastes, selling products with SR features. As time goes on, he benefits from the progressive vanishing of that sensitiveness, choosing locations closer and closer to the left extreme of the ethical segment, until $t = \bar{t}$, when his optimal location falls to $a = 0$[13].

[13] Figure 5.1 in the next section provides four examples of locations in which CASE 2 occurs.

4.3 Case 3. The monopolist PMP chooses a permanent level of SR

CASE 3 describes the situation in which the monopolist always chooses to incorporate, to some extent, SR features in his product. The optimal location does not depend on t, because $\lambda(t) = 0$, so that $a(t) = a^*(t) = a^* = (R_p - w)/(2sw)$. The reason for a null costate variable can be found by considering that, in the main problem (4), if $P_A = R_p \ \forall t \in [0; \infty[$, the maximizing functional does not depend anymore on $f(t)$. Problem (4) becomes at this point an unconstrained maximum problem with $\lambda(t) = 0$. When the price is fixed at R_p, the decision to buy or not depends uniquely on consumer position on the segment and not on the cost of ethical distance (if the consumer is located at the left (right) of the firm he does (does not) buy whatever its costs of SR distance). This is why the functional does not depend on $f(t)$.

CASE 3 calls for a relatively high initial value of consumers' cost of ethical distance f_0. This parameter should be, as we explain in Appendix 2, at least greater than sw. But this is not sufficient to ensure that CASE 3 holds. Other parameters should be such that equation (19) can not let $f(t)$ fade. This happens for example when a^* is particularly high, because of a high spread between R_p and w or a low value of the transfer s. This spread implies high profits for the PMP when it does not imitate, because he can choose higher values for his price P_A. Without PMP's SR, on the contrary, the latter is fixed at R_p and therefore PMP's market share is lower. Moreover, the smaller is s, the more plausible is CASE 3, because, if transfers are low, then costs of becoming ethical are low too[14].

In the next section we are going to illustrate some interesting examples for given values of initial parameters.

5 Parametrization

The nice feature of our problem is that it has well defined and sound parametric assumptions. Hence, by looking at parametric examples of our solution we may draw quite general and interesting lessons from *Proposition 1*. In order to find the optimal controls of problem (4) we will bear in mind the three propositions outlined in the paper (*Proposition 2* and *Proposition 3* are defined in Appendix 2).

We will illustrate two scenarios of initial parameters. Inside those we will let that the initial psychological cost of social responsibility f_0 and the amount of transfers s assume different values, being these variables more likely to vary than other parameters in the reality.

First of all, we conveniently fix $\rho = 0.05$ and $\theta = 0.04$, respecting the condition $\theta < \rho$. Tables 1.A and 1.B show results for both scenarios in which π_1, π_2

[14] Further details on the parametric conditions needed to discriminate among the three cases are provided in Appendix 2.

and π_3 measure PMP's profits if CASE 1, CASE 2 or CASE 3 respectively hold. Such values are obtained by evaluating the following integral of the functional to maximize

$$\int_0^\infty e^{-\rho t}[P_A(t) - w(1 + a(t)s)] \left(\frac{R_p - P_A(t)}{f(t)} + a(t)\right) dt \tag{22}$$

whenever it is possible. The three profits are respectively the following

$$\begin{aligned}
\pi_1 &= \left(\frac{R_p - w}{2}\right)^2 \frac{1}{f_0(\rho - \theta)} && (23) \\
\pi_2 &= \int_0^{\bar{t}} e^{-\rho t} \left(\frac{R_p - w}{2}\right)^2 \frac{sw - 2\overline{\lambda} e^{(\theta+\rho)(r-t)}}{sw - \overline{\lambda} e^{(\theta+\rho)(r-t)}} dt + \\
&+ \int_{\bar{t}}^\infty e^{(\theta-\rho)t - \theta\bar{t}} \left(\frac{R_p - w}{2}\right)^2 \frac{1}{\bar{f}} dt && (24) \\
\pi_3 &= \left(\frac{R_p - w}{2}\right)^2 \frac{1}{\rho s w} && (25)
\end{aligned}$$

Table 1.A shows results for $R_p = 2$ with w conveniently normalised to one. Under this parametric conditions consumers conditional reservation price is twice as high as the market price paid to the subcontractee by the PMP. Table 1.A has nine columns: the first two show f_0 and s values, the third, the fourth and the fifth columns report profits given by equations (23), (24) and (25). In the sixth column we specify which of the three cases applies for the considered parametric values and, finally, the last two columns present the solutions of problem (4). The ninth column yields the value of $\bar{t}$ and it is empty because $\bar{t}$ never exists for these values of parameters. This means that we never have CASE 2 when $R_p = 2$ and $w = 1$. To this point remind that, in the previous section, we noted that a high spread between R_p and w (here it is equal to 1), reduces the probability of CASE 2, because it reinforces $f(t)$ along time (see eq. (19)). We also observed that, when s is very small, costs of becoming ethical are small too and therefore CASE 3 can hold. In fact CASE 3 is verified for high values of f_0 and small values of s.

We can verify that, when $f_0 \leq sw$, CASE 1 always holds according to *Proposition 2 (*see Appendix 2*)*. Moreover, the higher is f_0, the less likely is CASE 1 to be applied. It is important to note that the corresponding price P_A is always less than R_p. Otherwise PMP's market share would be zero. Nonetheless, price will be equal to R_p at infinity as we saw in section 4.1.

Having said that we have only one situation (when $f_0 = 3$ and $s = 0.05$)in which we can apply *Proposition3*described in Appendix 2. Under such circumstance we have $f_0 > sw - \frac{1}{\theta-\rho}\left(\frac{R_p-w}{2f_0}\right)^2$ and $sw \leq \left(\frac{R_p-w}{2}\right)^2 \frac{1}{\theta s^2 w^2}$, but CASE 2 can not be applied because $\bar{t}$ does not exist, so the optimal corner solution will be always along the side $P_A = R_p$ (CASE 3).

Table 1.A – Optimal PMP price and SR choice under different parametric criteria (1)								
$\rho = 0.05$ $\theta = 0.04$ $R_p = 2$ $w = 1$								
f_0	s	π_1	π_2	π_3	*Case*	a	P_A	$\bar{t}$
0.5	0.05	50		19	1	0	1.5	
	0.5	50		10	1	0	1.5	
	1	50		5	1	0	1.5	
1	0.05	25		19	1	0	1.5	
	0.5	25		10	1	0	1.5	
	1	25		5	1	0	1.5	
1.5	0.05	16.666		19	3	1	2	
	0.5	16.666		10	1	0	1.5	
	1	16.666		5	1	0	1.5	
2	0.05	12.5		19	3	1	2	
	0.5	12.5		10	1	0	1.5	
	1	12.5		5	1	0	1.5	
2.5	0.05	10		19	3	1	2	
	0.5	10		10	1	0	1.5	
	1	10		5	1	0.5	2	
3	0.05	8.3333		19	3	1	2	
	0.5	8.3333		10	3	1	2	
	1	8.3333		5	1	0	1.5	

All situations left are included in the interval explained in the *Remark* 2 about *Proposition 3* (see Appendix 2), when all cases hold. In such case optimal solutions are found by comparing profits under the three cases.

In Table 1.B we illustrate a different scenario in which, *caeteris paribus*, $R_p = 1.1$. In this way we may analyze a situation in which the spread between R_p and w is significantly lower than before.

Here PMP SR is more likely to occur as we expected, because f_0 is relatively higher than $sw - \frac{1}{\theta-\rho}\left(\frac{R_p-w}{2f_0}\right)^2$ in most scenarios (see *Proposition 3* in Appendix 2). We remark that $\frac{1}{\theta-\rho}\left(\frac{R_p-w}{2f_0}\right)^2$ is the expression for λ_0 when CASE 1 holds. As we can see in Appendix 2, this means that $f_0 > sw - \frac{1}{\theta-\rho}\left(\frac{R_p-w}{2f_0}\right)^2$ excludes CASE 1 itself, according to the inequality (13). To have CASE 1 in Table 1.B f_0 has to be small relatively to sw. When all cases are possible (see *Remark 2* in Appendix 2), CASE 1 never wins and it is more convenient for the PMP to imitate forever, because costs of transfers are very low. This happens every time $s = 0.05$.

Table 1.B - Optimal PMP price and SR choice under different parametric criteria (2)

$\rho = 0.05$
$\theta = 0.04$
$R_p = 1.1$
$w = 1$

f_0	s	π_1	π_2	π_3	*Case*	a	P_A	$\bar{t}$
0.5	0.05	0.5		1	3	1	1.1	
	0.5	0.5		0.1	1	0	1.05	
	1	0.5		0.05	1	0	1.05	
1	0.05	0.25		1	3	1	1.1	
	0.5	0.25	0.252	0.1	2	$a^*(t)$ *for t*<4.64 0 *for t*> 4.64 (*)	1.1 *for t*<4.64 1.05 *for t*> 4.64	4.64
	1	0.25		0.05	1	0	1.5	
2	0.05	0.125		1	3	1	1.1	
	0.5	0.125	0.155	0.1	2	$a^*(t)$ *for t*<24.36 0 *for t*>24.36 (*)	1.1 *for t*<24.36 1.05 *for t*>24.36	24.36
	1	0.125	0.132	0.05	2	$a^*(t)$ *for t*<13.66 0 *for t*>13.66 (*)	1.1 *for t*<13.66 1.05 *for t*>13.66	13.66
3	0.05	0.083		1	3	1	1.1	
	0.5	0.083	0.131	0.1	2	$a^*(t)$ *for t*<35.53 0 *for t*>35.53 (*)	1.1 *for t*<35.53 1.05 *for t*>35.53	35.53
	1	0.083	0.098	0.05	2	$a^*(t)$ *for t*<24.04 0 *for t*>24.04 (*)	1.1 *for t*<24.04 1.05 *for t*>24.04	24.04

(*)

$$a^*(t) = \frac{R_p - w}{2\left(sw - \left(\frac{R_p - w}{2\bar{f}}\right)^2 \frac{1}{\theta - \rho} e^{(\theta+\rho)(t-\bar{t})}\right)^2}$$

In all situations left we apply *Remark 1* (see Appendix 2) comparing profits π_1 and π_2. CASE 2 always occurs and gives rise to optimal locations $a(t)$ such as those represented in figure 5.1. The time threshold $\bar{t}$ determining PMP switch from partial to no SR is positively correlated to f_0 and negatively to s. In fact the higher is consumers' psychological cost, the longer is ethical PMP's SR choice. On the other hand, the higher is the transfer, the more expensive is PMP's SR choice.

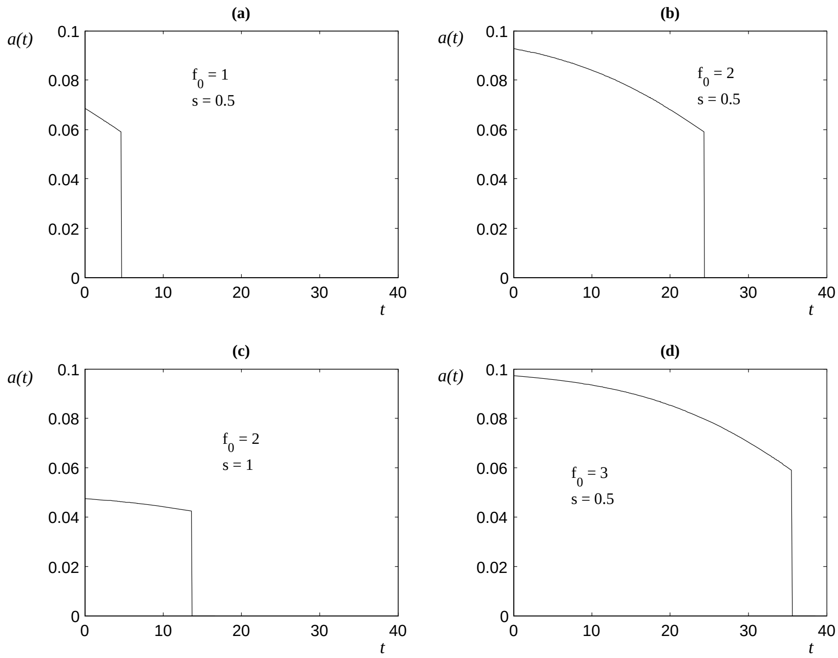

Fig. 5.1. Transition from (partial) PMP's SR choice to absence of SR for given parametric conditions.

6 Conclusions

What are the consequences of the growing consumer care for SR on product market competition? Can profit maximising behaviour and corporate social responsibility go hands in hands and under what conditions? Why the emphasis and advertising on corporate SR behavior is growing?

In this paper we try to provide a simple and tractable theoretical framework in which these questions can be analyzed and partially answered. The paper starts from the hypothesis, supported by empirical findings, that consumers' willingness to pay for social and environmental issues is heterogeneous and dynamically affected by habit persistence. It shows that a monopolist profit maximizing producer optimally chooses prices and socially responsible stance among three different strategies for given values of consumers' concern for social and environmental issues, production costs and consumers conditional (SR independent) reservation prices. More specifically, we observe that the PMP is interested in reducing its SR stance (or not to have it at all) not to reinforce consumers SR purchasing habits. The only case in which he chooses permanently SR is when the cost of social responsibility is low and the ratio between consumers' conditional (SR independent) reservation price and producer's production price is high enough so that SR costs can be entirely transferred on consumer prices.

A final consideration on our results may be that the level of SR predicted by the model in equilibrium may seem to low with respect to the one we observe. A likely answer is that it depends from factors not considered in this version of the model, such as the presence of profit or no profit competitors in SR which maintain a higher level of consumer SR and force the PMP producer to a higher SR stance.

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Appendix 1: Proof of *Proposition 1*

To analyze condition (13) we formulate two alternative hypotheses. The first is

(i): $f_{t\to\infty} \le sw - \lambda_{t\to\infty}$

where we define $f_{t\to\infty}$ and $\lambda_{t\to\infty}$ respectively as f and λ values for t which tends to infinity. We call $\bar{t} > 0$ a finite time such that hypothesis (i) holds for $t > \bar{t}$. In this situation the PMP chooses $(0, P_A^*)$ and differential equations for the state and the costate variables turn into:

$$f'(t) = -\theta f(t) \tag{26}$$

$$\lambda'(t) = (\rho + \theta)\lambda(t) + \left(\frac{R_p - w}{2f(t)}\right)^2 \tag{27}$$

Moreover, the transversality condition (15) holds, when H is equal to $H|_{(0,P_A^*)}$ which is given by equation (9). From equation (26) we have that $f(t) = \overline{f}e^{-\theta t}$, with $\overline{f} = f(\bar{t})$. So $f(t)$ is positive and decreasing. From equation (27) we have

$$\lambda(t) = e^{2\theta(t-\bar{t})}\frac{1}{\theta-\rho}\left(\frac{R_p - w}{2\overline{f}}\right)^2 + ce^{(\theta+\rho)t} \tag{28}$$

where c is a generic constant depending on the final condition on $\lambda(t)$. The latter can be obtained by substituting $f(t)$ and $\lambda(t)$ in the trasversality condition (15):

$$\lim_{t\to\infty}\left(\frac{R_p - w}{2}\right)^2 \frac{1}{\overline{f}(\theta-\rho)}\left[-\rho e^{-\theta\bar{t}+(\theta-\rho)t} + \theta e^{-(\theta+\rho)t-(2\rho-\theta)\bar{t}}\right] - \theta\overline{f}ce^{-\rho\bar{t}} = 0 \tag{29}$$

In (29) the first term goes to zero as $t \to \infty$, for $\theta < \rho$ everywhere, and the second term is constant. To let the limit go to zero it must be that $c = 0$. Hence, $\lambda(t)$ is given by the following:

$$\lambda(t) = e^{2\theta(t-\bar{t})}\frac{1}{\theta-\rho}\left(\frac{R_p - w}{2\overline{f}}\right)^2 \tag{30}$$

which is negative and decreasing.

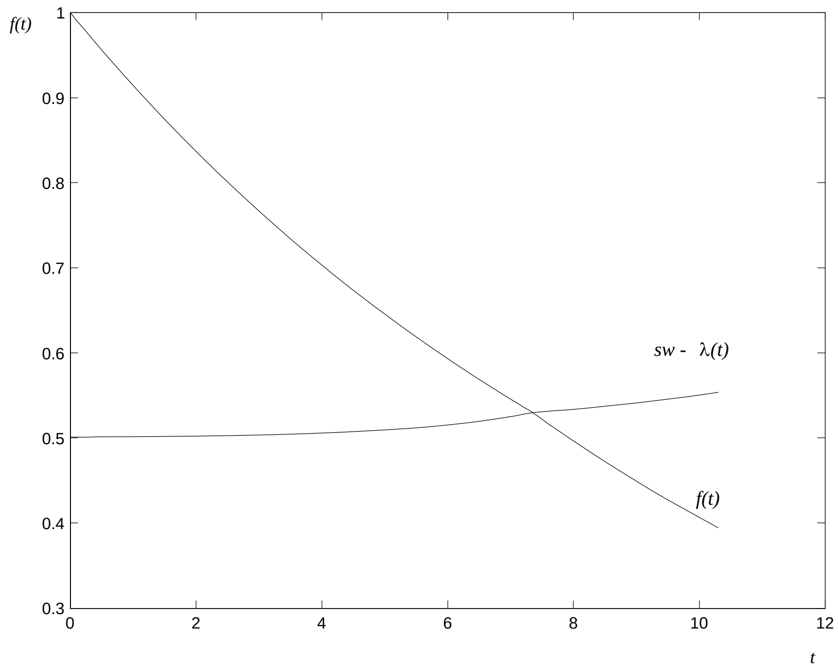

Fig. A1.1. The dymamic of consumers' cost of ethical distance under CASE 2.

Now we know the form of the two curves $f(t)$ and $sw - \lambda(t)$. Both are positive, but the first is decreasing while the second is increasing. This means that there exists a time $\overline{t} \in \left]-\infty; +\infty\right[$ in which the two will intersect. Hence, hypothesis (i) holds, as long as t goes back to $\overline{t}$. In $t = \overline{t}$ we will have $f(\overline{t}) = sw - \lambda(\overline{t})$ and, before $\overline{t}$, the inequality of hypothesis (i) will be inverted (see figure A1.1) and $f(t) > sw - \lambda(t)$ persists going backward to time zero. To show this last result let us suppose, *ab absurdo*, that there exists a time $\widehat{t} \in \left[0; \overline{t}\right[$ such that $f(t) > sw - \lambda(t)$ holds for $t \in \left[\widehat{t}; \overline{t}\right[$ and does not hold immediately before $\widehat{t}$. In $t = \widehat{t}$ it has to be $f(\widehat{t}) = sw - \lambda(\widehat{t})$: another intersection. Inside the interval $\left[\widehat{t}; \overline{t}\right[$ for $\lambda(t)$ we will have the following Cauchy problem

$$\begin{cases} \lambda'(t) = (\rho + \theta)\lambda(t) \\ \lambda(\overline{t}) = \overline{\lambda} = \lambda(t) = \frac{1}{\theta - \rho}\left(\frac{R_p - w}{2\overline{f}}\right)^2 \end{cases} \tag{31}$$

where the final condition is derived from equation (30) evaluated in $t = \overline{t}$ and $\overline{f} = f(\overline{t})$ is such that $\overline{f} = sw - \overline{\lambda}$. The solution is $\lambda(t) = \overline{\lambda}e^{(\theta+\rho)(t-\overline{t})}$ negative and decreasing. So $sw - \lambda(t)$ is again positive and increasing. Before $\widehat{t}$ functions $f(t)$ and $\lambda(t)$ are given by equations (26) and (27). Again, $f(t)$ is positive and decreasing, while $sw - \lambda(t)$ is positive and increasing. Hence, the following hypothesis has to hold before $\widehat{t} : f(t < \widehat{t}) \leq sw - \lambda(t < \widehat{t})$. However, since $sw - \lambda(t)$ is increasing, we have $sw - \lambda(t < \widehat{t}) < sw - \lambda(\widehat{t}) = f(\widehat{t})$. Given that

$f(t)$ is decreasing before $\widehat{t}$, it has to be necessarily that $f(\widehat{t}) < f(t < \widehat{t})$, and so $sw - \lambda(t < \widehat{t}) < f(t < \widehat{t})$ against the hypothesis we made in the beginning. Consequently, $\widehat{t}$ can never exist and $f(t) > sw - \lambda(t)$ will hold from zero to $\overline{t}$. The optimal location in this interval will be on the third corner solution (11).

We have defined $\overline{t}$ by considering that it can assume negative values too, in this way admitting the possibility that the PMP does not imitate ethical behaviour at all, for every $t \in [0, \infty]$ (see figure A1.2). This situation can occur also when $\overline{t}$ can not be calculated, as we saw in section 4.2.

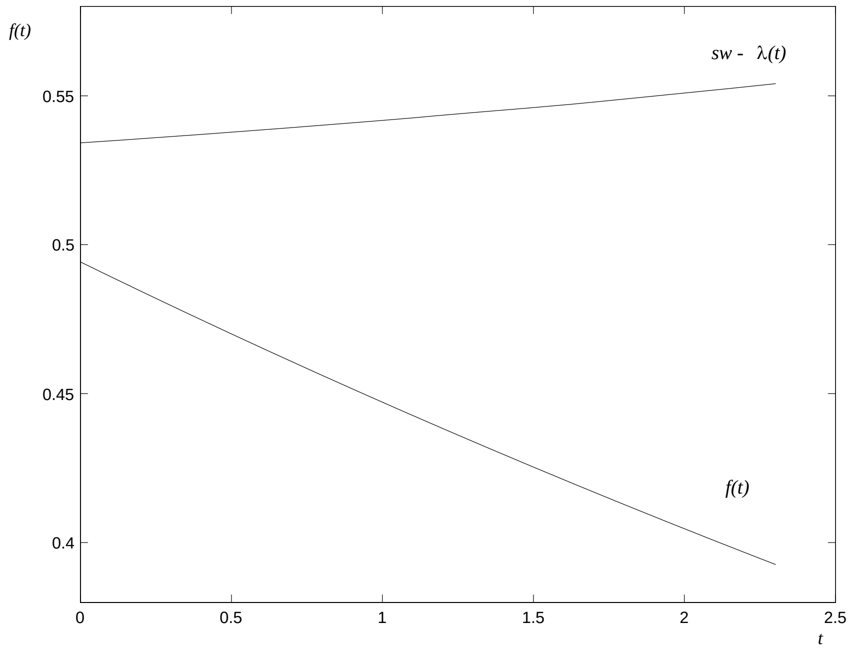

Fig. A.1.2. The dynamics of consumers' cost of ethical distance under CASE 1.

We will talk about the situation represented in figure A1.2 as "CASE 1", which corresponds to the first behaviour defined in *Proposition 1.* On the contrary, when $\overline{t} > 0$, PMP's behaviour, represented in figure A1.1, corresponds to the second strategy defined in *Proposition 1*, which we call "CASE 2".

We now remove hypothesis (i) and define the following alternative:

(ii) $f_{t\to\infty} \geq sw - \lambda_{t\to\infty}$

We call $\widehat{t} > 0$ a finite time such that hypothesis (ii) holds for $t > \widehat{t}$. The PMP chooses $(a^*(t), R_p)$ for $t > \widehat{t}$. The Hamiltonian around infinity is given by equation (12). At infinity, for $\lambda(t)$ and $f(t)$, we have eq. (19) and (20), which, with $f(\widehat{t}) = \widehat{f}$ and $\lambda(\widehat{t}) = \widehat{\lambda}$, generate two Cauchy problems solved by the following:

$$\lambda(t) = \widehat{\lambda} e^{(\theta+\rho)(t-\widehat{t})} \tag{32}$$

$$f(t) = e^{-\theta t}\left[\left(\frac{R_p - w}{2}\right)^2 \int_{\widehat{t}}^{t} \frac{e^{\theta r}}{\left(sw - \widehat{\lambda} e^{(\theta+\rho)(r-\widehat{t})}\right)^2} dr + \widehat{f}\right] \tag{33}$$

Combining the Hamiltonian of equation (12) and trasversality condition (15) with the expression above for $\lambda(t)$ we obtain:

$$\lim_{t\to\infty} \left(\frac{R_p - w}{2}\right)^2 \frac{e^{-\rho t}}{sw - \widehat{\lambda} e^{(\theta+\rho)(t-\widehat{t})}} - \theta\widehat{\lambda} e^{-(\theta+\rho)\widehat{t}+\theta t} f(t) = 0 \tag{34}$$

The first term goes to zero so the limit becomes

$$\lim_{t\to\infty} \left\{-\theta\widehat{\lambda} e^{-(\theta+\rho)\widehat{t}+\theta t} f(t)\right\} = 0 \tag{35}$$

and, substituting the expression for $f(t)$:

$$\lim_{t\to\infty} \left\{-\theta\widehat{\lambda} e^{-(\theta+\rho)\widehat{t}} \left[\left(\frac{R_p - w}{2}\right)^2 \left(\int_{\widehat{t}}^{t} \frac{e^{\theta r}}{\left(sw - \widehat{\lambda} e^{(\theta+\rho)(r-\widehat{t})}\right)^2} dr + \widehat{f}\right)\right]\right\} = 0 \tag{36}$$

The integral function in parenthesis is not easy to solve, but we can study the function $g(r) = \frac{e^{\theta r}}{\left(sw - \widehat{\lambda} e^{(\theta+\rho)(r-\widehat{t})}\right)^2}$. It behaves like $e^{\theta r - 2(\theta+\rho)r}$ as r goes to infinity. For this reason $g(r) \to 0$. So its integral, evaluated between $\widehat{t}$ and $t \to \infty$, is finite and positive. $\widehat{f}$ is finite and positive too, so the whole limit is zero, if and only if $\widehat{\lambda} = 0$.

Hypothesis (ii) is now $f_{t\to\infty} \geq sw$. The inequality persists going back untill $t = 0$, if $f(t)$ is decreasing or constant.

However it is easy to show that it does not change even if $f(t)$ is increasing. In fact, if $f(t)$ is increasing, then the two lines $f(t)$ and sw could intersect each other in $\widehat{t}$ and the inequality could change for $t < \widehat{t}$. There would be a period for $t < \widehat{t}$, let's say $\left[t_1, \widehat{t}\right]$, when $(0, P_A^*)$ holds as optimal control. In $\left[t_1, \widehat{t}\right]$ equations (26) and (27) hold with two final conditions: $f(\widehat{t}) = \widehat{f}$ and $\lambda(\widehat{t}) = \widehat{\lambda} = 0$. This last condition yields $\lambda(t) = 0\ \forall t \in \left[t_1, \widehat{t}\right]$, while $f(t) = \widehat{f} e^{-\theta(t-\widehat{t})}$ is decreasing. So $\widehat{t}$ can never exist because, for $t < \widehat{t}$, the relation $f(t) > sw$ continues to hold and, in this situation, $(0, P_A^*)$ can never be the optimal control. Here the PMP imitates for every t and always adopts the corner solution with $P_A = R_p$. The optimal location will be the one defined for the third corner solution, considering $\lambda = 0$. We label this as "CASE 3".□

Appendix 2: Further parametric condition to discriminate among the three cases

What we said about CASE 1 should not make it difficult to understand the following proposition.

Proposition 2: If $f_0 \leq sw$ the optimal location will be $a(t) = 0$ $\forall t$ and the optimal price will be $P_A^* = \frac{R_p+w}{2}$ (CASE 1).

Proof:

Let us consider again hypotheses (i) and (ii) in Appendix 1 to see what happens when $f_0 < sw$. If hypothesis (i) holds CASE 2 can never hold because, in $t = 0$, $f(t) = f_0 < sw < sw - \lambda(0)$, so that $a(t) = 0$. This means that only CASE 1 can occur. On the contrary, if hypothesis (ii) holds, CASE 3 must occur. But if CASE 3 holds we should have $f_0 > sw$ against the hypothesis of *Proposition 2*. We conclude that CASE 1 is the only possible choice for the PMP under $f_0 < sw$. $\square$

The result of *Proposition 2* is quite obvious. We have already seen that, when f_0 is particularly small, and now we know that it has to be less than sw, social responsibility is weak from the beginning and is not sufficient to trigger PMP's social responsibility. Remember again that, ever in this case, consumers' care for social responsibility is not without effects, because the PMP is compelled to choose a price lower than the contingent reservation price R_p, if he does not want to lose his market share.

Proposition 3: Assume that $f_0 > sw - \frac{1}{\theta-\rho}\left(\frac{R_p-w}{2f_0}\right)^2$, then there exists always an interval $[0; \bar{t}[$ such that the PMP imitates in it.

If $sw > \left(\frac{R_p-w}{2}\right)^2 \frac{1}{\theta s^2 w^2}$ that interval is finite;

if $sw \leq \left(\frac{R_p-w}{2}\right)^2 \frac{1}{\theta s^2 w^2}$ that interval can be infinite.

Proof:

We need to show that, when $f_0 > sw - \frac{1}{\theta-\rho}\left(\frac{R_p-w}{2f_0}\right)^2$, CASE 1 does not hold.

Let us suppose, *ab absurdo*, that it does hold. This means that either $\bar{t}$ does not exist or, if it exists, it is negative, so that our problem is expressed by the differential equations (26) and (27) with the usual initial condition $f(t) = f_0$ and the trasversality condition (15). The solution of the two Cauchy problems gives $\lambda(t) = e^{2\theta t}\frac{1}{\theta-\rho}\left(\frac{R_p-w}{2f_0}\right)^2$. Evaluating it in $t = 0$ we have $\lambda(0) = \frac{1}{\theta-\rho}\left(\frac{R_p-w}{2f_0}\right)^2$. Remembering that CASE 1 holds when $f(t) \leq sw - \lambda(t)$ $\forall t \in [0; \infty[$, we should have at zero $f_0 < sw - \frac{1}{\theta-\rho}\left(\frac{R_p-w}{2f_0}\right)^2$, against the hypothesis formulated. The two cases left can occur so we must have at least a finite period of PMP partial SR choice.

To show the second part of the proposition let's consider the definition of $f(t)$ in CASE 3, as a solution of the following Cauchy problem:

$$\begin{cases} f'(t) = -\theta f(t) + a^{*2} \\ f(0) = f_0 \end{cases} \tag{37}$$

where a^* is the optimal constant control given in the third point of *Proposition 1.*

We have

$$\begin{aligned} f(t) &= e^{-\theta t}\left[\int_0^t a^{*2} e^{\theta r} dr + f_0\right] = \\ &= e^{-\theta t}\left[f_0 - \frac{1}{\theta}\left(\frac{R_p - w}{2sw}\right)^2\right] + \frac{1}{\theta}\left(\frac{R_p - w}{2sw}\right)^2 \end{aligned} \tag{38}$$

Hence, $f(t)$ has a horizontal asymptote equal to $\frac{1}{\theta}\left(\frac{R_p-w}{2sw}\right)^2$. Moreover $f(t)$ is decreasing if $f_0 > \frac{1}{\theta}\left(\frac{R_p-w}{2sw}\right)^2$ and, otherwise, increasing. CASE 3 can occur when the inequality $f(t) > sw$ persists as t goes to infinity. If that asymptote is less than sw, $f(t)$ is first decreasing, until $f(t) < sw$ and therefore CASE 3 is impossible. For this reason we can have PMP partial SR for all t only if $sw \leq \left(\frac{R_p-w}{2}\right)^2 \frac{1}{\theta s^2 w^2}$. $\square$

Proposition 3 confirms our intuition developed in section 4.3, that is, when f_0 is sufficiently high and, in particular, greater than $sw - \frac{1}{\theta-\rho}\left(\frac{R_p-w}{2f_0}\right)^2$, it has effects on PMP's location, which can be different from zero. These effects could be permanent (CASE 3) if PMP's costs of ethical behaviour, represented by sw, are not so high, and, more specifically, less than $\left(\frac{R_p-w}{2}\right)^2 \frac{1}{\theta s^2 w^2}$.

This means that the PMP finds convenient to be ethical for ever, with a location equal to a^*, when consumers' psychological cost of ethical distance is initially high and transfers are low, so that $f(t)$ can never go below it (examples in Tables 1.A and 1.B confirm it). In this situation $f(t)$ does not go to zero. SR persists until infinity and the PMP has to take into account it, continuing to incorporate SR features in his product.

On the contrary, if transfers are high, then the PMP finds it convenient to fix initially a location $a^*(t) \leq a^*$ (in fact, we have always $\frac{R_p-w}{2sw} \leq \frac{R_p-w}{2(sw-\lambda(t))}$). This happens because high transfers make location a^* too expensive. At the same time the PMP can not locate in zero because a high f_0 would make his market share too low. A positive, but close to the left extreme, location on the ethical segment gives a small contribution to SR consumption and so to the growth of $f(t)$ in the law of motion (3). Hence, the solution of the differential equation is given by eq. (21): $f(t)$ goes to zero as $t \to \infty$, SR interest vanishes and the PMP can choose to locate in zero.

We showed that, when $sw \leq \left(\frac{R_p-w}{2}\right)^2 \frac{1}{\theta s^2 w^2}$, the PMP can be ethical for ever if $f(t)$ is decreasing. Actually, the probability that CASE 3 occurs is higher when $f(t)$ is increasing. Nevertheless, if $f(t)$ is increasing, SR not only does not vanish, but becomes stronger and stronger over time. Therefore, regardless of the behaviour of function $f(t)$ (increasing or decreasing), if $sw \le \left(\frac{R_p - w}{2}\right)^2 \frac{1}{\theta s^2 w^2}$ and $f_0 > sw - \frac{1}{\theta - \rho}\left(\frac{R_p - w}{2f_0}\right)^2$ (hypothesis of *Proposition 3*), then CASE 3 can occur, because costs of being ethical are always smaller than $f(t)$.

At this point it is easy to observe that CASE 3 can never occur if $sw > \left(\frac{R_p - w}{2}\right)^2 \frac{1}{\theta s^2 w^2}$, so we have the following:

Remark 1: If $sw > \left(\frac{R_p - w}{2}\right)^2 \frac{1}{\theta s^2 w^2}$, *there exists a* $\bar{t} \ge 0$ *such that the PMP does not imitate for* $t > \bar{t} \in [0; \infty[$[15].

To find the optimal control in this situation (CASE 1 or CASE 2) we can only calculate the whole profit in both possible cases (in CASE 2 only if $\bar{t}$ exists) and consider the one that yields the highest profit, by comparing equations (23) and (24).

In our analysis we left only one interval in which we do not know *a priori* what is the optimal choice for the PMP:

Remark 2: If $sw < \left(\frac{R_p - w}{2}\right)^2 \frac{1}{\theta s^2 w^2}$ and $sw < f_0 < sw - \frac{1}{\theta - \rho}\left(\frac{R_p - w}{2f_0}\right)^2$, *all three cases are possible.*

Here we compare three profits corresponding to the three different cases (or two cases if $\bar{t}$ does not exist), given by equations (23), (24) and (25).

[15] This observation is obvious for $f_0 < sw$, given *Proposition 2* and, for $f_0 > sw - \frac{1}{\theta - \rho}\left(\frac{R_p - w}{2f_0}\right)^2$, given the first point of *Proposition 3.* Now we show it holds also for $sw < f_0 < sw - \frac{1}{\theta - \rho}\left(\frac{R_p - w}{2f_0}\right)^2$. Therefore, in this situation only CASE 1 or CASE 2 can occur.