IAAEU Discussion Paper Series in Economics
No. 09/2018

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September 2018

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September 26, 2018

Abstract:

We theoretically analyse the relationship between Corporate Social Responsibility (CSR) and tax avoidance of an oligopolistic firm. The firm maximises a weighted sum of profits and a CSR objective which depends on output and the firm's contribution to public good provision, i.e. tax payments. Making one CSR element more important induces the firm to adhere less to the other and to reduce tax avoidance. Hence, simultaneously a substitutive and a complementary relationship between CSR and tax avoidance can be observed. Therefore, employing composite indicators of CSR prevents an empirical identification of this linkage. Moreover, if tax avoidance declines, CSR activities will increase. Consequently, the overall link between CSR and tax avoidance is theoretically ambiguous.

Keywords:
Corporate Social Responsibility, Public Good, Oligopoly, Output, Tax Avoidance

JEL: H 26, L 13, L 31, M 14

* Previous versions of this paper have been presented at the 2nd Workshop on Applied Economic Theory at the Philipps-Universität (2017) in Marburg, the 18th annual meeting of the Association for Public Economic Theory (2017) in Paris, and the 10th Norwegian-German Seminar on Public Economics (2017) in München. I am grateful for helpful comments by participants and, particularly by two anonymous referees, an associate editor, and Sebastian Kessing.

1. Introduction

1.1 Research Objective

In recent decades, the importance of socially responsible firm behaviour has increased tremendously. Nowadays most large companies document how Corporate Social Responsibility (CSR) objectives are pursued and attained.[1] However, there is no consensus about what CSR exactly constitutes. The European Commission (2011, p. 6) defines CSR as "the responsibility of enterprises for their impacts on society. … To fully meet their corporate social responsibility, enterprises should have in place a process to integrate social, environmental, ethical, human rights and consumer concerns … ." Another often cited description by the World Business Council for Sustainable Development (2000, p. 8) states that CSR "is the continuing commitment by business to contribute to economic development while improving the quality of life of the workforce and their families as well as of the community and society at large." These characterisations have in common the notion that firms pursue objectives, in addition to profits.

Clearly, some components of CSR are directly beneficial for enterprises. If a particular human relations policy raises productivity, it may benefit employees and result in higher profits. Similarly, producing goods of high quality can simultaneously make consumers and the firm better off. Furthermore, if firms have market power and a CSR policy helps them to commit to a certain output level, this can increase profits. Hence, profit maximisation and engaging in CSR activities can be consistent. However, such conformity will not always arise and pursuing CSR objectives then has detrimental effects on (short-run) profitability. Improving working conditions may benefit employees, but raise the firm's cost by more than revenues via higher productivity. Another pertinent example may be the case of firms having market power and producing a quantity which is less than the welfare-maximising level. Expanding production in order to take into account consumer concerns can lower profits.

While CSR includes a multitude of aspects, the payment of taxes is usually not associated with it. This is exemplified by the documents from which the definitions quoted above stem: They do not deal with taxation. However, in recent years this neglect has been criticized and suggestions have been formulated to incorporate the payment of taxes according to the spirit and not only the letter of the law into the definition of CSR (Sikka 2010, Narotzki 2016, Col and Patel 2018).[2] This is also reflected in the addition of information requirements relating to tax payments and tax strategies in the Global Reporting Initiative (GRI) G4 Sustainability Reporting Guidelines and

[1] The KPMG Survey of Corporate Responsibility Reporting (KPMG 2017), which is based on data from 45 countries, states that three quarters of the 100 largest firms of each country and more than 90 percent of the 250 globally leading firms reported on corporate responsibility in 2015.
[2] See also de la Peña (2014) and Scheiwiller and Symons (2018).

the DOW Jones Sustainability Index (Bird and Davis-Nozemack 2018). These developments suggest that the incentives to pay taxes differ for firms which pursue a CSR objective, in comparison to their purely profit-maximising counterparts.

The starting point of this paper is that CSR activities are costly and that firms will counteract the resulting decline in profits by other adjustments in behaviour. Such responses may relate to input choices, pricing strategies or the extent to which reported and actual activities diverge (Bagnoli and Watts 2017). They may also involve illegal behaviour like the non-observance of labour regulations, environmental restrictions, liability rules or tax laws. We consider a widespread behavioural adjustment, namely tax avoidance. There is ample evidence that firms try to (legally) avoid taxes by appropriate transfer pricing policies, making suitable location choices or exploiting loopholes in tax law.

Slemrod (2007, p. 28) reports that the average tax gap for the Corporation Income Tax in the United States – that is, the difference between the amount of taxes due and the volume paid voluntarily and in time – was about 17% in 2001. Clausing (2016) estimates that profit shifting reduces annual corporate tax revenues in the United States by US $77 to $111 billion. Updating calculations by Crivelli et al. (2016), Cobham and Janský (2018) calculate global revenue losses due to profit shifting in the range of US $500 billion. Given these sizeable revenue losses, tax avoidance activities may constitute an important means to counteract negative profit effects of CSR activities. As an illustrative example, the recent reports about the so-called Paradise Papers[3] describe the consequences of tax avoidance activities of numerous large, internationally renowned companies with substantial market power. Often these companies are also particularly keen to emphasise their responsibility for society. Accordingly, their behaviour indicates the empirical relevance of the interaction between tax avoidance and CSR activities.

In this paper, we focus on an issue which has been debated intensively in the mostly empirical literature on tax avoidance behaviour of firms which undertake CSR activities. Specifically, we enquire whether socially responsible firm behaviour and tax avoidance activities are complements or substitutes. In the former case, more socially responsible firms will avoid taxes to a greater degree, resulting in a positive correlation between CSR activities and tax avoidance. In the latter case, the correlation is negative and CSR firms will avoid lower amounts of taxes than firms pursuing no CSR objectives. The policy relevance of knowledge about this relationship is obvious. If CSR is welfare-enhancing and CSR and tax avoidance are substitutes, fostering socially responsible behaviour by firms will yield a kind of double dividend because

[3] See the extensive documentation on the website of the International Consortium of Investigative Journalists (https://www.icij.org/investigations/paradise-papers/).

tax avoidance declines simultaneously. If, however, the two are complements, enticing firms to adhere to a CSR objective will have adverse effects in terms of tax revenues. The intention to do good by making firms behave socially responsible may then actually have adverse welfare consequences. If, alternatively, CSR behaviour is detrimental to welfare, strengthening CSR in the presence of a complimentary relationship will result in a kind of double damage.[4]

1.2 Contribution

Our contribution is based on the idea that a firm maximises a weighted sum of net profits and a CSR objective. CSR activities on their own reduce profits but can be welfare-enhancing. Net profits can be raised by tax avoidance activities. We are agnostic about the motivation for the CSR objective. It may arise because firm owners are truly convinced that pursuing a CSR objective is beneficial or since they succumb to demands by pressure groups, which require such behaviour (Calveras et al. 2007).

If firms act in a first best environment without taxation, profit-maximisation results in a Pareto-efficient outcome. Accordingly, a CSR objective can cause a welfare improvement if it counteracts deviations from a first-best environment. We choose two such aspects from the long list of CSR elements, which are empirically probably also the most relevant ones: Insufficient production (1) of the private good and (2) of goods and services provided by the government. Accordingly, in the present framework we assume the firm's behaviour has detrimental welfare consequences at two margins: First, the firm has market power, such that output is inefficiently low. Second, tax payments are used to finance government output, which we consider as a public good for simplicity. Assuming insufficient public good provision, tax avoidance also has adverse effects. Therefore, the CSR component of the firm's objective consists of two elements which can potentially induce the firm to behave in a welfare-improving manner.[5] The first CSR element is increasing in the firm's output and the second in its tax payments. In order to analyse the relationship between CSR and tax avoidance, we alter the importance of the CSR elements in the firm's objective, as well as the marginal gain from avoiding taxes.

This modelling set-up does not predetermine the relationship between CSR and tax avoidance. If the importance of the output objective rises, the firm produces a higher quantity and the CSR element is attained to a greater degree. At the same time, the rise in output increases the tax base,

[4] This is the basis for Milton Friedman's (2002, p. 133) famous and often quoted dictum that "in a free economy, … there is one and only one social responsibility of business – to use its resources and engage in activities designed to increase its profits, so long as it stays within the rules of the game …"

[5] In terms of language, we distinguish the CSR *objective* of the firm which encompasses all aspects of CSR, on the one hand, and CSR *elements* on the other hand. CSR *elements* refer either to the output or the public good aspect of the CSR *objective*.

such that more taxes are avoided, prior to any further adjustment in the firm's behaviour. Thus, this part of the model is a priori compatible with a positive and, hence, complementary relationship between CSR and avoidance activities. If the costs of avoidance rise, tax avoidance goes down and tax payments rise. Therefore, the CSR element of better public good provision, respectively higher tax payments, and tax avoidance are negatively related and constitute substitutes. Again, this line of argument applies to a situation in which additional alterations in firm behaviour have not yet been taken into account.

To preview our findings, however, we have to incorporate all output and tax avoidance adjustments. When doing so, the model predicts that if one CSR element becomes more important and is realised to a greater degree, tax avoidance activities fall. This suggests that CSR and avoidance are substitutes. However, if this CSR element, which we label the primary one, is attained to a greater degree, the firm will accomplish the other, secondary one to a lesser degree. This is caused by the reduction in the relative payoff from pursuing this secondary element of CSR. Hence, the two elements are substitutes. This, in turn, implies that less tax avoidance occurs simultaneously with a lower attainment of the secondary CSR element because of adjustments in firm behaviour. Accordingly, this secondary CSR element and tax avoidance are complements.

Our theoretical predictions suggest that empirical approaches that are based on composite indicators of CSR are bound to generate conflicting evidence with respect to the relationship between CSR and tax avoidance. If the composite indicator attaches sufficient importance to what we have called primary element of CSR, the theoretical analysis predicts a substitutive relationship. If the weight attached to the secondary element is high enough, empirically a complementary relationship will be expected. Consequently, empirical analyses of the effect of CSR on tax avoidance should be based on measures of CSR which focus on their distinct components (cf. Lanis and Richardson 2012a, Laguir et al. 2015, and Col and Patel 2018). Furthermore, our analysis suggests that the findings may vary with the measure under scrutiny. In addition, we show that if tax avoidance is made less attractive, a substitutive relationship between avoidance and CSR arises. This suggests that empirical approaches which consider changes in CSR due to variations in tax avoidance can yield different outcomes than if the reverse relationship is looked at.

Our findings crucially depend on the assumption that there are two CSR elements which both depend at least indirectly on the firm's output choice. This feature ensures that optimal CSR levels have to be determined jointly and, given the dependence of tax avoidance behaviour on output, both vary with avoidance activities. However, our results also hold for a setting in which firms do not take an environmental externality into account, produce an excessive quantity, and CSR partly corrects for this type of market failure.

The remainder of the paper is structured as follows: In the next section we review the literature. Section 3 describes the model and Section 4 derives optimal firm behaviour. In Section 5 we look at the consequences of making the CSR elements more important and of changing the marginal gains from avoiding taxes, while Section 6 concludes. An appendix collects second-order and stability conditions, derivations for an example with linear demand, as well as proofs of the propositions summarising our findings.

2. Literature

The relationship between tax avoidance and CSR has been debated either in a non-formal, theoretical manner or, alternatively from an empirical vantage point. A sound formal framework, which predicts how a firm's profit and CSR objectives interact in this context and which can inform empirical analyses, does not yet exist to the best of our knowledge. This lack is surprising since Christensen and Murphy (2004) already stated one and a half decades ago that tax issues had long been neglected in the debate about CSR. According to the corporate culture perspective a company that avoids taxes can claim to adhere to other CSR objectives with less credibility (Lanis and Richardson 2012a, 2015, Hoi et al. 2013, and Col and Patel 2018). Desai and Dharmapala (2006a) focus on the divergence of interests between managers of a firm and its owners. Strengthening CSR and restricting tax avoidance activities may both limit a manager's ability to pursue own objectives instead of those of shareholders. In consequence, all of the above mentioned contributions suggest that tax avoidance and CSR are negatively related and constitute substitutes. A contrary hypothesis, based on a risk-management perspective argues that tax avoidance imposes risk on firms, against which they can hedge by more extensive CSR activities (Hoi et al. 2013, Col and Patel 2018). This viewpoint suggests a complementary relationship.

Analyses of tax avoidance (or evasion) activities by firms usually assume them to be profit-maximising entities.[6] This view has been supplemented by the assumption that firms are run by managers who do not act on behalf of shareholders (Crocker and Slemrod 2005, Desai and Dharmapala 2006b). Hence, a firm's actions are no longer governed by a profit-maximisation objective, but by the manager's selfish concerns. Wu and Yang (2011) is a contribution we are

[6] See the widely cited contributions on tax evasion or avoidance by Marrelli and Martina (1988), Virmani (1989) or Yaniv (1995). Besfamille et al. (2013) provide a political economy perspective and Goerke (2014) surveys the relevant literature.

aware off which considers tax evasion by a firm, which also pursues an output-related objective. They examine a monopoly and focus on the separability of output and evasion choices. In sum, the theoretical literature on tax avoidance or evasion has not taken into account CSR.

Instead, the relationship between CSR and tax avoidance has been studied most intensively from an empirical perspective. Lanis and Richardson (2012a) report a negative correlation between a composite CSR indicator and also for some of its components and effective tax rates for about 400 Australian corporations.[7] Huseynov and Klamm (2012) focus on the impact of fees to tax auditors on tax payments and also investigate in how far various measures of CSR affect this relationship. For a sample of more than 2,000 American firms, they find no consistent relationship between six measures of CSR and effective tax rates. If significant, the estimated coefficients relating to the strength of CSR are mostly negative. Hoi et al. (2013) look at a sample of about 2,500 US firms and employ a variety of indices of tax avoidance and a composite CSR indicator. They consistently find that firms which score lower on the CSR indicator are more likely to avoid taxes. Moreover, they use a legal change to ascertain the impact of tax avoidance on CSR and observe a negative effect. Watson (2015) employs a binary indicator of CSR. Cash-based effective tax rates of about 2,000 US firms are correlated negatively with CSR scores if profitability is less than average. In a paper published a year later, Davis et al. (2016) use a sample of more than 5,000 US firms and establish a negative relationship between various indicators of CSR and the effective cash tax rate. Most recently, Col and Patel (2018) consider a DiD-framework and show that a legal change, which made it more attractive for some firms to have an affiliate in a tax haven, increases the respective firms' CSR rating (see also Preuss 2010, 2012). This is true for a composite indicator, as well as sub-indices of CSR.

Moving away from the United States, Muller and Kolk (2015) investigate multinational firms in India and observe that companies with a reputation for CSR pay higher effective tax rates. Laguir et al. (2015) explicitly distinguish between different indicators of CSR. They find that effective tax rates are greater for French firms with a higher index of CSR in the social dimension, while a positive correlation between tax avoidance and the economic dimension of CSR can be observed. There is no relation with regard to governance and environmental aspects. Amidu et al. (2016) analyse about 500 firms from Ghana and observe no correlation. Finally, Mao (2018) employs a matching approach and a composite CSR indicator and consistently finds that CSR scores of Chinese firms are positively associated with tax avoidance activities.

[7] Lanis and Richardson (2012b) look at a small sample of Australian firms and analyse the relationship between tax aggressiveness and the length of disclosures about CSR issues in the companies' annual report. They observe a positive correlation.

In sum, empirical contributions provide a mixed picture. Even for a single country, the United States, both substitutive and complementary linkages between CSR and tax avoidance can be observed. Moreover, the various studies do not conceptually distinguish between composite and specific indicators of CSR. This empirical ambiguity emphasises the need for a thorough theoretical analysis. Lastly, only few studies can explicitly distinguish between changes in CSR behaviour, which affects tax avoidance, and the opposite direction of influence.

3. Model

We consider a firm which has market power because it is a monopolist or a (Cournot-) oligopolist. It maximizes a weighted sum of net profits and a CSR objective with respect to output and tax avoidance. Gross profits $\pi(x, X)$ depend on the own quantity, x, of the homogeneous commodity produced and, unless the firm is a monopolist, on the quantity brought to the market, X, by competitors. Gross profits are zero if there is no production ($x = 0$), and positive otherwise, in order to make the tax avoidance problem meaningful. Moreover, gross profits are strictly concave in the own quantity, x, and maximal at $x = x^{pm}$, implying that $\pi_x >/=/< 0$ for $x </0/> x^{pm}$, and $\pi_{xx} < 0$. As usual, subscripts denote partial derivatives. Since taxes on output and on revenues distort output choices and have differential effects in oligopoly (see, f. e., Delipalla and Keen 1992, Lapan and Hennessy 2011), we assume that gross profits are taxed. They are subject to a linear tax at rate τ, $0 < \tau < 1$. Hence, taxation on its own has no distortionary consequences. Tax avoidance activities reduce the official tax burden, $\tau\pi$, by a fraction α, $0 \le \alpha \le 1$, at costs K. These costs depend on the amount of taxes avoided, $K = K(A)$, $A = \alpha\tau\pi(x, X)$. Consequently net profits, π^n, including the cost of avoidance, equal:

$$\pi^n(x, X, \alpha) = \pi(x, X)(1 - \tau(1 - \alpha)) - K(A(x, X, \alpha)) \tag{1}$$

Equation (1) indicates that the firm's choice of output depends on the quantity produced by other firms, X. Moreover, changes in exogenous parameters affect the behaviour of all firms. Therefore, the characterisation of the equilibrium and its stability, as well as the comparative static analysis have to take repercussions via alterations in X into account. In order to do so, we assume that all firms are identical and consider a Cournot-Nash setting. Denoting the optimal output choice by x^* and the total number of firms by n, in a symmetric equilibrium $X = (n - 1)x^*$ holds. If the output price declines in aggregate output, $X + x = nx^*$, then gross profits will also fall in the equilibrium quantity, $\pi_{x^*} < 0$.

The costs of tax avoidance, K(A), may arise because the firm hires tax advisors who help to exploit legal loopholes, makes use of transfer price schemes or shifts profits to low tax jurisdictions. We neither explicitly specify the source of avoidance opportunities, nor consider, for example, the consequences of differential taxation rules concerning transfer pricing (as looked at by Juranek et al. 2018), in order to keep the analysis as simple and as general as possible. The costs of tax avoidance are increasing and convex in the amount of taxes avoided and zero if no avoidance occurs, such that $K(0) = 0$ and K_A, $K_{AA} > 0$ for $A > 0$.[8] To ensure an interior solution, furthermore, $K_A(0) = 0$ holds. The costs K are not tax deductible since otherwise authorities could easily infer the extent of avoidance activities.[9]

The CSR component is represented by two elements. First, the firm gains from contributing to the provision of the public good, which is financed by tax revenues. We model this aspect by assuming that the firm's payoff rises with H, where H is an increasing and strictly concave function of tax payments $V = (1 - \alpha)\tau\pi(x, X)$, such that $H = H(V)$, and $H_V > 0 > H_{VV}$ for $V > 0$ hold. Moreover, $1/ H_V(0) \rightarrow 0$, so that it is optimal for the firm to choose a positive value of V.

The second CSR element reflects the fact that the profit-maximising quantity x^{pm} is less than the socially optimal amount because of the firm's market power. Hence, we assume that the firm's payoff rises with G, where G is an increasing function of own output, x, $G_x > 0$.

Accordingly, the objective Π, which the (representative) firm maximises with respect to x and α, can be written as:

$$\Pi(x, \alpha) = \pi(x, X)(1 - \tau(1 - \alpha)) - K(A(x, X, \alpha)) + \theta H(V(x, X, \alpha)) + \gamma G(x) \tag{2}$$

The importance of the tax element of CSR for the firm's payoff, Π(x, α), is measured by the parameter θ, $0 \leq \theta$. The relevance of the output component is indicated by γ, $0 \leq \gamma$.[10] If these parameters take the value of zero, the firm's payoff is not affected by CSR considerations.

The function H(V) in equation (2) captures the idea that paying taxes as such becomes more valuable for a CSR firm. Therefore, also the marginal valuation of tax avoidance changes. Given

[8] Hong and Liskovich (2016) provide evidence that fines imposed under the US Foreign Corrupt Practices Act are negatively affected by CSR activities. If, in accordance with this finding relating to corruption, the costs of tax avoidance declined with CSR this modification would, ceteris paribus, give rise to a complementary relationship between tax avoidance and CSR.

[9] Ignoring this informational aspect, we show below that our results also hold if costs K are tax deductible.

[10] In the theoretical literature on privatisation, public sector firms are often assumed to maximise the sum of consumer and producer surplus. Privatisation is then modelled as a greater importance of the profit component. A firm pursuing an output CSR objective may, hence, bear a certain analytical resemblance to a partially privatised firm. As indicated above, however, tax avoidance or evasion by firms has been looked at primarily for profit-maximising entities. Moreover, our subsequent findings are crucially dependent on the assumption that there are two CSR elements. Hence, the firm under consideration cannot be viewed as a partially privatised company. Nonetheless, it may be worthwhile in a separate analysis to further pursue the implications of the conceptual similarity.

this broad perspective, $H(V)$ can be interpreted in a variety of ways. It can, for example, capture the visibility of tax payments. The greater their perceptibility is, the more public opinion appreciates a given payment and the higher the gain from paying taxes and making a contribution to public good provision. Alternatively, H can describe the effectiveness of government agencies since it indicates the degree to which taxes are transformed into goods and services, which are beneficial to society. Furthermore, the function $H(V)$ may capture the consequences of a strategic interaction between tax payers because an increase in payments by the firm under consideration can alter payments by other firms. Irrespective of the interpretation of $H(V)$, the increase in the firm's objective resulting from paying taxes is becoming smaller the more of them it pays, due to strict concavity of $H(V)$. The implicit assumption underlying this feature is that the firm is relatively large and has a sizeable impact on tax revenues.[11]

Making the firm's payoff, $\Pi(x, \alpha)$ an increasing function of output via the component $G(x)$ is compatible with the notion that the firm's objective increases with consumer surplus or social welfare (cf. Goering 2008a/b, Kopel and Brand 2012, Wilner 2013, Kopel et al. 2014, Matsumura and Ogawa 2014, Lambertini et al. 2016, Planer-Friedrich and Sahm 2017). In this case, and assuming linear demand, $G_{xx} > 0$ would hold.[12] It is also conceivable that the gain from producing higher output declines with x, such that $G_{xx} < 0$.

Before concluding the description of the model, we may note that it is straightforward to illustrate the subsequent findings in the context of an example with linear demand and simple specifications of $K(A)$, $H(V)$, and $G(x)$.[13] This allows us to explicitly calculate optimal output and avoidance levels, x^* and α^*. In order to do so, we assume that inverse demand equals $P(x, X) = 1 – (x + X)$ and production costs are zero. Hence, gross profits equal $\pi(x , X) = (1 – (x + X))x$. Costs of avoidance are specified as $K(A) = \mu A^{\beta}$, μ, $\beta > 1$, and the output-related CSR element as $G(x) = x^2/2$, where $\gamma < 1 – \tau(1 – \theta)$. To ensure that optimal values can easily be calculated we assume that the CSR element $H(V)$ is linear in tax payments and given by $V = (1 – \alpha)\tau\pi$. The firm's payoff $\Pi^L(x, \alpha)$, where the superscript L indicates the linear specification, is:

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[11] It is straightforward to expand the framework by assuming that public good provision depends positively on tax payments by other agents, as well. This extension would allow distinguishing between local and non-local public goods, since the relative contribution of the firm would be higher in the former and lower in the latter case. None of the subsequent findings is affected by such a modification. Besley and Ghatak (2007) analyse a model of CSR in which in equilibrium (some) profit-maximising firms contribute to the provision of a public good. Hence, their contribution provides a micro-foundation for our assumption.

12 Sometimes, a distinction is made between customer orientation and consumer surplus in the CSR objective. The former is based on the idea that firms care for the surplus generated by own production activities, as our specification of $G(x)$ implies. The latter presumes that the gain G is a function of total output $x + X$ (see Königstein and Müller (2001) and Planer-Friedrich and Sahm (2016)). We show in Appendix A.1 that this distinction is without qualitative impact on our results.

13 I am deeply grateful to an anonymous referee for indicating this means of clarifying result.

$$\Pi^L(x,\alpha) = (1 - (x+X))x(1-\tau(1-\alpha)) - \mu A^\beta + \theta V + 0.5\gamma x^2 \tag{3}$$

Both, the general formulation (2) and the linear simplification (3), assume that the firm's payoff increases in output because its profit-maximising choice is too low, on account of the market power of the firm. However, an alternative approach to the importance of CSR is the starting point that firms produce in a way which does not sustain natural resources. If they do not take such negative production externalities into account, the output element of CSR could also reduce the firm's payoff. In this case, $\gamma < 0$ will be the appropriate assumption if the gain from lower production, say due to less detrimental environmental effects, dominates the benefits of higher output, resulting from counteracting the impact of market power (see Lambertini et al. 2016). We will show below that our main findings continue to hold for the case of $\gamma < 0$ (see Section 5.3), i.e., if CSR relates to environmental aspects.

4. Optimal Choices

The first-order conditions for the firm's optimum are given by $\Pi_x = \Pi_\alpha = 0$. Suppressing the dependence of A and V on X for notational convenience, and using

$\partial K/\partial x = K_A(A(x, \alpha))\cdot(\partial A/\partial x) = K_A(A(x, \alpha))\cdot\alpha\tau\pi_x$,

$\partial K/\partial\alpha = K_A(A(x, \alpha))\cdot(\partial A/\partial\alpha) = K_A(A(x, \alpha))\cdot\tau\pi$,

$\partial H/\partial x = H_V(V(x, \alpha))\cdot(\partial V/\partial x) = H_V(V(x, \alpha))\cdot(1-\alpha)\tau\pi_x$, as well as

$\partial H/\partial\alpha = H_V(V(x, \alpha))\cdot(\partial V/\partial\alpha) = -H_V(V(x, \alpha))\cdot\tau\pi$,

the first-order conditions can be expressed as

$$\Pi_\alpha = \tau\pi Y_\alpha = 0, \tag{4}$$

where

$$Y_\alpha \equiv 1 - K_A(A(x,\alpha)) - \theta H_V(V(x,\alpha)) = 0, \tag{5}$$

as the tax liability, $\tau\pi$, is positive, and as

$$\begin{aligned}\Pi_x &= \pi_x(x,X)[1-\tau+\tau\alpha(1-K_A(A(x,\alpha))-\theta H_V(V(x,\alpha)))+\theta\tau H_V(V(x,\alpha))]+\gamma G_x(x)\\ &= \pi_x(x,X)[1-\tau(1-\theta H_V(V(x,\alpha)))]+\gamma G_x(x)+\tau\alpha\pi_x(x,X)Y_\alpha\\ &= Z_x+\tau\alpha\pi_x(x,X)Y_\alpha = 0,\end{aligned} \tag{6}$$

where

$$Z_x \equiv \pi_x(x,X)[1-\tau(1-\theta H_V(V(x,\alpha)))]+\gamma G_x(x) = 0 \tag{7}$$

The optimal choice of tax avoidance activities, defined in (5) and denoted by α^*, balances the marginal gain in terms of lower tax payments with the marginal costs of avoidance, K_A, and the reduction in the payoff resulting from lower tax payments, H_V. The restrictions imposed on K(A) and H(V) above ensure $\alpha^* < 1$. We, additionally, assume that α^* is positive, i.e., that no tax overpayments (Rice 1992, Goerke 2008) occur. This implies that $\theta H_V(\tau\pi) < 1$ holds, such that $Y_\alpha > 0$ at $\alpha = 0$. Given an interior solution, the firm's optimal choice of α implies that $1 - \theta H_V = K_A > 0$, such that $\theta H_V < 1$ and $1 - \tau(1 - \theta H_V) > 0$. Therefore, optimal output x*, as characterised by equation (7), balances the (negative) marginal effect on after-tax profits, $\pi(x^*, X)(1 - \tau(1 - \theta H_V))$, with the gain, for example, in terms of a rise in consumer surplus.[14]

Due to the output objective, profits decline with output, that is, the firm produces more than its profit-maximising output level, $x^* > x^{pm}$.[15] Moreover, equation (7) clarifies that the output choice will be distorted, irrespective of whether the tax is levied on profits or another tax base.

The second-order conditions for a maximum of Π are derived in Appendix A.1 and require $\pi_{xx}(1 - \tau(1 - \theta H_V)) + \gamma G_{xx} < 0$. Moreover, stability in a (Cournot-) oligopoly requires not only $\pi_{xx} < 0$ but also $\pi_{xx^*} < 0$ (see Section 4 and Appendix A.1), which we henceforth assume to be the case.

In the case of linear demand and the specific functional forms for K(A), H(V) and G(x) (cf. equation (3)), optimal choices, x* and α*, can be computed explicitly (see Appendix A.2):

$$x^* = \frac{1 - \tau(1 - \theta)}{(1 + n)[1 - \tau(1 - \theta)] - \gamma} \tag{8}$$

$$\alpha^* = \frac{1}{\tau\pi(x^*)}\left[\frac{1 - \theta}{\mu\beta}\right]^{\frac{1}{\beta - 1}} = \frac{[(1 + n)[1 - \tau(1 - \theta)] - \gamma]^2}{\tau(1 - \tau(1 - \theta) - \gamma)(1 - \tau(1 - \theta))}\left[\frac{1 - \theta}{\mu\beta}\right]^{\frac{1}{\beta - 1}} \tag{9}$$

Given the linear specification of H(V), α* will be positive, as long as $\theta < 1$ holds. In the absence of CSR activities ($\theta = \gamma = 0$), output would conform to the textbook case ($x^* = 1/(1 + n)$). Further, the fraction of the tax burden avoided would decline with the tax rate, as the costs, K, are a function of the amount of taxes avoided (Yaniv 1995, Goerke 2014).

[14] If the costs of tax avoidance, K, are tax deductible, they would reduce the objective Π in equation (2) by $K(1 - \tau)$, instead of K. The modified first-order conditions would in this case be given by $1 - K_A(1 - \tau) - \theta H_V = 0$ and equation (7). Thus, our subsequent results are qualitatively unaffected if K were tax deductible.

[15] Additionally, in the absence of the output objective ($\gamma = 0$), the standard separability result would arise, namely that tax avoidance (or evasion) does not affect the firm's output decision (cf. Yaniv 1995). Wu and Yang (2011) have shown for a monopolist that separability between output and tax evasion choices no longer arises if the firm maximizes a utility function which is increasing in profits and output.

5. Comparative Statics

5.1 Modelling the Interaction of CSR and Tax Avoidance

In the present setting, the impact of changes in exogenous parameters on tax avoidance can be measured by the resulting variation in α^*, that is, the fraction of the tax liability, $\tau\pi$, which is not paid. An alternative indicator is the total amount of taxes avoided, $A = \alpha^*\tau\pi$. It incorporates changes in the tax base, i. e. profits, π. We will consider both measures below since they capture different aspects of firm behaviour.

In order to analyse the relationship between CSR and tax avoidance empirically, one could compare tax avoidance activities of firms with and without CSR objective, or with differentially pronounced CSR aims. This approach has generally been pursued (Huseynov and Klamm 2012, Lanis and Richardson 2012a, Hoi et al. 2013, Watson 2015, Davis et al. 2016, Amidu et al. 2016). Alternatively, the intensity of CSR objectives could be contrasted for firms with differential tax avoidance activities (Hoi et al. 2013, Amidu et al. 2016, Col and Patel 2018). In the context of the present model, the first approach is tantamount to analysing the effect of an increase in the parameters γ and θ. The theoretical counterpart to the second empirical approach is an analysis of an exogenous change in tax avoidance. Such a variation in avoidance activities can be attained by altering its marginal costs. Therefore, for further use, the derivatives of the modified first-order conditions (5) and (7) with respect to the weights of the CSR elements, θ and γ, and the marginal costs of tax avoidance, K_A, are required. They are given by $Z_{xK_A} = Y_{\alpha\gamma} = 0$, $Z_{x\theta} = \pi_x \tau H_V < 0$, $Y_{\alpha\theta} = -H_V < 0$, $Y_{\alpha K_A} = -1$, and $Z_{x\gamma} = G_x > 0$.

5.2 Greater Importance of Tax Element of CSR

We first consider the impact of the tax element in the objective, that is, the parameter θ. The subsequent proposition summarises our findings:

> Proposition 1: A greater importance of tax payments reduces output and tax avoidance, while tax payments increase.
>
> Proof: See Appendix A.3

A greater importance of tax payments raises the firm's incentives to pay taxes. A company can achieve this aim via two channels, namely by raising the tax base, that is profits, and by reducing tax avoidance. Profits can be increased by lowering output because the firm produces a quantity in excess of the profit-maximising level. Since higher profits, ceteris paribus, raise the amount of taxes avoided, a priori the overall impact of the fall in x* and α* on the amount of taxes avoided is uncertain. In the Appendix (A.3, equation (A.29)) we show that the direct effect via avoidance dominates the tax base impact. Consequently, not only tax payments, V, rise, but also the total amount, A, of taxes avoided declines.

In terms of the specific example of a linear demand schedule (cf. equation (3)), we can note that output declines (see Appendix A.2). Lower output raises profits, π(x*), which, in turn, contributes to a fall in the fraction, α*, of the tax burden that is avoided. Moreover, a greater importance of tax payments has a direct negative impact on avoidance, also for a given level of profits. Consequently, the amount of taxes avoided declines, while overall tax payments go up.

Proposition 1 allows us to provide a first answer to the main question of the paper: Are CSR and tax avoidance activities related, and if so, positively or negatively, i.e., are they complements or substitutes? In order to do so, we differentiate between the primary CSR element, which is directly affected by the change in the parameter θ, namely tax payments, and the secondary element. The change of this secondary element is attained only indirectly in that a rise in the parameter θ also alters output and, hence, the CSR element G(x). Proposition 1 shows that the tax element of CSR, i.e. in this case primary one, and tax avoidance are substitutes. The importance of the tax objective rises, while tax avoidance goes down and tax payments rise. Thus, more socially responsible firms, which finance a greater amount of the public good, avoid taxes to a smaller extent. If, however, we look at the correlation between tax avoidance and the secondary CSR element, we note that less output and, hence, a lower degree to which the output element is attained goes hand in hand with less tax avoidance. This indicates a complementary relationship.

5.3 Greater Importance of Output Element of CSR

Our findings relating to the output element of CSR, i.e. the parameter γ, are contained in:

> Proposition 2: A greater importance of output has uncertain effects on the fraction of tax obligations avoided, lowers the amount of taxes avoided and tax payments, while it raises output.
>
> Proof: See Appendix A.4

A greater importance of the output objective induces the firm to raise production. Higher output, in turn, reduces profits. Therefore, the marginal costs of avoidance decline and tax avoidance, ceteris paribus, rises. Lower profits also reduce tax payments, V, such that the marginal gain from paying taxes rises. Ceteris paribus, tax avoidance declines. The net effect depends on the optimal fraction, α^*, of tax payments avoided. If $\alpha^* < (>) \theta H_{VV}/(\theta H_{VV} - K_{AA}) < 1$, the optimal fraction, α^*, avoided will fall (rise) with a greater importance of the output objective.[16] Because the fall in the tax base, π, dominates a possible rise in α^*, the amount of taxes avoided, $A = \alpha^*\tau\pi$, declines with γ (cf. Appendix A.4, equation (A.33)). Tax payments, V, are reduced and, thus, less of the public good is provided. This effect occurs since the tax base effect is relatively large, compared to the fall in taxes avoided.

When we consider our specific example (equation (3)), a greater importance of the output element induces the firm to produce a greater quantity (cf Appendix A.2). Higher output reduces profits, $\pi(x^*)$, which has a positive impact on the fraction, α^*, of the tax burden avoided. This is the case because the costs of avoidance are convex in the amount, A. Lower profits, ceteris paribus, reduce this amount, such that it becomes optimal to raise the fraction, α^*. Note that this unambiguous prediction results in the general setting as well if the gain from paying taxes and contributing to the public good is linear in tax payments ($H_{VV} = 0$, cf. equation (A.32) in Appendix A.4). As in the general setting, A and V decline.

In the case looked at in Proposition 2, the primary CSR element is the output level and the secondary one given by tax payments because the latter is only affected indirectly by a rise in γ. Proposition 2 implies that the output element of CSR and the total amount of taxes avoided are substitutes. This implication ties in with the finding summarised in Proposition 1. Furthermore, a greater importance of the output element reduces tax payments and public good provision and the amount of taxes avoided. Hence, we again observe a complementary relationship.

Thus far, we have assumed that the firm's payoff rises with more output due to the CSR objective ($\gamma > 0$). Assume instead that $\gamma < 0$ holds, for example, because production harms the environment and this negative externality is not internalised.[17] In this case, a greater importance of the CSR element is tantamount to a decline (not an increase) in the parameter γ. Furthermore, $\gamma < 0$ implies that the firm produces less than the profit-maximising quantity, such that $\pi_x(x^*) > 0$ (cf. equation (7)). Appendix A.4 clarifies that the changes in the fraction, α^*, as well as the amount, A, of taxes avoided and tax payments, V, owing to a fall in the parameter γ, will be the same for

[16] This finding implies that a firm which has no output-related CSR objective and does not avoid taxes ($\alpha^* = 0$) will not start doing so if an output-related CSR element is included in its overall objective function.

[17] Lambertini and Tampieri (2015) and Lambertini et al. (2016) explicitly model the trade-off facing a CSR firm between detrimental environmental effects of higher output, on the one hand, and the beneficial impact of greater production due to its effect on consumer surplus, on the other. They show that the relative strength of the two effects determines the CSR firm's choices relative to that of its profit-seeking counterpart.

$\pi_X > 0$ as they are predicted with respect to a rise in γ and assuming $\pi_X < 0$. Hence, Proposition 2 also applies to a setting in which the output element of CSR induces the firm to reduce production to below the level required by profit-maximisation, obviously with the exception of the variation in output itself.

5.4 Greater Importance of both Elements – Composite CSR Index

The previous sub-sections have clarified that a greater importance of one CSR element tends to result in a lower amount of taxes avoided while the respective (primary) CSR element is achieved to a greater degree. This is tantamount to a substitutive relationship. While the relevance of the secondary CSR element is not varied, it is attained to a lesser degree because primary and secondary CSR elements are substitutes. This indicates a complementary link between tax avoidance and (secondary) CSR element. In empirical applications often composite indicators of CSR are used. Hence, we can also analyse how tax avoidance and CSR change if a composite indicator of CSR increases. Define this composite indicator as the sum of the weights of both CSR elements, $\gamma + \theta$. We subsequently consider the case in which both elements rise and also briefly comment on outcomes which occur if one element becomes more important and the other one loses relevance, while the sum, $\gamma + \theta$, grows. We can summarise our findings in:

> Corollary 1: A simultaneous increase in the importance of both CSR elements lowers the amount of taxes avoided and has uncertain effects on tax payments. A sufficient condition for the fraction of tax obligations avoided to decline is that a greater importance of the output element does not raise this fraction. Further, a sufficient condition for output to rise is that the importance of both CSR elements increases equally.
>
> Proof: See Appendix A.5

If either of the CSR elements becomes more important, the amount of taxes avoided, A, increases, as Propositions 1 and 2 clarify. Hence, a simultaneous increase unambiguously raises A. If only the sum of both elements, $\gamma + \theta$, increases, while one of the summands declines, the overall impact on A cannot be signed. The fraction, α^*, of tax obligations avoided declines with the importance, θ, of the tax element of CSR and will also do so with the relevance, γ, of the output element if α^* is not too high (see sub-section 5.3). Given $d\alpha^*/d\gamma \leq 0$, an increase in both CSR elements will, hence, lower the fraction α^*, as well.

Since the relationship between both CSR elements, the primary and secondary one, is substitutive, a simultaneous increase in the importance of both elements will have countervailing effects on output and tax payments. In the case of output, it is possible to show that it will rise if both CSR elements have the same weight in the firm's objective ($\gamma = \theta$) or, more generally the output element is sufficiently important. Moreover, a greater weight of both CSR elements raises tax payments via a fall in the amount of taxes avoided, A. Additionally, it reduces tax payments due to the rise in output and the ensuing decline in the tax base. The changes in the tax base and the amount of taxes avoided cannot be compared quantitatively.

In terms of the specific example of a linear demand schedule, a simultaneous, equal-sized increase in the relevance of both CSR elements raises output (cf. (A.21) and (A.22) in Appendix A.2 and using the fact that $\pi(x^*) > 0$ requires $1 - \tau(1 - \theta) - \gamma > 0$). Moreover, the increase has uncertain effects on the fraction, α^*, of the tax burden avoided and on tax payments, V. Finally, the amount of taxes avoided declines (cf. Appendix A.2).

In sum, an empirically observable increase in a composite indicator of CSR is unlikely to be informative with regard to the relationship between tax avoidance and the degree to which CSR objectives are fulfilled. The reason for the ambiguity is the substitutive relationship between different CSR elements. Therefore, the overall degree to which the CSR objective is reached depends on the relative weights of the different elements. Since the weights which a firm applies are unlikely to be known to outside researchers, it is not feasible to gauge the 'true' change in a composite CSR indicator from an observable variation in such a measure.

It is sometimes argued that a greater importance of a firm's output-related CSR objective reduces the relevance of the tax element. The analysis of this sub-section allows evaluating the impact of this kind of linkage. In order to do so, assume that the weight of the tax element, θ, decreases with the relevance of the output element of CSR, γ, such that $\theta = \theta(\gamma)$ and $d\theta/d\gamma < 0$.[18] Propositions 1 and 2 then suggest that a greater relevance of the output element of CSR raises output, has uncertain consequences for tax avoidance and reduces tax payments, V, because these payments not only decline if the tax element of CSR becomes smaller but also if the output element gains relevance (cf. equations (A.30) and (A.34)).

5.5 Marginal Costs of Tax Avoidance

A rise in the marginal costs of tax avoidance, that is, an increase in K_A, can be achieved if the costs of tax advisors rise. Alternatively, authorities may close tax loopholes, such that a given

[18] I am grateful to an associate editor for suggesting this additional interpretation of the above results.

amount of avoidance is more difficult and costly to achieve. Proposition 3 condenses how the variables of interest change.

Proposition 3: An increase in the marginal costs of tax avoidance induces the firm to expand output and to reduce tax avoidance. Moreover, tax payments rise.

Proof: See Appendix A.6

Higher marginal costs of avoidance imply that the optimal fraction, α^*, of tax obligations not paid declines. If tax avoidance activities become less pronounced, ceteris paribus, the firm finances more of the public good. Consequently, the marginal gains from paying taxes decrease. For a given tax rate, payments can be lowered by reducing profits. One way to achieve this objective is to expand output.[19] If the fraction of the tax burden avoided becomes smaller and output rises, the amount of taxes avoided declines because the tax base falls. Ceteris paribus, tax payments rise. However, the increase in output lowers the tax base, decreasing tax payments, V. Since the avoidance impact dominates the tax base effect (see Appendix A.6, equation (A.41)), higher marginal costs of tax avoidance, K_A, raise tax payments.[20]

In the context of the specific example of a linear demand schedule (see equation (3)), an increase in the marginal costs of avoidance, $K_A = \mu\beta A^{\beta-1}$, while the cost level K, $K = \mu A^{\beta}$, is held constant, can be achieved via an increase in β, subject to $dK = 0$. This implies $\mu = \mu(\beta)$. Given a linear function H(V) in this setting, the optimal output level, x^*, is unaffected by a variation in K_A (see equation (8)). Moreover, the optimal fraction of taxes avoided, α^*, declines with higher marginal costs (see Appendix A.2). If output and, thus, profits remain the same, the amount of taxes avoided declines and tax payments rise with higher marginal costs of tax avoidance.

In consequence, lower tax evasion and greater tax payments coincide. This is equivalent to a substitutive relationship between tax avoidance and the tax element. In this case, also the other, output-related CSR element is attained to a higher degree. Hence, in contrast to variations of parameters affecting the importance of CSR elements, the induced change in tax avoidance is always related in a substitutive manner to the extent to which CSR elements are achieved. This

[19] Landsberger and Subotnik (1976) analyse the behaviour of a monopolist which maximises a utility function that increases in revenues and profits. Since a lower fraction of taxes avoided is tantamount to a higher effective tax rate, our findings mirror their prediction that a higher profit tax will induce the monopolist to expand production.

[20] Note that higher marginal costs of tax avoidance reduce profits, $\pi(1-\tau(1-\alpha)) - K(A)$, taking into account Proposition 3 and $K_A < 0$, since:

$$\frac{d[\pi(1-\tau(1-\alpha)) - K(A)]}{dK_A} = \pi_x(1-\tau+\tau\alpha(1-K_A)\frac{\partial x^*}{\partial K_A} + \tau\pi(1-K_A)\frac{\partial \alpha^*}{\partial K_A}$$

Hence, profits and CSR activities are inversely related. This prediction is consistent with empirical findings, f.e. by Fernández-Kranz and Santaló (2010), that CSR is correlated positively with indicators of output market competition.

suggests that changes in tax avoidance may affect CSR differently than alterations in CSR activities alter avoidance choices.

5.6 Summary

The subsequent table summarises our predictions, as described above.

Table 1: Summary of Changes in Output and Indicators of Tax Avoidance Behaviour

		Endogenous Variables			
		1	2	3	4
		x^*	α^*	$A = \alpha^*\tau\pi(x^*)$	$V = \tau\pi(x^*)(1 - \alpha^*)$
1	θ	(–)	(–)	(–)	(+)
2	γ	(+)	(+) if $K_{AA}\alpha^* + \theta H_{VV}(1 - \alpha^*) > 0$	(–)	(–)
3	$\theta = \gamma$	(+)	(?)	(–)	(?)
4	K_A	(+)	(–)	(–)	(+)

The findings indicate that:

(1) Changes in the various indicators of tax avoidance do not always have qualitatively identical effects on endogenous variables (cf. line 2, columns 2 and 3).

(2) The relationship between tax avoidance and CSR behaviour may be substitutive or complementary if the importance of CSR objectives is varied.

(3) The impact of higher costs of tax avoidance on CSR activities is positive (line 4).

(4) Changes in composite CSR indicators are less likely to generate clear-cut predictions relating to tax avoidance than variations of individual elements (compare lines 1 and 2 with line 3).

6. Conclusions

In this paper we analyse a firm which pursues a CSR objective and also avoids taxes. The CSR objective consists of two elements, output and tax payments. The latter component implies that the marginal costs of tax avoidance rise, while the former has an ambiguous impact. We enquire whether the link between CSR activities and avoidance is substitutive or complementary. In our setting, CSR activities lower profits. On the one hand, this implies that the gains from profit-raising behaviour, such as tax avoidance, rise. On the other hand, tax avoidance can be shown to become more costly. Therefore, a priori the relationship is ambiguous.

We find that a greater importance of either of the CSR elements induces the firm to adhere to the respective element more strongly, while the other is pursued less intensively. At the same time, a smaller amount of taxes is avoided (cf. Table 1, col. 3). Therefore, there is a substitutive linkage between the CSR element which becomes more important and tax avoidance, as well as a complementary relationship with respect to the other CSR element. The intuition for the different kinds of linkages is as follows: If one CSR element becomes more important, the gain from avoiding taxes declines. This is the case since either the tax base declines such that avoidance becomes less beneficial. Alternatively, the gain from paying taxes increases. At the same time, the firm pursues the two CSR elements according to their marginal impact on its payoff. If one element becomes more important, the other automatically loses relevance at the margin and is, hence, attained to a lesser degree.

If the linkage between tax avoidance and CSR activities is substitutive, strengthening CSR activities can yield a kind of double dividend. While the above theoretical considerations often predict a substitutive relationship, in many instances this simultaneously involves a complementary linkage with another CSR element. Hence, the question arises whether the double-dividend effect can be ensured by an appropriate design of policies which foster CSR behaviour.

We also show that a composite CSR indicator often has ambiguous effects (cf. Table 1, row. 3). This is the case because even an equal-sized change in the relevance of all CSR elements can alter their relative importance. Consequently, our theoretical investigation suggests that empirical analyses of the relationship between tax avoidance and CSR can only be informative about behaviour if the various dimensions of CSR activities are adequately accounted for.

An alternative means to analyse the relationship between tax avoidance and CSR activities is to exogenously alter avoidance behaviour. Higher marginal costs of tax avoidance raise the gain from adhering to both CSR elements. Therefore, tax avoidance is negatively related to both CSR activities (Table 1, line 4). Consequently, the relationship between CSR and tax avoidance depends not only on the fact which CSR indicator is varied, but also on the question of whether the effect of CSR activities on tax avoidance is considered, or the reverse relationship is looked at. The intuition for this difference is that making tax avoidance more costly does not alter the relative importance of different CSR elements.

From a policy perspective our analysis does not provide unequivocal support for measures which raise the incentives to pursue CSR objectives. While we have shown that the relationship between tax avoidance and CSR activities may well be substitutive, a complementary linkage can also occur. Specifically, policies which strengthen firms' CSR activities may also have detrimental consequences with regard to tax revenues. Accordingly, more stringent regulations relating to CSR reporting, as required by the European Union Directive 2014/95/EU, can make large companies and their customers more aware of CSR and induce them to spend more on CSR activities. However, our investigation indicates that more CSR awareness may be complemented by side-effects, which appear to be undesirable from a welfare point of view.

In order to derive our predictions, we have chosen one particular way to model the interaction between tax avoidance and CSR. More specifically, the gains from tax avoidance vary with the output level, which, in turn, affects the payoff from pursuing the CSR objective. Moreover, these gains depend on tax payments, which also influence the payoff from pursuing the CSR objective. As outlined in Section 2, avoiding taxes can lower the credibility of pursuing CSR objectives. In our setting, this could be incorporated as a direct negative impact of tax avoidance on the weights, γ and θ, of the CSR objectives. Alternatively, CSR activities can reduce the risk a firm faces due to tax avoidance. In the present framework, this could be modelled as a direct effect of CSR activities on the probability of successfully avoiding taxes, which is currently normalised to unity, or on the (expected) costs, K, from doing so. In future research it may worthwhile to analyse such modification.

Furthermore, it may be insightful to take into account empirical evidence that tax avoidance activities and CSR behaviour are related to firm characteristics, such as firm size (Bachas et al. 2018, Belz et al. 2018). In our model, this could be incorporated by interpreting the costs of tax avoidance and the relevance of the CSR objective as functions of these firm features. Our analysis suggests that such dependence may strengthen or weaken the relationship between tax avoidance and CSR, but is unlikely to alter the predictions summarised in Table 1 in a qualitative manner. It may also be worthwhile to consider the relationship between tax avoidance and CSR for other taxes than a profit tax and different CSR objectives because such alternative taxes may distort output choices. In addition, one could consider tax evasion activities. They differ from avoidance because tax evasion involves state-dependent payoffs. This may then also be applicable to the gains from and, particularly, the costs of CSR activities. Finally, we abstract from the possibility to substitute between alternative inputs. As CSR behaviour relates to inputs as well, our analysis suggests that the relationship between CSR and input choices may be affected in a multitude of possibly conflicting ways.

7. References

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8. Appendix

A.1: Second-order Conditions and Stability

Omitting arguments of derivatives for notational simplicity, the second-order conditions for a maximum of Π are given by:

$$\Pi_{xx} = Z_{xx} + \tau\alpha^*(\pi_{xx}\underbrace{Y_\alpha}_{=0} + \pi_x Y_{\alpha x}) = Z_{xx} + \tau\alpha^*\pi_x Y_{\alpha x} < 0 \tag{A.1}$$

$$\Pi_{\alpha\alpha} = \tau\pi(x^*, X)Y_{\alpha\alpha} < 0 \tag{A.2}$$

$$\Pi_{x\alpha} = Z_{x\alpha} + \tau\pi_x(\underbrace{Y_\alpha}_{=0} + \alpha^* Y_{\alpha\alpha}) = Z_{x\alpha} + \tau\pi_x\alpha^* Y_{\alpha\alpha} \tag{A.3}$$

$$\Pi_{\alpha x} = \tau(\pi_x\underbrace{Y_\alpha}_{=0} + \pi(x^*, X)Y_{\alpha x}) = \tau\pi(x^*, X)Y_{\alpha x} \tag{A.4}$$

and

$$\Pi_{xx}\Pi_{\alpha\alpha} - \Pi_{\alpha x}\Pi_{x\alpha} = (Z_{xx} + \tau\alpha^*\pi_x Y_{\alpha x})\tau\pi(x^*, X)Y_{\alpha\alpha} - \tau\pi(x^*, X)Y_{\alpha x}(Z_{x\alpha} + \tau\pi_x\alpha^* Y_{\alpha\alpha})$$

$$= \tau\pi(x^*, X)(Z_{xx}Y_{\alpha\alpha} - Y_{\alpha x}Z_{x\alpha}) > 0 \tag{A.5}$$

where

$$Z_{xx} = \pi_{xx}(1 - \tau(1 - \theta H_V)) + (\pi_x\tau)^2\theta H_{VV}(1 - \alpha^*) + \gamma G_{xx} < 0 \tag{A.6}$$

$$Y_{\alpha\alpha} = -\tau\pi(x^*, X)\underbrace{(K_{AA} - \theta H_{VV})}_{(+)} < 0 \tag{A.7}$$

$$Z_{x\alpha} = -\pi_x\tau^2\theta H_{VV}\pi(x^*, X) < 0 \tag{A.8}$$

$$Y_{\alpha x} = -\tau\pi_x(K_{AA}\alpha^* + \theta H_{VV}(1 - \alpha^*)) \tag{A.9}$$

The determinant of the system resulting from the two modified first-order conditions (5) and (7) is given by D = $Z_{xx}Y_{\alpha\alpha} - Z_{x\alpha}Y_{\alpha x}$ and has the same sign as the system originating from the original first-order conditions defined in (A.5), as $\tau\pi(x^*, X) > 0$. D is given by:

$$D = \underbrace{-\tau\pi(x^*, X)}_{(-)}\left\{[\pi_{xx}(1 - \tau(1 - \theta H_V)) + \gamma G_{xx}](K_{AA} - \theta H_{VV}) + \underbrace{(\pi_x\tau)^2\theta H_{VV}K_{AA}}_{(-)}\right\} \tag{A.10}$$

D will surely be positive if the term in square brackets in (A.10) is non-positive, i.e., if the profit function is sufficiently concave, relative to the weighted impact of output.

In a symmetric equilibrium, X = (n – 1)x* holds, and the modified first-order conditions (5) and (7) can be expressed as functions of equilibrium output, x*, only:

$$Y_\alpha(\alpha^*, x^*) = 1 - K_A(\underbrace{\alpha^*\tau\pi(x^*)}_{=A}) - \theta H_V(\underbrace{(1 - \alpha^*)\tau\pi(x^*)}_{=V}) = 0 \tag{A.11}$$

$$Z_x(\alpha^*, x^*) = \pi_x(x^*)[1 - \tau(1 - \theta H_V((1 - \alpha^*)\tau\pi(x^*))] + \gamma G_x(x^*) = 0 \qquad (A.12)$$

Totally differentiating (A.11) and (A.12) with respect to the optimal quantity, x*, which varies for all firms equally, and the optimal level of avoidance, α*, we obtain (A.7) and (A.8), as well as:

$$Z_{xx^*} = \pi_{xx^*}(1 - \tau(1 - \theta H_V)) + \pi_x \pi_{x^*} \tau^2 \theta H_{VV}(1 - \alpha^*) + \gamma G_{xx^*} < 0 \qquad (A.13)$$

$$Y_{\alpha x^*} = -\tau\pi_{x^*}(K_{AA}\alpha^* + \theta H_{VV}(1 - \alpha^*)) \qquad (A.14)$$

Since there are no equilibrium repercussions via the choice of avoidance α*, but only via output, we distinguish the derivatives with respect to output, which incorporate equilibrium effects, from those which characterise the second-order conditions by using x* instead of x. Hence, $\partial\pi/\partial x^* = \pi_{x^*}$ and $\partial\pi_x/\partial x^* = \pi_{xx^*} \neq \pi_{xx}$ unless n = 1.

The determinant, D*, of the system of equations (A.7), (A.8), (A.13) and (A.14) is given by:

$$D^* = Z_{xx^*}Y_{\alpha\alpha} - Y_{\alpha x^*}Z_{x\alpha}$$

$$= \underbrace{-\tau\pi(x^*)}_{(-)}\left\{[\pi_{xx^*}(1 - \tau(1 - \theta H_V)) + \gamma G_{xx^*}]\underbrace{(K_{AA} - \theta H_{VV})}_{(+)} + \underbrace{\pi_x \pi_{x^*} \tau^2 \theta H_{VV} K_{AA}}_{(-)}\right\} \qquad (A.15)$$

Given π_{x^*}, $H_{VV} < 0 < K_{AA}$, a sufficient condition for the equilibrium to be stable (D* > 0), is that the term in square brackets in (A.15) is non-positive. Assuming π(x, X) = P(x + X)x - c(x), where P is the price, dP/d(x + X) = P' < 0, and c(x) is an increasing and convex cost function, the first-order condition is given by π_x = P'(x* + X)x* + P(x* + X) – c'(x*) = 0. The second derivative equals π_{xx} = P''(x* + X)x* + 2P'(x* + X) – c''(x*).

Imposing symmetry, π_x = P'(nx*)x* + P(nx*) – c'(x*) = 0 and π_{xx^*} = P''(nx*)nx* + (1 + n)P'(nx*) – c''(x*) = π_{xx} + (n – 1)(P''(nx*)x* + P'(nx*)) holds. In a Cournot-oligopoly (n > 1), the stability condition is stricter than the second-order requirement as $\pi_{xx^*} < 0$ implies $\pi_{xx} < 0$, irrespective of the sign of P''(nx*)x* + P'(nx*), but not vice versa (cf. Seade 1980).

If the output element of CSR depends on aggregate output, x* + X, such that G(x* + X) holds, the second-order conditions (A.1), respectively (A.6), and the determinant (A.10) will not be affected, because of the Cournot-Nash-assumption. In a symmetric equilibrium, G(x* + X) = G(nx*). Hence, the derivative G_{xx^*} in (A.15) would have to be reinterpreted accordingly and the stability condition be stricter, relative to a setting in which G varied with the firms production only. If $G_{xx^*} < 0$ applies, the stability requirement would be relaxed.

A.2: Linear Example

Taking the derivatives of the firm's objective (3), and subsequently making use of the symmetry assumption, ($x + X = nx^*$), the modified first-order conditions can be expressed as:

$$Y_\alpha = 1 - \mu\beta(\alpha^*\tau\pi(x, \alpha^*))^{\beta-1} - \theta = 0 \qquad (A.16)$$

$$Z_x = (1 - (1+n)x^*)[1 - \tau(1-\theta)] + \gamma x^* = 0 \qquad (A.17)$$

Solving (A.17) for the equilibrium output level, we obtain (8):

$$x^* = \frac{1 - \tau(1-\theta)}{(1+n)[1 - \tau(1-\theta)] - \gamma} \qquad (A.18)$$

Therefore, gross profits are:

$$\pi(x^*) = (1 - nx^*)x^* = \frac{(1 - \tau(1-\theta) - \gamma)(1 - \tau(1-\theta))}{[(1+n)[1 - \tau(1-\theta)] - \gamma]^2} < 1 \qquad (A.19)$$

Solving (A.16) for α, and substituting out profits yields (9):

$$\alpha^* = \frac{1}{\tau\pi(x^*)}\left[\frac{1-\theta}{\mu\beta}\right]^{\frac{1}{\beta-1}} = \frac{[(1+n)[1-\tau(1-\theta)]-\gamma]^2}{\tau(1-\tau(1-\theta)-\gamma)(1-\tau(1-\theta))}\left[\frac{1-\theta}{\mu\beta}\right]^{\frac{1}{\beta-1}}, \qquad (A.20)$$

which we assume to be positive. The derivatives of x^* and α^* with respect to γ and θ are:

$$\frac{\partial x^*}{\partial\gamma} = \frac{1 - \tau(1-\theta)}{[(1+n)[1-\tau(1-\theta)]-\gamma]^2} > 0 \qquad (A.21)$$

$$\frac{\partial x^*}{\partial\theta} = -\frac{\tau\gamma}{[(1+n)[1-\tau(1-\theta)]-\gamma]^2} < 0 \qquad (A.22)$$

$$\frac{\partial\alpha^*}{\partial\gamma} = \frac{[(1+n)[1-\tau(1-\theta)]-\gamma][(n-1)[1-\tau(1-\theta)]+\gamma]}{\tau[1-\tau(1-\theta)](1-\tau(1-\theta)-\gamma)^2}\left[\frac{1-\theta}{\mu\beta}\right]^{\frac{1}{\beta-1}} > 0 \qquad (A.23)$$

$$\frac{\partial\alpha^*}{\partial\theta} = -\gamma\frac{[(1+n)[1-\tau(1-\theta)]-\gamma][(n-1)[1-\tau(1-\theta)]+\gamma]}{[1-\tau(1-\theta)]^2(1-\tau(1-\theta)-\gamma)^2}\left[\frac{1-\theta}{\mu\beta}\right]^{\frac{1}{\beta-1}}$$
$$+\frac{[(1+n)[1-\tau(1-\theta)]-\gamma]^2}{\tau(1-\tau(1-\theta)-\gamma)(1-\tau(1-\theta))}\underbrace{\frac{1}{\mu\beta(1-\beta)}}_{(-)}\left[\frac{1-\theta}{\mu\beta}\right]^{\frac{2-\beta}{\beta-1}} < 0 \qquad (A.24)$$

From the definition of A, $A = \alpha\tau\pi(x^*)$, we observe that A is independent of γ (since $H_{VV} = 0$), while the amount of taxes avoided declines with the importance of the tax element, θ. Tax payments, V, decrease with the output objective, γ, and rise with the relevance of the tax element of CSR, θ. Consequently, a simultaneous, equal-sized change of both components reduces the amount of taxes avoided, A, and has indeterminate consequences for tax payments, V. Furthermore, we can note that α^* in (A.20) can be expressed as $\alpha^* = A/(\tau\pi(x^*))$.

An increase in $K_A = \mu\beta A^{\beta-1}$, while $K = \mu A^{\beta}$ is held constant, can be achieved via an increase in β, subject to $dK = (\partial K/\partial\beta)d\beta + (\partial K/\partial\mu)d\mu = 0$. This implies $\mu = \mu(\beta)$ and $d\mu/d\beta = -\mu \log A > 0$, since $A = \alpha\tau\pi(x^*) < 1$, given $0 < \alpha, \tau, \pi(x^*) = (1 - nx^*)x^* < 1$. Optimal output, x^*, varies neither with μ nor β and is, therefore, unaffected by the marginal costs of tax avoidance, K_A, given the simplifying assumption of a linear function H(V). The sign of $d\alpha^*/d\beta$ is determined by the sign of $d\log A/d\beta$, since $\tau\pi(x^*)$ is independent of β and $\mu(\beta)$. Making use of the fact that $\log A = (1/(\beta - 1)) \log[(1 - \theta)/(\mu\beta)]$ in the second line of (A.25), the derivative is:

$$\frac{d\log A}{d\beta} = \frac{1}{(\beta-1)^2}\log\left(\frac{1-\theta}{\mu\beta}\right) + \frac{1}{1-\beta}\left[\frac{\mu + \beta(d\mu/d\beta)}{\mu\beta}\right]$$

$$= \frac{1}{1-\beta}\left[\log A + \frac{1-\beta\log A}{\beta}\right] = \underbrace{\frac{1}{\beta(1-\beta)}}_{(-)} < 0 \qquad (A.25)$$

Therefore, the optimal fraction of the tax burden avoided, α^*, declines with greater marginal costs of tax avoidance.

$$\frac{\partial\alpha^*}{\partial\beta} = \frac{1}{\tau\pi}\frac{d\log A}{d\beta}A = \alpha^*\frac{d\log A}{d\beta} < 0 \qquad (A.26)$$

A.3: Greater Importance of Tax Element of CSR

Using equations (A.7), (A.8), (A.13) and (A.14), $Z_{x\theta} = \pi_x\tau H_V$, $Y_{\alpha\theta} = -H_V$ as well as the definitions $A = \alpha^*\tau\pi(x^*)$ and $V = (1 - \alpha^*)\tau\pi(x^*) = \tau\pi(x^*) - A$, we obtain:

$$\frac{dx^*}{d\theta} = \frac{Y_{\alpha\theta}Z_{x\alpha} - Z_{x\theta}Y_{\alpha\alpha}}{D} = \frac{\pi_x\tau^2 H_V \pi K_{AA}}{D} < 0 \qquad (A.27)$$

$$\frac{d\alpha^*}{d\theta} = \frac{Y_{\alpha x^*}Z_{x\theta} - Z_{xx^*}Y_{\alpha\theta}}{D} = H_V\frac{\pi_{xx^*}(1-\tau(1-\theta H_V)) + \gamma G_{xx^*} - \pi_x\pi_{x^*}\tau^2 K_{AA}\alpha^*}{D} < 0 \quad (A.28)$$

$$\frac{dA}{d\theta} = \tau\left[\alpha^*\pi_{x^*}\frac{dx^*}{d\theta} + \pi\frac{d\alpha^*}{d\theta}\right] = \frac{\tau\pi H_V}{D}[\pi_{xx^*}(1-\tau(1-\theta H_V)) + \gamma G_{xx^*}] < 0 \qquad (A.29)$$

$$\frac{dV}{d\theta} = \underbrace{\tau\pi_{x^*}\frac{dx^*}{d\theta}}_{(+)} - \frac{dA}{d\theta} = \frac{\tau\pi H_V}{D}[\pi_x\pi_{x^*}\tau^2 K_{AA} - (\pi_{xx^*}(1-\tau(1-\theta H_V)) + \gamma G_{xx^*})] > 0 \quad (A.30)$$

A.4: Greater Importance of Output Element of CSR

Following the same approach as in Appendix A.3 and making use of $Z_{x\gamma} = G_x > 0 = Y_{\alpha\gamma}$ yields:

$$\frac{dx^*}{d\gamma} = \frac{-G_x Y_{\alpha\alpha}}{D} > 0 \tag{A.31}$$

$$\frac{d\alpha^*}{d\gamma} = -\underbrace{\frac{\tau\pi_{x^*}G_x}{D}}_{(-)}(K_{AA}\alpha^* + \theta H_{VV}(1-\alpha^*)) \tag{A.32}$$

$$\frac{dA}{d\gamma} = \tau\left[\alpha^*\pi_{x^*}\frac{dx^*}{d\gamma} + \pi\frac{d\alpha^*}{d\gamma}\right] = -\frac{\tau^2\pi_{x^*}G_x\pi\theta H_{VV}}{D} < 0 \tag{A.33}$$

$$\frac{dV}{d\gamma} = \tau\pi_{x^*}\frac{dx^*}{d\gamma} - \frac{dA}{d\gamma} = \frac{\tau^2\pi_{x^*}G_x\pi K_{AA}}{D} < 0 \tag{A.34}$$

A.5: Simultaneous Increase in Importance of both CSR Elements

Since $dA/d\theta$ and $dA/d\gamma$ are both negative (see (A.29) and (A.33)), a simultaneous increase in the importance of both elements reduces A. Because $d\alpha^*/d\theta < 0$, $d\alpha^*/d\gamma \leq 0$ is a sufficient condition for α^* to fall with a simultaneous increase in γ and θ.

Combining (A.27), (A.31) and (7) for $d\theta = d\gamma$ yields:

$$\frac{dx^*}{d\theta} + \frac{dx^*}{d\gamma} = \frac{\tau\pi}{D}[K_{AA}(\pi_x\tau H_V + G_x) - G_x\theta H_{VV}] \tag{A.35}$$

Assuming $\theta = \gamma$, the first-order condition (7) can be rewritten as:

$$\pi_x(1-\tau) + \theta[\pi_x\tau H_V(V)) + G_x] = 0 \tag{A.36}$$

Since $\pi_X < 0$ from (7), the expression in square brackets in (A.36) is positive. Given $H_{VV} < 0$, $dx^*/d\theta + dx^*/d\gamma > 0$ for $\theta = \gamma$.

Combining (A.30) and (A.34) yields:

$$\frac{dV}{d\theta} + \frac{dV}{d\gamma} = \frac{\tau\pi}{D}[K_{AA}\tau\pi_{x^*}(H_V\tau\pi_x + G_x) - H_V(\pi_{xx^*}(1-\tau(1-\theta H_V)) + \gamma G_{xx^*})] \tag{A.37}$$

This expression cannot be signed, even if $\theta = \gamma$ and, hence, $H_V\tau\pi_X + G_X > 0$ hold (cf. (A.36)), since the term following H_V in (A.37) is negative and deducted.

A.6: Marginal Costs of Tax Avoidance

Using equations (A.7), (A.8), (A.13) and (A.14) and $Z_{xK_A} = 0$ and $Y_{\alpha K_A} = -1$, the effects of an increase in the marginal costs of avoidance are found to be:

$$\frac{dx^*}{dK_A} = \frac{\pi_x \tau^2 \theta H_{VV} \pi}{D} > 0 \tag{A.38}$$

$$\frac{d\alpha^*}{dK_A} = \frac{Z_{xx^*}}{D} < 0 \tag{A.39}$$

$$\frac{dA}{dK_A} = \tau\alpha^* \pi_{x^*} \underbrace{\frac{dx^*}{dK_A}}_{(+)} + \tau\pi \underbrace{\frac{d\alpha^*}{dK_A}}_{(-)} < 0 \tag{A.40}$$

$$\frac{dV}{dK_A} = \tau\pi_{x^*} \frac{dx^*}{dK_A} - \frac{dA}{dK_A} = -\frac{\tau\pi}{D}[\pi_{xx^*}(1 - \tau(1 - \theta H_V)) + \gamma G_{xx^*}] > 0 \tag{A.41}$$

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