Believing in Corporate Social Responsibility An Indirect Evolutionary Analysis*

Werner Güth† Oliver Kirchkamp‡

14 December 2020

Abstract

On a global market firms are randomly paired to engage in duopolistic competition based on conjectural payoffs which may or may not differ from their true profits. Although they decide guided by conjectural payoffs, evolutionary fitness is determined by true profits. More specifically, competitors may have wrong or true beliefs concerning how their demand level depends on their competitor's price as well as on their own Corporate Social Responsibility (CSR) expenditures. In the tradition of indirect evolution, specifically evolution of preferences, we first solve all possible duopoly markets, based on commonly known payoff conjectures and then derive the evolutionarily stable conjectures. Believing that CSR expenditures enhance demand is evolutionarily stable only when this is actually true. In contrast, evolutionarily stable beliefs concerning price interdependence usually differ from the actual price interdependence.

JEL: C73, M14
Keywords: Corporate social responsibility, indirect evolution

1 Introduction

Firms do not just operate on anonymous markets but exist and evolve together with their social environment with many mutual dependencies. In view of such social and environmental embeddedness of commercial engagements a natural question is whether commercial behavior is guided by profit seeking or additionally by social and environmental concerns.[1]

Of course, it may be useful for a firm to invest not only in itself but also in its social infrastructure, for example, by supporting the education system in order to finally hire more skillful employees. Such social responsibility is not just a possibility but an

*We thank the reviewer and the editor for helpful comments how to improve the manuscript.

†MPI for Research on Collective Goods. Kurt-Schumacher-Str. 10. 53113 Bonn. Germany. gueth@coll.mpg.de.

‡FSU Jena. Carl-Zeiss-Str. 3. 07737 Jena. Germany. oliver@kirchkamp.de.

[1] In the literature this debate is related to the one between the shareholder and stakeholder perspective (see Güth and Kliemt, 2018, for fundamental (philosophical) aspects of this debate).

actual fact, as, for instance, analyzed by Baron (2008). But does this preclude investing in the social and environmental infrastructure of commercial firms when such investments do not pay off directly, e.g., in predictable ways? By now, many studies consider the effects of Social Corporate Social Responsibility (CSR), captured either by the activities themselves or via CSR expenditures, however—to the best of our knowledge—without questioning and analyzing their evolutionary stability, i.e. the survival chances of CSR-guided firms.

In this paper we allow for both: that CSR expenditures are demand enhancing and that they are neutral, i.e., not affecting demand. The true effect of CRS expenditures will often be unknown to firms. So firms can rely only on conjectural beliefs about the impact of CSR and optimize given their beliefs. Our analysis assumes not only uncertainty about how CSR expenditures affect demand but also how demand depends on the competitor's sales choice. Thus each firm is characterized by two conjectural belief parameters whose co-evolution will be analyzed.

Now markets select firms according to their true profits, i.e. profits define fitness which determines the evolutionary selection among firms.

Our indirect analysis (see Berninghaus, Güth, and Kliemt, 2012, for a selective review) assumes that average true profits measure fitness which allows us to

- derive the evolutionarily stable conjectural belief parameters concerning CSR expenditures and market interdependence and
- distinguish between "conjectural utility" driving (rational) choices and "fitness" selecting the co-evolving choice determinants, namely the two conjectural belief parameters of each firm.

Rationality in decision making could be substituted also by learning (so that fast learning would be combined with slow evolution). Since firms usually involve many stakeholders, conjectural beliefs and their changes are assumed to be publicly known. Firms compete being aware of not only their own but also of their competitor's beliefs.

We do not just assume conjectural beliefs but are interested in how they evolve to answer the following questions:

- Will eventually conjectural beliefs become rational, i.e., converge to the truth? If so, firms would soon learn not to invest in CSR when their CSR expenditures do not enhance demand but would, vice versa, engage in CSR spending only when they are truly profitable.
- Will non-rational conjectural belief evolution render firms more cooperative or competitive, compared to rational beliefs regarding strategic market interaction?
- How do the true demand parameters influence the stability of conjectural beliefs?

Capturing social responsibility of commercial firms by "subjective conjectural payoffs" including CSR effects appears like an analysis of "social preferences" which became fashionable in behavioral and experimental economics (see, for a recent survey

Cooper and Kagel, 2016). Here social preferences are often used to align (equilibrium) predictions with actually, often experimentally observed behavior which mainly transforms the question "why do firms invest in CSR?" in asking "why do firms care for social responsibility?" We will address this not only by allowing firms to become CSR obliged but also by analyzing whether and when CSR concerns could evolve.

Capturing corporate social responsibility by richer payoff concerns than only profit is discussed in much more detail by Baron (2008). This literature essentially maintains the unitary actor tradition of neoclassical economics before developing principal-agent theory which allows for intra-firm as well as inter-firm (strategic) conflicts. By assuming conjectural payoff functions to determine market behavior we avoid analyzing intra-firm conflicts. Actually, conjectural payoffs including CSR concerns may be justified as a compromise of possibly diverging motives among the firm's stakeholders. In view of methodological individualism this may not be very convincing since one finally would like to see how intra-firm bargaining and conflict resolution can let stakeholders agree on such conjectural payoffs.[2]

In summary: although we "dig deeper" by investigating whether and when CSR concerns are evolutionarily stable, our analysis does not avoid all criticisms against CSR-concerns of commercial firms. Our approach is based on the usual assumption in evolutionary biology, namely bilateral encounters in large populations with random pairing. Thus market selection of conjectural beliefs relies on average expected profits due to many such encounters. The indirect evolutionary analysis requires the usual two-step analysis: one first solves all possible duopoly markets which then allows to specify the evolutionary game for which one derives the evolutionarily stable conjectural beliefs.

Section 2 introduces the market setup and shows how market results change when entertaining idiosyncratic conjectural beliefs. The indirect evolutionary analysis is performed in Section 3. Section 4 discusses and compares its results. Section 5 supplements the static analysis of evolutionary stability in Section 3 by a dynamic one. Section 6 concludes.

2 The market setup

Firms competing on the same sales markets are sometimes (geographically) closely located, for example, due to nearby universities and research institutes which allow to acquire the basic knowledge for designing and producing what the firms sell. Nevertheless, firms, which compete in selling, do not necessarily interact in aspects of CSR. Especially small firms affect their environment only locally and compete with other small firms in non-overlapping environments. On global markets, for example, competitors may be located in different countries with idiosyncratic and independent social and environmental conditions. This justifies why we restrict direct mutual dependencies to price competition.

[2]One possibility would be a one-population evolutionary setup with individuals randomly assigned to the different stakeholder roles (see Berninghaus, Güth, and Kliemt, 2012, 1. for indirect evolutionary exercises 2. of asymmetric games where different roles are possible).

To save on parameters, we assume standardized individual units of demand $x_i(\geqslant 0)$ as well as of CSR activity[3] $S_i(\geqslant 0)$ for all firms i so that linear demand x_i, depending on own price $p_i(\geqslant 0)$ and own S_i as well as on competitor j's price $p_j(\geqslant 0)$ but not on S_j for $j \neq i$, can be specified via

$$x_i = x_i(p_i, p_j, S_i) = 1 - p_i + a p_j + b S_i \,. \tag{1}$$

The two parameters a and b are assumed to satisfy $0 < a < \min(1, 2 - b^2)$ and $b > 0$. Profits[4] are given by

$$\Pi_i = \Pi_i(p_i, p_j, S_i) = x_i p_i - \frac{1}{2} S_i^2 \,. \tag{2}$$

Here $a \in (0, 1)$ and $b(\geqslant 0)$ are the true demand parameters. No firm i is informed about these parameters. One of the research questions will be how the true demand parameters a and b affect the evolutionarily stable conjectural beliefs and thereby conjectural payoffs as well as the profits of the competing firms. Without a clue or signal about a and b, each firm i relies on individual conjectural beliefs $\alpha_i \in [0, 1]$ and $\beta_i(\geqslant 0)$ concerning a, respectively b. We assume these beliefs to be commonly known whenever for a given sales period randomly matched firms i and j with $i \neq j$ engage in duopolistic competition.

Although the true profits are always symmetrically determined by a and b, firms i and j may form different conjectural beliefs. In asymmetric duopolistic competition firms maximize

$$U_i = (1 - p_i + \alpha_i p_j + \beta_i S_i) p_i - S_i^2/2$$

via p_i and S_i for $i \in \{1, 2\}$ and $i \neq j$. Since both firms i and j know (α_i, β_i) and (α_j, β_j), the market game is one of complete information, but possibly one with diverging conjectural beliefs. Computing the unique equilibrium yields the following:

$$p_i(\alpha_i, \beta_i, \alpha_j, \beta_j) = \frac{2 - \beta_j^2 + \alpha_i}{4 - 2\,\beta_j^2 - 2\,\beta_i^2 + \beta_i^2\,\beta_j^2 - \alpha_i\,\alpha_j} \tag{3}$$

$$S_i(\alpha_i, \beta_i, \alpha_j, \beta_j) = \frac{\left(2 - \beta_j^2 + \alpha_i\right)\,\beta_i}{4 - 2\,\beta_j^2 - 2\,\beta_i^2 + \beta_i^2\,\beta_j^2 - \alpha_i\,\alpha_j} \tag{4}$$

One can compare these results with the symmetric equilibrium choices

$$p_i^* = \frac{1}{2 - b^2 - a} =: p^* \tag{5}$$

$$S_i^* = \frac{b}{2 - b^2 - a} =: S^* \tag{6}$$

$$x_i^* = \frac{1}{2 - b^2 - a} \tag{7}$$

$$\Pi_i^* = \frac{2 - b^2}{2(2 - b^2 - a)^2} \tag{8}$$

[3] In case of multi-dimensional CSR-activities this would, of course, assume that these activities can be aggregated in a suitable way.

[4] Prices are interpreted as unit profits except for CSR expenditures. This can be justified by assuming constant production marginal costs (except for CSR expenditures).

for $i \in \{1,2\}$ resulting from maximizing true profits rather than conjectural and possibly asymmetric payoffs.

3 Indirect evolutionary analysis

Due to the true symmetry of all possible duopoly encounters, we are mainly interested in monomorphic conjectural beliefs (α, β) about competition and about the effect of CSR, respectively. Consider the interaction between a mutant i and an incumbent member j of a monomorphic population. Mutant i holds beliefs (α_i, β_i). Any incumbent's beliefs are (α, β). Mutant i and incumbent j choose prices p_i, p_j and expenditures in CSR S_i, S_j as determined by the conjectural belief equilibrium (3) and (4) with $\alpha_j = \alpha$ and $\beta_j = \beta$. Mutant i's expected true profit is given by

$$\Pi_i^e = -\frac{\left(\alpha_i-\beta^2+2\right)\left(2(a+3)\beta_i^2-2a\alpha-4(a+1)-4b\beta_i+\alpha_i\left(-2b\beta_i+\beta_i^2+2\alpha+2\right)+\beta^2\left(2b\beta_i-3\beta_i^2+2\right)\right)}{2\left(\alpha_i\alpha-\left(\beta_i^2-2\right)\left(\beta^2-2\right)\right)^2}. \quad (9)$$

For an (α, β) monomorphism to be evolutionarily stable, it is necessary that it cannot be invaded by mutants. Any (α_i, β_i) mutant confronting an (α, β) encounter should not expect a higher profit than the profit for $(\alpha_i, \beta_i) = (\alpha, \beta)$. For an interior evolutionarily stable (α, β) monomorphism in the sense of evolutionary stable strategies (ESS, see Maynard Smith and Price, 1973), $\Pi_i^e(\alpha_i, \beta_i)$ should be maximized by $\alpha_i = \alpha$ and $\beta_i = \beta$. The necessary[5] conditions for such an interior solution determine the unique (interior) evolutionarily stable conjectural beliefs $\alpha^\oplus$ and $\beta^\oplus$ as a function of the true demand parameters a and b via

$$\alpha^\oplus = \frac{a\left(2-b^2\right)}{2-b^2-a}, \quad \beta^\oplus = b\,. \quad (10)$$

This is a striking result: after evolution has taken its course firms cannot be wrong about b. Firms correctly anticipate how CSR expenditures S_i determine their demand level x_i. Either $b = 0$, i.e. CSR expenditures S_i do not affect quantities x_i. Then firms i will expect $\beta_i = \beta^\oplus = b = 0$. Alternatively $b \neq 0$, i.e. CSR expenditures S_i do affect quantities x_i. In this case firms will correctly believe that x_i depends on S_i via the demand parameter $\beta_i = \beta^\oplus = b(\neq 0)$.

Similarly, rational beliefs α about competition would require $\alpha^\oplus = a$ and, thus, $a = 0$, i.e. the price p_j has no effect on quantities x_i. Hence, rational beliefs would deny duopolistic interaction.

Proposition 1 *The evolutionarily stable (interior)* $(\alpha^\oplus, \beta^\oplus)$ *monomorphism implies rational beliefs concerning* b*, i.e.,* $\beta^\oplus = b$*, whereas rational beliefs concerning price competition would require to let both,* $\alpha^\oplus$ *and* a*, converge to zero.*

Specifically, for $a > 0$ one has $\alpha^\oplus > a$, i.e. firms believe to gain **more** than actually true from their competitor's price.

From Equation (10) also follows that only for $a+b^2/2 < 1$ (i.e. if market interaction (a) and the effect of CSR (b) are sufficiently small) we have $\alpha^\oplus + {\beta^\oplus}^2 < 2$. In line with

[5] The sufficient conditions are also satisfied.

Equations (5) and (7) this condition must be satisfied for positive equilibrium prices and quantities.

By assuming $1 > a > 0$ we have excluded the border case $a = 0$ of true monopolistic price competition. Since $2-b^2 > 0$, true monopolistic price competition ($a = 0$) excludes evolutionarily stable divergent ($\alpha^{\oplus} \neq a$) beliefs: when a approaches 0, also $\alpha^{\oplus}$ converges to 0. Thus, when price competition becomes truly monopolistic in the sense of Chamberlin (1951) and Robinson (1953) the evolutionarily stable beliefs will reflect monopolistic competition, too. Such approximate consistency of $\alpha^{\oplus}$ and a as for $a \to 0$ is, however, an exception since $\alpha^{\oplus} = a$ requires $a = 0$ due to $b^2 < 2$.

4 ESS properties

By definition the $(\alpha^{\oplus}, \beta^{\oplus})$ monomorphism implies symmetric choices $p_i = p^e$ and $S_i = S^e$ for $i \in \{1, 2\}$. Substituting (10) into (3) and (4), and then (1) and (2), we obtain the following market results:

$$p^e = \frac{2 - a - b^2}{(2 - b^2)(2 - 2a - b^2)} \tag{11}$$

$$S^e = \frac{b(2 - a - b^2)}{(2 - b^2)(2 - 2a - b^2)} \tag{12}$$

$$x^e = \frac{2 - a^2 - a - b^2}{(2 - b^2)(2 - 2a - b^2)} \tag{13}$$

$$\Pi^e = \frac{(2 - a)^2 - b^4}{2(2 - b^2)^2(2 - 2a - b^2)} \tag{14}$$

Let us compare the ESS of the conjectural belief game, given by (11)-(14), with the equilibrium of the game with correct beliefs, p^*, S^*, x^*, Π^*, from (5)-(8). As usual when analysing markets we assumed prices and sales quantities to be positive. Here, we even wanted them to be positive since we want to rely on interior market equilibria for all possible constellations of conjectures, the true and the evolving ones. Rather than specifying for each possible (a)symmetric constellation compact sets of possible price choices yielding interior equilibrium prices we will guaranteed interior equilibrium prices for all (a)symmetric constellations of individual conjectures. For this the most challenging case is when analysing that a rare mutant will not invade an otherwise monomorphic population: one implicitly assumes that not only the evolutionary conjectures but also the mutant conjectures yield positive equilibrium prices. Thus, one neglects mutant conjectures which would not guarantee positive equilibrium choices.[6] Altogether we focus on markets for which neither competition nor evolving conjectures will ever imply market exit by one of the interacting sellers. For the case of positive prices and quantities, $a + b^2/2 < 1$, the comparison between rational and evolutionarily stable conjectural beliefs suggests **less fierce** competition. Specifically, we find the following:

[6] Güth and Peleg (2001) prove quite generally the existence of evolutionary game models satisfying such conditions.

- $p^e > p^*$, i.e., evolving prices are **larger**,
- $S^e > S^*$, i.e., evolved corporate social responsibility is **stronger**, and
- $\Pi^e > \Pi^*$, i.e., firms, guided by their evolutionarily stable monomorphic conjectural beliefs, **earn more**.

From (10) follows $\alpha^{\oplus} > a$, i.e. firms exaggerate the impact of their competitor's prices. Hence, firms choose higher prices p^e and sell larger quantities x^e (according to (11) and (13), respectively) than with rational beliefs. Larger prices and quantities leads to more CSR activities S^e (according to Equation (12)).

5 Evolutionary dynamics

In Section 4 we compared market outcomes for the true and commonly known parameters a and b with parameters from evolutionarily stable monomorphic beliefs $\alpha^{\oplus}$ and $\beta^{\oplus} = b$ for $a \neq 0$. Section 4 was based on a static approach in the spirit of evolutionarily stable strategies (ESS, Maynard Smith and Price, 1973). In contrast to the static concept of ESS, replicator dynamics allow us to better understand the evolutionary process leading to—when dynamically stable—the evolutionarily stable, e.g. $(\alpha^{\oplus}, \beta^{\oplus})$, endpoint of evolutionary dynamics.

We define the determinant of the Hessian as follows:

$$D = \partial^2 \Pi_i^e / \partial \alpha_i^2 \cdot \partial^2 \Pi_i^e / \partial \beta_i^2 - (\partial^2 \Pi_i^e / \partial \alpha_i \partial \beta_i)^2 .$$

If $a + b^2/2 < 1$ (i.e. the effect a of market interaction and the effect b of CSR are not too large, which is required to have positive prices and quantities) then $\partial^2 \Pi_i^e / \partial \alpha_i^2 < 0$, $\partial^2 \Pi_i^e / \partial \beta_i^2 < 0$, so that $D > 0$ (stable, the dynamics approaches the ESS). If, however, $1 - b^2/2 < a < 2 - b^2$, then $\partial^2 \Pi_i^e / \partial \alpha_i^2 > 0$ so that $D < 0$ (unstable, the dynamics does not approach the ESS).[7]

Figures 1 and 2 illustrate the adaptation of (α, β) graphically in the α, β plane by trajectories revealing the change for given points (α, β). For each dynamically stable constellation $(\alpha^{\oplus}, \beta^{\oplus})$ the basin of attraction is the set of all (α, β) points from which the dynamics, indicated by the sequence of trajectories, finally leads to $(\alpha^{\oplus}, \beta^{\oplus})$. The illustrations show that if such $(\alpha^{\oplus}, \beta^{\oplus})$ exists with a generic basin of attraction around it, it may depend on the starting point whether $(\alpha^{\oplus}, \beta^{\oplus})$ will actually evolve, i.e., the basins of attraction may not cover all the α, β range.

Proposition 2 *Uniqueness of the $(\alpha^{\oplus}, \beta^{\oplus})$-ESS does not guarantee a global basin of attraction according to replicator dynamics.*

Figure 1 presents an example for the dynamically stable case $a < 1 - b^2/2$ and Figure 2 for the unstable case $a \geqslant 1 - b^2/2$. The red $\bigcirc$ denotes the case of correct expectations $\alpha = a$ and $\beta = b$. The red $\oplus$ shows the necessary condition for the evolutionarily stable state (Equation 10). For both parameter constellations shown in Figure 1, the basin of attraction is incomplete. Whether $(\alpha^{\oplus}, \beta^{\oplus})$ is reached depends on the starting

[7] Note, furthermore, that for $1 - b^2/2 < a < 2 - b^2$ we have $p^e < 0$ and $x^e < 0$.

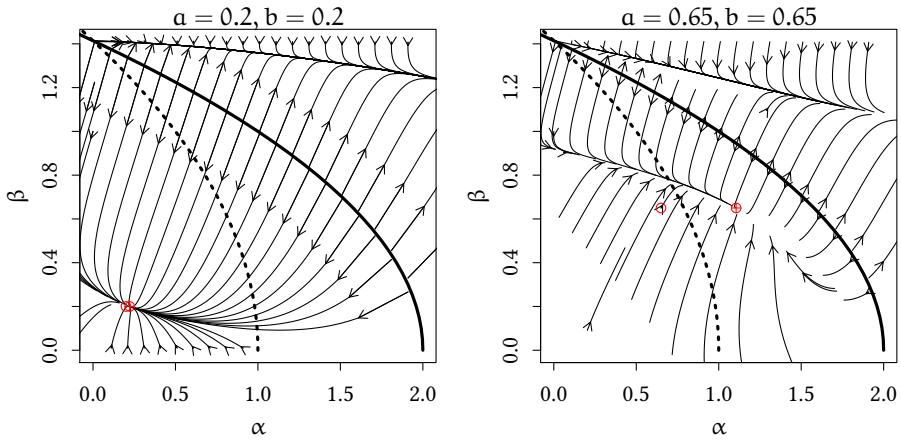

Figure 1: Dynamically stable ESS-equilibria i.e., $(\alpha^{\oplus}, \beta^{\oplus})$ is an interior point of its generic basin of attraction.
The thick solid line indicates $\alpha = 2 - \beta^2$. The dashed line indicates $\alpha = 1 - \beta^2/2$. The thin lines are the trajectories of the evolutionary dynamics. The ESS $(\alpha^{\oplus}, \beta^{\oplus})$ given by (10) is indicated with a red $\oplus$. Correct beliefs a, b are indicated with a red $\circ$.

point. Only when initially $\alpha + \beta^2 < 2$ (i.e. prices and quantities are positive), the result will be the ESS given by (10). The example $a = 0.65, b = 0.65$ illustrates how evolutionary dynamics can carry belief adaptation far away from rational beliefs $(\circ)$ to the evolutionarily stable $(\alpha^{\oplus}, \beta^{\oplus})$ monomorphic beliefs $(\oplus)$.

Figure 2 shows two examples of an unstable monomorphism. Note that all a, b constellations in Figure 1 and 2 satisfy $0 < a < 2 - b^2$, but not $a + b^2/2 < 1$, i.e. the stationary point given by (10) is a saddle point.

Proposition 3 *The evolutionary adaptation leads to the unique (interior) evolutionarily stable monomorphism* $(\alpha^{\oplus}, \beta^{\oplus})$

- *if* $a < 1 - b^2/2$ *(i.e. the equilibrium is stable), and*
- *if the adaptation process starts within its generic basin of attraction given by* $0 < \alpha < 2 - \beta^2$ *of which* $(\alpha^{\oplus}, \beta^{\oplus})$ *is an interior point.*

The dynamic analysis illustrates how one can go wrong when only relying on the static notion of evolutionary stability like the so-called evolutionarily stable strategy (ESS). However, our dynamic investigation also demonstrates that the unique $(\alpha^{\oplus}, \beta^{\oplus})$ monomorphism of conjectural beliefs has generic validity: it is uniquely dynamically stable in its generic basin of attraction.

6 Conclusions

In the literature on Corporate Social Responsibility (CSR) one often does not clearly distinguish between

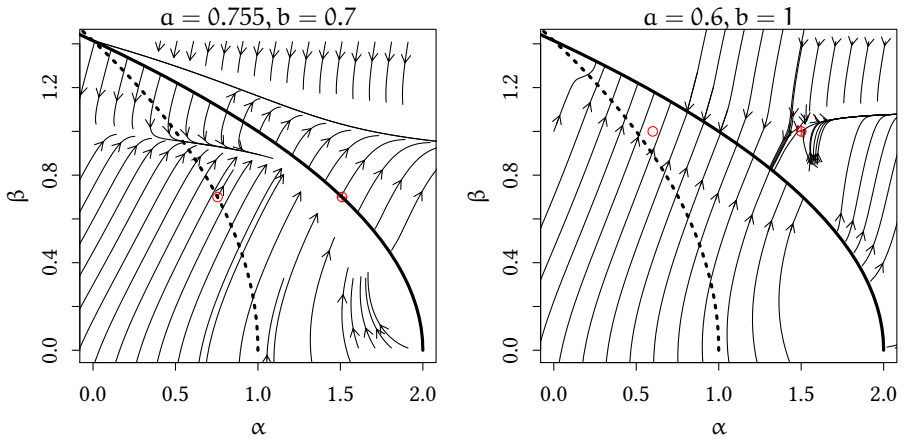

Figure 2: Not dynamically stable.
The thick solid line indicates $\alpha = 2 - \beta^2$. The dashed line indicates $\alpha = 1 - \beta^2/2$. The thin lines are the trajectories of the evolutionary dynamics. The ESS $(\alpha^{\oplus}, \beta^{\oplus})$ given by (10) is indicated with a red $\oplus$. Correct beliefs a, b are indicated with a red $\circ$.

- CSR expenditures as special investments so that a firm investing in CSR expenditures will gain from the investment, e.g. in the sense of enhancing its demand, and
- CSR expenditures without any clearly foreseeable effects for future profits.

Our market setup allows for the latter: competitive firms may entertain arbitrary beliefs and investigate how market results are affected by such beliefs. But rather than postulating and justifying certain beliefs, we were interested in whether such beliefs will evolve. Specifically, we have derived via an indirect evolutionary analysis the evolutionarily stable (ESS) and—additionally—also the (replicator) dynamically stable conjectural beliefs in how

- the competitor's price (the belief parameters α_i and α_j) and
- own CSR expenditures (the belief parameters β_i and β_j)

affect own demand. One finding is that $\beta^{\oplus} = b$, i.e. that firms will finally entertain rational beliefs concerning the CSR expenditure effect on demand. This result seems striking. But is it really surprising?

We assume that firms interact through price competition. However, in our analysis we rule out direct CSR-interaction. Own demand depends only on own CSR expenditures, but not on the expenditures of the competitor. This explains why rational expectations about the effect of CSR (about β) are evolutionarily stable, but expectations about price competition (about α) are not (except for the special case $a = 0$).

Does this model assumption render the striking result less intuitive or even unimportant? In our view, it is often realistic that firm i's demand is not directly linked to

CSR expenditure S_j of their competitor. Firms compete in sales, but firms often face very different and independent social environments and natural habitats. If so, our demand specification is justified and the striking result important. After evolution has taken its course, firms which invest in CSR expenditures do so based on correct $\beta^{\oplus} = b$ beliefs.

Conversely, firms not investing in CSR are right in the sense of $\beta^{\oplus} = b = 0$. Actually, one could argue that empirical evidence of substantial CSR-expenditures let us infer from our analysis that CSR-expenditures truly enhance them, i.e. that the true parameter b is positive.

The hybrid answer to the question "will firms entertain rational conjectural beliefs?", namely

- no, since $\alpha^{\oplus}$ beliefs are inconsistent with a, except for $a = 0$, and induce fiercer price competition, and
- yes, how CSR expenditures directly affect demand levels is correctly perceived, i.e., $\beta = b$,

may therefore be important.

Let us finally comment on indirect evolution, the method by which we have explored under which conditions CSR-concerned firms can survive in market competition. Whereas one usually views evolutionary adaptation as a substitute for rather unrealistic (commonly known) rationality, e.g. when providing evolutionarily justifying for rationality, indirect evolution allows to combine both, rationality and evolution. So our analysis assumes reacting optimally to conjectural beliefs, but does not require common knowledge when investigating which conjectural beliefs will evolve. Here selection according to true profits determines the survival prospects of conjectural beliefs. We hope that this provides a new perspective for studying CSR.

References

Baron, David P (2008). "Managerial contracting and corporate social responsibility". In: *Journal of Public Economics* 92.1, pp. 268–288.

Berninghaus, Siegfried, Werner Güth, and Hartmut Kliemt (2012). "Pull, push or both: indirect evolution in economics and beyond". In: *Evolution and Rationality: Decisions, Co-operation, and Strategic Behaviour Ken Binmore and Samir Okasha (eds), Cambridge University Press*, pp. 110–132.

Chamberlin, Edward H (1951). "Monopolistic competition revisited". In: *Economica*, pp. 343–362.

Cooper, David and John H Kagel (2016). "Other regarding preferences: a selective survey of experimental results". In: *Handbook of experimental economics*. Ed. by John H. Kagel and Alvin E. Roth. Vol. 2. Princeton University Press, pp. 217–289.

Güth, Werner and Hartmut Kliemt (2018). "Corporate Social Responsibility". In: *Handbook on the economics of social responsibility: individuals, corporations and institutions*. Ed. by Lorenzo Sacconi and Giacomo Degli Antoni. Cheltenham: Edward Elgar.

Güth, Werner and Bezalel Peleg (2001). "When will payoff maximization survive? An indirect evolutionary analysis". In: *Journal of Evolutionary Economics* 11, pp. 479–499.

Maynard Smith, J. and G. Price (1973). "The Logic of animal conflicts". In: *Nature* 246, pp. 15–18.

Robinson, Joan (1953). "Imperfect competition revisited". In: *The Economic Journal*, pp. 579–593.