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Social awareness and duopoly competition

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Abstract

Human actions are often guided both by individual rationality and by social norms. In this paper we explore how duopoly market competition values the variants of a product, when these variants embody at different levels the requirements derived from some social norm. In a model where preferences of consumers depend partially on the levels of compliance of the variants with the social norm, we characterize the equilibrium path along which firms choose sequentially their level of compliance and their price.

Keywords: social norms, others regarding preferences, vertical product differentiation.

JEL Classification: D11, L13, Q58

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"If a consumer buys a product which lacks any environmental friendly characteristics, he might have a bad conscience because environmental awareness is expected from him. His environmental attitude is influenced by friends, parents, partners, or by the media, but it is often not strong enough to push the market share of environmental incompatible products towards zero and that one of the environmentally friendly substitute towards one." (Conrad, 2005, 2)

1 Introduction

Consider a consumer willing to buy some variant of a product. She has the choice between two variants, one at the exclusion of the other. The first variant, while perfectly satisfying his/her individualistic and private needs, lacks however some environmental friendly characteristics. On the contrary, the alternative variant, though less attractive from the consumer's private and individualistic viewpoint, by far better meets the environmental requirements of the community in which this consumer lives. This would be the case for instance if the consumer, fan of speediness, has to buy a car and hesitates between buying a very fast polluting car or a car of some different brand, known for its green characteristics. Assuming that environmental awareness in the community she lives to be very significant, this consumer might choose to buy this alternative brand, even if the first variant fits better her "private" preferences: doing otherwise would entail a social disapproval so considerable that it would enforce a reversal of her private preferences between the two variants.

As an alternative example, consider a beverage containing some proportion of fruit juice and alcohol. According to the period and the national community under study, this proportion can vary between 0 and 100%. For instance, at the Prohibition time, it had to be equal to 0 while, in Western countries today, no explicit constraint exists concerning the level of this ratio. Nevertheless, for road security reasons, most regions have adopted several rules limiting the quantity of alcohol allowed in the drivers' blood, with huge fines to be paid by them when the edict is openly violated. These rules not only enhance the rise of an anti-alcohol social norm in the society, but they give rise to an objective punishment, should the drivers not comply with the rule. A driver who likes alcohol might privately prefer to drink a variant of this beverage containing a higher proportion of alcohol than fruit juice. However, the fear of the fine punishment might induce her to reverse her private preference, and rather consume a lighter drink with more fruit juice and less alcohol.

Also consider the market for lemons *versus* for new cars. There are at least three reasons why the Society prefers the number of new cars to be increased while simultaneously the supply of available lemons to be decreased. First, increasing the number of new cars increases demand on the labour market decreasing thereby unemployment. On the other hand, decreasing the number of lemons increases the average security on the roads since there are less car accidents implying new cars than lemons. Finally, new cars are less polluting than lemons. These are the reasons why the French Government had recently edicted the so-called *"prime à la casse".* According to this rule, the driver of a lemon buying a new car obtains from the Government a lump-sum subsidy if he/she buys a new car and let the lemon to be destroyed. Such a rule indirectly subsidizes the variant "new car" and constitutes an indirect penalty against the lemons. Similarly, the subsidy provided by the government to consumers buying solar panels might well distort their private preferences with respect to alternative forms of energy, like electricity or gaz.

A last example is the attitude of tobacco fans with respect to cigarettes' consumption.Thirty years ago, it was fashionable to smoke cigarettes since most of the movies stars were hard smokers or, at least, behaved as if they would be. In the meantime, the disastrous effects of tobacco on health were extensively documented and an anti tobacco social norm developed, leading for instance to the interdiction of smoking into public buildings, with a fine to be perceived in case of breach.

All the above examples and comments reveal that, when making their shopping decisions, consumers are not only interested in meeting their private needs, but also guided in their choice by the degree to which their choice complies with some social norm. Furthermore, consuming a variant obeying a weak compliance with the norm can generate a social punishment, while a stronger one a social reward. In the words of Jon Elster (Elster, 1989, 99), "for norms to be *social*, they must be shared by other people and partly sustained by their approval and disapproval. They are also sustained by the feelings of embarrassment, anxiety, guilt and shame that a person suffers at the prospect of violating them".

The duopoly theory developed hereafter is based on the judgement that, in some cases, human actions are typically guided both by individual rationality and by social norms. Also it assumes that the variants of some good are reflecting more or less adequately the social driving force lying behind the norm. Consider a market with two different variants of a good embodying some characteristics complying more or less with a social norm, like a beverage containing more or less alcohol, or a car and its green and brown variants. In this situation, the shopping decision cannot be viewed as if the level of compliance of the variants with the norm would not play a role in the choice of the consumer: it would deny the right for the consumer to be guided by the importance she pays to her *others regarding preferences via* her appliance with the social norm. Accordingly, we propose in the following to incorporate in the utility function of the consumer a new term depending, for each variant, on the level of its compliance with the social norm. Furthermore, we introduce the idea of "social reward" and "punishment" by assuming that the utility for a specific variant does not depend only on its own level of compliance with the norm, but also on the *social reward-punishment differential:* the larger this differential, the higher the difference between the reward when buying the most complying variant and the punishment when buying the other one. Incorporating these new ingredients into the model of course affects the demand functions of the firms, whatever the level of compliance of their variants with the social norm. Finally, we assume that the firms are able to select this level of compliance in some domain. The decisions about prices and variants are taken sequentially, first price level of compliance and then price, and we examine the properties of the subgame perfect equilibrium of this sequential game.

Our findings are as follows. According to the relative importance consumers pay to the compliance of the variants with the social norm, either both firms are active in the market at positive equilibrium prices, or only the one with the highest level of compliance is active, the rival firm being excluded from the market. The smaller the social reward-punishment differential between the variants, the higher the chance to observe two variants at equilibrium. On the contrary, when this differential is large, only the variant with the higher level of compliance can survive at equilibrium. In this case, two subcases must be distinguished. In the first, the owner of this variant behaves as a monopolist, but it must set a price sufficiently low to keep the rival firm out of the market. In the other one, when the social reward differential is sufficiently large, the rival can no longer threaten the monopolist to enter the market. Then, it is optimal for the monopolist to quote the pure monopoly price. Finally the levels of compliance are fully determined in the first stage of the game. When both firms are active at equilibrium prices corresponding to the top level of compliance, the firm with the higher level of compliance chooses precisely this top level while the low level of compliance firm chooses a strictly smaller level of compliance than the top one. Nevertheless, the higher the threat of punishment, the more compliant the choice of the latter.

The model explored in this paper shares several features with the traditional vertical product differentiation model (Gabszewicz and Thisse, 1979). Nevertheless, the introduction of "*others regarding preferences", via* the existence of a social norm, considerably alters the predictions of the latter. The differences and similarities between the two models and their predictions will be systematically pointed out along the equilibrium analysis.

A striking example of goods subject to the existence of a social norm are *environmental products*. It is not surprising that applying our results to environmental economics, leads to derive interesting insights in this specific field. Although recently an increasing attention has been devoted to the impact of environmental awareness on market equilibrium (Conrad 2005, Eriksson 2004, Moraga-Gonzales and Padròn-Fumero 2002, Rodriguez-Ibeas 2007 *inter alia*), to the best of our knowledge, we are the first to explore the policy implications of green consumerism while nesting the social concern of consumers into the literature on environment. Moreover, as it will be shown later, our approach displays some properties directly comparable with those emerging in models on the end-of-pipe approach[1]. Thus, our paper opens the door to a clear comparison between measures based on green consumerism and the traditional environmental regulation.

In the next section we present the formal model. Then we proceed with the equilibrium analysis in section 3. We end up with a short conclusion.

2 The model

Consider two variants of the same product, A and B, and some social norm developed in a community whose members are identified by the interval $[0, \bar{\mu}]$, $0 < \bar{\mu}$. We say that variant A *fits better* the social norm than variant B if *everybody* in this community feels that consuming variant A complies better with the norm than variant B. Thus, assume, indeed, that variant A fits better the social norm than variant B. Firm A (resp. firm B) produces variant A (resp. variant B) at no cost[2].

Let $\mu\nu_A$ (resp. μv_B) with $\mu \in [0, \bar{\mu}]$ be a component of the satisfaction -we call it the individual μ- *social concern* for product A- obtained by consumer μ when consuming one unit of variant A (resp. B): , ν_A (resp. v_B) represents for all consumers the rate at which variant A (resp. B) fits the social norm, or its *level of compliance*, so that $\nu_A > \nu_B$. All consumers agree on the levels of compliance ν_A and ν_B but we assume them to be ranked in the domain $[0, \bar{\mu}]$ according to the size of their social awareness. This introduces heterogeneity in the population since all individuals are not uniformly concerned with the social norm: the closer to 0, the weaker the social awareness of individual μ in the community.

Furthermore, we assume that consuming variant A rather than variant B also affects the satisfaction of the consumer because consuming a variant better complying with the social norm generates a socially worthy identity, transformed in turn into a *social reward*[3]. Conversely, consuming a variant less complying with the social norm generates a feeling of social disapproval transformed in turn into a *social punishment*[4]. An immediate byproduct of the above is that the benefit from consuming variant A rather than variant B is higher, the larger the difference between ν_A and ν_B. In the following, we call this difference the *reward-punishment differential.* Thus, we add to the utility $\mu\nu_A$ another term measuring the social benefit (reward) of consuming one unit of variant A rather than variant B, namely $\alpha(\nu_A - \nu_B)$. Symmetrically, to the utility μv_B, we add the term $\beta(\nu_B - \nu_A)$ to capture the frustration (punishment) incurred by the consumer when she consumes one unit of variant B rather than A. Finally, the utility for consumer μ when choosing variant A (resp. B) writes as

$$V_A(\mu) = \begin{cases} \mu\nu_A + \alpha(\nu_A - \nu_B) & \text{if she chooses variant } A, \\ 0 & \text{otherwise.} \end{cases},$$

(resp.

$$V_B(\mu) = \begin{cases} \mu v_B + \beta(\nu_B - \nu_A) & \text{if she chooses variant } B, \\ 0 & \text{otherwise} \end{cases}).$$

It is assumed that

$$0 < \beta \leq \alpha \leq \bar{\mu},$$

with $\alpha, \beta \in]0, 1]$.

When there exist markets on which the two variants can be exchanged against money, at unit prices p_i, $i = A, B$, the utility after purchasing variant A (resp. B) is given by $U_A(\mu) = V_A(\mu) - p_A$ (resp. $U_B(\mu) = V_B(\mu) - p_B$).

Finally we assume that the level of compliance is chosen by the firms in some domain $[\underline{\nu}, \overline{\nu}]$: there exists a lowest level of compliance $\underline{\nu}$ such that, if the proposed variant would not meet this level, the social norm would be violated. On the contrary, there exists a highest level of compliance $\overline{\nu}$ guaranteeing that the social norm is fully satisfied.

3 Equilibrium analysis

We consider a two-stage game. In the first stage, firms have to decide the extent to which their variant complies with the social norm, namely, $v_i, i = A, B$. In the second stage of the game, each firm chooses its price $p_i, i = A, B$.

The game is solved by backward induction. Assuming that firms first choose the level of compliance $\nu_i, i = A, B$, in the domain $[\underline{\nu}, \overline{\nu}]$ and then their price, we determine first the demand for each firm as a function of p_i and ν_i, for $i = A, B$. Then, we determine the price equilibrium for given levels of compliance and, finally, we identify the optimal level of compliance.

Traditionally, when deciding whether purchasing a good, a consumer takes into account the benefit deriving from the intrinsic characteristics of the good and the price at which it is sold. As we have just seen, the existence of a social norm introduces further ingredients into her decision process. In particular, when an individual takes into consideration the consequences in terms of social reward and punishment, deriving from a specific purchase, a variant which would not be *a priori* considered in the shopping list, can be bought for its social value. In order to embed these ingredients in our formal analysis, we define hereafter both the marginal consumer $\hat{\mu}(p_A, p_B)$ indifferent between buying variant B or variant A at prices p_A and p_B,, (solution of the equation $V_A(\mu) - p_A = V_B(\mu) - p_B$), namely:

$$\hat{\mu}(p_A, p_B) = \frac{p_A - p_B}{\nu_A - \nu_B} - (\alpha + \beta),$$

as well as the consumer $\mu_i(p_i)$ who is indifferent between buying product i and not buying at all (solution of the equation $U_i(\mu_i, p_i) = 0$). Accordingly, we write:

$$\mu_B(p_B) = \frac{p_B + \beta(\nu_A - \nu_B)}{\nu_B} (> 0)$$

and, in the same way,

$$\mu_A(p_A) = \frac{p_A - \alpha(\nu_A - \nu_B)}{\nu_A} > 0 \text{ if } p_A > \alpha(\nu_A - \nu_B).$$

From the above definitions, we provide in appendix 1 the demand functions faced by Firm B and Firm A, respectively, namely

$$D_B = \begin{cases} \overline{\mu} - \mu_B(p_B) & \text{iff} \quad \mu_B(p_B) < \overline{\mu} < \hat{\mu}(p_A, p_B) \\ \hat{\mu}(p_A, p_B) - \mu_B(p_B) & \text{iff} \quad \mu_B(p_B) \leq \hat{\mu}(p_A, p_B) \leq \overline{\mu} \\ 0 & \text{iff} \quad \hat{\mu}(p_A, p_B) < \mu_A(p_A, p_B) < \overline{\mu} \end{cases}$$

and

$$D_A = \begin{cases} \overline{\mu} - \mu_A(p_A, p_B) & \text{iff} \quad \hat{\mu}(p_A, p_B) < \mu_A(p_A, p_B) < \overline{\mu} \\ \overline{\mu} - \hat{\mu}(p_A, p_B) & \text{iff} \quad \mu_B(p_A, p_B) \leq \hat{\mu}(p_A, p_B) \leq \overline{\mu} \\ 0 & \text{iff} \quad \mu_B(p_A, p_B) < \bar{\mu} < \hat{\mu}(p_A, p_B) \end{cases}$$

Notice that, in the case $\mu_B(p_A, p_B) < \overline{\mu} < \hat{\mu}(p_A, p_B)$, the demand function for firm B turns out to be $\overline{\mu} - \mu_B(p_A, p_B) > 0$, while that for firm A is zero. Thus, it is immediate to conclude that in this range of $\mu-$parameters, firm B monopolizes the market, while firm A is inactive. By the same token, firm A monopolizes the market whenever $\hat{\mu}(p_A, p_B) < \mu_A(p_A, p_B) < \overline{\mu}$, firm B being inactive in this range of $\mu-$parameters. Finally, in the case when $\mu_B(p_A, p_B) \leq \hat{\mu}(p_A, p_B) \leq \overline{\mu}$, firm A and firm B share the market.

We start now solving the game. To this end, we move to the analysis of the second stage where price competition between firms takes place, assuming that the level of compliance has been chosen by each firm at the first stage.

3.1 The second stage game: choosing the price

Let Π_i be the profit function of firm $i, i = A, B$, defined by

$$\Pi_i(\nu_i, p_i, \nu_j, p_j) = p_i D_i(p_i, p_j).$$

In order to identify the equilibrium prices, we first define the best reply functions of Firm A and Firm B[5].

We find that the prices observed at equilibrium crucially depend on the ratio $\frac{\nu_A}{\nu_B}$. According as the value of this ratio is smaller or larger than H_1, with $H_1 = \frac{(\bar{\mu} - \alpha + \beta)}{2\beta}$, the corresponding equilibrium prices lead to two different market structures[6]. In the first, observed when $\frac{\nu_A}{\nu_B} \leq H_1$, both firms are active in the market and equilibrium prices p_A^* and p_B^* are positive and given by:

$$\begin{cases} p_A^* = ((2\alpha + \beta)\,\nu_A - \alpha\nu_B)\,\frac{2\bar{\mu}\nu_A(\nu_A - \nu_B)}{4\nu_A - \nu_B} \\ p_B^* = ((\bar{\mu} - \alpha + \beta)\,\nu_B - 2\beta\nu_A)\,\frac{(\nu_A - \nu_B)}{4\nu_A - \nu_B}. \end{cases}$$

Notice that the condition $\frac{\nu_A}{\nu_B} \leq H_1$ cannot be met without the inequality $H_1 > 1$ to be met, implying $\overline{\mu} > \alpha + \beta$ from the very definition of H_1. The larger $\bar{\mu}$, the more significant the heterogeneity among consumers and the larger the domain of $(\alpha, \beta)-$values satisfying the condition $\bar{\mu} > \alpha + \beta$. Thus, the market can sustain both variants if *(i)* the heterogeneity among consumers ($\bar{\mu}$) is sufficiently large and/or *(ii)* the role of punishment and reward on consumers' decisions is not too significant.

The equilibrium prices identified above are exactly those which would obtain in a vertical product differentiation model if the reward-punishment differential would not play any role. Using the interpretation of the reward-punishment differential as a difference between a subsidy and a tax rate on the two variants, we see that the existence of this subsidy and tax increases (resp. decreases) the equilibrium price p_A^* (resp. p_B^*) compared with the equilibrium values observed in the traditional vertical differentiation model with an uncovered market. The rationale behind this finding is that the reward-punishment differential strengthens the traditional market power of firm A, while weakening that of its rival firm B.

By contrast to the above analysis, firm A evicts firm B from the market in the case when $\frac{\nu_A}{\nu_B} > H_1$. Indeed, variant A is so significantly complying with the consumption norm (compared with variant B), that no consumer is willing to buy variant B, whatever its price. In this latter case, the equilibrium prices of firms A and B are given, respectively, by

$$\begin{cases} p_A^+ = \frac{(\nu_A-\nu_B)(\beta\nu_A+\alpha\nu_B)}{\nu_B} \\ p_B^+ = 0 \end{cases} \quad \text{if} \quad \frac{\nu_A}{\nu_B} \leq H_2$$
$$\begin{cases} \overset{\circ}{p}_A = \frac{1}{2}\left(\bar{\mu}\nu_A + \alpha\left(\nu_A - \nu_B\right)\right) \\ \overset{\circ}{p}_B = [0, y] \end{cases} \quad \text{if} \quad \frac{\nu_A}{\nu_B} > H_2,$$

with $H_2 = \frac{\bar{\mu}-\alpha+2\beta+\sqrt{\bar{\mu}^2+\alpha^2+4\beta^2-2\bar{\mu}\alpha+4\bar{\mu}\beta+4\alpha\beta}}{4\beta}$. Thus, when $\frac{\nu_A}{\nu_B} \leq H_2$ and the reward-punishment differential does not exist, the equilibrium price p_A^+ coincides with the so called "limit price" arising in a vertical product differentiation model when the high quality firm drives the low quality one out of the market at equilibrium[7]. In this case, the equilibrium price p_A^+ turns out to be higher, the higher β. Indeed, a high value of β magnifies the role of social punishment, thereby reducing *ceteris paribus* the benefit coming from purchasing variant B. As a consequence, firm A can keep out from the market the competitor at a relatively higher equilibrium price p_A^+, compared with a scenario with a weaker punishment incurred by consumers when buying variant B.

Accordingly, when the inequality $\frac{\nu_A}{\nu_B} \leq H_2$ holds, firm B, in spite of being inactive in the market, still affects the equilibrium outcome. On the contrary, when $\frac{\nu_A}{\nu_B} > H_2$, the monopolist A is a "true" monopolist to the extent that his rival can no longer affect the equilibrium. By the way, it is easy to check that the price $\overset{\circ}{p}_A$ is the pure monopoly price corresponding to the situation where firm B would simply not exist. In this case[8], one can see that the resulting market share $D_A^{\circ} = \frac{(\mu\nu_A+\alpha(\nu_A-\nu_B))}{2\nu_A}$, when assuming $\alpha = 0$, coincides with that observed in the "true" monopoly case.

We can summarize the above findings as follows.

Proposition 1 *At the subgame price equilibrium, depending on the value of the ratio $\frac{\nu_A}{\nu_B}$, either both firms are active in the market at positive equilibrium prices ($\frac{\nu_A}{\nu_B} \leq H_1$), or only the firm endowed with the higher level of compliance is active, the rival firm being excluded ($\frac{\nu_A}{\nu_B} > H_1$).*

Observe that, when $\frac{\nu_A}{\nu_B} \leq H_2$, the monopolist optimal price is the limit price p_A^+: this price, with $p_A^+ < \overset{\circ}{p}_A$, is set sufficiently low to keep the rival B out of the market. On the contrary, when $\frac{\nu_A}{\nu_B} > H_2$, in spite of the fact that firm B can no longer credibly threaten the monopolist, it is optimal for the latter to quote a rather low price (the pure monopoly price) so as to serve a large set of consumers which otherwise would refrain from buying. We conclude that:

Corollary 2 *When the market is monopolized by firm A, its optimal price is given by* $\min\left[p_A^+, \overset{\circ}{p}_A\right]$.

3.2 The first stage game: choosing the level of compliance

Let us consider now the first stage of the game when the firms choose their level of compliance ν_i, in the domain$[\underline{\nu}, \bar{\nu}]$, $i = A, B$. First, notice that, in the subdomain corresponding to $\frac{\nu_A}{\nu_B} \leq H_1$, the profit function of firm A is increasing in ν_A. Consequently, in the domain of v_A-values satisfying $\frac{\nu_A}{\nu_B} \leq H_1$, the best reply $\varphi_A(\nu_B)$ remains constant and equal to $\bar{\nu}$. When $H_1 < \frac{\nu_A}{\nu_B} \leq H_2$, the same property holds because firm'A profit function is also monotonically increasing in v_A so that in this domain $\bar{\nu}$ remains the best reply of A. Finally, when $H_2 < \frac{\nu_A}{\nu_B}$, there is no longer a game between firms A and B since the former is a pure monopolist and, in this case, it chooses the pure monopoly price. It is easy to show that the corresponding profit function is also monotonically increasing in v_A. In conclusion, the best reply function of firm A with respect to the choice of v_A is constant in the whole domain $[\underline{\nu}, \bar{\nu}]$.

Regarding firm B, in the domain where she is active, namely $\frac{\nu_A}{\nu_B} \leq H_1$, her best reply function $\nu_B(\nu_A)$ obtains as:

$$\nu_B(\nu_A) = \gamma\nu_A,$$

with $\gamma = \frac{\left(2\bar{\mu}-2\alpha-\beta+\sqrt{(2\bar{\mu}-2\alpha+\beta)(2\bar{\mu}-2\alpha+25\beta)}\right)}{7\bar{\mu}-7\alpha+3\beta} < 1$. Thus

Proposition 3 *When the reward-punishment differential is small, the levels of compliance corresponding to the Nash equilibrium are given by* $(\bar{\nu}, \gamma\bar{\nu})$ *. When this differential is large, firm B is inactive, and firm A selects* $\bar{\nu}$*.*

It is worth noticing that this result is not in line with the traditional findings in vertical differentiation. Indeed, in vertical differentiation models, the low quality firm can be inactive under particular conditions on the model's parameters only if the market is covered, with *all* consumers buying some variant. Then, a finiteness property holds, according to which a single firm only can survive at equilibrium (see Gabszewicz and Thisse (1980)) On the contrary, when the market is uncovered, the finiteness property does not apply. Due to the social norm, the firm with the lower level of compliance is kept out from the market even when the latter is uncovered, as it is the case both under limit pricing or pure monopoly.

It is easy to see that, when $\alpha = \beta = 0$,the model considered above boils down to the usual model of vertical product differentiation studied by Gabszewicz and Thisse (1979).

Finally, evaluating the derivative $\frac{\partial \nu_B}{\partial \beta}$ in the subdomain defined by the condition $\frac{\nu_A}{\nu_B} \leq H_1$ (see appendix 4), we get

Proposition 4 *The compliance level increases with β.*

Accordingly , the parameter β can be viewed as an incentive for the less complying firm B to increase its level of compliance. When β increases, the punishment for deviating from the social norm becomes more and more influential on the consumer's decision. At some point, namely, when β becomes so high that the condition $\bar{\mu} > \alpha + \beta$ is violated (thereby implying that the inequality $\frac{\nu_A}{\nu_B} \leq H_1$ no longer holds), then the less complying firm is driven out of the market: all consumers feel that it sells a variant insufficiently complying with the social norm.

4 An application to environmental economics

As stated in the introduction, environmental economics constitutes a natural field for applying the above results. In this interpretation, the variant with the higher degree of compliance should be viewed as a "green" product, the "brown" one being identified with the firm showing the lowest level of compliance with the environmental norm. In this strand of literature, the core question is to identify means for reducing pollution damage at the international level. In Europe, the environmental policy is identified by the EU Emission Trading Scheme. Launched in 2005, this scheme is mainly based on a “cap and trade" principle: a cap defines the total amount of greenhouse gases that can be emitted by producers. Nevertheless, this approach has been questioned, as unilateral environmental policies can drive out firms to countries with less stringent regulation (the so called *pollution havens*) or,on the contrary, incite these countries to use environmental dumping to attract FDI.

Our analysis reveals that there exist alternative ways, based on profit-driven mechanisms, to sustain green production, with positive effects on pollution abatement. Assuming that the pollution damage decreases with the level of compliance, our results can be interpreted as follows. First, whatever the equilibrium market configuration, a pollution abatement is driven by the existence of *others regarding preferences*, compared with the situation when consumers' behavior would be only shaped by individual rationality. In the case when both firms are active at equilibrium, *the compliance level selected by both firms is higher than it would be without such preferences while the market share of the brown variant shrinks.* As for the monopoly case, the pollution abatement follows directly from the fact that the brown variant must simply disappear from the market.

Furthermore, the above pollution abatement is a direct consequence of the market mechanism, and not following from an explicit environmental policy.

Thanks to this, it escapes the *carbon leakage* phenomenon taking place when an explicit unilateral abatement policy is introduced, inducing polluting firms to relocate in pollution havens with less stringent regulation (see on this Sanna Randaccio and Sestini, 2012). Indeed, the brown firm of our model is prevented to relocate in a pollution haven while selling her variant in the home market: no consumer would be interested in buying this variant due to its too low level of compliance with the social norm.

5 Conclusion

In this paper we explore how duopoly market competition values the variants of a product, when these variants embody at different levels the requirements derived from some social norm. Introducing a model in which preferences of consumers depend partially on the levels of compliance of the variants with the social norm, we characterize the equilibrium path along which firms choose sequentially their level of compliance and their price. We conclude that the dependance of preferences on the level of compliance exerts a beneficial effect on the choice of variants by firms. In particular, when interpreting these results in the framework of environmental concernment, they reveal the existence of a pollution abatement obtained independently from any explicit environmental policy.

While economists generally adopt a methodological position of strict individualism when depicting consumers' behavior, one must recognize that often consumers' decisions are significantly influenced by their social environment and the set of values that it conveys. Of course this recognition does not simplify the analysis of market behavior because it introduces externalities in the preferences of individuals. Nevertheless, it seems useless to get around this difficulty: more and more frequently, consumption decisions involve elements borrowed from the social sphere of individuals. Think of tobacco, drugs, brown products, arms and other goods, viewed as nuisances by a majority of the community in which consumers are immersed. The present paper is an essay to explore this world using the traditional tools of economic analysis.

6 Appendix

6.1 Appendix 1

First, notice that $(\hat{\mu} - \mu_B)$ and $(\hat{\mu} - \mu_A)$ had the same sign as $(\mu_A - \mu_B)$.

Let us denote by $\bar{p}_B = \bar{\mu}\nu_B - \beta(\nu_A - \nu_B)$, the reservation price of the variant B for the consumer $\bar{\mu}$ such that for any $p_B > \bar{p}_B$, no consumer is willing to buy variant B. Then, let us denote by $p_B^B = p_A - (\bar{\mu} + (\alpha + \beta))(\nu_A - \nu_B)$ given p_A, the value of price p_B corresponding to which consumer $\bar{\mu}$ is indifferent from buying variant A or variant B. Finally, let us denote by $\breve{p}_B = \frac{\nu_B}{\nu_A} p_H - (\nu_A - \nu_B)\frac{\beta\nu_A + \alpha\nu_B}{\nu_A}$ the value of price p_B such that for any $p_B \leq \breve{p}_B$, $\hat{\mu} \leq$

$\bar{\mu}$. Symmetrically, we denote $\bar{p}_A = \bar{\mu}\nu_A + \alpha(\nu_A - \nu_B)$ as the price p_A such that no consumer is willing to buy variant A for $p_A > \bar{p}_A$, and $\breve{p}_A = \frac{\nu_A}{\nu_B} p_B + (\nu_A - \nu_B)\frac{\beta\nu_A + \alpha\nu_B}{\nu_B}$ the value of price p_A such that for any $p_A \leq \breve{p}_A$, $\mu_L \leq \hat{\mu} \leq \bar{\mu}$. Finally, let $p_A^B = (\bar{\mu} + (\alpha+\beta))(\nu_A - \nu_B) + p_B$ be value of p_A corresponding to which $\bar{\mu}$ is indifferent from buying variant A or variant B, given p_B.

Thus, we can split each demand functions into two separate functions as follows.

If $p_A \geq \bar{\mu}\nu_A + \alpha(\nu_A - \nu_B)$, then firm's B demand function writes as

$$D_B = \begin{cases} \bar{\mu} - \frac{p_B + \beta(\nu_A - \nu_B)}{\nu_B} & \text{if} \quad p_B \leq \bar{p}_B \\ 0 & \text{if} \quad p_B \geq \bar{p}_B \end{cases},$$

while, if $p_A \leq \bar{\mu}\nu_A + \alpha(\nu_A - \nu_B)$

$$D_B = \begin{cases} \bar{\mu} - \frac{p_B + \beta(\nu_A - \nu_B)}{\nu_B} & \text{if} \quad p_B \leq p_B^B \\ \frac{p_A - p_B}{\nu_A - \nu_B} - (\alpha+\beta) - \frac{p_B + \beta(\nu_A - \nu_B)}{\nu_B} & \text{if} \quad p_B^B \leq p_B \leq \breve{p}_B \\ 0 & \text{if} \quad p_B \geq \breve{p}_B. \end{cases},$$

Furthermore,

$$\min\{\bar{p}_B, p_B^B\} = \begin{cases} \bar{p}_B & \text{if} \quad \mu_H \geq \bar{\mu} \\ p_B^B & \text{if} \quad \mu_H \leq \bar{\mu}. \end{cases}.$$

Indeed, the inequality $\bar{p}_B \leq p_B^B$ implies that $p_A \geq \bar{\mu}\nu_A + \alpha(\nu_A - \nu_B)$ or $\bar{\mu} \leq \mu_H$, so thay $D_A = 0$. Thus, firm B may obtain the whole demand of the market or be inactive according to the position of μ_B w.r.t $\bar{\mu}$. In particular, $D_B = \bar{\mu} - \mu_L$, if $\mu_B < \bar{\mu}$; while $D_B = 0$ if $\mu_B \geq \bar{\mu}$.

Moving to firm's A demand function:

if $p_B \geq \bar{\mu}\nu_B - \beta(\nu_A - \nu_B)$, then it writes as

$$D_A = \begin{cases} \bar{\mu} - \frac{p_A - \alpha(\nu_A - \nu_B)}{\nu_A} & \text{if} \quad p_A \leq \bar{p}_A \\ 0 & \text{if} \quad p_A \geq \bar{p}_A \end{cases}$$

while if $p_B \leq \bar{\mu}\nu_B - \beta(\nu_A - \nu_B)$,

$$D_A = \begin{cases} \bar{\mu} - \frac{p_A - \alpha(\nu_A - \nu_B)}{\nu_A} & \text{if} \quad p_A \leq \breve{p}_A \\ \bar{\mu} - \left(\frac{p_A - p_B}{\nu_A - \nu_B} - (\alpha+\beta)\right) & \text{if} \quad \breve{p}_A \leq p_A \leq p_A^B \\ 0 & \text{if} \quad p_A \geq p_A^B. \end{cases}$$

Since,

$$\min\{\bar{p}_A, \breve{p}_A\} = \begin{cases} \bar{\mu}\nu_A + \alpha(\nu_A - \nu_B) & \text{if} \quad \mu_B \geq \bar{\mu} \\ \frac{\nu_A}{\nu_B} p_B + (\nu_A - \nu_B)\frac{\beta\nu_A + \alpha\nu_B}{\nu_B} & \text{if} \quad \mu_B \leq \bar{\mu} \end{cases}$$

as the inequality $\breve{p}_A \geq \bar{p}_A$ implies $p_B \geq \bar{\mu}\nu_B - \beta(\nu_A - \nu_B)$ or $\bar{\mu} \leq \frac{p_B}{\nu_B} + \frac{\beta(\nu_A - \nu_B)}{\nu_B} = \mu_B$, so that $D_L = 0$. Thus Firm A obtains the whole demand of the market or be inactive according to the position of μ_A w.r.t $\bar{\mu}$. In particular, $D_A = \bar{\mu} - \mu_A$, if $\mu_A < \bar{\mu}$; while $D_A = 0$ if $\mu_A \geq \bar{\mu}$.

Summarizing the above findings allows to write the following demand functions:

$$D_B = \begin{cases} \bar{\mu} - \frac{p_B+\beta(\nu_A-\nu_B)}{\nu_B} & \text{if } \ p_B \leq \min\{\bar{p}_B, p_B^B\} \\ \frac{p_A-p_B}{\nu_A-\nu_B} - (\alpha+\beta) - \frac{p_B+\beta(\nu_A-\nu_B)}{\nu_B} & \text{if } \ p_B^B \leq p_B \leq \breve{p}_B \\ 0 & \text{if } \ p_B \geq \breve{p}_B \end{cases}$$

$$D_A = \begin{cases} \bar{\mu} - \frac{p_A-\alpha(\nu_A-\nu_B)}{\nu_A} & \text{if } \ p_A \leq \min\{\bar{p}_A, \breve{p}_A\} \\ \bar{\mu} - \left(\frac{p_A-p_B}{\nu_A-\nu_B} - (\alpha+\beta)\right) & \text{if } \ \breve{p}_A \leq p_A \leq p_A^B \\ 0 & \text{if } \ p_A \geq p_A^B \end{cases}$$

Appendix 2

Best reply functions of firm B in the price game:

It derives from the demand functions that:

- Whenever $p_A \geq \bar{p}_A$, namely $\bar{\mu} - \mu_A < 0$, then

$$\Pi_B = \begin{cases} p_B\left(\bar{\mu} - \frac{p_B+\beta(\nu_A-\nu_B)}{\nu_B}\right) & \text{if } \ p_B \leq \bar{p}_B \\ 0 & \text{if } \ p_B \geq \bar{p}_B. \end{cases}$$

From the F.O.C, one can immediately write the best reply function $\varphi_L(p_A)$:

$$\varphi_B(p_A) = \begin{cases} \frac{1}{2}\left(\bar{\mu}\nu_B - \beta(\nu_A-\nu_B)\right) & \text{if } \ \ \bar{p}_B > 0 \\ [0, y] & \text{if } \ \ \bar{p}_B \leq 0 \end{cases}$$

- On the contrary, if $p_A \leq \bar{p}_A$, namely $\bar{\mu} - \mu_A > 0$, then profit functions for Firm B turn out to be:

$$\Pi_B = \begin{cases} p_B\left(\bar{\mu} - \frac{p_B+\beta(\nu_A-\nu_B)}{\nu_B}\right) & \text{if } \ p_B \leq p_B^B \\ p_B\left(\frac{p_A-p_B}{\nu_A-\nu_B} - (\alpha+\beta) - \frac{p_B+\beta(\nu_A-\nu_B)}{\nu_B}\right) & \text{if } \ p_B^B \leq p_B \leq \hat{p}_B \\ 0 & \text{if } \ p_B \geq \hat{p}_B \end{cases}$$

  The F.O.C imply:

$$\begin{cases} p_B = \frac{1}{2}\left(\bar{\mu}\nu_B - \beta(\nu_A-\nu_B)\right) & \text{if } \ \ p_B \leq p_B^B \\ p_B = \frac{1}{2\nu_A}\left(p_A\nu_B - (\nu_A-\nu_B)(\beta\nu_A + \alpha\nu_B)\right) & \text{if } \ \ p_B^B \leq p_B \leq \hat{p}_B \end{cases}$$

1. If $\bar{p}_B \leq 0$ then $\hat{p}_B < \tilde{p}_B < 0$. Thus, firm B's profit is equal to 0 for all $p_B \in [0, y]$ and
$$\varphi_B(p_A) = [0, y], \forall p_A$$
2. If $\bar{p}_B > 0$ then:
   (a) whenever $\tilde{p}_B \leq p_B^B$,then $\varphi_B(p_A) = \tilde{p}_B$
   (b) whenever $\hat{p}_B \geq \max\{0, p_B^B\}$, then $\varphi_B(p_A) = \hat{p}_B$

(c) whenever $0 \leq \hat{p}_B \leq p_B^B \leq \tilde{p}_B$, then $\varphi_B(p_A) = p_B^B$

(d) whenever $\hat{p}_B \leq 0$, then the profit is equal to 0 and $\varphi_B(p_A) = [0, y]$.

Notice that S.O.C are always satisfied.

Best Reply function of firm A in the price game:

Applying the same rationale as above, one can derive that:

- If $p_B \geq \bar{p}_B$,

$$\Pi_H = \begin{cases} p_A\left(\bar{\mu} - \frac{p_A - \alpha(\nu_A - \nu_B)}{\nu_A}\right) & \text{if} \quad p_A < \bar{p}_A \\ 0 & \text{if} \quad p_A \geq \bar{p}_A \end{cases}$$

From the F.O.C, it derives that the best reply function is:

$$\varphi_A(p_B) = \tfrac{1}{2}\nu_A\left(\bar{\mu} + \alpha\frac{1}{\nu_A}(\nu_A - \nu_B)\right) \quad \text{if} \quad \bar{p}_A > 0.$$

We easily check that S.O.C are satisfied.

- Otherwise, if $p_B \leq \bar{p}_B$, then profit function writes as:

$$\Pi_H = \begin{cases} p_A\left(\bar{\mu} - \frac{p_A - \alpha(\nu_A - \nu_B)}{\nu_A}\right) & \text{if} \quad p_A \leq \check{p}_A \\ p_A\left(\bar{\mu} - \left(\frac{p_A - p_B}{\nu_A - \nu_B} - (\alpha + \beta)\right)\right) & \text{if} \quad \check{p}_A \leq p_A \leq p_A^B \\ 0 & \text{if} \quad p_A \geq p_A^B \end{cases}$$

F.O.C. imply that:

$$\begin{cases} \tilde{p}_A = \frac{1}{2}\nu_A\left(\bar{\mu} + \alpha\frac{1}{\nu_A}(\nu_A - \nu_B)\right) & \text{if} \quad p_A \leq \check{p}_A \\ \hat{p}_A = \left(\bar{\mu} + (\alpha + \beta) + \frac{p_B}{\nu_A - \nu_B}\right)\left(\frac{1}{2}(\nu_A - \nu_B)\right) & \text{if} \quad \check{p}_A \leq p_A \leq p_A^B \end{cases}$$

We check by a simple computation that S.O.C satisfied. So,

1. whenever $\tilde{p}_A < \check{p}_A$, or $p_B > \frac{(\bar{\mu}\nu_A\nu_B - (\nu_A - \nu_B)(2\beta\nu_A + \alpha\nu_B))}{2\nu_A}$, then $\varphi_A(p_B) = \tilde{p}_A$;

2. whenever $\check{p}_A \leq \hat{p}_A \leq p_A^B$, or $p_B < \frac{(\bar{\mu}\nu_B - 2\beta\nu_A - \alpha\nu_B + \beta\nu_B)(\nu_A - \nu_B)}{(2\nu_A - \nu_B)}$, then $\varphi_A(p_B) = \hat{p}_A$.

3. whenever $\hat{p}_A < \check{p}_A$, or $\frac{(\bar{\mu}\nu_B - 2\beta\nu_A - \alpha\nu_B + \beta\nu_B)(\nu_A - \nu_B)}{(2\nu_A - \nu_B)} \leq p_B \leq \frac{(\bar{\mu}\nu_A\nu_B - (\nu_A - \nu_B)(2\beta\nu_A + \alpha\nu_B))}{2\nu_A}$, then $\varphi_A(p_B) = \check{p}_A$.

Appendix 3

Three cases have to be distinguished for the best reply function of Firm A at the second stage according to the sign of the thresholds of its definition domain, namely the sign of $\frac{(\bar{\mu}\nu_A\nu_B - (\nu_A - \nu_B)(2\beta\nu_A + \alpha\nu_B))}{2\nu_A}$ and $\frac{(\bar{\mu}\nu_B - 2\beta\nu_A - \alpha\nu_B + \beta\nu_B)(\nu_A - \nu_B)}{(2\nu_A - \nu_B)}$.

To this aim, notice that

$$\frac{(\bar{\mu}\nu_B - 2\beta\nu_A - \alpha\nu_B + \beta\nu_B)(\nu_A - \nu_B)}{(2\nu_A - \nu_B)} > 0 \Leftrightarrow \frac{\nu_A}{\nu_B} < H_1,$$

with $H_1 = \frac{(\bar{\mu}-\alpha+\beta)}{2\beta}$; while

$$\frac{(\bar{\mu}\nu_A\nu_B - (\nu_A - \nu_B)(2\beta\nu_A + \alpha\nu_B))}{2\nu_A} > 0 \Leftrightarrow \frac{\nu_A}{\nu_B} < H_2,$$

with $H_2 = \frac{\bar{\mu}-\alpha+2\beta+\sqrt{\bar{\mu}^2+\alpha^2+4\beta^2-2\bar{\mu}\alpha+4\bar{\mu}\beta+4\alpha\beta}}{4\beta}$.

This implies that there are four cases of intersection between the best reply functions of both firms:

- Case 1: $\frac{\nu_A}{\nu_B} < H_1$;
- Case 2: $H_1 \leq \frac{\nu_A}{\nu_B} < H_2$;
- Case 3: $H_2 \leq \frac{\nu_A}{\nu_B} \leq \frac{(\bar{\mu}+\beta)}{\beta}$;
- Case 4: $\frac{\nu_A}{\nu_B} > \frac{(\bar{\mu}+\beta)}{\beta}$.

These four cases are depicted in Figure 1. Notice from the figure, that cases 3 and 4 can be combined because they lead to the same set of price equilibria. In Case 1, firms A and B share the market, thereby both being active at some positive equilibrium prices; in the two remaining case only firm A can be active in the market at some positive equilibrium price.

6.2 Appendix 4

Proof of Proposition 4.
First, notice that, the difference between the equilibrium $\nu_A - \nu_B$ writes

$$\frac{\left(5\mu - 5\alpha + 4\beta - \sqrt{52\mu\beta - 8\mu\alpha - 52\alpha\beta + 4\mu^2 + 4\alpha^2 + 25\beta^2}\right)}{(7\mu - 7\alpha + 3\beta)}\bar{\nu}.$$

In order to prove the statement in the Proposition 4, it suffices to show that $\frac{\partial}{\partial\beta}(\nu_A - \nu_B) < 0$. Indeed, given that $\nu_A = \bar{\nu}$, the difference $(\nu_A(=\bar{\nu}) - \nu_B)$ can decrease iff ν_B raises. The derivative of the above expression w.r.t. β, namely $\frac{\partial}{\partial\beta}(\nu_A - \nu_B)$, boils into

$$\frac{\left(170\alpha - 170\mu - 97\beta + 13\sqrt{52\mu\beta - 8\mu\alpha - 52\alpha\beta + 4\mu^2 + 4\alpha^2 + 25\beta^2}\right)}{(7\mu - 7\alpha + 3\beta)^2\left(\sqrt{52\mu\beta - 8\mu\alpha - 52\alpha\beta + 4\mu^2 + 4\alpha^2 + 25\beta^2}\right)}(\mu - \alpha).$$

While both terms at the denominator are positive, the term at the numerator is negative. So, we can conclude that this derivative is negative, meaning that the higher β the lower the $(\nu_A - \nu_B)$, or in other words (given $\nu_A = \bar{\nu}$), the higher β the higher ν_B. **Q.E.D.**

FOOTNOTES

1. Typically, the end-of pipe technologies allows to reduce pollution emissions by implementing add-on measures rather than using cleaner inputs or production process (Copeland and Taylor, 1994).

2. This assumption is a little awkward because one can imagine that a more compliant variant should entail some costly investments not obligatory when the compliance of the variant is a less important variable. However, if these investments' costs are fixed , they would not alter the following analysis. This assumption is introduced for simplicity.

3. This social reward can sometimes assume the shape of a subsidy, as in the example of the solar panels above.

4. This social punishment may sometimes assume the shape of a tax or a fine, like in the example of the car drivers above.

5. Details on these functions are provided in Appendix 2.

6. See Appendix 3 for details.

7. Notice however that, contrary to the limit pricing strategy used by the high quality firm in a vertically differentiated market, the limit price strategy used here by firm A does not imply that the market is covered.

8. Notice that market share corresponding to the monopoly case when a limit price is quoted defines as ${D_A}^+ = \frac{(\mu\nu_B - \beta(\nu_A - \nu_B))}{\nu_B}$.

References

[1] Conrad K. (2005). Price Competition and Product Differentiation When Consumers Care for the Environment, *Environmental and Resource Economics*, 31, 1–19.

[2] Copeland, B. R. and M.S. Taylor. (1994). North-South Trade and the Environment. *The Quarterly Journal of Economics*, 109 (3), 755-87.

[3] Elster Jon (1989). Social Norms and Economic Theory, *Journal of Economic Perspectives*, 3(4), 99-117.

[4] Eriksson, C. (2004). Can green consumerism replace environmental regulation? a differentiated products example. *Resource and Energy Economics*, 26, 281-293.

[5] Gabszewicz, J.J. and J.F. Thisse. (1979). Price competition, quality and income disparities. *Journal of Economic Theory, 20*, 340–359.

[6] Moraga-Gonzalez, J. L. and N. Padro-Fumero (2002). Environmental Policy in a Green Market, *Environmental & Resource Economics*, 22, 419–447.

[7] Rodriguez-Ibeas, R. (2007). Environmental Product Differentiation and Environmental Awareness. *Environmental & Resource Economics* 36, 237-254.

[8] Sanna-Randaccio F. and R. Sestini (2012). The Impact of Unilateral Climate Policy with Endogenous Plant Location and Market Size Asymmetry, *Review of International Economics*, 20(3),580-599.

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