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Abstract

The purpose of this paper is to investigate how socially concerned consumers' preferences affects firms' decisions to commit to social responsibility. In a market in which firms face the same demand function and products are homogeneous, we find that a large group of socially concerned consumers or a low cost of social responsibility induces an equilibrium outcome in which ethical and standard firms coexists in the same market. Our result is relevant because we do not assume a product differentiation setup and firms do not separate the market through labeling schemes.

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1 Introduction

Corporate social responsibility (CSR) is defined as "[a] concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis" (see Green Paper, 2001). One of the most famous example of CSR is Fairtrade. Fairtrade is an alternative approach to conventional trade: producers in over fifty countries respects several standards set by FLO International (Fairtrade Labelling Organizations International) such as guaranteeing decent wages to workers, ensuring health and safety standards and providing adequate housing where relevant. In some markets, firms who commit to CSR, hereafter ethical firms coexists with firms which do not integrate any social concern in their business operations, hereafter standard firms and ethical[1] products are likely to cost a similar price to other products of the same quality (see `http://www.fairtrade.net/faqs.html?&no_cache=1$`).

On the consumers' side, many surveys and opinion polls show a predisposition of consumers to CSR activities of firms (see MORI, 2000; The Co-operative Bank, 2007). For instance, in MORI (2000), the first study devoted to social responsibility conducted across twelve European countries, "70% of European consumers say that a company's commitment to social responsibility is important when buying a product or service". However there appears to be a divergence between these surveys and the volume of sales of ethical products, the CSR market is still a small proportion of the total annual household consumer spending (see for instance The Co-operative Bank, 2007; Tallontire et al., 2001). Indeed not all the consumers who declare to be socially concerned purchase ethical products. Thus, what we can deduce from these surveys is that a group of consumers is socially concerned in the sense that it desires to have a market in which ethical firms operate.

The purpose of this paper is to investigate how the presence of this group of consumers affects firms decision to commit to CSR. In a market in which firms face the same demand function and products are homogeneous, we find that a large group of socially concerned consumers or a low cost of

[1] We use the term "ethical" in a broad sense to cover specific issues such as labor and environmental standards, fairtrade and the like.

CSR induces an equilibrium outcome in which ethical and standard firms coexists in the same market. One assumption is crucial for our findings: utility of socially concerned consumers is higher when ethical firms operate in the market than the case in which market is entirely composed of standard firms.

Research into CSR can be traced back to an important question in the political and economic debate: do firms have any kind of social responsibility beyond employment, production of goods and services and the maximization of profits (Friedman, 1970)? This kind of responsibility in firms' decisions has been underestimated by mainstream theory. However, the dichotomy between theoretical conclusions and actual firms' behavior appears puzzling. As a result, not surprisingly, CSR research has mainly focused on why some firms choose to internalize social costs beyond legal constraints.[2] To answer this question, some scholars introduce the concept of CSR in an oligopoly framework with product differentiation. The fact that consumers are concerned about social traits of products is the foundation of the existence of firms that commit to CSR. Contributions in this strand of literature have been made, amongst others, by Arora and Gangopadhyay (1995); Amacher et al. (2004); Alves and Santos-Pinto (2008); Becchetti and Solferino (2003); Conrad (2005); Davies (2005); Mitrokostas and Petrakis (2008). In this literature, firms can decide their commitments to CSR and then compete on prices or quantities. Consumers are socially concerned in the sense that they are willing to pay a price premium for buying goods labeled as ethical. Through ethical labeling firms are able to separate the market and obtain different demand functions; in a duopoly setting, ethical firm serves the most socially concerned consumers while its rival the less ones, each firm obtaining positive market demands and profits. These contributions are similar to traditional product differentiation models where firms offer different qualities of products at different segments of the market (see, for instance, Motta, 1993; Tirole J., 1988). Our model differs from this literature since incentives of firms to commit to CSR are obtained in a homogeneous product setup where firms face the same demand function and a share of consumers desires to have a market in which ethical firms operate.

[2] A critical survey on this debate is Kitzmueller (2008).

We analyze a two-stage duopoly game. At the first stage, firms decide their commitments to CSR while, at the second stage, they compete on quantities (a là Cournot). Products are homogeneous. A firm who decides to commit to CSR supports a higher variable cost than a firm who does not invest in social responsibility[3]. On the consumers' side, we assume that there are two types of consumers, socially concerned and traditional. Traditional consumers do not give any value to the fact that ethical firms operate in the market. We solve the game backwards and we find that a large group of socially concerned consumers or a low cost of CSR induces an equilibrium outcome in which one of the two firms chooses to be ethical while the rival standard. Under these conditions, a symmetric Nash Equilibrium in mixed strategies also exists and firms choose to be ethical (standard) with positive and identical probabilities. Afterwards, we present a simple evolutionary model where the market structure[4] is composed by a single large population of firms programmed to play either ethical or standard production. Firms are pairwise randomly matched to play the first stage of the two-stage duopoly game and payoffs are the equilibrium profits obtained by firms in the second stage of the game. We look for an Evolutionary Stable Strategy (ESS) and we find that, when the group of socially concerned consumers is large enough or cost of CSR is low, the unique ESS of the model corresponds to the unique symmetric mixed-strategy equilibrium of the two-stage game. This implies that equilibrium mixed strategies of the two-stage game represents the evolutionary stable population state of our model, where the probability to adopt ethical (standard) production represents the population share of ethical (standard) firms which operate in the economy. Hence, at the ESS, ethical and standard firms coexists and market cannot be entirely composed of either ethical or standard firms. The same result is obtained in a dynamic framework (using the Replicator Dynamics): the unique symmetric mixed-strategy equilibrium of the two-stage

[3]We assume a higher variable cost for the ethical firm since a positive commitment to CSR represents the respect of an ethical code of conduct that the firm decides to adopt in the production of goods: as an example, we may think to the adoption of an environmentally friendly production system or to the respect of a minimum wage for workers.

[4]We adapt to our context a market structure similar to that assumed in Qin and Stuart, 1997 and Hehenkamp and Leininger, 1999.

game represents the unique globally stable population state. When cost of CSR is high or socially concerned consumers group is of a small size, results are different: at the ESS market is entirely composed of standard firms.

The next section introduces the two-stage game and its equilibria. In Section 3 we present the evolutionary model and results. In Section 4 we investigate the consequences of two kinds of policies that affect preferences for CSR and cost of CSR. Section 5 concludes.

2 The Two-Stage Game

In this Section we describe the two-stage duopoly game played by firms.

2.1 Consumers' Preferences

We assume that there are two types of consumers, socially concerned and traditional. The share of socially concerned consumers is denoted by $\beta \in [0,1]$, while the share of traditional consumers is $1-\beta$. Both types of consumers have the same taste parameter $v > 0$ and quasi-linear quadratic preferences. The utility of socially concerned consumers (SCC) is:

$$u = (v+\theta)q - \frac{q^2}{2} + m, \tag{1}$$

where q is the quantity, m is the numeraire and θ is the term which increments utility of SCC when at least one firm commits to CSR; hence, $\theta = 0$ if no firm commits to CSR and $\theta > 0$ if at least one firm in the market invests in social responsibility[5]. The utility of traditional consumers is given by:

$$u = vq - \frac{q^2}{2} + m. \tag{2}$$

Budget constraint of both types of consumers is

$$m + qp \leq y, \tag{3}$$

[5] We adopt a framework similar to Immordino (2008); in Immordino (2008) consumers are divided into two different groups: self-interested and inequity-averse consumers; both types of consumers have the same taste parameter and quasi-linear quadratic preferences. However, in Immordino (2008), inequity-averse consumers give a negative value to the presence of different labor standards in the economy (this assumption is due to Fehr and Schimdt, 1999). Indeed in our work we assume that socially concerned consumers give a positive value to the presence of ethical firms in the market.

where p is the price of product and $y > 0$ is the endowment of consumers. By maximizing utility of each type of consumer subject to the budget constraint we obtain their demand functions. Quantity demanded by SCC is $q = v + \theta - p$ while the demand of traditional consumers is $q = v - p$. Hence, market demand is given by:

$$q = \beta(v + \theta - p) + (1 - \beta)(v - p). \tag{4}$$

Demand is increasing in the taste parameter v, decreasing in price and increasing in θ and β. If no firm commits to CSR or no SCC are present in the economy, term $\beta\theta$ is equal to zero. Since, in the economy, only two firms operate in the market, q is the sum of the quantities produced by the two firms, $q = q_1 + q_2$. The inverse demand function is:

$$p = v + \beta\theta - (q_1 + q_2). \tag{5}$$

2.2 Firms' Choices

In the first stage of the game each firm i (with $i = \{1, 2\}$) can decide to be either ethical (e) or standard (s); the set of pure strategies of firm i is given by $S_i = \{e, s\}$. The mixed-strategy set of each firm i is given by $\Delta = \{\delta \in \Re^2_+ : \sum_{s_i=e,s} \delta_{s_i} = \delta_e + \delta_s = 1\}$ and hence $\delta_s = 1 - \delta_e$. A mixed strategy profile is a vector $\left(\delta, \delta'\right)$ whose components $\delta = (\delta_e, 1 - \delta_e)$ and $\delta' = \left(\delta'_e, 1 - \delta'_e\right)$ are respectively the mixed strategies played by firms 1 and 2.

For any $s_i \in S_i$ firm i's cost function is $C_i(s_i, q_i) = c_{s_i} q_i$ where if $s_i = e$, $c_e \in (0, v)$ and if $s_i = s$, $c_s = 0$. In the second stage, firms observe the choices made in the first stage and simultaneously decide quantities in order to maximize profits. Products of the two firms are homogeneous. We solve the game backwards, beginning with the second stage.

The second stage problem of each firm i is

$$\max_{q_i} \pi_i = [v + \beta\theta - (q_i + q_j)]q_i - c_{s_i} q_i, \tag{6}$$

with $i \neq j$. To solve the second stage we have to analyze separately the following three cases: i. both firms decide to be ethical $(s_i, s_j) = (e, e)$; ii.

both firms decide to be standard $(s_i, s_j) = (s, s)$; iii. firm i decides to be ethical and firm j standard $(s_i, s_j) = (e, s)$.

Case .i. If, at the first stage, both firms decide to be ethical, firms' best replies (with $i \neq j$) are

$$q_i(q_j) = \frac{1}{2}(v + \beta\theta - q_j - c_e). \tag{7}$$

Equilibrium quantities are

$$q_i^*(e, e) = q_j^*(e, e) = \frac{1}{3}(v + \beta\theta - c_e), \tag{8}$$

and equilibrium profits are

$$\pi_i^*(e, e) = \pi_j^*(e, e) = \frac{1}{9}[c_e - (v + \beta\theta)]^2. \tag{9}$$

Case .ii. If, at the first stage, both firms decide to be standard and hence $\theta = 0$, firms' best replies (with $i \neq j$) are

$$q_i(q_j) = \frac{1}{2}(v - q_j). \tag{10}$$

Equilibrium quantities are

$$q_i^*(s, s) = q_j^*(s, s) = \frac{1}{3}v, \tag{11}$$

and equilibrium profits are

$$\pi_i^*(s, s) = \pi_j^*(s, s) = \frac{1}{9}v^2. \tag{12}$$

Case .iii. If, at the first stage, firm i decides to be ethical and j standard, firms' best replies (with $i \neq j$) are

$$q_i(q_j) = \frac{1}{2}(v + \beta\theta - c_e - q_j), \tag{13}$$

$$q_j(q_i) = \frac{1}{2}(v + \beta\theta - q_i). \tag{14}$$

Equilibrium quantities are

$$q_i^*(e, s) = \frac{1}{3}(v + \beta\theta - 2c_e), \tag{15}$$

$$q_j^*(e,s) = \frac{1}{3}(v + \beta\theta + c_e), \tag{16}$$

with

$$q_i^*(e,s) < q_j^*(e,s). \tag{17}$$

Equilibrium profits are

$$\pi_i^*(e,s) = \frac{1}{9}[2c_e - (\beta\theta + v)]^2, \tag{18}$$

$$\pi_j^*(e,s) = \frac{1}{9}[c_e + \beta\theta + v]^2, \tag{19}$$

with

$$\pi_i^*(e,s) < \pi_j^*(e,s). \tag{20}$$

We now solve the first stage of the game. At each strategy profile (s_1, s_2) is associated a payoff profile $(\pi_1^*(s_1, s_2), \pi_2^*(s_1, s_2))$, where $\pi_i^*(s_1, s_2)$ is the equilibrium profit of firm i of the second stage of the game. Matrix 2x2 of figure 1 represents the first stage of the game.

		Firm 2	
		e	s
Firm 1	e	$\pi_1^*(e,e)$,$\pi_2^*(e,e)$	$\pi_1^*(e,s)$,$\pi_2^*(e,s)$
	s	$\pi_1^*(s,e)$,$\pi_2^*(s,e)$	$\pi_1^*(s,s)$,$\pi_2^*(s,s)$

Figure 1: The First Stage.

Equilibria of the model depend on parameters c, v, θ and β. In particular there are two[6] different equilibrium configurations:

(1) *Ethical and standard firms coexists in the market.* The model admits two asymmetric Nash equilibria in pure strategies: $(s_1^*, s_2^*) = (e,s)$, $(s_1^*, s_2^*) = (s,e)$, and one symmetric Nash equilibrium in mixed strategies with $\delta_e^* = \delta_e'^* = \frac{(2c_e - \beta\theta)(2c_e - \beta\theta - 2v)}{4c_e^2 + \beta\theta(\beta\theta + 2v)} \in (0,1)$.

(2) *Market is entirely composed of standard firms.* The model admits one symmetric Nash equilibrium in pure strategies: $(s_1^*, s_2^*) = (s,s)$.

[6]There also exists a third equilibrium configuration in which the model admits two asymmetric Nash equilibria in pure strategies: $(s_1^*, s_2^*) = (e,s)$, $(s_1^*, s_2^*) = (s,e)$ and one symmetric Nash equilibrium in pure strategies $(s_1^*, s_2^*) = (s,s)$. We do not take in consideration this configuration since it is a special case of the model (see the Appendix).

We summarize our findings in the following Proposition.

Proposition 2.1 *When $\theta \geq 2v$, ethical and standard firms coexists in the market if and only if $\beta \in \left[\frac{2v}{\theta}, 1\right]$ for any $c_e \in (0, v)$; if instead $\beta \in \left(0, \frac{2v}{\theta}\right)$, coexistence is obtained if and only if $c_e \in \left(0, \frac{\beta\theta}{2}\right)$ where $\frac{\beta\theta}{2} < v$. When $\theta < 2v$, ethical and standard firms coexists in the market if and only if $c_e \in \left(0, \frac{\beta\theta}{2}\right)$. Otherwise, market is entirely composed of standard firms.*

Proof See the Appendix.

When $\beta = 0$ (all the consumers are traditional), our model is a standard Cournot duopoly game where firms have different marginal costs; at equilibrium, each firm chooses standard production ($c_e = 0$) since it is the dominant strategy. When $\beta > 0$, ethical production can be convenient for one of the two firms but not for both. Indeed, when firm i chooses to be ethical, standard production is the dominant strategy for firm j, whatever is c_e and β. If instead firm i chooses to be standard, ethical production can be convenient for firm j. Proposition 2.1 indicates that, in this case, there exists a substitution effect between c_e and β as incentives for firm j to choose ethical production. In particular, when SCC attach weak importance to the presence of ethical firms in the market (i.e. $\theta < 2v$), firm j chooses to be ethical only if cost c_e is relatively low $\left(c_e \in \left(0, \frac{\beta\theta}{2}\right)\right)$ and β does not play any role in this choice. If instead SCC attach great importance to the presence of ethical firms in the market (i.e. $\theta \geq 2v$), a large group of SCC $\left(\beta \in \left[\frac{2v}{\theta}, 1\right]\right)$ becomes the dominant incentive for firm j to commit to CSR: if firm j chooses ethical production, a relatively high β increases so much market demand (through term $\theta\beta$) that cost of CSR becomes irrelevant in firm j's choice. The opposite holds with a relatively low value of β $\left(\beta \in \left(0, \frac{2v}{\theta}\right)\right)$.

3 The evolutionary model

A central question of this paper is to study under what conditions coexistence between ethical and standard firms is an equilibrium outcome robust to evolutionary pressures. In order to investigate this issue, in this Section, we present a simple evolutionary model in which the economy is composed by a single large population of firms where a share $\delta_e \in [0, 1]$ is ethical and a share $\delta_s = 1 - \delta_e$ is standard. Then we analyze whether coexistence between ethical and standard firms – i.e. $0 < \delta_e < 1$ – is a *stable* population state both in a static and a dynamic analysis.

3.1 A static analysis

Let us assume that our economy is constituted by a single large (infinite) population of firms programmed to play either ethical or standard production (e or s). The proportions of ethical and standard firms are respectively $\delta_e \in [0, 1]$ and $\delta_s = 1 - \delta_e$, with $\delta = (\delta_e, \delta_s) \in \Delta$. Let us also assume that firms are pairwise randomly matched to play the first stage of the two-stage game of Section 2, where payoffs are the equilibrium profits obtained by firms in the second stage of the game. Figure 1 represents the four possible matches and the associated payoffs. Let us now assume that the population of firms in our economy is originally in state $\delta \in \Delta$ (as an example we may think of a situation in which δ is the population state led by evolution). The profit earned by a firm drawn at random from the population state δ when also its rival is drawn at random from δ is given by:

$$\Pi(\delta, \delta) = \begin{bmatrix} \delta_e & 1 - \delta_e \end{bmatrix} \begin{bmatrix} \pi^*(e, e) & \pi^*(e, s) \\ \pi^*(s, e) & \pi^*(s, s) \end{bmatrix} \begin{bmatrix} \delta_e \\ 1 - \delta_e \end{bmatrix} \tag{21}$$

$$= A\delta_e^2 + B\delta_e + C. \tag{22}$$

where

$$A = [\pi^*(e, e) - \pi^*(s, e) - \pi^*(e, s) + \pi^*(s, s)], \tag{23}$$

$$B = [\pi^*(s, e) + \pi^*(e, s) - 2\pi^*(s, s)], \tag{24}$$

and

$$C = \pi^*(s, s). \tag{25}$$

$\Pi\left(\delta', \delta\right)$ is the profit earned by a firm drawn at random from an alternative population state $\delta' \in \Delta$ when its rival is drawn at random from population state $\delta \in \Delta$, $\Pi\left(\delta, \delta'\right)$ is the profit earned by a firm drawn at random from $\delta \in \Delta$ when its rival is drawn at random from an alternative population state $\delta' \in \Delta$ and $\Pi\left(\delta', \delta'\right)$ is the profit earned by a firm drawn at random from $\delta' \in \Delta$ when also its rival is drawn at random from δ'. We define as evolutionary stable a population state which satisfies the following definition.

Definition A strategy (population state) $\delta \in \Delta$ is defined as an *evolutionary stable strategy* (ESS) if for every $\delta' \neq \delta$ it is:

(a) $\Pi(\delta, \delta) > \Pi\left(\delta', \delta\right)$; or

(b) $\Pi(\delta, \delta) = \Pi\left(\delta', \delta\right)$ and $\Pi\left(\delta, \delta'\right) > \Pi\left(\delta', \delta'\right)$.

In other words, a population state δ is evolutionary stable if, for each alternative population state, there exists a positive invasion barrier such that, if the population share of firms of the alternative population state falls below this barrier, then firms of population state δ earns a higher payoff than that of the alternative population state (see Weibull J. W., 1995). In our model, an equilibrium configuration is represented by an evolutionary stable population state (ESS). The following proposition indicates the ESS of the model.

Proposition 3.1 *When $\beta \in \left[\frac{2v}{\theta}, 1\right]$ or $c_e \in \left(0, \frac{\beta\theta}{2}\right)$, there exist an ESS in which ethical and standard firms coexists in the market. Otherwise, there exists an ESS in which market is entirely composed of standard firms.*

Proof See the Appendix.

When the group of SCC is large enough $\left(\beta \in \left[\frac{2v}{\theta}, 1\right]\right)$ or the cost of CSR is low $\left(c_e \in \left(0, \frac{\beta\theta}{2}\right)\right)$, a market entirely composed of either ethical or standard firms is not evolutionary stable. The ESS corresponds to the unique symmetric mixed strategies Nash equilibrium[7] $\delta_e^* = \delta_e'^* = \frac{(2c_e - \beta\theta)(2c_e - \beta\theta - 2v)}{4c_e^2 + \beta\theta(\beta\theta + 2v)} \in (0, 1)$; this implies that population shares of ethical and standard firms, δ_e^* and δ_s^*, are strictly positive: ethical and standard firms coexists into our economy and earn $\Pi(\delta^*, \delta^*)$ (see equation (21) where $\delta_e = \delta_e^*$). Otherwise,

[7]When the group of SCC is large enough or the cost of CSR is low, our evolutionary model corresponds to a Hawk-Dove game; a well-known result in the evolutionary literature is that, in a Hack-Dove game, the ESS corresponds to the unique symmetric mixed strategy equilibrium of the game: pure hawkishness or pure doveness are not evolutionary stable strategies (see Weibull J. W., 1995; Vega-Redondo F., 2003).

the ESS corresponds to the unique symmetric pure strategies Nash equilibrium $\delta_e^* = \delta_e^{\prime *} = 0$; the evolutionary stable population share of ethical firms is equal to zero and population is entirely composed of standard firms which earn $\pi^*(s, s)$. This is also the case when all the consumers are traditional, i.e. when $\beta = 0$.

3.2 A dynamic analysis

Let us analyze the evolutionary model presented in the previous section adopting a dynamic approach. We undertake the most basic dynamic model used in the evolutionary literature, the Replicator Dynamics (hereafter RD). Time is measured continuously and, in every time period $t \geq 0$, firms from a single large (infinite) population are pairwise randomly selected to play the first stage of the two-stage game of Section 2. Each firm is programmed to play a pure strategy (e or s) and, at each time period t, $\delta_t = (\delta_{e,t}, 1 - \delta_{e,t}) \in \Delta$ represents respectively the proportions of ethical ($\delta_{e,t}$) and standard ($1 - \delta_{e,t}$) firms in the population respectively (i.e. the population state). Population state $\delta_t \in \Delta$ is formally identical to a mixed strategy. The expected profit using pure strategy $s_i = e$ or s, at a random match t, when the population is in state $\delta_t \in \Delta$, is $\Pi_t(s_i, \delta_t)$, while the average expected profit in the population at any random match t (i.e. the profit earned by a firm drawn at random from the population) is $\Pi_t(\delta_t, \delta_t)$. Supposing that the net reproduction rate of each firm (i.e. each strategy s_i) is proportional to its score $\Pi_t(s_i, \delta_t)$, with the RD we have the following continuous-time dynamic system for $\delta_{s,t}$:

$$\dot{\delta}_{s_i,t} = \delta_{s_i,t}[\Pi_t(s_i, \delta_t) - \Pi_t(\delta_t, \delta_t)] \tag{26}$$

where $\dot{\delta}_t$ is the derivative of δ_t with respect of t. A well-known result in the evolutionary literature which correlates the RD with the notion of ESS (due to Hofbauer et al., 1979) is that any population state corresponding to an ESS is asymptotically stable in terms of the RD with a single population of players[8]. Hence, it follows that

[8]This result is no more satisfied in case of multiple populations of players (see Fudenberg D. and Levine D. K., 1998).

Proposition 3.2 *When $\beta \in \left[\frac{2v}{\theta}, 1\right]$ or $c_e \in \left(0, \frac{\beta\theta}{2}\right)$, there exist a globally stable population state in which ethical and standard firms coexists in the market. Otherwise, there exists a asymptotically stable population state in which market is entirely composed of standard firms.*

Proof See Proposition (3.1) and Hofbauer et al. (1979).

4 Policy Implications

In the Green Paper (2001), CSR is defined as an instrument which can promote "a positive contribution to the strategic goal decided in Lisbon: to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion" (see the Green Paper, 2001, p. 6). The expansion of CSR is thus considered crucial for the EU institution. In this Section we investigate how a policy maker can expand CSR. We concentrate our analysis on two kinds of policies that affect preferences – through β – and cost of CSR – through c_e.[9] A policy based on schooling and education may increment the number of socially concerned consumers (β) in the economy, and a policy maker can promote CSR providing subsidies to ethical firms in order to reduce their social costs c_e.

Let us assume that the economy is at ESS, $\delta_e^* = \frac{(2c_e - \beta\theta)(2c_e - \beta\theta - 2v)}{4c_e^2 + \beta\theta(\beta\theta + 2v)} \in (0, 1)$. A policy which reduces social costs of ethical firms (c_e) always causes an expansion of ethical firms in the economy (δ_e^*) and a reduction of standard firms (δ_s^*): $\frac{\sigma\delta_e^*}{\sigma c_e} < 0$ and $\frac{\sigma\delta_s^*}{\sigma c_e} > 0$ (see the Appendix). Moreover, as c_e goes to 0, the economy tends to be entirely composed of ethical firms $\delta_e^* \to 1$. An interesting result is also obtained when c_e tends to its upper value. When cost of CSR is low $\left(c_e \in \left(0, \frac{\beta\theta}{2}\right)\right)$ and c_e tends to its upper value $\left(\frac{\beta\theta}{2}\right)$, the economy tends to be entirely composed of standard firms $\delta_e^* \to 0$; this does not happen when SCC' group is large $\left(\beta \in \left[\frac{2v}{\theta}, 1\right]\right)$. In this case, as c_e tends to its upper value (v), the proportion of ethical firms does not tend to zero but to a positive fixed value. Hence, when a policy maker does not reduce social cost of ethical firms and the cost tends to its upper value, a large

[9] There are other parameters which may be included in our analysis; however, given our framework β and c_e generate more interesting results.

group of SCC is essential to have a market in which ethical firms operate. These results are summarized in figures 2 and 3.

	$c_e \to 0$	$c_e \to \frac{\beta\theta}{2}$
δ_e^*	1	0
δ_s^*	0	1

Figure 2: The ESS when cost of CSR is low.

	$c_e \to 0$	$c_e \to v$
δ_e^*	1	$\frac{(\beta\theta-2v)\beta\theta}{4v^2+\beta\theta(\beta\theta+2v)} > 0$
δ_s^*	0	$\frac{(\beta\theta+v)4v}{4v^2+\beta\theta(\beta\theta+2v)} > 0$

Figure 3: The ESS when the SSC' group is large.

A policy on β has a similar impact on δ_e^* and δ_s^*. In particular, a policy which increments the number of socially concerned consumers β always causes an expansion of ethical firms in the economy (δ_e^*) and a reduction of standard firms (δ_s^*): $\frac{\sigma\delta_e^*}{\sigma\beta} < 0$ and $\frac{\sigma\delta_s^*}{\sigma\beta} > 0$ (see the Appendix). However, differently from a policy on c_e, a policy on β cannot induce the economy to be entirely composed of ethical firms: as β tends to its upper value (1), the share of ethical firms tends to a positive fixed value which is negatively correlated to c (as c_e goes to 0, the value of δ_e^* tends to 1). When β tends to 0, the economy tends to be entirely composed of standard firms (δ_e^* tends to a negative value) and, finally, as β tends to $\frac{2v}{\theta}$, the share of ethical firms tends to a positive fixed value.

5 Concluding remarks

This paper proposes a partial equilibrium model in which socially concerned consumers' preferences affect firms' decisions to commit to CSR. We made a crucial assumption: a share of consumers is *socially concerned* in the sense that they desire to have a market in which ethical firms operate. Under this assumption, we found that a large group of socially concerned consumers or a low cost of CSR induces an equilibrium outcome in which ethical and standard firms coexist in the market. This result is relevant because we do not assume a product differentiation set-up and firms are not able to separate the market through ethical labeling. Moreover, a strictly positive share of socially concerned consumers is essential to obtain these results: when all the consumers are traditional our model is a standard Cournot game in which no firm decides to commit to CSR.

We also analyzes two kinds of policies: a policy which increments the number of socially concerned consumers in the economy (β) and a policy which reduces social costs of ethical firms (c_e). We found that any policy which either increments the share of socially concerned consumers or reduces social cost always induces an expansion (reduction) of ethical (standard) firms in the economy. However only a policy which reduces social cost c_e is able to induce the economy to be entirely composed of ethical firms. Our policy analysis suffer from the partial equilibrium set-up adopted; indeed an extension of our analysis to a general equilibrium set-up could give a better understanding of our results in terms of policies and their implications on welfare.

A Appendix

A.1 Proofs of Propositions

Proof of Proposition 2.1.
Let us suppose that firm j chooses to be ethical. From equations (9) and (19), firm i always chooses to be standard since inequality

$$\pi_i^*(s,e) = \frac{1}{9}[c_e + \beta\theta + v]^2 > \frac{1}{9}[c_e - (v + \beta\theta)]^2 = \pi_i^*(e,e) \tag{27}$$

is always satisfied.
Let us suppose that firm j chooses to be standard. From equations (12) and (18), firm i chooses to be ethical if and only if

$$\pi_i^*(e,s) = \frac{1}{9}[2c_e - (\beta\theta + v)]^2 > \frac{1}{9}v^2 = \pi_i^*(s,s). \tag{28}$$

Inequality (28) can be rewritten as

$$4c_e^2 - 4c_e(\beta\theta + v) + \beta^2\theta^2 + 2\beta\theta v > 0 \tag{29}$$

The right-hand side of inequality (29) is a second-order polynomial which is represented by a convex parabola whose roots are

$$c_{e1} = \frac{\beta\theta}{2} \tag{30}$$

and

$$c_{e2} = \frac{\beta\theta + 2v}{2}, \tag{31}$$

with $\Delta = 16v^2 > 0$ (for any value of v) and $c_{e2} > c_{e1} > 0$ for $\beta > 0$. If $\beta = 0$, $c_e 1 = 0$, $c_e 2 = v$, and inequality (28) is never satisfied: firm i chooses to be standard for any value of $c_e \in (0, v)$. If $\beta > 0$, inequality (28) is satisfied if and only if $c_e \in \left(0, \min\left(\frac{\beta\theta}{2}, v\right)\right)$ (firm i chooses to be ethical); if instead $c_e \in \left(\min\left(\frac{\beta\theta}{2}, v\right), v\right)$, inequality (28) is not satisfied and firm i chooses to be standard. Finally, if $c_e = \min\left(\frac{\beta\theta}{2}, v\right)$ with $c_e \neq v$, firm i is indifferent between e and s. This implies the following.

(i) When $\theta < 2v$, $v > c_{e1}$ for any value of $\beta \in (0, 1]$ and

  (a) if $c_e \in (0, c_{e1})$, firm i chooses to be ethical;

  (b) if $c_e = c_{e1}$, firm i is indifferent between ethical and standard production; and

  (c) if $c_e \in (c_{e1}, v)$, firm i chooses to be standard.

(ii) When $\theta \geq 2v$ and $\beta \in \left[\frac{2v}{\theta}, 1\right]$, firm i chooses to be ethical.

(iii) When $\theta \geq 2v$ and $\beta \in \left(0, \frac{2v}{\theta}\right)$, cases (a), (b) and (c) holds.

To summarize there are three equilibrium configurations.

(1) If $\beta > 0$ and case i.a holds or case ii holds or case iii.a holds, the model admits two asymmetric Nash equilibria in pure strategies $(s_1^*, s_2^*) = (e, s)$ and $(s_1^*, s_2^*) = (s, e)$.

(2) If $\beta = 0$ or $\beta > 0$ and case i.c holds or $\beta > 0$ and case iii.c holds, the model admits one symmetric Nash equilibrium in pure strategies: $(s_1^*, s_2^*) = (s, s)$.

(3) If $\beta > 0$ and case i.b holds or case iii.b holds, the model admits one symmetric Nash equilibrium in pure strategies $(s_1^*, s_2^*) = (s, s)$ and two asymmetric Nash equilibria in pure strategies $(s_1^*, s_2^*) = (e, s)$ and $(s_1^*, s_2^*) = (s, e)$.

Let us now analyze the case in which firms 1 and 2 respectively play mixed strategies δ and δ' with $\delta, \delta' \in \Delta$. From

$$E\pi_1(s_1 = e) = E\pi_1(s_1 = s) \tag{32}$$

and

$$E\pi_2(s_2 = e) = E\pi_2(s_2 = s), \tag{33}$$

where $E\pi_i(s_i)$ is the expected profit of firm i when firm i plays pure strategy s_i and firm j mixed strategy $\delta \in \Delta$, it holds that

$$\delta_e = \delta_e' \equiv \frac{\pi^*(e,s) - \pi^*(s,s)}{[\pi^*(e,s) - \pi^*(s,s)] + [\pi^*(s,e) - \pi^*(e,e)]} = \frac{(2c_e - \beta\theta)(2c_e - \beta\theta - 2v)}{4c_e^2 + \beta\theta(\beta\theta + 2v)}. \tag{34}$$

Equality (34) is an equilibrium mixed strategy if and only if $\delta_e = \delta_e' \in (0, 1)$. This holds only in case (1). In case (2) $\delta_e = \delta_e' < 0$, while, in case (3) it is $\delta_e = \delta_e' > 1$.

Proof of Proposition 3.1.
From conditions i. and ii. of definition (3.1), it follows that an ESS must be a symmetric Nash equilibrium. Thus, the candidates to be an ESS are the symmetric Nash equilibria of the game: $(s_1, s_2) = (s, s)$ (which implies $\delta_e^* = \delta_e'^* = 0$) and (δ^*, δ^*) with $\delta_e^* = \delta_e'^* = \frac{(2c_e - \beta\theta)(2c_e - \beta\theta - 2v)}{4c_e^2 + \beta\theta(\beta\theta + 2v)} \in (0, 1)$.

Let us verify if these two equilibria are evolutionary stable strategies. Let us start with (δ^*, δ^*). Since (δ^*, δ^*) is a mixed strategies equilibrium, it holds that

$$\Pi(\delta^*, \delta^*) = \Pi\left(\delta', \delta^*\right) \tag{35}$$

This implies that (δ^*, δ^*) to be an ESS must verify

$$\Pi\left(\delta^*, \delta'\right) > \Pi\left(\delta', \delta'\right) \quad \text{for all } \delta' \neq \delta. \tag{36}$$

$\Pi(\delta^*, \delta') - \Pi\left(\delta^{'}, \delta'\right)$ is given by

$$\Pi(\delta^*, \delta') - \Pi\left(\delta^{'}, \delta'\right) = \frac{a^2\delta_e^{'2} - 2ab\delta_e^{'2} + b^2}{a} = \frac{\delta_e^{'}(a-b)^2}{a}, \tag{37}$$

where

$$a = [\pi^*(s,e) - \pi^*(e,e)] + [\pi^*(e,s) - \pi^*(s,s)] \tag{38}$$

and

$$b = [\pi^*(e,s) - \pi^*(s,s)]. \tag{39}$$

Since $\delta_e^{'} \in (0,1)$ and $a > 0$ (from case 1 – Proof of Proposition 2.1 – it holds that $\pi^*(s,e) > \pi^*(e,e)$ and $\pi^*(e,s) > \pi^*(s,s)$), equality (36) is satisfied and (δ^*, δ^*) is an ESS.

Let us now verify if $(s_1, s_2) = (s,s)$ is an ESS. (s,s) is an equilibrium in cases 2 and 3 (see Proof of Proposition 2.1). Let us assume that we are in case 2 (see Proof of Proposition 2.1). $\Pi(\delta^*, \delta^*) - \Pi\left(\delta^{'}, \delta^*\right)$ is given by

$$\Pi(\delta^*, \delta^*) - \Pi\left(\delta^{'}, \delta^*\right) = \pi^*(s,s) - [\delta_e^{'}\pi^*(e,s) + (1-\delta_e^{'})\pi^*(s,s)] = b\delta_e^{'}, \tag{40}$$

with $\delta_e^{'} \in (0,1)$ and $b < 0$ (from case 2 – Proof of Proposition 2.1 – it holds that $\pi^*(e,s) < \pi^*(s,s)$). Hence condition i. of definition (3.1) is satisfied and $(s_1, s_2) = (s,s)$ is an ESS. Finally, let us assume that we are in case 3 (see Proof of Proposition 2.1). In this case, it is $\Pi(\delta^*, \delta^*) = \Pi\left(\delta^{'}, \delta^*\right)$ (condition i. of definition 3.1 is not satisfied) and $\Pi\left(\delta^*, \delta^{'}\right) - \Pi\left(\delta^{'}, \delta^{'}\right)$ is given by

$$\Pi\left(\delta^*, \delta^{'}\right) - \Pi\left(\delta^{'}, \delta^{'}\right) = \delta_e^{'2}\left[\pi^*(s,e) - \pi^*(e,e)\right], \tag{41}$$

where $\pi^*(s,e) > \pi^*(e,e)$ and $\delta_e^{'} \in (0,1)$. Hence condition ii. of definition (3.1) is satisfied and $(s_1, s_2) = (s,s)$ is an ESS also in case 3.

A.2 Policy Implications

Policy on social cost
Let assume that economy is at ESS, $\delta_e^* = \frac{(2c_e-\beta\theta)(2c_e-\beta\theta-2v)}{4c_e^2+\beta\theta(\beta\theta+2v)} \in (0,1)$ (case 1, Proof of Proposition 2.1). Derivative of δ_e^* with respect to c_e is:

$$\frac{\sigma\delta_e^*}{\sigma c_e} = \frac{16(v+\beta\theta)c_e^2 - 8\beta\theta v^2 - 4\beta^3\theta^3 - 12\beta^2\theta^2 v}{\left(4c_e^2 + \beta^2\theta^2 + 2\beta\theta v\right)^2}. \tag{42}$$

Since the denominator $\left(4c_e^2 + \beta^2\theta^2 + 2\beta\theta v\right)^2$ is strictly greater than zero, the sign of $\frac{\sigma\delta_e^*}{\sigma c_e}$ depends on the sign of the numerator $16(v+\beta\theta)c_e^2 - 8\beta\theta v^2 - 4\beta^3\theta^3 - 12\beta^2\theta^2 v$, which is a second-order polynomial (represented by a convex parabola) whose roots are

$$\underline{c} = -\frac{\sqrt{2\beta\theta v + \beta^2\theta^2}}{2} < 0 \tag{43}$$

and

$$\overline{c} = \frac{\sqrt{2\beta\theta v + \beta^2\theta^2}}{2} > 0. \tag{44}$$

If $\overline{c} \geq v$, it is $\frac{\sigma\delta_e^*}{\sigma c_e} < 0$ for any $c_e \in (0,v)$; if instead $\overline{c} < v$, $\frac{\sigma\delta_e^*}{\sigma c_e} < 0$ if $c_e \in (0,\overline{c})$ and $\frac{\sigma\delta_e^*}{\sigma c_e} \geq 0$ if $c_e \in [\overline{c}, v)$. This implies the following:

(i) If $\beta \geq \frac{\left(\sqrt{20}-2\right)v}{2\theta}$, it is $\frac{\sigma\delta_e^*}{\sigma c_e} < 0$;

(ii) If $\beta < \frac{(\sqrt{20}-2)v}{2\theta}$ and $c_e \in (0, \bar{c}]$, it is $\frac{\sigma\delta_e^*}{\sigma c_e} \leq 0$;

(iii) If $\beta < \frac{(\sqrt{20}-2)v}{2\theta}$ and $c_e \in (\bar{c}, v)$, it is $\frac{\sigma\delta_e^*}{\sigma c_e} > 0$.

Since $\frac{(\sqrt{20}-2)v}{2\theta} > \frac{2v}{\theta}$ and $\bar{c} > \frac{\beta\theta}{2}$, it is $\frac{\sigma\delta_e^*}{\sigma c_e} > 0$ for any value of c_e and β that satisfies case (1) of Proof of Proposition 2.1, i.e. for any value of c_e and β such that the economy is at the ESS $\delta_e^* = \frac{(2c_e-\beta\theta)(2c_e-\beta\theta-2v)}{4c_e^2+\beta\theta(\beta\theta+2v)} \in (0,1)$. Moreover, since $\delta_s^* = 1-\delta_e^*$, it is $\frac{\sigma\delta_s^*}{\sigma c_e} < 0$ for any value of c_e and β such that the economy is at the ESS $\delta_e^* = \frac{(2c_e-\beta\theta)(2c_e-\beta\theta-2v)}{4c_e^2+\beta\theta(\beta\theta+2v)} \in (0,1)$.

Policy on preferences

Let assume that economy is at ESS, $\delta_e^* = \frac{(2c_e-\beta\theta)(2c_e-\beta\theta-2v)}{4c_e^2+\beta\theta(\beta\theta+2v)} \in (0,1)$ (case 1, Proof of Proposition 2.1). Derivative of δ_e^* with respect to β is:

$$\frac{\sigma\delta_e^*}{\sigma\beta} = \frac{4\theta c_e\left(-4c_e^2+\beta^2\theta^2+2\beta\theta v+2v^2\right)}{\left(4c_e^2+\beta^2\theta^2+2\beta\theta v\right)^2}. \tag{45}$$

Since the denominator $\left(4c_e^2+\beta^2\theta^2+2\beta\theta v\right)^2$ is strictly greater than zero, the sign of $\frac{\sigma\delta_e^*}{\sigma\beta}$ depends on the sign of the numerator $4\theta c_e\left(-4c_e^2+\beta^2\theta^2+2\beta\theta v+2v^2\right)$, which is a second-order polynomial (represented by a convex parabola) whose roots are

$$\beta_1 = -\frac{v+\sqrt{4c_e^2-v^2}}{\theta} < 0 \tag{46}$$

and

$$\beta_2 = \frac{-v+\sqrt{4c_e^2-v^2}}{\theta}, \tag{47}$$

with $\Delta = 4c_e^2 - v^2$. When $c_e \in \left(0, \frac{v}{2}\right]$, $\Delta \leq 0$; this implies that the numerator of equality (45) is strictly greater than zero for any $\beta \in (0,1)$ and $\frac{\sigma\delta_e^*}{\sigma\beta} > 0$. Let us study the case in which $c_e \in \left(\frac{v}{2}, v\right)$ and $\Delta > 0$. In this case, it results that $\beta_2 \leq 0$ if $c_e \in \left(\frac{v}{2}, \frac{v}{\sqrt{2}}\right]$ and $\beta_2 > 0$ if $c_e \in \left(\frac{v}{\sqrt{2}}, v\right)$. Hence, when $c_e \in \left(0, \frac{v}{\sqrt{2}}\right]$, the numerator of equality (45) is strictly greater than zero for any $\beta \in (0,1)$ and $\frac{\sigma\delta_e^*}{\sigma\beta} > 0$. When $c_e \in \left(\frac{v}{\sqrt{2}}, v\right)$, $\beta_2 < 1$ if and only if

$$4c_e^2 - 2v^2 - 2\theta v - \theta^2 < 0. \tag{48}$$

The left-hand side of inequality (48) is a second-order polynomial represented by a convex parabola whose roots are

$$c_e^{'} = -\frac{\sqrt{2v^2+\theta^2+2\theta v}}{2} < 0 \tag{49}$$

and

$$c_e^{''} = \frac{\sqrt{2v^2+\theta^2+2\theta v}}{2} > 0. \tag{50}$$

If $c_e^{''} > v$, then $\beta_2 < 1$ for any $c_e \in (0, v)$. If instead $c_e^{''} \leq v$, then $\beta_2 < 1$ if $c_e < c_e^{''}$ and $\beta_2 \geq 1$ if $c_e \geq c_e^{''}$. In particular, $c_e^{''} > v$ is satisfied if and only if

$$\theta^2 + 2\theta v - 2v^2 > 0. \tag{51}$$

The left-hand side of inequality (51) is a second-order polynomial represented by a convex parabola whose roots are

$$\theta_1 = -v(\sqrt{3}+1) < 0 \tag{52}$$

and

$$\theta_2 = v(\sqrt{3}+1) > 0, \tag{53}$$

with $\Delta = 12v^2 > 0$. Hence

- if $\theta \leq \theta_2$, $\theta^2 + 2\theta v - 2v^2 \leq 0$ and $c_e^{''} \leq v$;
- if $\theta > \theta_2$, $\theta^2 + 2\theta v - 2v^2 > 0$, $c_e^{''} > v$ and $\beta_2 < 1$ for any $c_e \in (0, v)$.

In summary, it follows that

(a) $\frac{\sigma\delta_e^*}{\sigma\beta} > 0$ if $c_e \in \left(0, \frac{v}{\sqrt{2}}\right]$ or $\theta \leq \theta_2$, $c_e \in \left(\frac{v}{\sqrt{2}}, c_e^{''}\right)$ and $\beta \in (\beta_2, 1]$ or $\theta > \theta_2$ and $\beta \in (\beta_2, 1]$;

(b) $\frac{\sigma\delta_e^*}{\sigma\beta} = 0$ if $\theta \leq \theta_2$, $c_e \in \left(\frac{v}{\sqrt{2}}, c_e^{''}\right)$ and $\beta = \beta_2$ or $\theta > \theta_2$ and $\beta = \beta_2$;

(c) $\frac{\sigma\delta_e^*}{\sigma\beta} < 0$ if $\theta \leq \theta_2$, $c_e \in \left(\frac{v}{\sqrt{2}}, c_e^{''}\right)$ and $\beta \in (0, \beta_2)$ or $\theta \leq \theta_2$ and $c_e \in \left[c_e^{''}, v\right)$ or $\theta > \theta_2$ and $\beta \in (0, \beta_2)$.

Let us verify that in case 1 of Proof of Proposition 2.1, case (a) is always satisfied. Let us assume that $\theta \geq 2v$ and $\beta \in \left[\frac{2v}{\theta}, 1\right]$. In this case, it is $\theta > \theta_2$ and $\beta_2 < \frac{2v}{\theta}$; this implies that $\left[\frac{2v}{\theta}, 1\right]$ is a subset of $(\beta_2, 1]$ and hence $\frac{\sigma\delta_e^*}{\sigma\beta} > 0$ (see case (a)).
Let us assume that $\theta \geq 2v$, $\beta \in \left[0, \frac{2v}{\theta}\right)$ and $c_e \in (0, c_{e1})$. In this case, it is $\theta > \theta_2$ and $\beta_2 < \frac{2v}{\theta}$. If $\beta \in \left(\beta_2, \frac{2v}{\theta}\right]$, it is $\frac{\sigma\delta_e^*}{\sigma\beta} > 0$; if instead $\beta \in (0, \beta_2)$, then we have to check for c_e. In particular, it results that $c_{e1} < \frac{v}{\sqrt{2}}$ and $(0, c_{e1})$ is a subset of $\left(0, \frac{v}{\sqrt{2}}\right]$ if $\beta < \frac{2v}{\theta\sqrt{2}} < \frac{2v}{\theta}$ and $\frac{2v}{\theta\sqrt{2}} > \beta_2$. Hence, for $\beta \in (0, \beta_2)$, $\beta < \frac{2v}{\theta\sqrt{2}}$ and $\frac{\sigma\delta_e^*}{\sigma\beta} > 0$ (see case (a)).
Let us assume that $\theta < 2v$ and $c_e \in (0, c_{e1})$. It results that $c_{e1} < \frac{v}{\sqrt{2}}$ if $\theta < \frac{2v}{\beta\sqrt{2}}$ and $\frac{2v}{\beta\sqrt{2}} \geq 2v$ if $\beta \leq \frac{1}{\sqrt{2}}$. Hence, if $\beta \leq \frac{1}{\sqrt{2}}$, $\theta < 2v$ implies that $(0, c_{e1})$ is a subset of $\left(0, \frac{v}{\sqrt{2}}\right]$ and $\frac{\sigma\delta_e^*}{\sigma\beta} > 0$. If instead $\beta \in \left(\frac{1}{\sqrt{2}}, 2v\right)$, it is $\frac{2v}{\beta\sqrt{2}} < 2v$ and $c_{e1} > \frac{v}{\sqrt{2}}$ for $\theta \in \left(\frac{2v}{\beta\sqrt{2}}, 2v\right)$. Since $\frac{2v}{\beta\sqrt{2}} > \theta_2$, $\theta \in \left(\frac{2v}{\beta\sqrt{2}}, 2v\right)$ implies $\theta > \theta_2$. Moreover, since $\beta_2 < \frac{1}{\sqrt{2}}$, $\beta > \frac{1}{\sqrt{2}}$ implies $\beta \in (\beta_2, 1]$ and case (a) holds: $\frac{\sigma\delta_e^*}{\sigma\beta} > 0$.

We can conclude that, for any value of c_e and β such that the economy is at the ESS $\delta_e^* = \frac{(2c_e - \beta\theta)(2c_e - \beta\theta - 2v)}{4c_e^2 + \beta\theta(\beta\theta + 2v)} \in (0, 1)$, it is $\frac{\sigma\delta_e^*}{\sigma\beta} > 0$ and $\frac{\sigma\delta_s^*}{\sigma\beta} < 0$ because $\delta_e^* = 1 - \delta_s^*$.

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