

Watchdogs of the Invisible Hand: NGO Monitoring and Industry Equilibrium*

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Abstract

One response to the perceived downsides of globalization has been rising pressure by advocacy non-governmental organizations (NGOs) on multinational firms. We build a simple model of NGO-firm interaction embedded in an industry environment with endogenous markups, to study the effect of this pressure on the industry equilibrium (intensity of competition, market structure, and the share of socially responsible firms). In the long run, multiple equilibria might exist: one with fewer firms and a positive share of them being socially-responsible, and the other with more firms but a none of them acting socially responsibly. The welfare in the developing country does not always increase with the NGO pressure.

Keywords: NGOs, corporate social responsibility, private regulation, monopolistic competition.

JEL Classification: L31, L13, D43.

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1 Introduction

Globalization - the increasing international flows of trade and foreign direct investment (FDI) - has been deeply affecting many developing-country economies. One of the principal channels of this influence has been a spectacular rise of the outsourcing in the manufacturing sector into the developing countries with comparative advantage in production of manufactured goods, i.e. large and relatively well-educated labor forces (mainly South-East Asian countries). For example, in the South of China alone, more than 300 factories work for Mattel (a multinational specialized in the production of toys) and more than 15 000 factories in the developing world work for Disney.¹ In 2003 Nike worked with over 900 factories around the world (O'Rourke 2003). Most of those factories are situated in developing countries.

This large-scale change has been mostly led by two fundamental factors. The first is the technological change that allowed producers to split the production process and outsource large segments of the supply chain to subsidiary firms in developing countries. Global outsourcing began in the 1970s by transferring part of the production of shoes, toys, cheap electronics, clothing to China, Taiwan and Malaysia (Gereffi 2006) The second is the huge difference in low-skilled wages between developed and developing countries (for the effect of the wage gap on globalization, see Feenstra 1998, Freeman 1995, and Sachs and Shatz 1996).

Several authors show that this facet of globalization had a substantial positive effect on the welfare of developing-country citizens. Feenstra and Hanson (1996) show how outsourcing increases the average-skill intensity of production and thus the skill premium both in developed and developing countries. This relies on the fact that outsourced activities are unskilled labor-intensive with respect to those conducted in developed countries, but skilled labor-intensive with respect to those conducted in developing countries. Moreover, some empirical studies (Rama 2002, Artecona and Cunningham 2002) show that globalization reduces the gender gap in earnings in poor countries.

However, critics have been arguing that globalization and outsourcing of manufacturing to developing countries have also brought large negative consequences. One issue is that weak environmental standards in developing countries, coupled with the vulnerability of the poor to degradation in environmental conditions, imply that large-scale increase in manufacturing in such a setting can have a large negative effect on the most fragile sections of the

¹The Campaign for Better Working Conditions in the Toys Industry, www.peuples-solidaires.org/c-est-pas-du-jeu.

population (Dalmas 2007, Dasgupta et al. 2002, and Bulte and van Soest 2001). Second, poor state enforcement of international labor standards might imply the rise of 'sweatshops', i.e. the exploitation of workers in the manufacturing firms. Finally, the rapid rise of the manufacturing sector might have led to an increase in social inequality (Stiglitz 2004, Stiglitz and Charlton 2005).

One of the responses to these negative perceptions of globalization has been the emergence of international advocacy non-governmental organizations (NGOs). These entities are mission-oriented organizations whose main objectives are reducing these negative effects of globalization, by exerting pressure on multinational firms, so as to induce them to change their production patterns, internalizing those negative consequences. The well-known examples of such NGO activities include the international campaigns against Nike (triggered by the poor working conditions in its suppliers' factories in Vietnam), WalMart (caused by its' anti-union activities), and Tiffany & Co. (related to the sales of 'conflict' diamonds). The techniques employed by NGOs aimed at multinational firms vary from lawsuits and organized political lobbying to mobilizing consumer protests and boycotts to destruction of firm property. Baron (2010) and Yaziji and Doh (2009) provide good descriptive analyses of the interactions between NGOs and multinational firms.

These activities called by Baron (2001) "private politics" have been increasing mainly because traditional labor and environmental regulations and the government-implemented monitoring and enforcement systems on which they depend are overwhelmed by changes in the global economy (O'Rourke 2003). While precise measures of the evolution of private politics activities by NGOs do not exist, an indication of their rising importance for the corporate world is the twenty-fold increase in the number of citations referring to NGOs in Financial Times over the last ten years (Yaziji and Doh 2009). Harrison and Scorse (2010) show how the number of articles regarding child labor has increased of 300 percent and the number of articles on sweatshop activities has increased by more than 400 percent in the last decade. This shows that the role of NGOs as 'civic regulators' of multinational firms has been turning massive, so as to affect the entire industries (e.g. apparel, textile, mining).

Economists have started recently to study the interactions between NGOs and corporations. While several interesting theoretical models of one-to-one NGO-firm interaction have been developed (Baron 2001, Baron and Diermeier 2007, Feddersen and Gilligan 2001, Immordino 2003), there exist no models that analyze the effects of NGO pressure at industry-

level economic variables, such as aggregate output, market structure, the intensity of competition, and the share of firms that change their production patterns in response to NGO pressure.

Conducting a fully-fledged theoretical analysis of the effects of NGO activity on an industry as a whole (rather than on single firms) is important for several key reasons. First, a host of industry-level variables that are crucial for economic behavior and social welfare are simply not studied in the single-firm models. These include, for instance, the number of firms in the industry and the degree of intensity of competition between firms. Second, industry-level characteristics might, in their turn, affect the individual firms' payoffs from adopting (or not) socially-responsible actions under the pressure by NGOs, as well as the NGOs' payoffs from putting the pressure on firms. In such a case, the industry-level analysis might help to explain empirically the extent of socially-responsible actions by firms and watchdog activities of NGOs by linking them to observable industry-level variables (e.g., market size, entry costs, or the degree of homogeneity of the industry products). Finally, given that NGO pressure affects profits of individual firms and in the long run firms can decide on entry to and exit from the industry, the long-run effects of NGO pressure on corporations can turn out to be quite different from the short-run effects (with a fixed market structure).

The main contribution of this paper is to analyze the industry-level short- and long-run equilibrium effects of NGO pressure. To do so, we build a simple game-theoretic model of the interaction between an NGO and a firm, in which the NGO monitors the adoption by firms of 'socially responsible' actions (e.g. international labor standards or environment-friendly technologies), and the firm decides between adopting a costly socially-responsible action or eschew this action and face the risk of a damage inflicted by the NGO if the non-adoption is discovered. We then embed this interaction in a model of industry equilibrium with heterogeneous firms and endogenous mark-ups, borrowed from the recent theoretical literature in international trade (Melitz and Ottaviano 2008, Ottaviano, Tabuchi, and Thisse 2002). In the short-run industry equilibrium, the model captures the degree of competition in the industry, the monitoring effort by the NGO, and the fraction of firms adopting the socially responsible actions. Allowing for free entry, we then determine, in the long-run equilibrium, in addition to the three variables mentioned above, also the market structure (i.e. the number of firms in the industry). We study how the short- and long-run industry equilibria change

in response to exogenous changes in NGO payoffs, firm technology (production costs), and consumer preferences. Finally, we briefly analyze the implications of encouraging private activism on the welfare of citizens in developing countries.

2 Model

2.1 Setup

Consider an industry with N (identical) firms and one non-governmental organization (NGO). The NGO is mission-oriented organization in the sense of Besley and Ghatak (2005), whose mission involves serving as a watchdog organization of the industry, i.e. as an enforcer of adoption by the firms of certain "socially responsible" actions. These actions are costly for firms but are beneficial for the society at large. Moreover, the government institutions are too weak to enforce these actions via public policies. Thus, in the absence of the NGO pressure, no firm engages in these actions. The examples involve multinational corporations operating in developing countries that choose whether to comply with international labor standards, use environment-friendly production technologies, and adopt affirmative-action human resource management practices.

Consider a typical firm. For simplicity, let's assume that the adoption of socially responsible actions is a binary action, and call the adoption "green" action and the non-adoption "brown" action. Let $e \in [0, 1]$ denote the probability of adopting the "green" action and $E \in [0, 1]$ be the monitoring effort exerted by the NGO.

The timing is as follows:

1. The NGO decides on its monitoring effort E for each firm i . Simultaneously, each firm chooses the "green" action with probability e . The choice of the "green" or "brown" action is irreversible.
2. The NGO discovers the choice of the action by the firm with probability E . If the NGO discovers that the firm has adopted "brown" technology, the firm has to bear an additional cost (as explained below), while the NGO gets a certain benefit H (for example, higher future donations thanks to the media exposure of the NGO campaign).²

²Limardi (2011) reports that an additional case of non-compliance with international labor standards by a multinational firm, discovered by an NGO, triggers an increase of private donations to the NGO or the order of 20 per cent.

The punishment inflicted by the NGO if the misbehavior of the firm is detected can take the form of a boycott, public criticism or reputation-damaging activism (as, for instance, in Baron and Diermeier 2007). Therefore, the additional cost that the firm has to bear can be thought of as the cost of "rebuilding" its reputation. For the sake of simplicity, we assume that the NGO campaign against the misbehaving firm has a sufficiently strong reputational effect to serve as a credible threat for the firm (Baron 2010). Moreover, consumers cannot discern the choice of technology by the firm, we are in the realm of credence goods, since the quality of the good (i.e. the technology it embodies) is not observable neither before nor after purchase it.

Note that we rule out possible cooperation between NGO and firms. This cooperation has been heavily criticized in recent years since auditors in these cooperative programs are paid directly by the firms that are being monitored, which thus leaves substantial scope for corruption. Thus, firms are nowadays reluctant to enter into such agreements and in the last years, a new approach has emerged to respond to this credibility concern. This involves independent monitoring and verification by NGOs. O'Rourke (2003) defines this new monitoring mechanism as "socialized regulation".

The brown action implies for the firm the marginal cost of production equal to c_B , with corresponding profit $\pi(c_B)$. The green action implies a marginal cost φc_B and profits $\pi(\varphi c_B)$. If the NGO detects the brown action of the firm, it is able to impose a penalty, which implies the marginal cost equal to λc_B , and the profit equal to $\pi(\lambda c_B)$. We assume that $\lambda > \varphi > 1$. In other words, the firm's marginal cost is highest when it adopts brown action and gets caught by the NGO, it is smaller if the firm adopts green action, and is smallest when the firm adopts brown action and this action does not get discovered.

2.2 Firm-NGO interaction

At stage 1, the problem of the firm is to maximize its expected profits:

$$e\pi(\varphi c_B) + E(1 - e)\pi(\lambda c_B) + (1 - e)(1 - E)\pi(c_B)$$

The corresponding first-order condition implies the optimal action choice of the firm:

$$e = \begin{cases} 1 & \text{if } \pi(\varphi c_B) > E\pi(\lambda c_B) + (1 - E)\pi(c_B) \\ 0 & \text{if } \pi(\varphi c_B) < E\pi(\lambda c_B) + (1 - E)\pi(c_B) \\ \in [0, 1] & \text{if } \pi(\varphi c_B) = E\pi(\lambda c_B) + (1 - E)\pi(c_B) \end{cases},$$

which can also be written as

$$e = \begin{cases} 1 & \text{if } E > \rho \\ 0 & \text{if } E < \rho \\ \in [0, 1] & \text{if } E = \rho \end{cases}, \quad (1)$$

where

$$\rho \equiv \frac{\pi(c_B) - \pi(\varphi c_B)}{\pi(c_B) - \pi(\lambda c_B)} \quad (2)$$

denotes the relative disincentive (in terms of profit differential) of acting green as compared to acting brown and being punished. Note that ρ increases with the marginal cost of production under green action (φ) and decreases with the cost of punishment (λ).

Intuitively, the firm chooses which of the two losses to avoid: the loss from adopting the green action or the loss from taking the risk of being caught as a brown-action firm. When the monitoring effort of the NGO is sufficiently high, the size of the second loss outweighs that of the first, and the firm prefers to choose the green action.

The problem of the NGO is as follows. Let V_G and $V_B (< V_G)$ denote the per-firm payoff of the NGO if the firm adopts green or brown action, respectively, and H denote the (per-firm) payoff from "capturing" the brown-action firm (i.e. benefits of visibility, as discussed above). The NGO chooses how many firms to inspect. We suppose that inspecting K firms costs $\Psi(K)$ with $\Psi(0) = \Psi'(0) = 0$, $\Psi'(K) \geq 0$, and $\Psi''(K) > 0$ for all $K \in [0, N]$. Therefore, the probability that a given firm is inspected is

$$E = \frac{K}{N}$$

Let's denote with m the fraction of firms that choose the green action. Then, the problem of the NGO is:

$$\max_{K \in [0, N]} K[mV_G + (1 - m)(V_B + H)] + (N - K)[mV_G + (1 - m)V_B] - \Psi(K).$$

The first-order condition of this problem is³:

$$(1 - m)H = \Psi'(K)$$

or

$$(1 - m)H = \Psi'(NE). \quad (3)$$

³The second order condition for a maximum are satisfied as $\Psi''(K) > 0$.

This equation pins down the NGO's optimal choice of monitoring, given the firms' behavior, $E(m)$. Explicitly solving for E , we obtain

$$E = \frac{\Psi'^{-1}((1-m)H)}{N}.$$

Given that Ψ is convex, E is decreasing in m . The intuition is straightforward: higher fraction of firms adopting green action reduces the visibility benefits that the NGO obtains from (costly) monitoring and thus leads to a lower monitoring effort.

Assuming that the number of firms N is sufficiently big, by the law of large numbers, the probability that any given firm chooses the green action is approximately equal to the fraction of green-action firms, i.e. $m = e$. The two first-order conditions, (1) and (3), jointly determine the Nash equilibrium of the game and pin down the equilibrium green-action adoption by firms and monitoring effort by the NGO, m^* and E^* :

$$\begin{aligned} E^* &= \rho = \frac{\pi(c_B) - \pi(\varphi c_B)}{\pi(c_B) - \pi(\lambda c_B)} \\ m^* &= 1 - \frac{\Psi'(N\rho)}{H}. \end{aligned}$$

Figure 1 describes graphically the Nash equilibrium of the game⁴.

[Insert Figure 1 about here]

The equilibrium of the game is in mixed strategies. Intuitively, there cannot exist a pure-strategy equilibrium: if all firms act green, the NGO's best response is not to exert any monitoring effort. If instead, all firms act brown, the NGO has the maximum incentives to monitor; however, then all firms will find it beneficial to switch to acting green. Therefore, in equilibrium, any given firm must be just indifferent between acting green or brown. The equilibrium thus pins down the fraction of firms that act green, $m^* \in (0, 1)$, which must be compatible with the equilibrium monitoring effort of the NGO, $E(m^*)$. Technically, the mixed-strategy equilibrium obtains because the actions of NGO and firms are strategic substitutes and the firms are (ex ante) identical.

Simple comparative statics can be easily performed. An increase in the marginal cost of green-action production (φ) or a fall in the production of punished brown-action firms (λ)

⁴We assume of course that the cost function $\Psi(N\rho)$ is convex enough and/or the reputation gain H small enough to ensure that the equilibrium value of NGO monitoring per firm E is less than 1. Formally this is obtained when $H \leq \Psi'(N)$.

shifts rightward the best response function of firms (1), as it increases the relative disincentives of acting green (as compared to acting brown). Hence, in a new equilibrium, fewer firms act green and the NGO exerts higher monitoring effort. This corresponds to a move from point A to point B in Figure 2.

[Insert Figure 2 about here]

Instead, an increase in the number of the firms in the industry (N), a fall in the visibility benefits of the NGO (H), or an increase in the marginal cost of monitoring ($\Psi'(\cdot)$) leads to a downward shift in the best-response function of the NGO (a reduction in monitoring effort E for a given fraction of green-acting firms m). In a new equilibrium we obtain a lower equilibrium fraction m^* of green-acting firms, whereas the monitoring effort of the NGO $E^* = \rho$ rests the same as before. The intuition for this result is the following. The NGO's decreased payoffs from monitoring (for a given initial level of m) translates into lower monitoring effort. However, this immediately implies that all firms switch to acting brown. Then, the NGO's probability of 'capturing' brown-acting firms shoots up, thus inducing it to restore its effort of monitoring, just to the level where all the firms are again indifferent between acting brown or green. Graphically, this corresponds to a move from point A to point C .

2.3 Market structure

So far we left unspecified the competitive environment of the industry, having this summarized into the profit function $\pi(\cdot)$ of a typical firm evolving in this industry. To be more precise on the interactions between NGO monitoring, competitive strategies and industrial market structure, we need to be more specific on the way firms interact with each other in the sector. At this stage, different alternatives are possible. One way would be to consider an oligopoly industry in which firms interact strategically and there is NGO external monitoring on the choice of technology. It is well known from the literature on strategic trade policy and government regulation (see, for instance, Krugman and Brander 1983, Brander and Spencer 1985, and Eaton and Grossman 1986) that such external interventions in an oligopolistic context lead to strategic effects between firms, as they provide commitment capacities to the firms on their strategic alternatives. However, the nature of these strategic effects depends very much on the mode of competition assumed between firms (Cournot-quantity versus

Bertrand-price competition). We abstract from such oligopolistic strategic effects and focus on the interactions between NGO activity and industrial market structures, by taking the alternative perspective of a monopolistic competitive industry with firms producing horizontally differentiated products (and we leave for future research the analysis of oligopolies in a context with NGOs).

More precisely, we embed our NGO-firm interaction in a simple linear-quadratic model of monopolistic competition with endogenous mark-ups (Ottaviano, Tabucchi and Thisse 2002, Melitz and Ottaviano 2008). We prefer this specification to the standard monopolistic competitive model with Dixit-Stiglitz type preferences for the following reason. The Dixit and Stiglitz (1977) model implies constant mark-ups for firms. This aspect in turn impedes the possibility for competitive pressure to affect firms' margins and firm-level output, reducing significantly the impact of a change in market structure on firms and consequently NGO behavior⁵.

2.3.1 Demand side

Consider an economy with L consumers. Consumer preferences are defined over a continuum of differentiated varieties indexed by $i \in \Omega$ and a homogenous good chosen as the numeraire. The preferences are described by the linear-quadratic utility function

$$U = q_0 + \beta \int_{i \in \Omega} q_i di - \frac{1}{2} \gamma \int_{i \in \Omega} q_i^2 di - \frac{1}{2} \left[\int_{i \in \Omega} q_i di \right]^2,$$

where q_0 and q_i denote consumption of, respectively, the numeraire good and variety i of the differentiated good. The demand parameters β and γ are positive, with β denoting the degree of substitutability between the numeraire good and the differentiated varieties and γ standing for the degree of product differentiation between varieties. If $\gamma = 0$, varieties are perfect substitutes and consumers care only about the total consumption level over all varieties, given by

$$Q^c = \int_{i \in \Omega} q_i di.$$

Let p_i be the price of one unit of variety i , and let's assume that consumers have positive demand for the numeraire good. Then, standard utility maximization gives the individual

⁵In particular, this feature implies that the relative disincentive (in terms of profit differential) of acting green as compared to acting brown and being punished is not affected by the intensity of competition between firms. In such case, the equilibrium NGO monitoring effort is not affected by the degree of competition between firms and the industrial market structure.

inverse demand function

$$p_i = \beta - \gamma q_i - Q^c,$$

whenever $q_i > 0$. This holds when

$$p_i \leq \frac{1}{\gamma + N} (\gamma\beta + N\bar{p}),$$

where N is the measure of the set of varieties Ω with positive demand and \bar{p} is the average price index, given by

$$\bar{p} = \frac{1}{N} \int_{i \in \Omega} p_i di.$$

The average price index equals to

$$\bar{p} = \beta - \frac{\gamma}{N} Q^c - Q^c = \beta - \frac{\gamma + N}{N} Q^c.$$

Total demand for variety i can thus be expressed as

$$q_i = Lq_i = \frac{\beta L}{\gamma + N} - \frac{L}{\gamma} p_i + \frac{N}{\gamma + N} \frac{L}{\gamma} \bar{p}, \quad (4)$$

where q_i is the market demand for variety i . Note that in this linear demand system for varieties, the price elasticity of demand is driven by the intensity of competition in the market. More intense competition is induced either by a lower average price for varieties \bar{p} or by more product varieties (larger N). Thus, the price elasticity of demand increases with N and decreases with \bar{p} .

2.3.2 Production

The numeraire good 0 is produced with constant returns to scale (one unit of good 0 requires one unit of labor) under perfectly competitive conditions. Contrarily, each variety of the differentiated good is produced under monopolistically competitive conditions. Although firms in that differentiated good sector are ex-ante identical, after their choice of action (brown or green) and NGO monitoring, they actually have different ex-post costs of production c_i : c_B for brown firms that are not punished by the NGO, λc_B for those brown firms that are punished and φc_B for the green firms.

Consider now a given variety i produced with marginal cost c_i . Then, profits for that variety can be written as

$$\pi_i = q_i(p_i - c_i).$$

The profit maximizing output level $q_i = q(c_i)$ and price level $p_i = p(c_i)$ are related to each other by the following expression:

$$q_i = q(c_i) = \frac{L}{\gamma} [p(c_i) - c_i]. \quad (5)$$

Note that output per firm increases with the size of the market L .

The profit-maximizing price can be written as

$$p(c_i) = \frac{1}{2} \left[c_i + \frac{\beta\gamma}{\gamma + N} + \frac{N}{\gamma + N} \bar{p} \right]. \quad (6)$$

Thus, the (absolute) markup over price is

$$p(c_i) - c_i = \frac{1}{2} \left[\frac{\beta\gamma}{\gamma + N} + \frac{N}{\gamma + N} \bar{p} - c_i \right]. \quad (7)$$

In addition to the taste for variety parameter γ , the markup is now also determined by the intensity of competition which depends on the average price for varieties \bar{p} and on the number of N varieties and firms in the market.

The average price \bar{p} and average cost \bar{c} can be expressed as

$$\bar{p} = \frac{\bar{c} + \frac{\beta\gamma}{\gamma + N}}{\frac{2\gamma + N}{\gamma + N}}, \quad (8)$$

$$\bar{c} = \frac{1}{N} \int_{i \in \Omega} c_i di, \quad (9)$$

and, therefore, the equilibrium profits of a firm with cost c_i are given by

$$\pi(c_i) = \frac{L}{4\gamma} [c_D - c_i]^2. \quad (10)$$

Here, c_D is the cut-off cost level

$$c_D = \frac{2\beta\gamma}{2\gamma + N} + \frac{N}{2\gamma + N} \bar{c} \quad (11)$$

i.e. it is the level of the cost for a firm that is indifferent between remaining in the industry or exiting. This firm earns zero profits, given that its price is driven down to the marginal cost, $p(c_D) = c_D$. Any firm with the marginal cost $c_i < c_D$ earns positive profits.

The cut-off cost level c_D captures the intensity of competition in the industry. This cut-off cost declines (i.e. the competition is more intense) when there are more firms in the industry (larger N), when more low-cost firms are present in the market (lower \bar{c}), and when varieties are closer substitutes (smaller γ).⁶

⁶See Melitz and Ottaviano (2008) for the formal proof and further details.

2.4 Short-run industry equilibrium with NGO monitoring

We are now ready to analyze the industry equilibrium with NGO monitoring. Substitution of (10) into (2) gives us the threshold level:

$$\rho = \frac{(c_D - c_B)^2 - (c_D - \varphi c_B)^2}{(c_D - c_B)^2 - (c_D - \lambda c_B)^2} = \frac{(\varphi - 1)[2c_D - (\varphi + 1)c_B]}{(\lambda - 1)[2c_D - (\lambda + 1)c_B]}.$$

Note that the relative disincentives to act green versus brown (ρ) depends now on the cut-off cost level c_D . Deriving ρ with respect to c_D , we obtain:

$$\frac{\partial \rho}{\partial c_D} = \frac{2c_B(\varphi - \lambda)}{(\lambda - 1)[2c_D - (\lambda + 1)c_B]^2} < 0.$$

To understand the economic intuition for this, see Figure 3 which plots the profit functions of the brown-acting firm without punishment, of the green-acting firm, and of the brown-acting firm with punishment. The numerator of ρ is the difference between the profit of the brown-acting firm (unpunished) and that of the green-acting firm. Graphically, this corresponds to the vertical distance between curves x and y . Similarly, the denominator of ρ is the difference between the profit of the brown-acting firm (unpunished) and that of the brown-acting punished firm. Graphically, this difference is described by the vertical distance between curves x and z . Take some cost level c_D . One clearly sees that a small decrease in this cost, $c_D - \varepsilon$, implies a bigger relative fall in the distance between x and z curves than in the distance between x and y curves, i.e. when c_D decreases, the denominator of ρ shrinks faster (at the rate $2(\lambda - 1)$) than its numerator (which shrinks at the rate $2(\varphi - 1)$).

The Nash equilibrium (m^*, E^*) thus becomes⁷

$$\begin{aligned} E^*(c_D) &= \frac{(\varphi - 1)[2c_D - (\varphi + 1)c_B]}{(\lambda - 1)[2c_D - (\lambda + 1)c_B]}, \\ m^* &= 1 - \frac{\Psi'(NE^*(c_D))}{H}. \end{aligned}$$

Note that E^* is negatively sloped in the cut-off cost level, c_D , i.e. the equilibrium monitoring effort increases with the intensity of competition in the market:

$$\frac{\partial E^*(c_D)}{\partial c_D} = \frac{\partial \rho}{\partial c_D} < 0.$$

Intuitively, an increase in the intensity of competition (i.e. lower c_D) reduced more the disincentive from acting brown than the disincentive to act green. Therefore, at a given

⁷Note that a necessary and sufficient condition to have $E^*(c_D) < 1$ is that $2c_D > (\lambda + \varphi)c_B$ which is satisfied as long as $c_D > \lambda c_B > \varphi c_B$ (something that we assume).

NGO monitoring intensity, firms now have a lower incentive to act green. This implies that all firms start (temporarily) acting brown. Then, as the NGO adjusts its monitoring effort (upwards), the level of monitoring that makes the firms again indifferent between the two technologies increases. Thus, in the new equilibrium, we observe higher monitoring effort but a lower fraction of green-action firms.

Thus, given (3) and (11), the industry equilibrium is described by the following system:

$$\begin{aligned} E^*(c_D) &= \frac{(\varphi - 1)[2c_D - (\varphi + 1)c_B]}{(\lambda - 1)[2c_D - (\lambda + 1)c_B]} \\ m^* &= 1 - \frac{\Psi'(NE^*(c_D))}{H} \\ c_D &= \frac{2\beta\gamma}{2\gamma + N} + \frac{N}{2\gamma + N}\bar{c}(m, E) \end{aligned} \tag{12}$$

where, the industry average cost is given by:

$$\bar{c}(m, E) = [m\varphi + (1 - m)(E\lambda + (1 - E))]c_B$$

As shown in the appendix, simple inspection shows that, because of $\lambda > \varphi$, the function $\bar{c}(m, E^*(c_D))$ is decreasing in m , the fraction of firms acting green:

$$\frac{\partial \bar{c}(m, E^*(c_D))}{\partial m} < 0.$$

Intuitively, as $\lambda > \varphi$, the expected cost of acting brown (and eventually being punished) is larger than the cost of acting green. Hence, an increase in the fraction of green-action firms should lead to a reduction of the industry-average cost.

We may then rewrite the equilibrium conditions (12) as

$$\begin{aligned} E^*(c_D) &= \frac{(\varphi - 1)[2c_D - (\varphi + 1)c_B]}{(\lambda - 1)[2c_D - (\lambda + 1)c_B]} \\ m^* &= 1 - \frac{\Psi'(NE^*(c_D))}{H} \\ c_D &= \frac{2\beta\gamma}{2\gamma + N} + \frac{N}{2\gamma + N}\bar{c}(m, E^*(c_D)) \end{aligned} \tag{13}$$

For a given value of firms N in the industry, the second equation provides a positively-sloped relationship $m = \tilde{m}(c_D)$ and the third equation provides a negatively-sloped relationship $c_D = \tilde{c}_D(m)$. Hence the intersection of these two relationships (and, therefore, the short run industry equilibrium) is unique.⁸

⁸The formal proof of existence and uniqueness of the industry equilibrium for a given N is provided in the Appendix.

[Insert Figure 4 about here]

This is illustrated in Figure 4 which constructs graphically the short-run equilibrium. The bottom-left segment is simply Figure 1. Consider now two values of the cut-off cost level, c_D^0 and $c_D^1 (< c_D^0)$. The cut-off cost level c_D^0 corresponds to a certain level of equilibrium monitoring effort E^0 and a fraction of green-acting firms m^0 . As the intensity of competition in the product market increases (a move from c_D^0 to c_D^1), the negative relationship between c_D and E (the first equation of (13), depicted in the bottom-right segment of Figure 4) maps into a lower equilibrium fraction of firms acting green, as explained above. This, via the 45° line on the top-left segment, maps into the level m^1 , on the top-right panel of the figure. This gives us the relationship $m = \tilde{m}(c_D)$, described by the second equation of (13). Adding to this the relationship $c_D = \tilde{c}_D(m)$, operating via the industry-average cost \bar{c} and described graphically by the negatively-sloped line on the top-right panel, completes the construction of the equilibrium.

2.4.1 Comparative statics

We may now proceed to some simple comparative statics, analyzing the effect of changes in the exogenous parameters on the short-run industry equilibrium. In particular, we concentrate on the following changes:

- *Changes in the NGO payoffs:* an increase in H or a fall in $\Psi'(\cdot)$ (higher visibility benefit that the NGO gets per each brown-action firm punished or lower marginal cost of monitoring effort);
- *Changes in (relative) production costs:* an increase in λ (stronger effect of punishment by the NGO on firms' production costs); a decrease in φ (lower cost of acting green), a higher value of c_B (higher baseline marginal costs, e.g. coming from higher wages for the low-skilled labor in the developing country);
- *Changes in market structure:* a higher value of N (more firms in the industry; this will be endogenized in the long-run);
- *Changes in consumers' tastes:* a higher β or γ (higher elasticity of substitution between the numeraire good and the differentiated good or between the varieties of the differentiated good).

We consider each of them in turn.

Effect of changes in the NGO payoffs An increase in H or a fall in $\Psi'(\cdot)$ qualitatively have the same effect on the equilibrium values. Such a change only affects the $\tilde{m}(c_D)$ line, by shifting it leftward/up. Intuitively, the change occurs in the following manner. The first effect is that at a given level of intensity of competition, the monitoring effort by the NGO increases. Consequently, the fraction of green-acting firms increases. This corresponds to the move from A to B on Figure 5a.

[Insert Figure 5a about here]

This, in turn, leads to a decrease in the industry-average production cost, leading to tougher competition, which partially mitigates the incentives to act green. Thus, the fraction of green-acting firms falls, settling at the new equilibrium level which is higher than at the initial equilibrium (the move from B to C). We thus end up in the new equilibrium, with more intense competition and a higher fraction of green-acting firms:

$$\frac{\partial c_D}{\partial H} < 0, \quad \frac{\partial m^*}{\partial H} > 0, \quad \frac{\partial c_D}{\partial \Psi'(\cdot)} > 0, \quad \frac{\partial m^*}{\partial \Psi'(\cdot)} < 0$$

Effect of changes in (relative) production costs The effects of an increase in λ , a decrease in φ , and a decrease in c_B are qualitatively identical. Intuitively, as the cost of being punished by the NGO increases, all the firms temporarily want more to adopt the green action. The NGO's incentives to monitor fall; the required monitoring effort to make firms again indifferent (between the green and brown actions) goes down, but a higher fraction of firms act green. Thus, for a given intensity of competition, the fraction of green-acting firms goes up (leftward/up shift of the $\tilde{m}(c_D)$ line on Figure 5b and a move from point A to B)

[Insert Figure 5b about here]

However, an increase in λ affects also the $\tilde{c}_D(m)$ relationship. Given that the NGO monitoring falls, fewer brown-action firms are punished ex post. This reduces the industry-average cost and thus increases the intensity of competition (leftward shift of the $\tilde{c}_D(m)$ line, move from point B to C).

Thus, overall, the effect on c_D is clearly negative (i.e. equilibrium competition become much more intense). However, the net effect on the equilibrium fraction of green-acting firms is ambiguous:

$$\frac{\partial c_D}{\partial \lambda} < 0, \quad \frac{\partial m^*}{\partial H} \geq 0, \quad \frac{\partial c_D}{\partial \varphi} > 0, \quad \frac{\partial m^*}{\partial \varphi} \geq 0, \quad \frac{\partial c_D}{\partial c_B} > 0, \quad \frac{\partial m^*}{\partial c_B} \geq 0.$$

Effect of changes in market structure An exogenous increase in the number of firms in the industry, *ceteris paribus*, makes the market competition more aggressive (a reduction in c_D). This induces a lower fraction of firms to act green (graphically, this corresponds to a leftward shifts in the $\tilde{c}_D(m)$ line and the move from point A to B on Figure 5c).

[Insert Figure 5c about here]

This increases the NGO's incentives to monitor more, and the resulting increase in the brown-acting firms that are punished partially compensates the fall in c_D . However, the increase in N has also a second effect: more firms imply higher marginal cost of monitoring, which induces the NGO to adjust downwards its monitoring effort (dilution effect). Foreseeing this, even fewer firms act green, and we end up with an unambiguously lower fraction of firms acting green (rightward shift of the $\tilde{m}(c_D)$ line, a move from point B to C). The total effect on equilibrium competition is ambiguous: as there are fewer green firms, the industry-average cost increases, and this softens the competition. However, the increase in the number of firms directly makes the market more competitive:

$$\frac{\partial c_D}{\partial N} \geq 0, \quad \frac{\partial m^*}{\partial N} < 0.$$

Effect of changes in consumer tastes Finally, let's consider an increase in β (or in γ , which has the same qualitative effects). This reduction in the degree of substitutability between the numeraire and the differentiated good relaxes the competition (an increase in c_D) and thus shifts the $\tilde{c}_D(m)$ line to the right (move from point A to B in Figure 5d).

[Insert Figure 5d about here]

This reduces the relative disincentive of acting green and thus increases the fraction of green-acting firms. This reduces industry-average costs, and partially compensates the fall in the intensity of competition (move from point B to C). The new equilibrium exhibits weaker competition and a higher fraction of firms acting green:

$$\frac{\partial c_D}{\partial \beta} > 0, \quad \frac{\partial m^*}{\partial \beta} > 0, \quad \frac{\partial c_D}{\partial \gamma} > 0, \quad \frac{\partial m^*}{\partial \gamma} < 0.$$

2.5 Long-run industry equilibrium

Next, we endogenize the market structure of the industry, by supposing that the entry into the industry is unrestricted. Then, in the long run, firms can enter and exit the industry. What will the equilibrium look like in the long run? The free-entry condition that pins it down equates the expected profit of a typical firm in the industry to the fixed cost of entry, which we denote with F :

$$m^e \pi(\varphi c_B) + E^e (1 - m^e) \pi(\lambda c_B) + (1 - m^e)(1 - E^e) \pi(c_B) = F.$$

Here, the long-run equilibrium values are denoted with subscript e . Given that the equilibrium strategy of a firm (in terms of green/brown action) is mixed, i.e. $m^e \in (0, 1)$, with any firm being indifferent between acting green or brown, the free-entry condition reduces to

$$\pi(\varphi c_B) = F,$$

or, using the expression for profits (10),

$$\frac{L}{4\gamma} [c_D - \varphi c_B]^2 = F.$$

This condition allows us to calculate the equilibrium intensity of competition⁹. Under free entry, the indicator of the intensity of competition, the cut-off marginal cost c_D^e , becomes

$$c_D^e = \varphi c_B + \sqrt{\frac{4\gamma F}{L}}. \quad (14)$$

Given (14), we then immediately obtain the long-run equilibrium values of the fraction of green-action firms m^e , NGO monitoring E^e , and the number of firms in the industry N^e :

$$E^e = \frac{(\varphi - 1) [2c_D^e - (\varphi + 1)c_B]}{(\lambda - 1) [2c_D^e - (\lambda + 1)c_B]} \quad (15)$$

$$m^* = 1 - \frac{\Psi'(NE^e)}{H} \quad (16)$$

$$c_D^e = \frac{2\beta\gamma}{2\gamma + N} + \frac{N}{2\gamma + N} \bar{c}(m^e, E^e). \quad (17)$$

⁹Technically, we require that $c_D > \lambda c_B$, because otherwise firms that are punished have to exit the market. We therefore assume that

$$\varphi c_B + \sqrt{\frac{4\gamma F}{L}} \geq \lambda c_B,$$

to ensure that c_D is always larger than λc_B . This basically corresponds to assuming that there is sufficient product differentiation.

Substituting (14) into (17) gives:

$$\varphi c_B + \sqrt{\frac{4\gamma F}{L}} = f(m, N). \quad (18)$$

Equation (16) defines a decreasing relationship $m = \bar{m}(N)$ between the share of green-action firms and the total number of firms in the industry. Intuitively, a higher number of firms increases the marginal cost of monitoring effort for the NGO, by the dilution effect. At a given level of monitoring effort, this higher cost has to be compatible with a higher marginal (visibility) benefit, i.e. a smaller share of firms acting green.

Equation (18), instead, describes a decreasing relationship $N = \bar{N}(m)$. The intuition for this is that if the share of green-action firms in the market increases, the cut-off level compatible with it decreases (because the green-action firms that have lower marginal costs than the (punished) brown-action ones), and this makes the market competition tougher. Hence, at the current industry structure, firms start making losses and some of them will exit the industry in the long run. This process will continue until the expected profits of firms does not make the free-entry condition hold again.

We can now analyze the shape of the equilibrium. For this, we first make the following convenient assumption:

$$\textbf{Assumption A} : [\beta - \varphi c_B]^2 > \frac{4\gamma F}{L} > [\lambda - \varphi]^2 c_B^2.$$

This assumption ensures two things. The first inequality ensures that the degree of substitutability between the numeraire good and the differentiated varieties β is large enough to get a positive demand for the differentiated products under free entry (i.e. $\beta > c_D^e$); The second inequality shows that the toughness of competition consistent with free entry is not too strong (i.e. $c_D^e > \lambda c_B$), ensuring that the punished acting brown firms are not driven out from the market.

Let's start first with the relationship $m = \bar{m}(N)$, described by the equation

$$m = 1 - \frac{\Psi'(NE^e)}{H}.$$

This relationship describes the fraction of green-acting firms m consistent with a free entry industry equilibrium with N active firms and an NGO effort of E^e . Given that the cost of monitoring effort $\Psi(\cdot)$ is convex, $m = \bar{m}(N)$ is monotonically decreasing, which takes the

value equal to zero at the point

$$N^0 = \frac{\Psi'^{-1}(H)}{E^e}.$$

Beyond point N^0 , we hit the corner solution $m = 0$. No firm adopts the green technology because of the strong dilution effect on NGO monitoring. The probability of being discovered as acting brown (and, consequently, being punished) is too small to deter firms to act green. Obviously this threshold N^0 is increasing in the visibility gain of the NGO H and decreasing in the convexity of the NGO cost function $\Psi(\cdot)$.

Let's now turn to the relationship $N = \bar{N}(m)$. This curve describes the free entry market structure N , given a fraction m of firms with costs φc_B (i.e., acting green), a fraction $(1 - m) E^e$ of firms with costs λc_B (i.e. acting brown and being punished) and a fraction $(1 - m)(1 - E^e)$ of firms with costs c_B (i.e. acting brown and remaining undiscovered).

Using (17) we can be shown (see Appendix) that $\bar{N}(m)$ takes an hyperbolic decreasing form:

$$N = \bar{N}(m) = \frac{2\gamma(\beta - c_D^e)}{\Omega_1(c_D^e)m - \Omega_0(c_D^e) + c_D^e},$$

where $\Omega_0(c_D^e)$ and $\Omega_1(c_D^e)$ are two positive constants with $\Omega_0(c_D^e) < c_D^e$ under Assumption A. At $m = 0$, this function takes the value

$$\bar{N}(0) = \frac{2\gamma(\beta - c_D^e)}{c_D^e - \Omega_0(c_D^e)} > 0.$$

We can also show (see Appendix) that under Assumption A, there exists at least one free entry industry equilibrium with NGO monitoring. Figure 6 describes the long-run industry equilibrium graphically.

Typically, when $N^0 > \bar{N}(0)$, which can also be written as:

$$H > \Psi' \left(E^e \frac{2\gamma(\beta - c_D^e)}{c_D^e - \Omega_0(c_D^e)} \right). \quad (19)$$

The free entry equilibria have to be with a strictly positive number of firms acting green (i.e. $m^* > 0$). On the other hand when (19) is not satisfied, the situation with no firm acting green (i.e. $m^* = 0$) is necessarily a free entry industry equilibrium. Intuitively, condition (19) requires that if no firm acts green ($m = 0$) and free entry into the industry is allowed, the NGO has sufficient incentives to start monitoring. This will occur when the visibility benefit to discover brown firms H is large enough and/or its marginal cost curve $\Psi'(\cdot)$ is not too steep (i.e. the cost function $\Psi(\cdot)$ is not too convex).

Concentrating on the interior industry equilibria as shown in Figure 6, a necessary and sufficient condition to get a *unique* interior equilibrium is the fact that at the equilibrium, the $\bar{N}(m)$ curve is flatter than the $\bar{m}(N)$ curve. This second condition can be interpreted as follows. Under NGO monitoring, the number of firms in the industry affects the cut-off cost level c_D in two ways. The first one is the direct (negative) Melitz-Ottaviano effect of competition. The second is the indirect positive effect: it comes from the fact that the higher number of firms in the industry induces the NGO to reduce its per-firm monitoring effort, and this leads to fewer firms acting green (i.e. lower m) and, consequently, to a higher *ex post* industry-average production cost (given that $\lambda > \varphi$). The second condition states that the first (direct) effect outweighs the second (indirect) one. Formally, the condition writes as

$$-\frac{\partial c_D}{\partial N} > -\frac{\partial c_D}{\partial m} \frac{\Psi''}{H} E^e, \quad (20)$$

where

$$\begin{aligned} \frac{\partial c_D}{\partial N} &= A'(N) + B'(N)\bar{c}(m, E^e) < 0, \\ \frac{\partial c_D}{\partial m} &= B(N) \frac{\partial \bar{c}(m, E^e)}{\partial m} < 0, \text{ with } A \equiv \frac{2\beta\gamma}{2\gamma + N}, \text{ and } B \equiv \frac{N}{2\gamma + N}. \end{aligned}$$

2.6 Comparative statics in the long run

How does an increase in the market size or a decrease in the fixed cost of entry affect the long-run equilibrium? Using our analysis above, we can now conduct this comparative statics exercise. Consider an increase in L (a decrease in F has the same qualitative effect). Its first effect is on $\bar{m}(N)$ relationship: larger market size implies that the profit of any given firm increases, which in turn stimulates entry and increases the toughness of competition (i.e. c_D^e goes down). As we know in a more competitive environment, firms have relatively less incentives to act green. A lower share of firms then chooses to act green, while the equilibrium level of NGO monitoring that makes the firms indifferent between acting green and acting brown should increase. In the long-run, as increased profits attract new entrants, the number of the firms in the industry increases. The impact of a larger market L corresponds to a counter-clockwise rotation in the $\bar{m}(N)$ line and a move from point A to B on Figure 7.

There is however also a second effect (reinforcing the first one). An increase in the market size also affect the $\bar{N}(m)$ relationship. Indeed, again, as the market becomes larger and competition more intensive, the equilibrium monitoring effort of the NGO E^e increases.

Ceteris paribus, this increases the fraction of punished brown firms and consequently the average cost of production \bar{c} in the industry. This, in turn, tends to soften the intensity of competition in the industry, inducing further entry of firms into the sector. Graphically, this comparative statics corresponds to an upward shift in the $\bar{N}(m)$ curve and the move from point B to C . Thus, the overall effect is the higher number of firms in the industry in the long run, a smaller share of them acting green, and more intense equilibrium monitoring by the NGO. These results can be summarized as:

$$\begin{aligned} \frac{\partial N^*}{\partial L} &> 0, & \frac{\partial m^*}{\partial L} &< 0, & \frac{\partial E^*}{\partial L} &> 0, \\ \frac{\partial N^*}{\partial F} &< 0, & \frac{\partial m^*}{\partial F} &> 0, & \frac{\partial E^*}{\partial F} &< 0. \end{aligned}$$

Another interesting comparative statics concerns the effect of increased visibility H of the NGO. This could reflect a more sensitive public opinion (to the NGO's advocacy activities) or an increased value of the NGO reputation and competence (for instance, caused by increased competition on the fundraising side). Simple inspection shows that an increase in H only affects the curve $\bar{m}(N)$. As H increases, the NGO has more incentives to monitor the industry. In order to re-adjust downward this monitoring effort to the level E^e that makes firms indifferent between acting brown or green, there should be an increase in the fraction of firms acting green in the sector. Graphically, the shift associated with an increase in H corresponds to a clockwise rotation in the $\bar{m}(N)$ line and a move from point A to B on Figure 8. The new equilibrium in B has a lower number of firms N in the industry and a larger fraction of firms acting green. The monitoring effort of the NGO in equilibrium is unaffected:

$$\frac{\partial N^*}{\partial H} < 0, \quad \frac{\partial m^*}{\partial H} > 0, \quad \frac{\partial E^*}{\partial H} = 0.$$

2.7 Multiple equilibria

Note that when $N^0 > N(0)$ and the condition (20) is not satisfied, our model may deliver multiple equilibria in the industry. Under NGO monitoring, the number of firms in the industry affects the cut-off cost level c_D in two ways. The first one is the direct (negative) Melitz-Ottaviano effect of competition: more firms in the industry lead to tougher competition. The second is an indirect positive effect: a higher number of firms induces the NGO to reduce its per-firm monitoring effort. This leads to fewer firms acting green (i.e. lower m) and as a consequence, to a higher *ex post* industry-average production cost (given that

$\lambda > \varphi$), relaxing the intensity of competition. This softening of competition, in turn, stimulates entry in the industry. When (20) does not hold, the second effect may dominate the first (direct) conventional effect and this creates a source of multiple equilibria. As shown in Figure 9, there can be one stable equilibrium at point C with few firms, a moderate level of competition, a relatively large fraction of firms acting green and a low level of NGO monitoring and another stable one at point A , with more intense competition, a smaller fraction of green firms and a more intense NGO monitoring.

Even when condition (20) is satisfied, but $N^0 < N(0)$, there still might be multiple equilibria in the long run. As we know, one equilibrium is the corner equilibrium (point A) with $N(0)$ firms (all of which act brown) and a relatively high level of NGO monitoring. As Figure 10 shows, there might also exist (at point C) an interior stable equilibrium (m^e, N^e) , with a smaller number of firms (some of them acting green) and, consequently, less intense NGO monitoring in equilibrium.

Interestingly, in such a situation, a small change that reverts the order ($N^0 > N(0)$ instead of $N^0 < N(0)$) can lead to a dramatic change in industry structure and NGO activity. Consider an increase in NGO visibility H or a reduction in the marginal cost of monitoring $\Psi'(\cdot)$. Such a shift will lead to a clockwise rotation in the $\bar{m}(N)$ line around the point $(1, 0)$ in Figure 11. A sufficiently large change in one of these parameters destroys the corner equilibrium at point A (with only brown acting firms and a market structure at $N(0)$). The increased NGO visibility will immediately result in higher NGO activity and monitoring, inducing some firms to adopt the green technology. As the fraction m of green firms increases in the industry, this reduces average costs of production in the industry and intensifies competition. This, in turn, induces some firms to exit the sector, relaxing market competition, and inducing an even larger fraction of firms to adopt the green technology. As this happens, the level of NGO monitoring decreases to adjust to its new long run situation which is a point C' . Paradoxically, the level of NGO activity in the long run can be lower than what it was in the initial equilibrium (with only brown-acting firms). The reason is simply that there has been an endogenous shift of market structure (towards less competition) which is more conducive of green technology adoption and, therefore, less need for NGO monitoring. Importantly, the long-run observational response of the NGO monitoring may be different from its short run reaction, as it interacts endogenously with the evolution of the industry market structure.

3 Conclusion

This paper has built a simple model of NGO-firm interaction embedded in an industry environment with endogenous markups. We have studied the effect of the watchdog NGO pressure on the industry equilibrium, in particular, on the intensity of competition, market structure, and the share of firms acting in socially responsible manner. In addition to analyzing the short-run effects of an exogenous change in NGO payoffs, production costs, market structure, or consumer preferences, we have analyzed the long-run behavior of the industry and the NGO. In the long run, we find that multiple equilibria can exist (one with fewer firms and a positive share of them being socially-responsible, and the other with more firms but a none of them acting socially responsibly).

What are the social or policy implications of our findings? Consider citizens' welfare in a developing country, in which a large share of workers is employed in manufacturing. Our long-run analysis indicates that a policy-driven increase in H does not necessarily improve the welfare of the workers in the developing country. This occurs because such a change will engender two effects: on the one hand, it will lead to more intensive monitoring by the NGO, but, on the other hand, it will lower the number of firms staying in the sector. The first effect unambiguously increases the welfare of workers, but the second reduces it. Thus, if the second effect is sufficiently large, promoting or subsidizing watchdog NGOs' activity in developing countries can reveal itself counterproductive.

We conclude by suggesting one direction for future work. The choice of acting green or brown in our model is assumed to be irreversible. In a more realistic model, firms would change their actions over time, which would imply that any given firm solves some kind of a optimal stopping problem, i.e. when to switch from the brown action to the green one. Exploring the robustness of our findings in such more general model would be very interesting.

4 Appendix

- **Proof that** $\frac{\partial \bar{c}(m, E^*(c_D))}{\partial m} < 0$.

Note that at the equilibrium value of NGO monitoring, the marginal cost of the brown-action firms is, on average, equal to

$$[E^*(c_D)\lambda + (1 - E^*(c_D))] c_B = \left[\frac{(\varphi - 1) [2c_D - (\varphi + 1)c_B]}{[2c_D - (\lambda + 1)c_B]} + 1 \right] c_B$$

As $\lambda > \varphi$, we have

$$\frac{2c_D - (\varphi + 1)c_B}{2c_D - (\lambda + 1)c_B} > 1$$

Hence

$$\left[\frac{(\varphi - 1)[2c_D - (\varphi + 1)c_B]}{2c_D - (\lambda + 1)c_B} + 1 \right] c_B > (\varphi - 1)c_B + c_B = \varphi c_B,$$

and

$$[E^*(c_D)\lambda + (1 - E^*(c_D))] c_B > \varphi c_B.$$

From here, it follows that

$$\frac{\partial \bar{c}(m, E^*(c_D))}{\partial m} = \varphi c_B - [E^*(c_D)\lambda + (1 - E^*(c_D))] c_B < 0.$$

QED.

• **Proof of existence and uniqueness of an equilibrium for a given N**

First, note that

$$\lim_{c_D \rightarrow \infty} E^*(c_D) = \hat{E} = \frac{\varphi - 1}{\lambda - 1} < 1.$$

Given the assumption that $c_D \geq \lambda c_B$,

$$E^*(c_D) < E^*(\lambda c_B) = \frac{(\varphi - 1)(2\lambda c_B - (\varphi + 1)c_B)}{(\lambda - 1)(2\lambda c_B - (\lambda + 1)c_B)}$$

Therefore, $m = \tilde{m}(c_D)$ is increasing in c_D , with

$$\lim_{c_D \rightarrow \infty} \tilde{m}(c_D) = 1 - \frac{\Psi'(N\hat{E})}{H} < 1$$

and

$$\tilde{m}(\lambda c_B) = 1 - \frac{\Psi'(NE^*(\lambda c_B))}{H}.$$

At the same time, for the second relationship ($c_D = \tilde{c}_D(m)$), we have

$$\frac{\partial \tilde{c}_D(m)}{\partial m} = \frac{B(N) \frac{\partial \bar{c}(m, E^*(c_D))}{\partial m}}{1 - B(N)(1 - m)(\lambda - 1)c_B \frac{\partial E^*(c_D)}{\partial c_D}} < 0,$$

where

$$A(N) = \frac{2\beta\gamma}{2\gamma + N} < \beta \quad \text{and} \quad B(N) = \frac{N}{2\gamma + N} < 1.$$

Thus, $\tilde{c}_D(m)$ is decreasing in m , and, moreover,

$$\begin{aligned}\tilde{c}_D(0) &= A(N) + B(N) [E(\tilde{c}_D(0)) \lambda c_B + (1 - E(\tilde{c}_D(0))) c_B], \\ \tilde{c}_D(1) &= A(N) + B(N) c_G.\end{aligned}$$

Next, denote as $\Theta(m) = \tilde{m} [\tilde{c}_D(m)] - m$. This function has the following properties:

$$\Theta'(m) = \tilde{m}' [\tilde{c}_D(m)] \tilde{c}'_D(m) - 1 < 0,$$

with $\Theta(0) = \tilde{m} [\tilde{c}_D(0)] > 0$ and $\Theta(1) = \tilde{m} [\tilde{c}_D(1)] - 1 < 1 - \frac{\Psi'(N\hat{E})}{H} - 1 < 0$. Thus, there exists a unique value $m^{SR} \in (0, 1)$ such that $\Theta(m^{SR}) = 0$. Consequently, there is a unique fixed point m^{SR} and a unique equilibrium $m^{SR}(N)$, c_D^{SR} and E^{SR} , given by

$$\Theta(m^{SR}) = 0; \quad c_D^{SR} = \tilde{c}_D(m^{SR}); \quad E^{SR} = E^*(\tilde{c}_D(m^{SR})).$$

QED.

• **Proof of existence of an industry equilibrium with free entry**

- **The curve $N = \bar{N}(m)$:**

Consider first the relationship $N = \bar{N}(m)$. Note first that using the first equation of (13), the industry-average cost $\bar{c}(m, E)$ writes as:

$$\begin{aligned}\bar{c}(m, E) &= [m\varphi + (1 - m)(E\lambda + (1 - E))] c_B = \\ &= [1 + E(\lambda - 1) + m((\varphi - 1) - E(\lambda - 1))] c_B = \\ &= c_B \left[1 + \frac{(\varphi - 1)(2c_D - (\varphi + 1)c_B)}{2c_D - (\lambda + 1)c_B} + m \left((\varphi - 1) - \frac{(\varphi - 1)(2c_D - (\varphi + 1)c_B)}{2c_D - (\lambda + 1)c_B} \right) \right] \\ &= \Omega_0(c_D) - \Omega_1(c_D)m,\end{aligned}$$

where

$$\Omega_0(c_D) \equiv c_B [1 + E(\lambda - 1)] = \frac{c_B [\varphi(2c_D - \varphi c_B) - \lambda c_B]}{2c_D - (\lambda + 1)c_B}$$

and

$$\Omega_1(c_D) \equiv c_B [(\varphi - 1) - E(\lambda - 1)] = \frac{(\lambda - \varphi)(\varphi - 1)c_B^2}{2c_D - (\lambda + 1)c_B} > 0.$$

Note that as long as $\lambda c_B < c_D$, one has $\Omega_0(c_D) < c_D$. Indeed, as

$$E = \frac{(\varphi - 1)(2c_D - (\varphi + 1)c_B)}{(\lambda - 1)(2c_D - (\lambda + 1)c_B)} < 1$$

Then:

$$\Omega_0(c_D) = c_B [1 + E(\lambda - 1)] < \lambda c_B < c_D$$

Using the previous expression for $\bar{c}(m, E)$, (17) now becomes

$$\begin{aligned} c_D^e &= \frac{2\beta\gamma}{2\gamma + N} + \frac{N}{2\gamma + N} \bar{c}(m^e, E^e) = \\ &= \frac{1}{2\gamma + N} (2\beta\gamma + N [\Omega_0(c_D^e) - \Omega_1(c_D^e)m^e]). \end{aligned}$$

Solving this equation for N , we obtain

$$N = \frac{2\gamma(\beta - c_D^e)}{\Omega_1(c_D^e)m^e - \Omega_0(c_D^e) + c_D^e}.$$

Thus, the relationship $N = \bar{N}(m)$ is hyperbolic and decreasing. At $m = 0$ it takes the value

$$N(0) = \frac{2\gamma(\beta - c_D^e)}{c_D^e - \Omega_0(c_D^e)}.$$

- **The curve** $m = \bar{m}(N)$:

Let's now turn to the relationship $m = \bar{m}(N)$, described by the equation

$$m = 1 - \frac{\Psi'(N^e E^e)}{H}.$$

Given that the cost of monitoring effort $\Psi(\cdot)$ is convex, $m = \bar{m}(N)$ is monotonically decreasing, which takes the value equal to zero at the point

$$N^0 = \frac{\Psi'^{-1}(H)}{E^e}.$$

and such that $\bar{m}(0) = 1$ (as $\Psi'(0) = 0$).

- **Existence of a free entry equilibrium**

(i) Consider the first case where $N^0 > \bar{N}(0)$. Denote the following function $\Theta(m) = (\bar{m} \circ \bar{N})(m)$ for all $m \in [0, 1]$. As is clear, given assumption A and the fact that $c_D^e - \Omega_0(c_D^e) > 0$, the functions $N = \bar{N}(m)$ is continuous for $m \in [0, 1]$. Also the function $m = \bar{m}(N)$ is a continuous function of N . Now $\bar{N}(0) < N^0$ implies that $\bar{m}(\bar{N}(0)) > 0$ and $\Theta(0) = (\bar{m} \circ \bar{N})(0) > 0$. Similarly given assumption A, $\bar{N}(1) = \frac{2\gamma(\beta - c_D^e)}{\Omega_1(c_D^e) - \Omega_0(c_D^e) + c_D^e} > 0$. Hence $\bar{m}(\bar{N}(1)) < \bar{m}(0) = 1$. Therefore $\Theta(1) = (\bar{m} \circ \bar{N})(1) < 1$. The function $\Theta(\cdot)$ is continuous on the interval $[0, 1]$ and such that $\Theta(0) > 0$ and $\Theta(1) < 1$. By Brower fixed-point theorem, there is at least a fixed point $m^* \in]0, 1[$ such that $\Theta(m^*) = m^*$. The point $(m^*, \bar{N}(m^*))$ corresponds to a free entry industry interior equilibrium.

(ii) Consider now the case $N^0 \leq \bar{N}(0)$. Then trivially $\bar{m}(\bar{N}(0)) = 0$ and the point $(0, \bar{N}(0))$ corresponds to a free entry industry (corner) equilibrium. **QED.**

Therefore, two conditions are jointly sufficient for the existence of a unique stable interior equilibrium: (i) that $N^0 > N(0)$, and (ii) at the equilibrium, the $\bar{N}(m)$ curve is flatter than the $\bar{m}(N)$ curve.

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Figure 1. Nash equilibrium

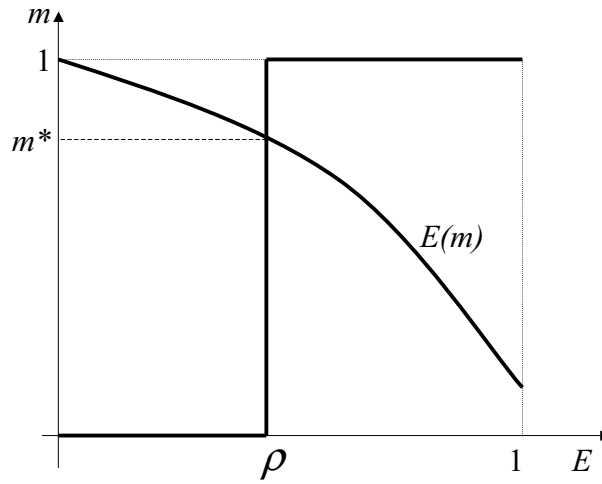


Figure 2. Comparative statics for Nash equilibrium

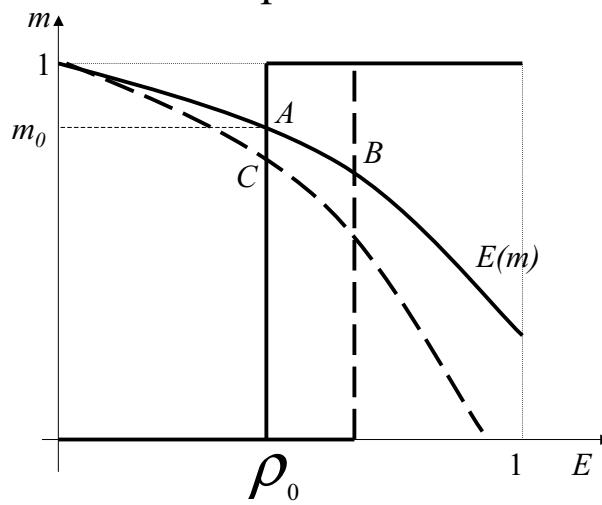


Figure 3. Profit functions in under monopolistic competition

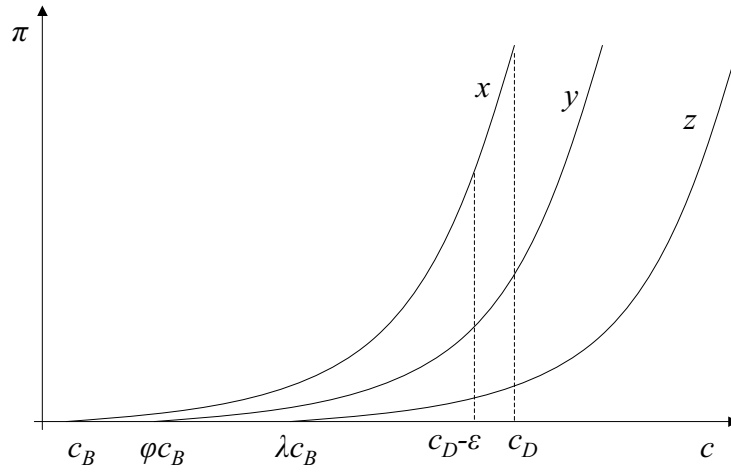


Figure 4. Construction of short-run industry equilibrium

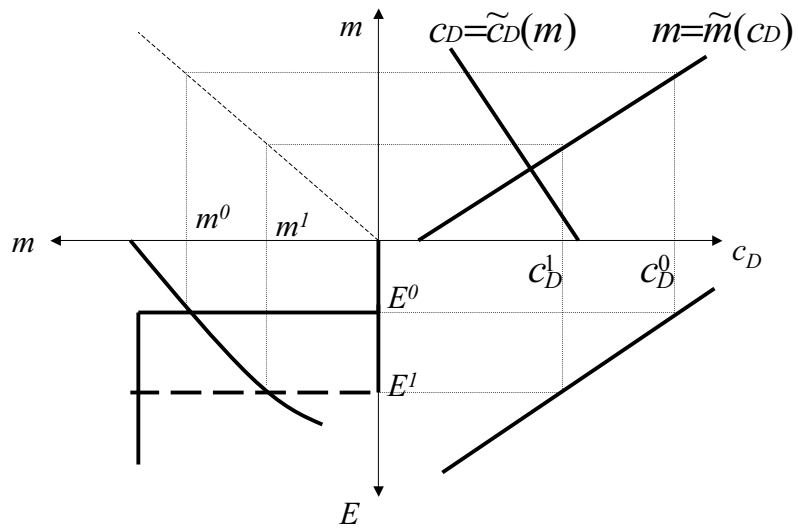


Figure 5a. Effect of a change in the NGO payoffs

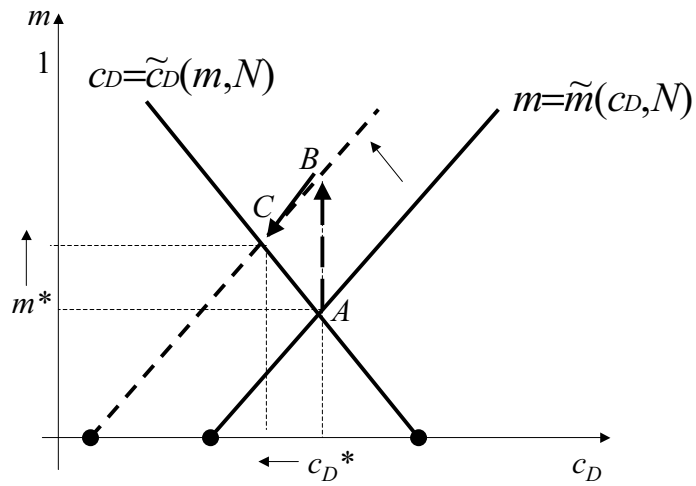


Figure 5b. Effect of a change in (relative) production costs

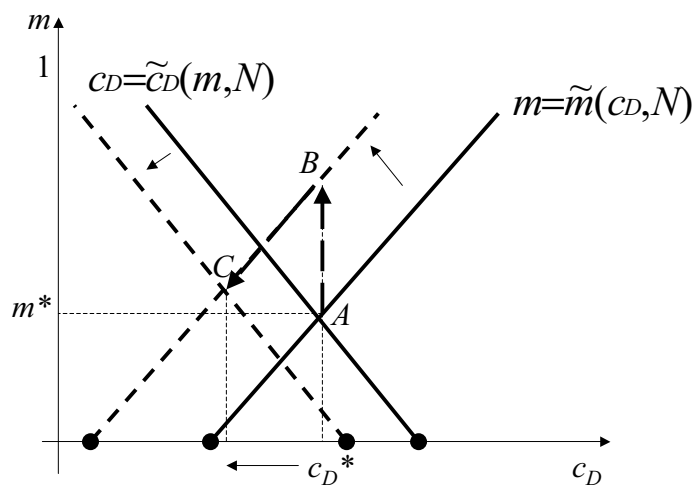


Figure 5c. Effect of a change in market structure

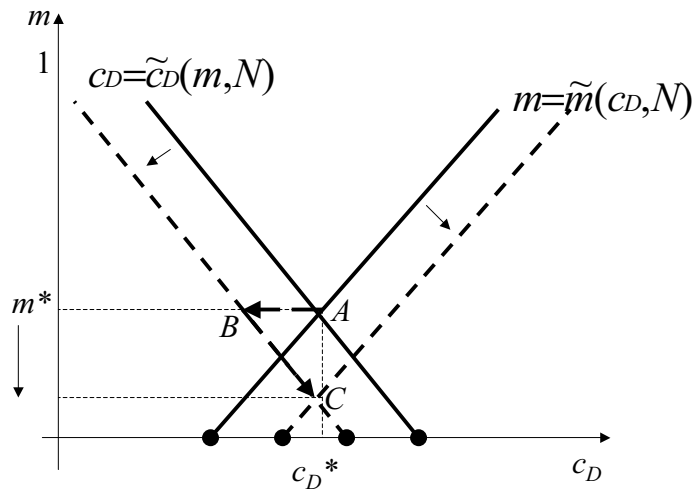


Figure 5d. Effect of a change in consumer tastes

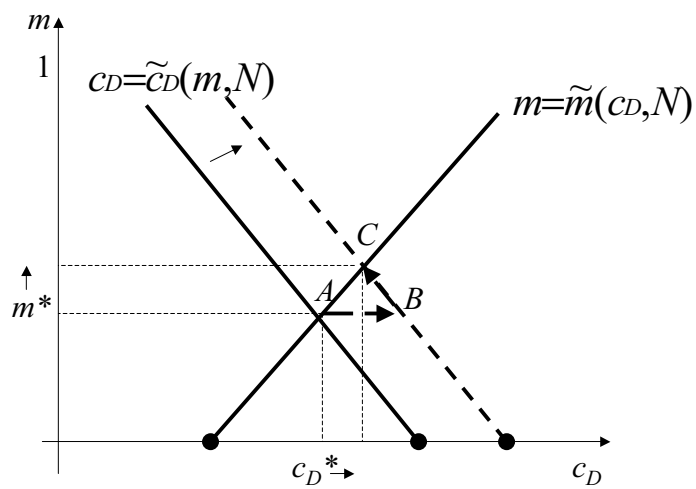


Figure 6. Long-run industry equilibrium

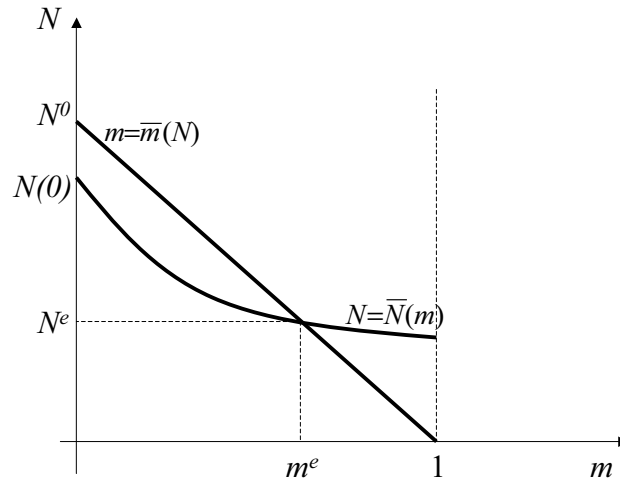


Figure 7. Long-run comparative statics: Effect of a change in market size or fixed cost of entry

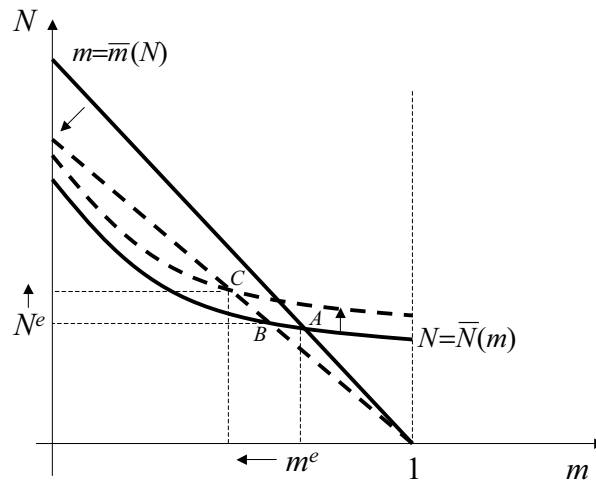


Figure 8. Long-run comparative statics: Effect of a change in NGO visibility benefit

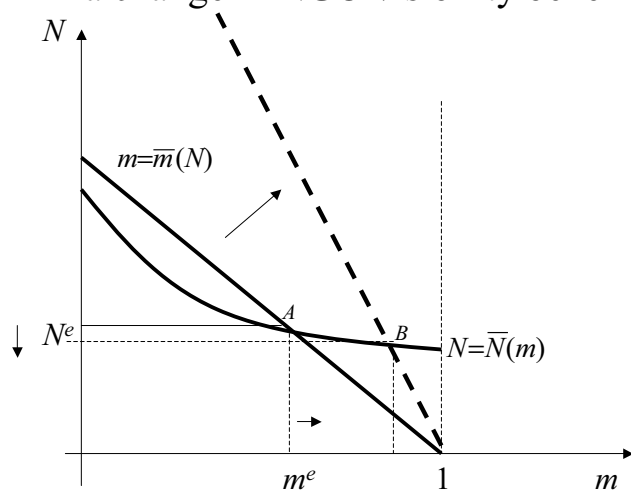


Figure 9. Multiple equilibria

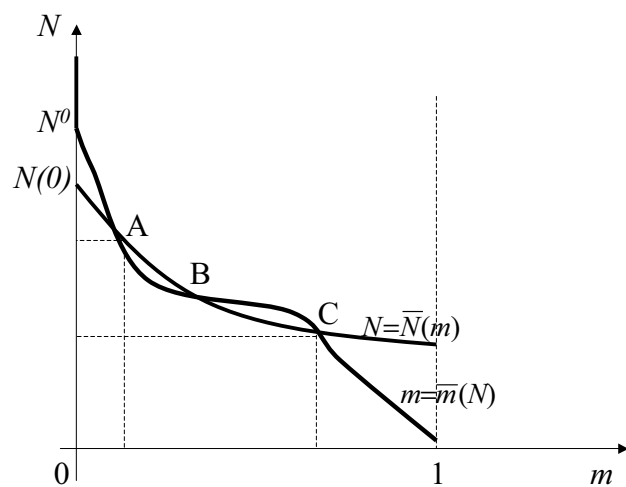


Figure 10. Multiple equilibria

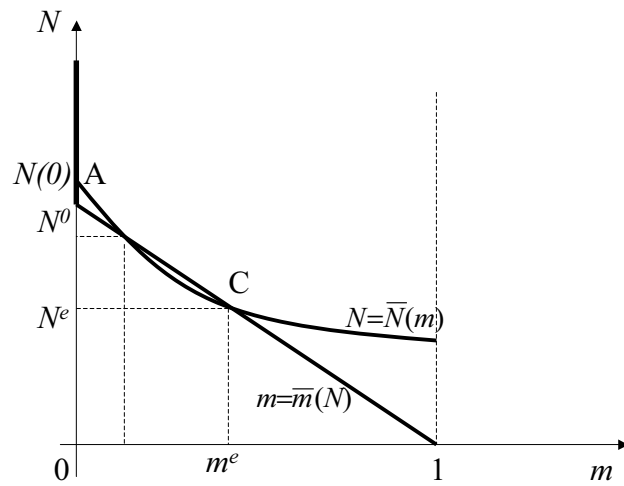


Figure 11. Multiple equilibria and shift of parameters

