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Strategic vs. altruistic Corporate Social Responsibility[1]

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Abstract

The concept of Corporate Social Responsibility (CSR) has evolved since Milton Friedman's 1970 assertion that a business's sole responsibility is profit. Today, global frameworks like the UN Global Compact and EU regulations emphasize corporate accountability, particularly regarding social and environmental impacts.

Corporate Social Responsibility (CSR) has become central in discussions of firm behavior, governance, and public goods provision. CSR however varies across firms. Some adopt basic strategic CSR (b-CSR), considering social and environmental issues only to the extent that they affect consumer demand and profitability. Others practice environmentally committed CSR (e-CSR), internalizing the full social cost of emissions. A few pursue fully committed CSR (w-CSR), aiming to maximize overall social welfare.

The paper analyzes CSR's effects on firm behavior through economic modeling. It first examines a single firm producing CO_2 emissions, where reducing emissions increases costs but appeals to environmentally conscious consumers. Three firm types—b-CSR, e-CSR, and w-CSR—are considered.

The study then extends to a competitive market with two firms engaged in Cournot competition. It examines scenarios where firms have different CSR commitments, analyzing how competition, emissions, and profits are affected. Finally, the paper compares these outcomes to an ideal scenario where firms are regulated to maximize social welfare.

***JEL*-Classification:** H23, L13, L31, G50.

Keywords: Motivation and sustainability of CSR under competition, mission oriented firms, consumers' environmental awareness and profit maximization, differentiated duopoly.

1 Introduction

The landscape of business and societal expectations has evolved significantly since Milton Friedman (1970) declared in 1970 that "the Social Responsibility of business is to increase its profits." Beginning in the early 2000s, Corporate Social Responsibility (CSR) emerged as a mainstream component of business strategy, supported by global initiatives such as the United Nations' Global Compact (2000) and the Sustainable Development Goals (SDGs) (2015), which emphasized the accountability of corporations. Similarly, regulations in the European Union require large and publicly listed companies to regularly disclose the social and environmental risks they encounter, as well as the broader impacts of their operations on people and the planet.

CSR embodies a firm's dedication to conducting business in an ethical, sustainable, and socially responsible way. This encompasses evaluating the effects of corporate decisions on various stakeholders, the environment, and broader society. Among these concerns, environmental issues often receive the most attention. However, certain organizations—particularly mission-driven firms such as La Poste Groupe—adopt a more holistic view, incorporating additional dimensions. These firms typically pursue positive social, environmental, or technological outcomes while maintaining financial sustainability, considering a wider range of stakeholders including employees, consumers, investors, and local communities.

Economic theory has approached CSR through multiple lenses, each reflecting different motivations and mechanisms. A foundational model by Besley and Ghatak (2007) presents CSR as a means for firms to provide public goods, responding to diverse consumer preferences and market signals. In this framework, CSR is viewed not as purely altruistic, but as a strategic choice aligned with a firm's long-term goals. Specifically, Besley and Ghatak (2007) define CSR as the *retailing of public goods*, suggesting that companies may offer products or practices with positive externalities—such as environmental protection or fair labor—when such actions align with consumer demand. This interpretation has gained traction by linking CSR to both public economics and market behavior. Crifo and Forget (2015) expand this concept, emphasizing the multidimensional nature of CSR across environmental, social, and governance (ESG) domains. Their research highlights the variability of CSR practices across sectors and firms, reflecting differences in institutional and strategic contexts. According to the Besley and Ghatak (2007) model, consumers derive utility not only from product consumption but also from CSR initiatives. Firms addressing these preferences can gain market advantage through differentiation. The model suggests CSR will be more prevalent in markets where consumers are willing to pay a premium for ethical standards.

Building on this, Ambec and De Donder (2022) and Gollier and Pouget (2022) introduce regulatory dynamics and investor behavior, illustrating how market outcomes may fall short of efficiency without supportive interventions such as subsidies or transparency requirements. The formal structure of a firm's objectives is crucial in determining the emergence of CSR behavior at equilibrium. Besley and Ghatak (2017) examine firms with dual objectives—profit and social impact—often described as hybrid organizations or social enterprises. They propose a utility function that balances financial returns and social outcomes, showing how alignment of mission across stakeholders can enhance firm performance. This framework supports legal innovations such as benefit corporations and cooperatives. Teraji (2009), using a behavioral approach, explores managerial motivations rooted in moral satisfaction and reputation, framing CSR as an expression of internal values rather than external incentives. This aligns with empirical findings from Burbano et al. (2018), who observe that CSR efforts boost employee morale and attract talent, even absent strong profit motives. Schinkel and Treuren (2024) contribute a game-theoretic model in which firms coordinate CSR efforts through collective agreements, overcoming free-rider challenges. Their analysis demonstrates that cooperative outcomes can be sustained when reputational spillovers are acknowledged. Similarly, Becchetti et al., 2014 frame CSR as a multiplayer prisoner's dilemma, underlining the need for institutional support to maintain socially optimal behavior.

Gollier and Pouget (2022) further incorporate investor preferences, showing that socially responsible investors can guide firms toward greater CSR adoption. Their work demonstrates that strong and transparent shareholder engagement can significantly elevate CSR outcomes.

Empirical research generally supports these theoretical insights. For instance, **?** employs a regression discontinuity approach using shareholder proposals to show that CSR positively affects long-term firm performance. Chatterji et al. (2016) report that companies with higher CSR ratings show greater stock price stability during economic shocks. Herkenhoff et al. (2024) analyze global supply chain CSR, noting that multinational firms face both reputational and contractual pressures that shape their CSR investments. Crifo and Forget (2015) highlight the variability in CSR adoption among French firms, linking intensity to firm size, governance, and regulatory environment.

Nonetheless, not all findings present CSR as unequivocally beneficial. Some researchers (e.g., Baron, 2001) argue that CSR can be misused for rent-seeking or to stave off regulation, suggesting its effectiveness is contingent on institutional integrity and transparency.

In our framework, we differentiate between types of firms based on their CSR orientation. A "basic strategic CSR" or "b-CSR" firm is one that considers emissions solely to comply with regulation or to avoid reputational losses that could impact demand. This extends Friedman's view by recognizing consumer sensitivity to environmental concerns. A more engaged approach is represented by "environmental committed CSR" or "e-CSR", where the firm internalizes the full social cost of its emissions. At the highest level is "fully committed CSR" or "w-CSR", wherein the firm actively seeks to maximize overall social welfare by considering all relevant stakeholders.

A key concern around CSR is its potential impact on profitability. This concern is especially salient for mission-driven firms, which must remain financially viable to generate positive societal impact. Profitability and responsibility are thus seen as complementary pillars of effective CSR.[1]

To explore these dynamics, we first model a single firm whose production generates CO_2 emissions, which contribute to global environmental externalities like climate

[1] See the current debates at the European level on the delicate balance between competitiveness and climate action and the various European Commission's initiatives to promote a "sustainable prosperity and competitiveness", including a package of proposals to simplify EU rules and boost competitiveness (Competitiveness Compass, Clean Industrial Deal Communication, Simplification Omnibus, 2040 climate target, and so on.

change. We assume that lowering emissions raises production costs—green technologies are costlier. Meanwhile, consumers' utility decreases with the negative environmental impacts of the goods they purchase, incurring a utility cost associated with higher emissions. This reflects growing consumer demand for sustainability-aligned brands.

We investigate three scenarios. First, the firm operates under a b-CSR model, taking emissions into account only insofar as they influence consumer demand. In the second case, the firm adopts an e-CSR stance, fully internalizing the social costs of emissions. Lastly, we analyze a w-CSR firm, which prioritizes social welfare in its decision-making.

These monopoly scenarios serve as benchmarks, isolating the effects of CSR on output and emissions, independent of market competition.

Next, we examine a duopoly where two firms offer differentiated products or services (e.g., parcel delivery) and compete à la Cournot. We generalize this setup by including CO_2 emissions as a second strategic variable alongside output.

Again, we consider three scenarios. In the first, both firms adopt a b-CSR strategy, focusing on emissions only to the extent they affect market share. In the second, one firm is b-CSR while the other follows an e-CSR model. The third scenario pits a b-CSR firm against a fully committed w-CSR competitor.

We compare the resulting market equilibria and examine how the second firm's profitability evolves as it adopts increasingly committed CSR standards. Finally, we contrast these outcomes with the socially optimal solution, where both firms are governed by a welfare-maximizing authority

2 Single product

Consider an industry with a single firm whose activity has an environmental impact which is reflected by its emissions. There is a continuum of identical consumers and assume for the time being that there is a single product. Let x denote consumption of the representative consumer, p the price paid to buy and consume the product and e the CO_2 emissions rejected in the atmosphere per unit consumed. We assume for the time being that consumers can observe e. Preferences are represented by

$$U(x, e) = u(x) - px - \sigma xe \tag{1}$$

Consumers' environmental awareness (CEA) is expressed in monetary terms, with σ representing the perceived cost of one unit of emissions. Maximizing (1) yields the demand function $x(q)$ which is determined by

$$u'(x) = p + \sigma e = q, \tag{2}$$

where q denotes the "full price" including environmental damage.

We can then also define the inverse demand function

$$q(x) = u'(x) \tag{3}$$

or alternatively,

$$p(x, e) = u'(x) - \sigma e \tag{4}$$

Production costs are given by $C(x, e)$ defined by

$$C(x, e) = c(x) - \gamma(e)x, \tag{5}$$

where $c'(x) > 0$, $c''(x) > 0$, $\gamma''(e) < 0$ and $\gamma'(e) > 0$ for $e < \bar{e}$ and $\gamma'(e) = 0$, for $e \geq \bar{e}$. In words, we assume that marginal costs are increasing (in quantity) and cost decreases with e up to $\bar{e}$ so that producing in a less polluting way is more costly.

Total emissions, E, have a social cost $\psi(E)$ where $E = xe$. This definition fits CO_2 emissions, which are global and additive.

3 First best

We start by characterizing the first-best (FB) allocation. To define social welfare, we follow the by now standard approach initially advocated by Hammond, 1987Hammond (1987) and Harsanyi, 1995 Harsanyi (1995) and do not include the CEA term in welfare.[2] This is commonly referred to as "laundering out" the altruistic term.

[2] See Cremer and Pestieau (2006) for a more detailed discussion. Hammond, 1987 Hammond (1987) pleads in favor of excluding all external preferences, even benevolent ones, from our social utility function. The reason is that including this term would amount to count the externality twice.

With this objective function, the FB allocation solves the following problem

$$\max_{x_i,e_i} SWF = u(x) - c(x) + x\gamma(e) - \psi(E) \tag{6}$$

The first order conditions (FOCs) are:

$$\gamma'(e^*) = \psi'(E^*) \tag{7}$$

$$u'(x^*) = c'(x^*) - \gamma(e^*) + e^*\psi'(E^*) \tag{8}$$

We assume throughout the paper that $\sigma < \psi'(E^*)$. In words, the (marginal and average) environmental cost perceived by the consumer is smaller than the full social marginal damage.

We now turn to the laissez-faire and study the equilibrium allocation. We consider different scenarios in various market configuration (monopoly vs. duopoly).

4 The Monopoly

We consider three different scenarios on a monopolized market. In the first scenario, the monopoly maximizes its profits, π, taking into account that the price it can charge depends on e. This can be interpreted as a basic strategic (b-CSR) monopoly. Profit is defined as

$$\pi = xp(x,e) - C(x,e).$$

In the second scenario, the monopoly maximizes

$$\pi - \delta\psi(E),$$

that is it takes a share $\delta \leq 1$ of the social environmental cost into account. We refer to this scenario as a e-CSR monopoly. Finally in the third scenario the monopoly maximizes social welfare as defined by (6); we refer to this as a w-CSR monopoly.

4.1 Strategic b-CSR

The program of a b-CSR monopoly is:

$$\max_{x,e} \pi = xp(x,e) - C(x,e)$$
$$= xp(x,e) - c(x) + x\gamma(e)$$

The FOCs with respect to x and e are respectively given by

$$p(x,e) + xp_x(x,e) - c'(x) + \gamma(e) = 0 \tag{9}$$
$$xp_e(x,e) + x\gamma'(e) = 0 \tag{10}$$

so that from

$$\gamma'(e) = \sigma$$

which using (3) can be rewritten as:

$$\frac{p(x,e) - c'(x)}{p(x,e)} = -\frac{xp_x(x,e)}{p(x,e)} - \frac{\gamma(e)}{p(x,e)} = -\varepsilon_p(x,e) - \frac{\gamma(e)}{p(x,e)} \tag{11}$$
$$\sigma = \gamma'(e) \tag{12}$$

where $\varepsilon_p(x,e) < 0$. As compared to a model without externality, the *price-cost margin rule* is lower than a model without environment issue (because of the additional marginal cost $\gamma(e)$). The second line represents the trade-off between environmental demand and marginal cost. As long as $\sigma = \gamma'(e) < \psi'(E)$, the rule implies an excessive level of e for a given x as compared to the first best (FB).

Equation (12) implies that

$$p(x,e) - c'(x) + \gamma(e) > 0$$

so that the price is larger than marginal costs. So for a given e output is too small. But the marginal cost is lower than in the FB (so that a competitive firm produces too much), but the monopoly effect brings us closer to the optimal output.

4.2 Environmental altruistic e-CSR

The program of a e-CSR monopoly is:

$$\max_{x,e} \pi = xp(x,e) - C(x,e) - \delta\psi\left(xe\right) = 0$$

where $\delta < 1$ represents the environmental concern. The FOCs with respect to x and e yield:

$$p\left(x,e\right) + xp_x\left(x,e\right) - c'\left(x\right) + \gamma\left(e\right) - \delta e\psi'\left(E\right) = 0 \tag{13}$$

$$xp_e\left(x,e\right) + x\gamma'\left(e\right) - \delta x\psi'\left(E\right) \tag{14}$$

Equation (14) yields

$$\gamma'\left(e\right) = \sigma + \delta\psi'\left(xe\right)$$

Now recall that the first best rule for e is $\gamma'\left(e^*\right) = \psi'\left(x^*e^*\right)$ so that, as compared to the first best (and the previous b-CSR monopoly), the rule for e is FB optimal if $\sigma = \psi'(E^*)(1-\delta)$. Otherwise, there is insufficient (resp. excessive) environmental concern if $\sigma < \psi'(E^*)(1-\delta)$ (resp. $\sigma > \psi'(E^*)(1-\delta)$). Or solving for δ

$$\delta \lesseqqgtr 1 - \frac{\sigma}{\psi'(E^*)}$$

Now the price cost margin is:

$$\frac{p\left(x,e\right) - c'\left(x\right)}{p\left(x,\bar{e}\right)} = -\varepsilon_p\left(x,e\right) - \frac{\gamma\left(e\right)}{p\left(x,e\right)} + \frac{\delta e\psi'\left(xe\right)}{p\left(x,e\right)}$$

which implies

$$p\left(x,e\right) - c'\left(x\right) + \gamma\left(e\right) - e\delta\psi'\left(xe\right) > 0$$

As compared to a b-CSR monopoly, the price is higher (for a given e) than marginal cost because of the marginal environmental cost.

4.3 Full altruistic w-CSR

Assuming the monopolist does laundering out, the fully altruistic monopoly solution is the FB allocations described in section 3.

5 Differentiated products

5.1 Demand

Assume now that there are two differentiated products, x_1 and x_2, and that consumers' preferences are given by

$$u(x_1, x_2) - p_1 x_1 - p_2 x_2 - \sigma x_1 e_1 - \sigma x_2 e_2, \tag{15}$$

The other notations remain the same, except that a subscript is added.

Maximizing (15) yields the demand functions $x_1(q_1, q_2)$ and $x_2(q_1, q_2)$, which are determined by

$$u_1(x_1, x_2) = p_1 + \sigma e_1 = q_1, \tag{16}$$

$$u_2(x_1, x_2) = p_2 + \sigma e_2 = q_2, \tag{17}$$

where

$$u_j = \frac{\partial u}{\partial x_j}, \qquad j = 1, 2,$$

and q_j denotes the "full price" including environmental damage. Defining

$$u_{ij} = \frac{\partial^2 u}{\partial x_i \partial x_j}, \qquad i, j = 1, 2,$$

one can easily check that the goods are substitutes, independent or complements according to

$$u_{12} = u_{21} \lesseqgtr 0.$$

In other words

$$\frac{dx_1}{dq_2} = \frac{dx_2}{dq_1} \gtreqless 0 \qquad \Longleftrightarrow \qquad u_{12} = u_{21} \lesseqgtr 0. \tag{18}$$

Note that the symmetry arises because preferences are quasi-linear so that Marshalian demands are also Hicksian demands (which are symmetric). As in the single product case we can define the inverse demand function as

$$q_i(x_1, x_2) = u_i(x_1, x_2) \qquad i = 1, 2,$$

or alternatively

$$p_i(x_1, x_2, e_i) = u_i(x_1, x_2) - \sigma e_i \tag{19}$$

5.2 Cost

We assume that there are two firms, each producing one of the goods with cost functions

$$C_i(x_i, e_i) = c_i(x_i) - \gamma_i(e_i)x_i, \tag{20}$$

where $c_i'(x_i) > 0$, $c''(x_i) > 0$, $\gamma_i''(e_i) < 0$ and $\gamma_i'(e_i) > 0$, for $e_i < \bar{e}_i$ and $\gamma_i'(e_i) = 0$, for $e_i \geq \bar{e}_i$. In words, we continue to assume that marginal costs are increasing (in quantity) and cost decreases with e_i up to $\bar{e}_i$ so that producing in a less polluting way is more costly. Total emissions are now given by $E = x_1e_1 + x_2e_2$

5.3 First best with differentiated products

The FB allocation with two differentiated products is obtained by solving the following problem

$$\begin{aligned} \max_{x_1,e_1,x_2,e_2} SWF = u(x_1, x_2) - c(x_1) - c(x_2) + x_1\gamma_1(e_1) + x_2\gamma_2(e_2) \\ - \psi(x_1e_1 + x_2e_2) \end{aligned} \tag{21}$$

The FOCs are:

$$\gamma_i'(e_i^*) = \psi'(E^*) \tag{22}$$

$$u_i(x_1, x_2) = c_i'(x^*) - \gamma_i(e^*) + e_i^*\psi'(E^*) \tag{23}$$

We now turn to the laissez-faire and study the equilibrium allocation on a duopoly market, by considering as in the monopoly case, different types of firms regarding their CSR.

6 Cournot duopoly

The two firms compete in a duopoly. This introduces the possibility of mixed market structures, for instance with a strategic and an altruistic firm. In all scenarios we assume that firm 1 is a b-CSR firm so that the scenarios are characterized by firm 2's objective.

We assume that the strategic variables are (x_i, e_i) and that they are chosen simultaneously. We study the Nash equilibrium.

In each scenario profits are given by

$$\pi_i = p_i(x_1, x_2, e_i)x_i - C_i(x_i, e_i), \tag{24}$$

where p_i is defined by (19).

We start by studying the general model for which some results can be obtained and then turn to numerical examples to obtain more explicit results.

6.1 Both firms are strategic

Each b-CSR firm maximize π_i as defined by (24) taking into account the fact that p_i is defined by (19). To concentrate on possible differences in the firm's objectives we consider symmetric utility (and thus demand) and cost functions.

The best-reply functions are determined by solving

$$\max_{x_i, e_i} \quad \pi_i = p_i(x_1, x_2, e_i)x_i - C_i(x_i, e_i), \tag{25}$$

Differentiating the profit function with the strategic variables, we obtain

$$p_i\left(x_1, x_2, e_i\right) + x_i \frac{\partial p_i\left(x_1, x_2, e_i\right)}{\partial x_i} - c'\left(x_i\right) + \gamma\left(e_i\right) = 0 \tag{26}$$

$$x_i \frac{\partial p_i\left(x_1, x_2, e_i\right)}{\partial e_i} + x_i \gamma_i'\left(e_i\right) = 0 \tag{27}$$

Rearranging equations (26) and (27), we get

$$p_i\left(x_1, x_2, e_i\right)\left[1 - \frac{1}{\left|\varepsilon_{p_1}\right|}\right] = c'\left(x_i\right) - \gamma_i\left(e_i\right) \tag{28}$$

$$\sigma = \gamma_i'\left(e_i\right) \tag{29}$$

These equations implicitly define the best-reply functions: $x_1 = f_1(x_2, e_2)$, $x_2 = f_2(x_1, e_1)$, $e_1 = g_1(x_2, e_2)$ and $e_2 = g_2(x_1, e_1)$

Note that from (29) it follows that e_i is constant at $\overline{e}_i$ and defined by (29). In other words a firm's level of e_i does not depend on that of the other firm. Consequently we return to a standard Cournot game where the cost is given by $c(x_i) - \gamma_i\left(\overline{e}_i\right) x_i$.

6.2 Mixed duopoly 1: Strategic and environmental concern

Assume that firm 1 is b-CSR so that its objective and thus it's best-reply functions are the same as in the previous subsection. Firm 2 is now e-CSR and maximizes

$$\max_{x_2, e_2} WE = x_2 p_2(x_1, x_2, e_2) - C_2(x_2, e_2) - \delta\psi\left(x_1 e_1 + x_2 e_2\right)$$

where

$$\delta < 1 - \frac{\sigma}{\psi'(E^*)}, \tag{30}$$

where E^* is the FB level. Assumption (30) ensures that the environmental cost taken into account by the firm does not exceed the socially optimal level.[3]

Because the best-reply function of firm 1 remains the same as in the previous subsection, e_1 is constant and at $\overline{e}_1$ defined by (29).

For firm 2 the FOCs can be written as

$$p_2\left(x_1, x_2, e_2\right) + x_2 \frac{\partial p_2\left(x_1, x_2, e_2\right)}{\partial x_2} - c'\left(x_2\right) + \gamma\left(e_2\right) - \delta e_2 \psi'\left(x_1 e_1 + x_2 e_2\right) = 0 \tag{31}$$

$$-\sigma + \gamma_2'\left(e_2\right) - \delta\psi'\left(x_1 e_1 + x_2 e_2\right) = 0. \tag{32}$$

The interpretation of these conditions is the similar to that of their counterpart for a e-CSR monopoly; see Subsection 4.2. In particular we have

$$\gamma'\left(e_2\right) = \sigma + \delta\psi'\left(x_1 e_1 + x_2 e_2\right),$$

which shows that now e_2 does depend on x_1 and e_1, except in the special case where $\psi'' = 0$ so that ψ is linear and the marginal social environmental cost is constant.

Note that when ψ is linear, e_2 is constant and defined by

$$\gamma'\left(\overline{e}_2\right) = \sigma + \delta\psi',$$

which not surprisingly implies that $\overline{e}_2 < \overline{e}_1$ so that the firm with environmental concern chooses a less polluting technology.

[3] Recall that the firm's demand and thus its profit depend on e via the term σe in consumers' preferences. This introduces a potential problem of double-counting which is avoided by assuming that δ is sufficiently small.

6.3 Mixed duopoly 2: Strategic and full altruism

We continue to assume that firm 1 is b-CSR. Consequently, its objective and best-replies remain the same as in the previous subsections.

Firm 2 is w-CSR and now solves[4]

$$\max_{x_2,e_2} SWF = u(x_1,x_2) - c(x_1) - c(x_2) + x_1\gamma(e_1) + x_2\gamma(e_2) \\ - \psi(x_1e_1 + x_2e_2) \tag{33}$$

which in the Cournot duopoly is equivalent to

$$\max_{x_2,e_2} SWF = u(x_1,x_2) - c(x_2) + x_2\gamma(e_2) \\ - \psi(x_1e_1 + x_2e_2) \tag{34}$$

The FOCs are given by

$$\frac{\partial SWF}{\partial x_2} = u_2(x_1,x_2) - c'(x_2) + \gamma(e_2) - e_2\psi'(x_1e_1 + x_2e_2) = 0, \tag{35}$$

$$\frac{\partial SWF}{\partial e_2} = x_2\gamma'(e_2) - x_2\psi'(x_1e_1 + x_2e_2) = 0. \tag{36}$$

Condition (35) can be written as

$$p_2 + \sigma e_2 - c'(x_2) + \gamma(e_2) - e_2\psi'(x_1e_1 + x_2e_2) = 0,$$

$$p_2 = c'(x_2) - \gamma(e_2) + e_2[\psi' - \sigma]. \tag{37}$$

The price is equal to the private marginal cost plus the environmental cost that is not taken into account by consumers. So implicitly the firm imposes a Pigouvian tax on itself. Consequently, it sets its prices above its private marginal cost so that when these are constant, the firm makes a profit of $e_2[\psi' - \sigma]$ which is positive. This profit depends on ψ while the profit of a strategic firm in scenario 1 does not. Consequently, a general comparison between the two profit levels is ambiguous.

[4] In the literature welfare maximizing firms typically face a budget constraint. Absent of environmental concerns it would be binding if returns to scale were increasing because marginal cost pricing yields negative profits. However, we assume decreasing returns to scale so that even simple (private) marginal cost pricing would yield a positive profit. With the environmental concern prices are set at social marginal cost which is larger than the private cost. Consequently, a break even constraint would not be relevant and can be ignored.

The level of e_2 is determined by the Pigouvian rule

$$\gamma'(e_2) - \psi'(x_1 e_1 + x_2 e_2).$$

When ψ is linear, e_2 corresponds to the first-best level defined by (22). By contrast, when ψ is nonlinear, e_2 depends on e_1 and x_1, which are not first-best optimal so that the same applies to the level of e_2.

6.4 Quadratic utilities

6.4.1 Demand

To obtain numerical examples, we consider the quadratic utility function used by Singh and Vives (1984) given by

$$u(x_1, x_2) = \alpha_1 x_1 + \alpha_2 x_2 - (\beta_1 x_1^2 + 2\eta x_1 x_2 + \beta_2 x_2^2)/2$$

where α_i and β_i are positive, $\beta_1\beta_2 - \eta^2 > 0$ and $\alpha_i\beta_j - \alpha_j\eta > 0$ for $i \neq j$. This yields linear demand functions and the inverse demands are given by

$$q_1 = p_1 + \sigma e_1 = \alpha_1 - \beta_1 x_1 - \eta x_2$$

$$q_2 = p_2 + \sigma e_2 = \alpha_2 - \beta_2 x_2 - \eta x_1$$

Note that from (18), the goods are substitutes if $\eta > 0$ and complements if $\eta < 0$. Defining $\delta = \beta_1\beta_2 - \eta^2 > 0$, $a_i = (\alpha_i\beta_j - \alpha_j\eta)/\delta$, $b_i = \beta_j/\delta$ for $i \neq j$ and $\theta = \eta/\delta$ we can write direct demand functions as

$$x_1 = a_1 - b_1 q_1 + \theta q_2$$

$$x_2 = a_2 - b_2 q_2 + \theta q_1$$

6.4.2 Production and environmental cost

We assume that the firms' cost functions are given by

$$C_i(x_i, e_i) = k_i x_i + \mu x_i (e_i - \bar{e}_i)^2,$$

so that there is a constant marginal cost which is decreasing in e_i. The quadratic specification is adopted to ensure that cost is concave in e_i.

For the environmental cost, we consider two specifications. First, a linear one with $\psi(E) = E$ and then, a quadratic one with $\psi(E) = (\theta/2)(E)^2$.

Note that, with this specification, one can obtain closed form solutions at least for the linear specification of ψ. The expressions for equilibrium outputs and emissions are reasonably simple, but those for welfare levels are complex and not very telling. We therefore present numerical results.

6.4.3 Parameters

To concentrate on the impact of CSR, we assume that the firms are otherwise symmetric. We consider the parameter values given in Table 1.

Parameters	interpretation	values
α	demand max price	25
β	demand sensitivity to own quantity	1
σ	demand sensitivity to e	0.2
η	demand degree of complementarity	0.5
μ	cost impact of e	1
δ	environment concern by firm 2 when S-FB	0.3
k	direct production cost	1
$\bar{e}$	max emission	5

Table 1: Parameter values

Example 1: linear environmental cost We first assume that the environmental cost is linear $\psi(E) = E$, so that the cost of pollution corresponds to the sum of the emissions of each of the two firms.

Two strategic b-CSR firms produce less and pollute more per unit than the socially optimal levels. Not surprisingly, welfare is smaller than in the first-best solution. Total emissions are, however, lower than their first-best value because of lower total output.

Faced with a b-CSR firm, the e-CSR firm produces less and with a more expensive technology: its level of emission per unit will be lower thus increasing the marginal cost of production. The b-CSR firm chooses the larger profit maximizing level of emission ($e_1 = 1-\sigma$) which decreases the marginal cost of production, so that its output increases.

	First Best	b-CSR	e-CSR	w-CSR
x_1	12.83	9.204	9.39	7.64
x_2	12.83	9.204	8.43	15.42
e_1	4.5	4.9	4.9	4.9
e_2	4.5	4.9	4.75	4.5
profit 1		84.71	88.30	58.50
profit 2		84.71	83.11	3.6
E	115.5	90.19	86.09	106.89
Welfare	247.042	224.338	221.85	235.737

Table 2: Solutions with a linear environmental cost $\psi(E) = E$

Because the e-CSR firm chooses a lower per unit emission and thus a higher marginal cost, its output is lower. The b-CSR firm will therefore make a larger profit than in the first scenario while that of the e-CSR firm is smaller. Overall emissions will be lower than in any other scenario but nevertheless, welfare will be lower because output is smaller.

Finally, when a b-CSR firm faces a w-CSR firm, the w-CSR firm, prioritizing collective well-being, will drastically increase production while using the first-best per-unit emission level. The use of the less polluting (but more costly) technology has a significant negative impact on its profits. The use of this less polluting technology, coupled with the significant increase in production, will increase welfare compared to the two other competition scenarios.

In Table 2 we present the result for a single set of parameter values. Our additional simulations have shown that they are robust. To illustrate this we show in appendix (A), that the qualitative results continue to hold for 2 alternative values of the substitution parameter η, namely $\eta = 0.2$ which implies a higher degree of substitution between the two products and $\eta = 0.7$ which implies more complementarity than $\eta = 0.5$ used in Table 2.

Example 2: quadratic environmental cost We now assume a quadratic environmental cost specified by $\psi(E) = (\theta/2)(E)^2$, where θ is a parameter that measures the magnitude of the environmental cost. We provide examples with three levels of θ in order to illustrate its impact on equilibria.

	First Best	b-CSR	e-CSR	w-CSR
x_1	15.94	9.20	9.22	7.71
x_2	15.94	9.20	9.13	15.14
e_1	4.99	4.9	4.9	4.9
e_2	4.99	4.9	4.88	4.47
profit 1		84.71	85.03	59.59
profit 2		84.71	84.62	3.82
E	159.21	90.19	89.81	105.54
Welfare	382.72	314.13	313.56	340.94

Table 3: $\theta = 0.01$

	First Best	b-CSR	e-CSR	w-CSR
x_1	12.50	9.20	10.39	11.50
x_2	12.50	9.20	4.42	0
e_1	4.44	4.9	4.9	4.9
e_2	4.44	4.9	3.81	0
profit 1		84.71	108.15	132.36
profit 2		84.71	54.58	0
E	111.12	90.19	68.10	56.37
Welfare	296.18	273.85	240	193.93

Table 4: $\theta = 0.1$

First as shown in Table 3, when θ and thus the environmental cost is small, the results are qualitatively the same as in the previous example with a linear environmental cost. However, they differ for larger levels of θ as shown in Tables 4 and 5.

In Table 3, with a larger level of θ, the w-CSR equilibrium implies an exit of firm 2. In this case, firm 1 is a monopolist with usual results yielding a solution with the usual properties: small production, large level of emissions per unit and thus a lower welfare than in the other scenarios. Table 5 shows that when the extent of externality is even larger, the e-CSR also implies the exit of firm 2 so that firm 1 is there also a monopolist. The e-CSR and the w–CSR equilibria thus yields the same outcome with the lowest level of welfare.

	First Best	b-CSR	e-CSR	w-CSR
x_1	8.57	9.20	11.50	11.50
x_2	8.57	9.20	0	0
e_1	3.72	4.9	4.9	4.9
e_2	3.72	4.9	0	0
profit 1		84.71	132.36	132.36
profit 2		84.71	0	0
E	63.84	90.19	56.37	56.37
Welfare	191.802	151.82	146.26	146.26

Table 5: $\theta = 0.2$

7 Conclusion

In recent years, the rise of social and environmental regulations has accelerated in response to the climate crisis and the need to preserve the planet's habitability. While these regulations are beneficial in reducing the negative externalities of production and consumption, they also raise an important question: How does the increasing stringency of these rules affect the incentives of environmentally conscious or mission-driven companies to voluntarily exceed legal requirements?

To explore this issue, we developed a model where two firms, each producing a single good, compete in a Cournot framework. We classify companies into three categories based on their environmental commitment. The first category consists of "strategic" firms (b-CSR), which account for their polluting emissions only insofar as they impact consumer demand and profitability. The second includes firms with heightened "environmental awareness" (e-CSR), which factor in the social cost of pollution when making decisions. The third comprises firms fully committed to the "common good" (w-CSR), prioritizing positive contributions to society.

When both firms are strategic (b-CSR), each determines its production level and pollution output to maximize profit, considering only the competitive dynamics. As a result, they opt for the least expensive, and consequently most polluting, technology while setting prices equal to marginal production costs.

However, if a strategic firm competes against an environmentally aware (e-CSR) or fully committed (w-CSR) firm, the strategic firm will still favor cost-minimizing, high-pollution technology. Meanwhile, the e-CSR or w-CSR firm will adjust its production and pollution levels in response. This adjustment could force the responsible firm out of the market, leaving the strategic firm with a monopoly—ultimately harming collective welfare.

These findings highlight the potential need for regulatory interventions to prevent responsible firms from being driven out of the market. Further research is required to identify effective policy measures. One possible solution could be the introduction of production quotas for purely strategic firms, ensuring that mission-driven companies have sufficient market space to operate.

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Appendix

A Alternative values of η

	First Best	b-CSR	e-CSR	w-CSR
x_1	16.04	10.45	10.53	9.77
x_2	16.04	10.45	9.72	17.29
e_1	4.5	4.9	4.9	4.9
e_2	4.5	4.9	4.75	4.5
profit 1		109.39	110.92	95.56
profit 2		109.39	108.49	3.6
E	144.37	102.49	97.81	125.72
Welfare	308.80	268.05	264.44	288.39

Table 6: Solutions with $\eta = 0.2$

	First Best	b-CSR	e-CSR	w-CSR
x_1	11.32	8.52	8.81	6.31
x_2	11.32	8.52	7.69	14.82
e_1	4.5	4.9	4.9	4.9
e_2	4.5	4.9	4.75	4.5
profit 1		72.62	77.63	39.87
profit 2		72.62	70.21	3.6
E	101.91	201.91	79.73	97.67
Welfare	217.97	83.51	199.97	210.57

Table 7: Solutions with $\eta = 0.7$