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The dynamics of socially responsible product differentiation and the habit formation of socially responsible consumers †§

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Abstract

In our model of socially responsible (SR) product differentiation two duopolists (a zero profit socially concerned producer and a profit maximizing producer) compete over prices and (costly) "socially and environmentally responsible" features of their products under a given law of motion of consumer's habits. In a continuous time model in which the location of the zero profit socially responsible entrant is fixed and the profit maximizing producer (PMP) limits himself to price competition without SR imitation, we show that the optimal dynamic PMP's price is always lower than his optimal static price since the PMP knows that, by leaving too much market share to his competitor, he will reinforce the habit of socially responsible consumption and loose further market share in the future. We also inspect the properties of equilibria when the PMP can imitate the entrant's SR and we find that, in this case, the threshold triggering a PMP strategy of SR imitation and minimum price differentiation is higher in the dynamic than in the static case, depending on the PMP's shadow cost of changes in consumer social responsibility.

KEYWORDS: product differentiation, social responsibility, fair trade.
JEL Classification: L13, L31

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1 Introduction

Corporate social responsibility is rapidly emerging as a new relevant competitive variable in product markets. A likely explanation for this new phenomenon is that the reduction of distances induced by technological progress has increased the importance of global public goods and the sensitiveness of the public opinion toward the preservation of the environment and the fight against poverty in less developed countries. This increased awareness has generated a series of "grassroot" welfare initiatives which focus on socially responsible (or socially concerned) saving and consumption. One of them is promoted by zero profit importers, distributors and retailers (called *fair traders*)[1] of food and textile products which have been partially or wholly manufactured by poor rural communities in developing countries. To be labelled as such, fair trade products need to respect a series of social and environmental criteria. Fair trade is just a small part of the market for socially responsible consumption (and savings) which is considerably growing. Fair trade products are beginning to achieve non negligible market shares. They captured around 2.5% of the tea market in Germany, 2.7% of the coffee market in the Netherlands and about 15% of the banana market in Switzerland in the year 2000. The existence of positive market shares for these products, whose price is often higher than that of traditional products, is a revealed preference argument for the relevance of socially concerned consumption and for the existence of ethical fairness arguments in consumers' utility function[2]. The diffusions of forms of socially responsible consump-

[1]The definition of fair trade in this paper is quite different from the traditional meaning of "Fair trade" in the field of industrial organization. From the 1930s onward (although there are antecedents going back to 1900), in both the US and the UK, the term refers to schemes that industry trade associations used to regulate competition among members, usually by requiring that prices be posted in advance and that no transactions take place except at posted prices. During the Great Depression in the U.S. such schemes were part of the National Recovery Act. In the more recent literature fair trade indicates "arguments that relate to certain conditions under which trade, and the production of traded goods, should minimally take place"(Maseland and Vaal, 2002[15]). In this framework fair trade generally refers to the absence of duties, controls and dumping practices in international trade (for a similar use of term, for example, see also Mendoza-Bahadur,2002[1]; Bhagwati,1996[3]; Stiglitz, 2002[17]; Suranovic, 2002[18]). The fair trade products we refer to in this paper are, on the contrary, food and artisan products which obtain the fair trade label when their production process follow some criteria for social and environmental sustainability established by the movement of fair trade importers and retailers.

[2]There is a growing interest for socially responsible savings and consumption also in the institutions. In 1999 the United Nations launched the Global Compact, a coalition of large businesses, trade unions and environmental and human rights groups, brought together to share a dialogue on corporate social responsibility. In the same year the European Commission issued a document on Fair Trade (29.11.1999 COM(1999) 619. In its introduction it is stated that *"Fair trade" is an example of development occurring through trading relationships and improved commercial opportunities to bridge the gap between developed and developing countries and to facilitate the better integration of developing countries in the world economy. "Fair trade" initiative give consumers the opportunity to contribute to-*

tion such as fair trade is accompanied by a wide range of imitation strategies enacted by traditional producers. Many companies are starting advertising not only price and quality, but also their socially responsible actions[3]. According to BBC news, on October the 7th, 2000 Nestle has launched a fair trade instant coffee as it looks to tap into growing demand among consumers. The BBC comments the news saying that "Ethical shopping is an increasing trend in the UK, as consumers pay more to ensure poor farmers get a better deal." and reports the comment of Fiona Kendrick, Nestle's UK head of beverages arguing that "Specifically in terms of coffee, fair trade is 3 percent of the instant market and has been growing at good double-digit growth and continues to grow." One of the world's biggest players in the coffee market, the US consumer good company Procter & Gamble, announced it would begin offering Fair Trade certified coffee through one of its specialty brands. Following Procter & Gamble's decision to start selling a Fair Trade coffee, also Kraft Foods, another coffee giant, committed itself to purchasing sustainably grown coffee. Furthermore, Kraft will buy 5m pounds of Rainforest Alliance certified coffee in the first year, according to an agreement between Kraft Foods and the Rainforest Alliance (EFTA Advocacy Newsletter n 9). What pushes large transnationals such as Kraft, Nestl or Starbucks to introduce new lines of socially responsible (fair trade) products ? Why they voluntarily reduce their profit margins on these products to increase their social and environmental sustainability by paying more to subcontractors or commodity producers and introducing higher environmental standards ?

The aim of this paper is to provide a theoretical background for this emerging form of competition. We do so by adopting a vertical differentiation approach and by reinterpreting the quality space in terms of ethical or "social responsibility" space.

The paper is divided into five sections (including introduction and conclusions). In the second section we present the basic features of the vertical differentiation model. In the third section we analyze the dynamic model in which a profit maximizing producer (henceforth PMP) competes in prices (but not in ethical location) with an "ethically"[4] concerned producer (henceforth fair trader or FT). Finally, we remove the assumption of PMP's fixed

wards sustainable economic and social development in developing countries through their purchasing preferences. More recently, in July 2001, Commission issued a Green Book COM(2001) 366 to promote firm social responsibility in the European framework. large part of the Green Book deals with fair trade.

[3]Corporate perception by consumers (90 percent of respondents) is by far the most selected item (against ethical values of managers, tax incentives and relationship with stakeholders) when a sample of interviewed socially responsible companies is asked about reasons for their socially responsible behavior in the "2003 Corporate social responsibility monitor"(downloadable at http:\ \ www.bdgglobal.com/issues/sr.asp).This finding is consistent with our hypothesis that ethical imitation is today a relevant competitive feature in product markets.

[4]Throughout all the paper we will call indifferently this player as SR or ethical player for simplicity and convenience. This does not imply any value judgement on the lack of

ethical location and let this producer jointly choose ethical location and prices in continuous time. In this section we evaluate the net contribution of FT to the PMP' SR behaviour.

2 The model

Most of the hypotheses in the model which follows are standard assumptions in the product differentiation literature. Some others are original and are given by the specific nature of ethical competition. A profit maximizing monopolist sells a good to consumers with inelastic, unit demands. Consumers are uniformly distributed across the line segment [0,1] according to their concerns for social responsibility. The monopolist activity consists of transforming raw materials received from unskilled producers in the South, paid with a monopsony wage(w)[5]. The final product is sold to consumers in the North. The monopolist maximizes profits by fixing a price P_A for his product. In this first version of the model we assume, for simplicity, and without lack of generality, that the incumbent has no social responsibility and is located at one extreme of the ethical segment (position $a = 0$). Consider now, in a fixed location case, the effects on the incumbent strategy of the entry of a socially concerned producer which generally takes a different position on the ethical segment and fixes a price P_B for his product. This producer, exactly as the fair trader described in the introduction (this is the reason why we call him also FT), is zero profit and his goal is to maximize transfers to raw material producers in the South to raise their wage from monopsony to competitive levels[6] and to transfer resources which can be invested in local public goods to improve future market opportunities for these producers[7]. The socially responsible features of the entrant therefore consist of selling

ethics of the other competitor.

[5]The reality is more complex since, under an alternative but equally valid approach, fair traders usually break excess bargaining powers of local buyers or transportation intermediaries which force local producers to sell primary or intermediate products at prices below what they would earn in a competitive market (with equal bargaining power between sellers and buyers). We nonetheless believe that our simple approach captures the essential point of the issue.

[6]We take the fair trader as an example of socially responsible producer and identify social responsibility in the resources transferred to producers in the South. Our model may be generalized and applied also to environmentally concerned producers by assuming that there are not "free lunches" in environmental responsibility and that the adoption of environmentally responsible production processes increases costs exactly as in our fair trader's example.

[7]The diffusion of producers which create private and social value without being profit maximizers is confirmed by the fact that fair trade producers exist and are growing. In the year 2000 there were 97 fair trade importers from 18 countries and 2740 no profit retailers of fair trade products only in Europe according to Fair Trade Association. In 2000, in the US and Canada, 600 outlets wholesaled Fair trade products, while at least 2575 offered retail. In 2001, at least 7000 provided retail.

his product at zero profit [8]and transferring a "free margin" s to finance investment in public goods and education in the South (exactly as the "fair trade" does in the reality). The FT zero profit condition is: $P_B = w(1+s)$. We assume that social responsibility depends on the amount s transferred to the South. Therefore the amount of this transfer determines the position on the segment[9]. In this first example, for simplicity, fair trader's location is exogenously set at the right extreme of the ethical segment so that $s = 1$. After FT's entry consumers may choose between products which differ in process and socially responsible features. The difference with respect to the traditional product differentiation models is that opposite locations in the consumers interval do not imply differences in physical distances, but in the psychological perception of the ethical value of the good[10]. The consideration of ethical instead of physical distance makes an important difference. Consistently with our concept of ethical distance, we assume that the cost of moving along the line segment is positive only for those going from a more ethical to a less ethical point (Figure 1). As a consequence, they incur in costs proportional to the "ethical" distance anytime they move to the left[11].

[8]The competition between a profit maximising and a zero profit producer relates our model to the mixed duopoly literature (Cremer, Marchand and Thisse (1991)[7]; Grilo, (1994)[11]) with the qualifying difference that the zero profit producer is not public and is concerned with welfare in the South and not with product quality in the North.

[9]Consider again that, since environmental responsibility is one of the main features of fair trade products, the reasoning of our model also applies when we replace the socially responsible (transfer to the South) with environmentally responsible (adoption of a more environmental product) feature of the ethical entrant. In this case we should assume a trade-off between environmental sustainability and production costs by assuming that the producer chooses a technique with an added marginal cost s for any unit sold, generated by the adoption of environmentally sustainable practices.

[10]In the model we abstract from considerations of asymmetric information and divergences between consumers' and sellers' perception of the ethical value of the good by assuming that they coincide. To reduce distance from reality it may be interesting in an extension of this model, to analyse market equilibria under asymmetric information and to consider the role of ethical labelling.

[11]The rationale for this assumption is that moving to the left implies choosing a product below one's ethical standards (which is psychologically costly), while moving to the right implies choosing a product above one's own ethical standards (and therefore we assume it does not give any psychological cost to the buyer). A large number of empirical findings clearly evidence the existence of a nonzero share of consumers which are not willing to pay extra money for social or environmental features of the product. To make an example 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) show that around 45 (49) percent of sample respondents are not willing to pay in excess for environmentally responsible features of a product. These consumers are either indifferent (thereby supporting our view of asymmetric costs of SR distance) or even find a disutility in buying a product above their ethical standards (i.e., they may believe that this money is waisted supporting the view of symmetric costs of distance). Even though we believe that the chosen one is the most faithful formalization of consumers' preferences on SR, the simmetry/asymmetry of distance costs may be open to debate. While a choice of symmetric costs of ethical distance would have placed the model definitely into

We assume that consumers utilities are decreasing in product price and also in the distance between consumer's ethical distance and the ethical value incorporated in the purchased product. The psychological cost of buying a product which is below one's own ethical standards is f times the ethical distance so that consumer's welfare when he satisfies his unit demand is

$W_c = R_p - P_i - f(x-a)$, if $x - a \geq 0$[12].

or

$W_c = R_p - P_i$, if $x - a < 0$

where P_i is the price of product sold by the i-th seller, R_p is the common consumers' reservation price and x denotes the generic consumer location on the ethical segment [13]. After FT's entry the consumer's indifference condition is equal to

$$\begin{cases} P_A + f(x-a) = P_B & if \quad x - a \geq 0 \\ P_A = P_B & if \quad x - a < 0 \end{cases}$$

It is clear that the FT has a nonzero market share when, for given values of x, $f(x-a) > P_B - P_A$. Since in this first simple case we set $a = 0$, we obtain the following market share for the incumbent

$$x* = \frac{P_B - P_A}{f}.$$

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the horizontal differentiation field, our choice of asymmetric costs of ethical distance places it in the vertical differentiation literature. For a reference to the traditional literature on horizontal product differentiation see Hotelling (1929)[13]; D'Aspremont, Gabsewicz and Thisse (1979)[9]; Economides (1984)[10]; Dasgupta and Maskin (1986)[14], while for vertical differentiation the seminal paper is Shaked-Sutton (1983)[19]. In a synthesis of the two perspectives Craemer and Thisse (1991)[8] show that location horizontal differentiation models can be considered as special cases of vertical differentiation models.

[12]The way we design consumers preferences is consistent with empirical evidence and consumers surveys in which values are shown to be a determinant of choices together with prices (see footnote 1 on 2003 Corporate social responsibility monitor). From a theoretical point of view this point has been remarkably analyzed, among others, by Sen (1993) [16], showing that people choose also on the basis of their values and, for this reason, they do not always choose what they would strictly prefer on the basis of prices.

[13]With the specification of the FT's behavior and consumer's position on the segment 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 subjective 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.

3 The SR differentiation model with simultaneous moves and open-loop strategies.

We now analyze what happens if the PMP chooses his strategies by taking into account that consumers' ethical preferences may change over time as a function of his location strategies. To do so we consider a dynamic model where that the PMP maximizes his objective function (the present value of his profit function) over an infinite time horizon, by designing a strategy for those variables which are under his control. Control variables are location and price and their choice influences the PMP objective function as well as the state of the consumers ethical preferences through a differential equation (the "law of motion of consumers' habit for social responsibility").

3.1 The dynamic model when FT location is exogenous and PMP's ethical location is fixed.

In this first simplified version of the model, locations of the two players are fixed. Therefore the PMP does not imitate the FT in social responsibility and competes only in prices. The PMP maximizes in continuous time the following intertemporal profit function

$$\max_{P_A(.)} \int_0^{\infty} e^{-\rho t}[P_A(t) - w] \left[\frac{P_B - P_A(t)}{f(t)}\right] dt \tag{1}$$

subject to the following law of motion of consumers' social responsibility

$$\begin{cases} f'(t) = -\theta f(t) + 1 - \left[\frac{P_B - P_A(t)}{f(t)}\right], \quad t > 0 \\ f(0) = f_0 > 0 \end{cases} \tag{2}$$

with $P_A \in (w, P_B)$.
[14]

The law of motion in (2) tells us that changes in consumers' social responsibility are affected, negatively, by depreciation from current levels of social

[14]Consider also that i) to rule out positive values generated by the product of negative margins and negative market shares we only look at solutions under a positive mark-up constraint and ii)the PMP price cannot be higher than the FT price for real and positive values of PMP's market shares.

responsibility (the parameter θ) and, positively, by the habit reinforcement generated by current aggregate consumption of socially responsible products [15]

By solving the maximization problem we may state the following proposition

Proposition 3.1 *In a continuous time model in which the profit maximizing producer limits himself to price competition without ethical imitation, and faces a zero profit socially responsible entrant with a fixed location, the PMP optimal behavior is to reduce prices in order to limit his competitor market share and, consequently, the formation of SR habits.*

Proof: To solve the problem we formulate the following current value Hamiltonian:

$$H(f, P_A, \lambda) = (P_A - w)\left(\frac{P_B - P_A}{f}\right) + \lambda\left[-\theta f + 1 - \left(\frac{P_B - P_A}{f}\right)\right] \quad (3)$$

We maximize H with respect to the control variable P_A.

The first order condition is:

$$\frac{\partial H}{\partial P_A} = \frac{P_B - P_A}{f} - \frac{P_A - w - \lambda}{f} = 0 \quad (4)$$

where λ, the costate variable, may be interpreted as the marginal value (cost) of the variation in consumers' social responsibility for the PMP.
Solving (4) for P_A, and substituting for P_B, we obtain the dynamic price reaction function of the PMP

$$P_A^* = w + \frac{sw + \lambda(t)}{2}. \quad (5)$$

[15] Our law of motion of consumer habits reflects a typical property of the vast literature on habit persistence models in which θ is a decay parameter which regulates the rate of consumption persistence (see, among others, Constantinides and Ferson (1991)[6] and Braun, Constantinides and Ferson (1993)[5]. Since sellers of CSR products typically advertise their products when selling them by accompanying them with detailed project description leaflets which increase consumer awareness on product characteristics, we conveniently assume that consumer care for SR is related to the aggregate level of sales. The hypothesis is supported by findings from a recent econometric analysis from Becchetti and Rosati(2004[2]) on a sample of around one thousand FT consumers showing that consumption habits have a significant effects on knowledge of FT criteria which, in turn, increases consumption of FT products. A similar approach is followed by Grilo, Shy and Thisse (2001)[12] when modelling consumers conformity. To find reference of the link between advertising and the shift of consumer tastes towards one product see among others (Bloch and Delphine, (1999)[4]) .

consider also that λ solves the following differential equation:

$$\lambda'(t) = (\rho + \theta)\lambda(t) - \left(\frac{P_B - P_A(t)}{f^2(t)}\right)(\lambda(t) - (P_A(t) - w)) \tag{6}$$

and the model has the following non transversality condition:

$$\lim_{t\to\infty} \lambda(t)e^{-\rho t} = 0 \tag{7}$$

By inspecting second order conditions we can see that the optimal price in (5) is a maximum since $\frac{\partial^2 H}{\partial P_A^2} = \frac{-2}{f} < 0$

When looking for P_A long term equilibrium value, we need to solve for the steady state values of P_A and f in the two differential equation system of P'_A and (2)obtaining the following solutions:

$$f_1 = \frac{(\rho + 2\theta) - \sqrt{\rho + 2\theta)^2 - \theta[w(\theta + \rho) + 1](2\rho + 3\theta)}}{\theta(2\rho + 3\theta)} \tag{8}$$

$$f_2 = \frac{(\rho + 2\theta) + \sqrt{\rho + 2\theta)^2 - \theta[w(\theta + \rho) + 1](2\rho + 3\theta)}}{\theta(2\rho + 3\theta)} \tag{9}$$

To obtain real solutions we need

$$\rho > \frac{\theta(3\theta w - 1)}{1 - 2\theta w}$$

or

$$\theta < \frac{1 - 2\rho w + \sqrt{1 + 4\rho^2 w + 8\rho w}}{6w}.$$[16]

Equilibrium prices are:

$$P_{A_1} = w + \frac{sw}{2} - \frac{1}{2(\rho + \theta)}\left[\frac{\rho + \theta + \sqrt{\rho + 2\theta)^2 - \theta[w(\theta + \rho) + 1](2\rho + 3\theta)}}{2\rho + 3\theta}\right]^2 \tag{10}$$

[16]This implies that, for $w = 1$, the loss of ethical memory must be below 2/5 for reasonable parameters ranges of the discount rate otherwise the model is not informative about the likely equilibria. Actually θ is 0.42 with $\rho = 0.85$ and 0.436 with $\rho = 0.95$. With these values we find that P_A* always respects the condition $w < P_A < w(1 + s)$.

$$P_{A_2} = w + \frac{sw}{2} - \frac{1}{2(\rho+\theta)}\left[\frac{\rho+\theta-\sqrt{\rho+2\theta)^2-\theta[w(\theta+\rho)+1](2\rho+3\theta)}}{2\rho+3\theta}\right]^2 \tag{11}$$

As we can see, in each equilibrium price, the second part measures the equilibrium value of λ, which is negative, as expected, when the market share effect of a change in social responsibility dominates over other effects. Since λ is the PMP's shadow value (cost) of a change in consumers' ethical perception, equation (7) tells that, By being negative, a higher λ implies a higher penalty from changes in consumers' ethical perception and therefore leads to a lower PMP optimal price in the dynamic than in the static case (see Becchetti and Solferino, 2003[**?**]). The intuition behind this result is that, by doing this, the PMP may preserve larger market shares and therefore reduce formation of socially responsible consumer habits (for further details see the Appendix). With $\lambda = 0$ we obtain the static version of the price reaction function. By inspecting it, we find that the incumbent price is obviously increasing in the fair trade transfer to the South. An inspection of the properties of the incumbent's price strategy after the fair trader's entry shows us that his optimal price is halfway between his zero profit price and the zero profit fair trader' price. This means that the incumbent divides the distance between these two prices in two halves. One of them is his margin and the other is the extent of the price cut.

If we analyze properties of the steady state and dynamics around equilibrium we find that the first equilibrium point is an unstable node and is obtained at lower levels of consumers social responsibility and PMP price. The second is a saddlepath and is obtained at a higher consumers social responsibility and PMP price. (A detailed analysis of properties and implications of this multiple equilibria solution is provided in the Appendix).

4 The continuous time model when the PMP chooses prices and ethical location and FT's ethical location is exogenously fixed

In this version of the model the PMP maximizes the following intertemporal profit function in continuous time

$$\max_{(a(.),P_A(.))} \int_0^\infty e^{-\rho t}[P_A(t) - w(1 + a(t)s)] \left[\frac{P_B - P_A(t)}{f(t)} + a(t)\right] dt \qquad (12)$$

subject to the following law of motion of consumers' social responsibility

$$\begin{cases} f'(t) = -\theta f(t) + 1 - \left[\frac{P_B - P_A(t)}{f(t)} + a(t)\right] + a(t)\left[\frac{P_B - P_A(t)}{f(t)} + a(t)\right], \quad t > 0 \\ f(0) = f_0 > 0 \end{cases} \qquad (13)$$

under the usual constraints of $a \in [0, 1]$, $P_A \in (w, P_B)$.

Note that (13) is slightly different from the law of motion (2) presented in the previous section, as, in this case, also the PMP may contribute to reinforce the habit of ethically responsible consumption in proportion to its market share, weighted by its degree of imitation of the FT.

We may start looking at this problem as an unconstrained maximization problem searching for interior solutions. Therefore we consider the following current value Hamiltonian:

$$\begin{aligned} H(f, a, P_A, \lambda) \quad = \quad & (P_A - w(1 + as))\left(\frac{P_B - P_A}{f} + a\right) + \qquad (14) \\ & + \lambda\left[-\theta f + 1 - \left(\frac{P_B - P_A}{f} + a\right) + a\left(\frac{P_B - P_A}{f} + a\right)\right] \end{aligned}$$

First order conditions for an optimum, with respect to the two PMP's control variables are:

$$\frac{\partial H}{\partial P_A} = \frac{P_B - P_A}{f} + a - \frac{P_A - w(1 + as) - \lambda}{f} - \frac{a\lambda}{f} = 0 \qquad (15)$$

and

$$\frac{\partial H}{\partial a} = P_A - w(1 + as) - sw\left[\left(\frac{P_B - P_A}{f}\right) + a\right] - \lambda + \lambda\frac{P_B - P_A}{f} + 2a\lambda = 0 \quad (16)$$

We may rewrite (15) as:

$$\lambda(a - 1) = P_B - P_A + af - P_A + w(1 + as)$$

and by replacing in (16), under the usual assumption of s exogenously set

equal to one, we get:

$$-[P_B - P_A][f - w + \lambda] = af[f - w + \lambda]$$

which implies

$a = \frac{P_B - P_A}{f} < 0.$

This solution is beyond constraints of PMP's ethical location. Therefore there are no internal maxima for this problem. We then look at solutions on the constraints and, in particular, where the PMP finds it optimal to undercut P_B price and $P_A^* = P_B - \varepsilon$ (which we will further demonstrate to be the optimal corner solution); with ε small enough to make PMP price lower than FT's one, thereby satisfying the upper constraint on P_A. Therefore we have to solve:

$$\max_{a(.)} \int_0^\infty e^{-\rho t}[P_B - \varepsilon - w(1 + a(t)s)] \left[\frac{\varepsilon}{f(t)} + a(t)\right] dt \tag{17}$$

subject to the usual law of motion of consumers' social responsibility

$$\begin{cases} f'(t) = -\theta f(t) + 1 - \left[\frac{\varepsilon}{f(t)} + a(t)\right] + a(t)\left[\frac{\varepsilon}{f(t)} + a(t)\right], \quad t > 0 \\ f(0) = f_0 > 0 \end{cases} \tag{18}$$

Solving the Hamiltonian for the first order condition on a we get:

$$\frac{\partial H}{\partial a} = P_B - \varepsilon - w(1 + as) - \left[\left(\frac{\varepsilon}{f}\right) + a\right] - \lambda + \lambda\frac{\varepsilon}{f} + a\lambda = 0 \tag{19}$$

Hence

$$a = \frac{1}{2} - \frac{\varepsilon}{2f} + \frac{\varepsilon}{2(\lambda - sw)}$$

since ε is a small and fixed quantity we may approximate (19) with:

$$-2a(t) - \lambda(t) + 2a(t)\lambda(t) + 1 = 0 \tag{20}$$

and therefore we obtain $a* \cong \frac{1}{2}$.

When we replace a* in (18), the law of motion becomes:

$$f' = -\theta f(t) + 1 - \frac{1}{2} + \frac{1}{4}$$

and, by imposing $f' = 0$, we find the steady state level of consumers' social responsibility (P_A^* and $a*$ are always steady state levels since they are constant and therefore P_A' and a' are equal to zero). We then obtain $f* = \frac{3}{4\theta}$ with $f*$ being lower, the higher the consumers' loss of ethical memory. We must check whether this is the maximum profit solution by comparing it with those on the other sides of the "constraint square" whose corners in the $[a,\ P_A]$ space are $(0,\ P_B - \varepsilon;\ 0,\ w + k;\ 1, P_B - \varepsilon;\ 1,\ w + k)$ (with k small enough). Intuitively it is impossible that $P_A = w + k$ because the corresponding profit would be low and we are in the point of the minimum possible price for the PMP. The only alternative is the solution in which ethical location is constrained to $a = 0$, and the price is optimally set by the PMP (we therefore fall in the situation of section 3.1 in which PMP ethical location was fixed).
To analyse the optimal equilibrium choice of the PMP in the long run we must compare his intertemporal profits under the two cases (with $a = 0$ and $a*$ approaching to $\frac{1}{2}$).
We may summarize the main results of this analysis in the following proposition:

Proposition 4.1 *i) If in $t = 0$ we are on some points on the stable path, the optimal control $a = 0$ will be a feasible solution for the steady state equilibrium only in a finite time interval. ii) for high enough values of t, the PMP may achieve a higher level of profits in steady-state, by choosing partial ethical imitation with $a = \frac{1}{2}$. iii) In all the other cases, PMP will not opt for ethical imitation location only if $f(t) < sw - \lambda(t)$*

Proof.
i)it's clear, as we have shown in the previous section, that the steady state equilibrium E_2 represents a possible solution only if in $t = 0$ we are in some points lying on the stable path (this is the case only for some specific parametric values of θ and ρ, as found in the Appendix), otherwise it will be impossible to reach a stable equilibrium.
ii)For $t \to \infty$, and for given parametric values of θ and ρ, f_0 lyes on the stable path. In this case in order to analyze the optimal PMP choice in steady-state, we must compare his intertemporal profit values in both cases for $a = 0$ and $a = \frac{1}{2}$. The PMP will opt for the first solution iff:

$$\pi|_{(0,P_{A2})} < \pi|_{(1/2,P_B-\epsilon)}$$

or

$$\frac{1}{\rho}\left[(P_{A2}-w)\left(\frac{P_B-P_{A2}}{f2}\right)\right]<\frac{sw}{4\rho}$$

which is always true under reasonable parameter values for ρ and θ (see footnote 17).
iii)To analyse the optimal PMP location choice in a more general context, we need to measure the Hamiltonian value when the PMP chooses not to imitate:

$$H|_{(0,P_{A2})}=\left(\frac{sw+\lambda}{2}\right)\left(\frac{sw-\lambda}{2}\right)+\lambda\left[1-\theta f-\frac{sw-\lambda}{2f}\right]$$

and we must compare this expression with the Hamiltonian for $a\cong\frac{1}{2}$, for a fixed enough small value of ϵ:

$$H|_{(\frac{1}{2},P_B-\varepsilon)}=\left(sw-\epsilon-\frac{sw}{2}\right)\left(\frac{\epsilon}{f}+\frac{1}{2}\right)+\lambda\left[1-\theta f-\left(\frac{\epsilon}{f}+\frac{1}{2}\right)+\frac{1}{2}\left(\frac{\epsilon}{f}+\frac{1}{2}\right)\right]$$

which implies, that, in order to have PMP partial ethical imitation, the following condition must hold:

$$f(t)>sw-\lambda(t)$$

If we compare this result with the one obtained in the static case (where a lower value of f is requested in order to have PMP ethical imitation), it is clear that in the dynamic version of the model the PMP finds it optimal not to foster consumers' sensitiveness to SR and therefore will choose not to imitate, unless for very high values of consumers ethical attitudes. Moreover, in a previous analysis Becchetti et al.(2005)[**?**] showed that this is the same necessary condition for a more ethical PMP also in the absence of a Fair trader. This implies that only information about the existence of a share of ethical consumers may induce the PMP to change its SR attitude. On the other side, FT's competition increases PMP's SR when consumers reservation price is close to the FT price. In fact, Becchetti et al.(2005)[**?**] find in their analysis that the PMP's ethical choice when he is alone on the market is $a=\frac{R_P-w}{2(sw-\lambda(t))}$ which, for $\lambda<0$ (as demonstrated in the Appendix), is lower than $\frac{1}{2}$, for $R_P=w(1+s)$. The comparison of our findings with those

of this paper suggest that, when λ is negative and large, the SR stance of the PMP is much larger (even for high consumers conditional reservation prices) in presence of the FT than when he is alone on the market. In such case we may conclude that the FT has a critical role in triggering PMP imitation in SR.

5 Conclusions

The model analyses the unexplored scenario of competition in social responsibility between a zero profit and a traditional profit maximizing producer. It shows that the PMP reacts in prices and ethical location to the entry of a socially concerned producer. If consumers' care for social responsibility is below a given threshold, he limits himself to price competition, offering his products at a discount with respect to the "socially responsible" product (the discount varies according to the PMP rate of intertemporal preference and to the law of motion of consumers' socially responsible habits). If consumers responsibility is above the same threshold, he finds it optimal to imitate partially the social responsible producer by choosing minimum price differentiation and about one half of the socially responsible producer's social transfer. The paper also shows that the present value of the PMP shadow cost of changes in consumers social responsibility crucially determines differences in equilibria between the static and the dynamic game: i) it makes PMP's price competition higher in the dynamic with respect to the static model, ii) it raises the threshold of consumers' social responsibility which triggers PMP's ethical imitation. The rationale for the observed differences between the static and the dynamic analysis is that, in the dynamic framework, the PMP must care about intertemporal effects of its current strategies on consumers SR habit persistence and on his future profits. A comparison with previous findings on PMP's optimal SR choice when he is alone on the market shows that, when the shadow price of changes in consumer SR is high (and even for large consumers conditional reservation prices), FT entry in the market raises significantly PMP SR choice. This implies that zero profit entrants such as the FT may have had a significant role in fostering SR habits in current product markets.

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Appendix

Steady state properties of the equilibrium when the PMP location is fixed.

To analyze properties of the steady state equilibrium in section 3.1 we must consider that the two differential equation system, formed by $P'_A = 0$ and (2), is highly nonlinear. Being

$P'_A = \frac{1}{2}(\rho + \theta)[P_A - P_B + P_A - w] + \frac{1}{2}\left(\frac{P_B + P_A}{f}\right)^2 = 0$

or

$a(2x - b) + \frac{(c-x)^2}{y^2} = 0$

where

$a = \rho + \theta; b = 2w + sw; c = P_B; x = P_A$ and $y = f$
Therefore we need to study the function

$$y^2 = \frac{(c-x)^2}{a(b-2x)}$$

which, for $y > 0$, becomes

$$y = \frac{(c-x)}{\sqrt{a(b-2x)}}$$

The intersections of this function with the two axes are as follows
$A_1 \equiv (0, \frac{c}{\sqrt{ab}})$,$A_2 \equiv (c, 0)$
Consider that we are only interested to solutions for which $\frac{b}{2} > x$. To identify the shape of this locus in the $[y, x]$ space consider that

$$\frac{\partial y}{\partial x} = \frac{-\sqrt{a(b-2x)} + \frac{2a(c-x)}{2\sqrt{a(b-2x)}}}{a(b-2x)} = \frac{x + c - b}{(b-2x)\sqrt{a(b-2x)}} > 0$$

But this last inequality corresponds exactly to $P_A - w > 0$. Therefore the

derivative is increasing in the feasible set of P_A values. Moreover, since it is possible to show that the $P'_A = 0$ locus is convex in the feasible set $b/2 > x$, and, given that the set of the real numbers is constrained to $b/2 > x$, we are interested only to the area in which the locus is convex. The second locus is:$1 - \theta f - \frac{P_B - P_A}{f} = 0$. By totally differentiating this expression we find that:

$$(1 - 2\theta f)df + dP_A = 0 \rightarrow \frac{df}{dP_A} = \frac{1}{2\theta f - 1}$$

which is a decreasing function $f < 1/2$ and increases when the inequality is reversed. This means that, when consumers' social responsibility is high, an increase in the PMP price is consistent with higher steady state levels of consumers social responsibility in equilibrium. This effect is due to the increase in the FT market share after the PMP price rise. On the contrary, for lower levels of consumers social responsibility, the opposite occurs and the steady state in the law of motion of consumers social responsibility is such that higher PMP prices imply lower levels of consumers social responsibility. This occurs because, for low levels of consumers social responsibility, the negative effect of the loss of ethical memory is higher than the positive impact of the increase in the FT share after PMP price rise. To identify the position of the two steady state loci in the $[P_A,\ f]$ space consider that $\frac{df'}{dP_A} = \frac{1}{f} > 0$ and $\frac{dP'_A}{df} = -\frac{2}{f^3}(P_B - P_A)^2 < 0$. The sign of the first derivative implies that, as far as the PMP raises his price, his market share tends to shrink and consumers social responsibility gets higher. The sign of the second derivative implies that, when consumers social responsibility is higher, the PMP reduces his price not to loose too much market share. We then have two equilibria, the first is an unstable node and is obtained at lower levels of consumers social responsibility and PMP price. The second is a saddlepath and is obtained at higher consumers social responsibility and PMP price. Figure 1 illustrates the phase diagram in which the two curves intersect each other in two points which correspond to the two equilibria $E_1 = (f_1, P_{A_1})$ and $E_2 = (f_2, P_{A_2})$. Around the first equilibrium social responsibility is so low that the depreciation effect dominates. Going rightward and below the equilibrium point, we may collapse to a point in which social responsibility goes to zero and the PMP price is moderately low. Going leftward and above this unstable node, the rise of social responsibility and/or PMP price leads to the area of the second equilibrium and to his saddlepath. Along this saddlepath we converge to the second equilibrium in which PMP prices are moderately low and consumers social responsibility is above one (the leftward monetary distance between the transfer considered fair by a given consumer and the effective transfer has more than proportional effects on

consumers preferences). In this equilibrium f is above one for reasonable parameters ranges of ρ and θ (and tends to be much larger, the lower the loss of ethical memory) and the PMP sells his product at a discount between .5 and .75 of the FT price.

Remark 5.1 It's clear that in order to reach E2, which is a saddle point, we should be on the stable path at the beginning of the problem or in $t = 0$. We also know that, before FT entry, the PMP practices a monopolistic price higher than P_A^*, therefore we are in a situation such that in $t = 0$, the PMP price $P(0) = P^M$ is on the right side of P_A^* and the only way to be on the stable path is that $f(0)$ must stand on the upper side of the curve $f' = 0$ or satisfy the equation

$$1 - \theta f - \frac{P_B - P_A}{f} = 0$$

which implies:

$$f(0) = \frac{1 + \sqrt{1 - 4\theta(P_B - P_A)}}{2\theta}$$

Proposition 5.2 *A positive PMP's market share necessarily implies in equilibrium a negative λ, or a negative shadow value of changes in consumers' social responsibility for the PMP.*

To demonstrate this proposition we show that λ needs to be negative when the PMP's market share is nonzero in the steady state. Consider a different system in which we look at market shares instead of PMP's price dynamics. PMP's market share dynamics is given by:

$$z' = d(\frac{P_B - P_A}{f})/dt = \frac{-P_A' f - (P_B - P_A)f'}{f^2}$$

Since P_B is assumed to be exogenous and constant, PMP's market share varies in time only for changes in the PMP price P_A and in consumers' ethical perception f. To find P_A' we differentiate (7) with respect to time and replace λ' with (5) thereby obtaining:

$$P_A' = \frac{1}{2}[\rho + \theta - \frac{P_B - P_A}{f}]\lambda + \frac{1}{2}[\frac{P_B - P_A}{f}](P_A - w)$$

This equation clearly shows that an increase in prices leads to further positive changes of the optimal price in time if the combined effect on profits

(increased margin on a reduced market share) in the second addend dominates the (expected negative) effect generated by the marginal cost in terms of PMP profits of a change in social responsibility of consumers. By replacing λ from (7) we get:

$$P'_A = \frac{1}{2}(\rho + \theta)[P_A - P_B + P_A - w] + \frac{1}{2}\left(\frac{P_B + P_A}{f}\right)^2$$

By replacing this value and f' from (2) in z', we obtain:

$$z' = \frac{-\frac{1}{2}(\rho + \theta)(2P_A - 2w - sw)}{f} - \frac{1}{2}\frac{z^2}{f}$$

Given that, when $P'_A = f' = 0$, also $z' = 0$, the steady state of the (z, f) system corresponds to the steady state of the (P_A, f) system.
In steady state, for $f \neq 0$, $z' \neq 0$ implies that:

$$z^2 - 2z(1 - \theta f) - (\rho + \theta)(2P_A - 2w - sw) = 0$$

We obtain steady state values of the market share and of consumers ethical perception by solving the two equation system made by (13) and $(1-\theta)f = 0$, which is the stationary counterpart of the law of motion in (2). By replacing this last expression in the equation above, and ruling out negative values of z, we get the following equilibrium value of z:

$$z* = \sqrt{2(\rho + \theta)\left[w(1 + \frac{s}{2}) - P_A\right]}$$

Note that this expression establishes that, for having a nonzero market share the PMP must fix a price below his static optimal price (the first part of the expression under square brackets). This result also tells us that the shadow value of λ is negative, as expected, since the PMP must increase his price competition if he want to avoid a dynamics of increasing social responsibility which will lead to further reduction of his market share in the future.