Socially Responsible Firms and Endogenous Choice of Strategic Incentives

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Abstract: In this paper we are analyzing a mixed quantity-setting duopoly consisting of a socially concerned firm and a profit maximizing firm. The socially concerned firm considers one group of stakeholders in its objective function and maximizes its profit plus a share of consumer surplus. Both firms have the option to hire a manager who determines the production quantity on behalf of the firm’s owner. We find that in the subgame-perfect equilibrium of this game both firms hire a manager and delegate the production choice. If the unit production costs of the firms are similar, then the socially concerned firm has a higher market share and even higher profit. Interestingly, we observe that as the share of consumer surplus taken into account by the socially concerned firm increases, also its profit might increase. The conclusion is that it pays off to take stakeholder interests into account, but not too much.

Keywords: Socially concerned firms; Corporate social responsibility; Strategic incentives; Mixed oligopoly.
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1 Introduction

Corporate Social Responsibility (henceforth CSR) has become mainstream. Nearly 80% of the largest 250 companies worldwide issued CSR reports in 2008, up from 50% in 2005 (KPMG 2008). Both, investors and consumers put increasing pressure on companies to consider social and environmental issues alongside business goals (Fernández-Kranz and Santalo 2010, Kitzmueller and Shimshack 2010, Starks 2009, Mohr et al. 2001). For example, in 2009 a group of 186 institutional investors who represent assets of 13 trillion US dollars signed a statement which suggests pathways to deal with the problems of global warming and greenhouse gases (The Economist, 2009). Furthermore, consumers are willing to pay a higher price for products with CSR attributes, as recent empirical evidence shows (e.g. Trudel and Cotte 2009, Auger et al. 2003). Consequently, the majority of managers believe that CSR creates shareholder value, results in a competitive advantage and in cost savings (e.g. Fortune 2003).

The link between corporate social performance and corporate financial performance has been intensively studied in empirical work. Early studies were inconclusive (McWilliams et al. 2006), although newer results seem to suggest that fine-grained methods yield more pronounced (positive) links between a proper definition of CSP and CFP (e.g. Carroll and Shabana 2010, Surroca et al. 2010, Brammer and Millington 2008, Godfrey et al. 2009, Hillman and Keim 2001). On the other hand, theoretical research on strategy and governance issues has largely neglected the topic of CSR until recently (see Kopel 2011 for a literature review). However, since socially responsible firms are active in the same markets as profit-maximizing firms, it is of considerable interest to ask which goals socially responsible firms might pursue and how their presence affects the firms’ performance and welfare (Goering 2010, 2008a, b, Becchetti and Hybrechts 2008, Casadesus-Masanell and Ghemawat 2006, but also Marwell and McInerney 2005, Schiff and Weisbrod 1991, and Lien 2002). Likewise, it also seems important to consider the organizational governance of these socially responsible firms, i.e. how their organizational structure and incentive systems differ from those of firms with other objectives (e.g. Berrone and Gomez-Mejia 2009; Mahoney and Thorne 2005, 2006, Frye et al. 2006) and which differences
in management’s behavior are induced (Berger et al. 2007, Du Bois et al. 2004). Furthermore, the interaction between the firms’ governance and product market competition are interesting and worthwhile to study. The insights of such an analysis certainly can make a contribution to the ongoing discussion about the true objective function of the firm and its impact on shareholders and other stakeholders.\(^1\) The present paper tries to shed light on some of these issues by using a formal modeling approach.

In particular, we consider a situation where a profit-maximizing firm competes against a socially responsible firm in a linear homogenous-product duopoly. In contrast to the profit-maximizing firm, the socially responsible firm is assumed to maximize an objective function which takes its profit plus a share of consumer surplus into account (see also Lambertini and Tampieri 2010, Goering 2007, 2008a, b, Lien 2002). To include organizational governance aspects in the model, we assume that both firms have the option to hire a manager, who is taking over the responsibility to determine the production quantity on behalf of the firms’ owners. If firms hire a manager, they write incentive contracts for their managers to provide strategic incentives. Within this model, we try to answer the following main research questions: (i) Will both firms hire managers and delegate the production decision? (ii) Does it pay off for a firm to be socially concerned, i.e. can it yield a competitive advantage to pursue goals different from profit and compensate the manager for it? (iii) What is the impact of an increasing concern for consumer welfare on prices, quantities, industry profits and welfare?

The motivation for pursuing these research questions is three-fold. First, from the strategic incentives literature which combines questions of governance with aspects of product market competition it is well-known that profit-maximizing firms have an incentive to commit to higher production quantities by delegating the production decision to a manager (e.g. Fershtman and Judd 1987, Kräkel 2002, 2005, Englmaier 2011). However, if the industry is comprised of profit-maximizing firms and firms with an objective function which includes non-profit motives, the result might be drastically different (e.g. White 2001). Hence, one contribution of this paper is to provide insights into the endogenously chosen governance of firms with heterogeneous objectives competing in oligopoly markets. Second, in a monopolistic setting a firm which pursues non-profit motives obviously does not maximize shareholder value. Therefore, it is argued, it is not the firm’s

business to pursue social goals. However, in imperfect competition settings a firm which maximizes an objective function which deviates from pure profits might nevertheless end up with higher profits than a firm with profit motives (see, e.g. Purroy and Salas 2000). Hence, the second contribution of our paper is that we provide an answer to the question, under which conditions can a socially responsible firm achieve a higher profit than a profit-maximizing rival? Third and finally, Goering (2007) considers a mixed duopoly model where a profit-maximizing firm competes against a non-profit organization which maximizes the sum of profit and a non-profit goal. He assumes that the non-profit organization can hire a manager, but the profit-maximizing firm cannot. We extend the analysis by letting the firm endogenously choose to hire a manager or not. We show that the subgame analyzed by Goering (2007) does not yield the equilibrium outcome of the game with endogenous hiring decisions. Furthermore, we also fully characterize the equilibrium outcomes for the case where firms have non-identical production unit costs, whereas Goering (2007) just provides numerical examples.

The model yields the following insights. In equilibrium, both firms hire managers and delegate their production decisions. If the profit-maximizing firm and the socially responsible firm have identical unit production costs, then the socially responsible firm has a higher market share than the profit-maximizing firm and obtains a higher profit. A comparative statics analysis shows a non-monotonic relationship between the equilibrium profit of the socially responsible firm and the share of consumer surplus the socially responsible firm includes in its objective function. The socially responsible firm’s profit first increases if this share is increased, but then decreases. Hence, it pays off to pay attention to stakeholders, but not too much. The reason is that in a situation of strategic interaction taking consumers’ welfare into account serves as a commitment device and may lead to an increased market share and an increase in the socially concerned firm’s profits. Furthermore, we also find that for an increase in this share, industry output and total welfare increases. If the profit-maximizing firm and the socially responsible firm have different unit production costs, then the comparison obviously depends on the cost differential. However, if the cost difference is not too large, than the insights of the symmetric cost case carry over to the more general situation with asymmetric costs.

In the next section we introduce the model. We then look at the overall equilibrium which emerges as the subgame-perfect outcome of the game. We end the paper with a brief discussion of the results and conclude with some suggestions for extensions of our simple model.
2 The Model

We use a simple linear inverse demand function,

\[ p = a - b(x_{SR} + x_{PM}), \]

where subscripts refer to the socially concerned or socially responsible firm (SR) and the profit-maximizing firm (PM), respectively. Production costs of the firms are given by \( C_k(x_k) = c_kx_k, \ k \in \{PM, SR\}. \) Obviously, the objective of the PM firm is to maximize profit,

\[ \pi_{PM} = (a - b(x_{SR} + x_{PM}) - c_{PM})x_{PM}. \] (1)

We assume that the objective function of the CSR is to maximize the sum of its profits \( \pi_{SR} = (a - b(x_{SR} + x_{PM}) - c_{SR})x_{SR} \) plus a share of consumer surplus \( CS \) (e.g. Lambertini and Tampieri 2010, Goering 2007, 2008a, b), i.e.

\[ V_{SR} = (a - b(x_{SR} + x_{PM}) - c_{SR})x_{SR} + \frac{\theta b(x_{SR} + x_{PM})^2}{2}, \] (2)

where the consumer surplus \( CS \) in our homogenous-product market is simply given by the last term. With this type of objective function we somehow try to capture a firm type referred to as syncretic stewardship model by Berger et al (2007), meaning an organization which embraces economic as well as non-economic goals.

Both firms can hire a manager and delegate the production decision. In line with the strategic incentives literature, we assume that the compensation contract of the PM firm’s manager is based on a weighted average of profits and sales revenue \( R = px_{PM} \) (see Kopel and Löffler 2008, Fershtman and Judd 1987, Sklivas 1987),

\[ U_{PM} = (1 - \gamma_{PM})(a - b(x_{SR} + x_{PM}) - c_{PM})x_{PM} + \gamma_{PM}R = \pi_{PM} + \gamma_{PM}(R - \pi_{PM}). \]

In other words, the compensation contract\(^2\) gives incentives to contribute

\(^2\)More precisely, total compensation for the managers is given by \( TC_k = A_k + B_kU_k, \ k \in \{PM, SR\} \), where only \( U_k \) is relevant for providing incentives. The para-
to the firm’s objective, but also includes a correction term which is used to provide strategic incentives in an oligopoly market. Similarly, the compensation contract of the SR firm’s manager is (see Goering 2007, Heywood and Ye 2009)

\[ U_{SR} = (1 - \gamma_{SR})(a - b(x_{SR} + x_{PM}) - c_{SR})x_{SR} + \frac{(\theta + \gamma_{SR})b(x_{SR} + x_{PM})^2}{2} = \pi_{SR} + \theta CS + \gamma_{SR}(CS - \pi_{SR}). \]

Again, the compensation contracts gives incentives to contribute to the SR firm’s objective including the non-profit motives, but corrects for differences between the two components consumer surplus and producer surplus. For \( \gamma_{SR} = 0 \) the SR manager’s goal coincides with the firm’s objective. We do not a priori restrict the sign of the parameters \( \gamma_{PM} \) and \( \gamma_{SR} \), so that they can be positive or negative.

Our game now proceeds as follows. First, the owners of the firms decide simultaneously if they want to hire a manager for their firm, hence the hiring decision is endogenous. If they (both) decide to hire a manager, then they write an appropriate incentive contract, i.e. they (simultaneously) select the bonus rate \( \gamma_k \) of the manager’s contract such that the corresponding objective function (1) or (2) is maximized. Finally, the manager of firm \( k \ (k \in \{PM, SR\}) \) selects the production quantity \( x_k \) such that the manager’s compensation \( U_k \) is maximized. Note that the owner’s decision at the hiring-contracting stage might as well be interpreted as the selection of a type of manager with preferences which match the firm objective reasonably well. This perspective seems suited if strategic incentive models are used to capture the interaction between firms with profit and non-profit motives. In this context the alignment problem of owners’ and managements’ is particularly interesting, but much less studied in the literature (e.g. Bandiera et al 2010, Baron 2008, Kitzmueller and Shimshack 2010).

The overall equilibrium of the game can then be derived by determining the Nash equilibrium of the following game in normal-form:

This matrix game captures the owners’ hiring decisions at the first stage, where \( ND \) stands for non-delegation and \( D \) for delegation. The entries in the cells of the matrix represent the firms’ payoffs in the corresponding subgame, i.e. the values of the objective function using the subgame-perfect choices of contracts and outputs. For example, \( \pi_{PM}^{DD} \) is the equilibrium profit

\( A_k, B_k \) are just used to guarantee that the corresponding manager’s total compensation equals the reservation utility, which for simplicity is assumed to be zero.
of the PM firm and $V^{DD}_{SR}$ is the SR firm’s equilibrium payoff (profit + $\theta \times$ consumer surplus) in the case where both firms hire managers and delegate the production decision. The payoff entries are determined by solving each of the corresponding subgames, to which we turn next.

### 3 Results

We first analyze the situation where both firms have identical unit production costs, i.e. $c_{SR} = c_{PM} = c$. For the sake of illustration, in the appendix we describe the backward induction process for the situation where both firms delegate. Second, since it can be argued that firms pursuing economic as well as non-economic goals have higher or lower costs, we will turn to the more general case where firms have non-identical unit production costs, $c_{SR} \neq c_{PM}$. As it turns out, the overall equilibrium of the two cases are identical, although some of the details of the outcomes and the comparative statics might differ depending on the cost difference.

#### 3.1 The case of identical unit costs

The four subgames in this case can be easily solved by backward induction. In the appendix we describe the details of the backward induction process for the $DD$-subgame and provide a complete list of all the quantities, bonus rates, prices, profits, and payoffs in the corresponding subgame-perfect outcomes. After inserting the subgames’ payoffs in the normal form, we can derive the overall equilibrium of the game. It is easy to realize that delegating the production decision to a manager is a dominant strategy for both firms independent of the values of the parameters.\(^\text{3}\) That is, both firms’ owners have an incentive to hire a manager and delegate the production decision to achieve a Stackelberg leader position at the market stage. The overall equilibrium $DD$ in the identical cost case can be characterized as follows.

\(^3\)This demonstrates that the situation studied by Goering (2007) – the PM firm does not delegate whereas the SR firm delegates – is not an equilibrium of the overall game.
• The bonus rate in the incentive contract for the PM firm’s manager is independent of b, whereas the bonus rate in the incentive contract for the SR firm’s manager is even independent of a, b and c. The incentive rates decrease for increasing value of θ.

• The SR firm produces a higher quantity than the PM firm, \( x_{DD}^{SR} > x_{DD}^{PM} \) and the difference gets more pronounced for larger values of θ.

• Due to its higher market share, the SR firm obtains a higher profit, \( \pi_{DD}^{SR} > \pi_{DD}^{PM} \), given that both firms sell their homogenous products for the same market price and have identical costs. Since consumer surplus is positive, this obviously also holds for the SR firm’s payoff.

• For increasing θ, industry output increases and the market price decreases. If the SR firm maximizes the sum of its profit and total consumer surplus (the limit case \( \theta = 1 \)), the market price drops to the level of unit costs. As a consequence, the profit-maximizing firm exits the market (\( x_{PM}^{DD} = 0 \) and \( \pi_{PM}^{DD} = 0 \)), whereas the SR firm takes over the whole market (\( x_{SR}^{DD} = \frac{a-c}{b} \) and \( V_{DD}^{SR} = \frac{(a-c)^2}{2b} \)). Observe that this replicates the result which is obtained for mixed oligopolies with e.g. a public firm or a consumer cooperative competing against a profit-maximizing firm (e.g. Marini and Zevi 2010).

• An interesting fact to notice is the dependence of the firms’ profits on the parameter θ. Not unexpectedly, for increasing values of θ, the PM firm’s profit is decreasing (for any admissible values of a, b, c). In contrast to this, the SR firm’s profit is increasing for \( \theta \leq 0.27184 \) and decreasing only for higher values. More precisely, \( \partial \pi_{DD}^{SR} / \partial \theta > 0 \) for \( \theta \in [0, 0.27184] \) and \( \partial \pi_{DD}^{SR} / \partial \theta > 0 \) otherwise. Hence, we obtain a non-monotonic, inverted U-shaped relationship between the equilibrium profit of the SR firm and the degree of concern the SR firm exhibits with respect to one of its primary stakeholders. In the light of the revived discussion about stakeholder or shareholder view, the result that a firm’s profit can simultaneously achieve both goals, that is increase the value for its stakeholders and at the same time increase its profits, even if it competes head-on against a profit-maximizing rival, is interesting. The reason here is that in a situation of strategic interaction accounting partially for a stakeholder group (here the consumers)

\[ ^{4} \text{A similar inverted U-shaped relationship between the economic success and the level of corporate environmental protection is discussed by Schaltegger and Synnestvedt (2002) in the context of a conceptual model.} \]
can serve as a commitment device and can result in an increase in the SR firm’s competitive advantage. In this sense, “... investing in stakeholder management may be complementary to shareholder value creation and may indeed provide a basis for competitive advantage ...” (Hillman and Keim 2001, p. 135). This result shows that non-profit maximizing firms competing against profit-maximizing rivals in an imperfect market can indeed have an advantage (see Kelsey and Milne 2008). It is important to notice, however, that such a social concern is rewarded only up to a point, that is "it pays to be good, but not too good" (Mintzberg 1983). If the firm already puts a high weight on consumer surplus, increasing the weight even further destroys shareholder value.

- We further notice that the SR firm’s payoff $V_{\text{SR}}^{\text{DD}}$ is increasing throughout for increasing $\theta$, since the increase in consumer surplus compensates for the decrease in profit. Compared to a situation without delegation we obtain $\pi_{\text{PM}}^{\text{NDND}} > \pi_{\text{PM}}^{\text{DD}}$ and $\pi_{\text{SR}}^{\text{NDND}} > \pi_{\text{SR}}^{\text{DD}}$ due to higher production quantities and a resulting lower market price. However, it is interesting to notice that in contrast to the strategic incentives literature (e.g. Fershtman and Judd 1987, Sklivas 1987) the firms might not be trapped in a prisoner’s dilemma situation. The reason is that $V_{\text{SR}}^{\text{NDND}} > V_{\text{SR}}^{\text{DD}}$ only if $\theta < 0.53414$, but $V_{\text{SR}}^{\text{NDND}} < V_{\text{SR}}^{\text{DD}}$ for higher values of $\theta$. Hence, if the SR firm’s weight on the consumer surplus is sufficiently high, then the SR firm’s payoff in equilibrium is higher than without delegation.

- We finally take a look at welfare. Although producer surplus (the sum of profits) is decreasing for increasing $\theta$, the increase in consumer surplus overcompensates the decrease and leads to an overall increase in total welfare.

3.2 The case of non-identical unit costs

We now turn to the more general model where firms have non-identical costs. Since it can be argued that socially concerned firms have higher or lower costs than a profit-maximizing firm, we do not assume any restrictions on the production unit costs beside the conditions which guarantee the viability of the model (see below). Socially concerned firms may have higher costs e.g. due to a lack of focus on a single objective or the potential for managerial entrenchment. On the other hand, it can be argued that socially concerned
firms can attract and retain highly motivated employees (e.g. Berger et al. 2007) and, hence, have lower costs.

To derive the subgame-perfect outcome of this model, we proceed in the same way as in the previous subsection (see also the appendix). We first derive the solutions and payoffs of all four subgames \((NDND, NDD, DND, DD)\) employing the usual backward induction approach. However, in the case of non-identical unit costs we have to take the non-negativity of quantities and payoffs into account, since if the unit cost differential between firms becomes too large, the cost follower exits the market.\(^5\) This yields a region in the cost parameter space (see Figure 1) where all subgames have non-negative quantities and payoffs, and all the second order conditions are fulfilled. To derive the overall equilibrium of the game, we can again substitute the firms’ payoffs into the normal form and derive the unique subgame-perfect outcome. The solution can now be characterized as follows.\(^6\)

- For values of the unit costs \(c_{SR}\) and \(c_{PM}\) in the region bounded by the lines where \(x^D_{PM} = 0\) and \(x^D_{SR} = 0\) (see Figure 1), the game has an admissible solution. The equations of these lines are given by \(c_{PM} = \frac{1-\theta}{3}a + \frac{2}{3-\theta}c_{SR}\) and \(c_{PM} = -\frac{4+4\theta-\theta^2}{4(4-\theta)(2-\theta)}a + \frac{2(6-\theta)}{(4-\theta)(2-\theta)}c_{SR}\), respectively. For combinations of the unit costs outside this region (but below the reservation price \(a\)), one of the firm exits the market, so that a monopoly solution would prevail due to the existence of a structural market entry barrier.

- As in the case of identical unit costs, in the unique subgame-perfect outcome of the game both firms hire managers and delegate the production decision in equilibrium.

- In the admissible region of unit costs, the profit of the socially concerned firm might become negative, if its cost disadvantage becomes too large (note that its payoff including a share of the consumer surplus is still positive). In this case the SR firm tries to make the manager

\(^5\)An additional complication in this case is that at the contracting stage the first order condition is a cubic equation. This equation can be solved by using the software package Mathematica for symbolic computation. Then the unique solution can be found by employing the second order conditions for a maximum. Detailed derivations are available upon request.

\(^6\)Since the expressions of the equilibrium values of the bonus rates, quantities, prices, payoffs, and profits are quite complicated, we abstain from presenting them in the paper. Instead we provide a verbal description based on Figure 1 which can be compared with the case of identical unit costs.
less aggressive by switching to a negative incentive rate, whereas the PM firm’s incentive rate for its manager is positive in the whole region. The dashed line in Figure 1 indicates the location where this transition occurs. The equation of this line is given by $c_{PM} = -\frac{1-\theta}{2-\theta}a + \frac{3-2\theta}{2-\theta}c_{SR}$.

- The profit of the PM firm is positive throughout. Hence, since we know that $\pi_{SR}^{DD} > \pi_{PM}^{DD}$ for $c_{PM} = c_{SR}$, we can conclude that $\pi_{SR}^{DD} < \pi_{PM}^{DD}$ if the cost disadvantage of the SR firm is sufficiently large.

- The dotted line in Figure 1 indicates the location where $x_{PM}^{DD} = x_{SR}^{DD}$. The equation of this line is given by $c_{PM} = -\frac{1+16\theta-46\theta^2}{35-24\theta+4\theta^2}a + \frac{36-8\theta}{35-24\theta+4\theta^2}c_{SR}$. Hence, if unit costs are above this line and within the admissible region, then $x_{PM}^{DD} < x_{SR}^{DD}$, and otherwise below the line. These observations show that the SR firm can achieve a higher market share and higher profits than the PF firm despite higher unit costs, if the cost disadvantage is not too large. This is similar to a situation in which a Stackelberg leader has higher unit costs, with the difference that in our model the commitment is with regard to the objective function and through the provision of strategic incentives.

- For increasing $\theta$, the lines $x_{PM}^{DD} = 0$ and $x_{SR}^{DD} = 0$ rotate downwards, but the dashed line rotates upwards to the left (this is indicated by small arrows in Figure 1). Hence, for increasing $\theta$ the SR firm becomes a stronger competitor, since it can have a large cost disadvantage, and still stays in the market whereas the PM firm exits. However, at the same time the region where the SR firm’s profit is positive is shrinking. Hence, the SR firm has to find financial funds to cover a potential loss. Note that for $\theta = 1$ the PM firm can only stay in the market if the SR firm has a cost disadvantage, but the SR firm makes a loss for each possible combination of unit costs.\footnote{Recall from the identical unit costs case that for $\theta = 1$ we have observed that the SR firm sets the price equal to its unit costs and the PM firm exits the market.}

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Figure 1: Combinations of unit costs $c_{PM}$ and $c_{SR}$ which yield admissible solutions of the game. The figure depicts the situation for $\theta = 0.25$.

- As in the case of identical unit costs, for increasing $\theta$ the quantity $x_{DD}^{SR}$ is increasing, the quantity $x_{DD}^{PM}$ is decreasing, and the market price is decreasing due to an increase in industry output.

- Again there is a non-monotonic relationship between $\theta$ and the SR firm’s profit in the case of non-identical costs. This follows since for all $\theta < 1$ the line of identical unit costs $c_{SR} = c_{PM}$ is located in the region where both firms make positive profits and payoffs depend continuously on the parameters. Hence, we certainly obtain an inverted U-shaped relation between the SR firm’s profit and its degree of social concern $\theta$ if the unit costs of the firms do not differ too much.

- The welfare analysis of the non-identical cost case turns out to be more intricate. First of all, notice that it is possible, that the producer surplus becomes negative. This may happen if the loss of the SR firm is larger than the profit of the PM firm. Nevertheless, consumer surplus
is larger and increasing in $\theta$. Overall, we obtain the following result. Welfare is increasing in $\theta$ if $c_{SR} > c_{PM}$. On the other hand, welfare is increasing in $\theta$ if the cost advantage of the SR firm is not too large. Otherwise, welfare may even decrease in $\theta$.

4 Discussion and Conclusions

In this paper we have studied a simple model of a mixed oligopoly where a profit-maximizing firm competes against a socially concerned firm. The choice of organizational governance is endogenized by giving both firms the option to hire a manager and to write a strategic incentive contract. It turns out that in equilibrium both firms delegate the production decisions independent of unit costs and other parameters. This result is in line with findings in the strategic incentives literature with profit-maximizing firms, although in our model the SR firm is not necessarily worse off in terms of its total payoff compared to a situation without delegation. However, our analysis also demonstrates that the scenario studied by Goering (2007) – only the SR firm delegates – is not part of an equilibrium. An interesting contribution of our analysis to the ongoing discussion if firms should pursue shareholder value maximization or should also include other stakeholders’ goals is that we demonstrate that in imperfect competition a firm can achieve both goals if it considers non-profit motives. A firm with non-profit motives can actually obtain higher profits than a profit-maximizing firms given that it does not put too much weight on consumers’ interest in the objective function.

Several extensions of our simple setup come to mind. We have assumed that firms offer homogeneous products. In the context of corporate social responsibility, it makes sense, however, to assume that products are horizontally and vertically differentiated (see Kopel 2011). In such a model price competition could be studied as well. Moreover, in our model a profit-maximizing firm and a socially responsible firm compete. But in real markets profit-maximizing, non-profit firms, socially concerned firms, and public firms coexist (Goering 2008a). We also did not consider timing issues in this setting, although it might be interesting to consider the emergence of a first- or second mover advantage in a mixed market (see Kopel and Löffler 2008, 2010).
Appendix

In this appendix we describe the backward induction procedure for our multi-stage game. Due to space constraints, we restrict ourselves to the DD-subgame, where both firms delegate. At the market stage, the managers select the production quantities such that their compensation is maximized. From the first-order conditions \( \frac{\partial U_{PM}}{\partial x_{PM}} = 0 \) and \( \frac{\partial U_{SR}}{\partial x_{SR}} = 0 \) we obtain the reaction functions

\[
x_{PM}(x_{SR}) = \frac{a - c(1 - \gamma_{PM})}{2b} - \frac{1}{2} x_{SR}
\]

\[
x_{SR}(x_{PM}) = \frac{(1 - \gamma_{SR})(a - c)}{b(2 - 3\gamma_{SR} - \theta)} - \frac{1 - 2\gamma_{SR} - \theta}{2 - 3\gamma_{SR} - \theta} x_{PM}.
\]

The intersection of the reaction functions yields the unique optimal quantities for both firms given the bonus rates in this stage:

\[
x_{PM}(\gamma_{PM}, \gamma_{SR}) = \frac{a(2\gamma_{SR} + \theta - 1) + c(\gamma_{PM}(3\gamma_{SR} + \theta - 2) - 2\gamma_{SR} - \theta + 1)}{b(4\gamma_{SR} + \theta - 3)}
\]

\[
x_{SR}(\gamma_{PM}, \gamma_{SR}) = \frac{c(-\gamma_{PM}(2\gamma_{SR} + \theta - 1) + \theta + 1) - a(\theta + 1)}{b(4\gamma_{SR} + \theta - 3)}.
\]

It can be checked ex post (i.e. using the equilibrium bonus rates) that the second-order conditions are fulfilled. We now have to substitute the quantities \( x_{SR}(\gamma_{PM}, \gamma_{SR}) \) and \( x_{PM}(\gamma_{PM}, \gamma_{SR}) \) into the objective functions (see equations (1) and (2)) to obtain the reduced-form payoffs. In the first stage, the firms’ owner chooses the corresponding incentive parameter \( \gamma_k \) for their manager’s contract such that the objective function is maximized. Solving the two first-order conditions, \( \frac{\partial \pi_{PM}}{\partial \gamma_{PM}} = 0 \) and \( \frac{\partial \pi_{SR}}{\partial \gamma_{SR}} = 0 \), simultaneously we obtain the reaction functions

\[
\gamma_{PM}(\gamma_{SR}) = \frac{(a - c)(2\gamma_{SR} + \theta - 1)^2}{2c(\gamma_{SR} - 1)(3\gamma_{SR} + \theta - 2)}
\]

\[
\gamma_{SR}(\gamma_{PM}) = \frac{a(-\theta) + a + c(-\gamma_{PM} + \theta - 1)}{2a(\theta + 2) + c((\gamma_{PM} - 2)\theta - 4)}.
\]
Solving the system of reaction functions, we realize that this system of equations has two solutions. The second-order conditions can be used to single out the solution which yields a maximum:

\[
\gamma_{PM}^{DD} = \frac{(-\theta(2\theta - 5)(-\theta + D + 2) - 12)(a - c)}{4c(\theta - 3)(-\theta + D + 3)}
\]

\[
\gamma_{SR}^{DD} = \frac{-\theta^2 + \theta - (\theta + 1)D + 6}{2(4\theta + 6)}
\]

where \( D = \sqrt{(\theta - 4)\theta + 12} \). Inserting these values of the incentive parameters into the reduced-form expressions for the quantities and payoffs gives the following subgame-perfect outcomes, profits, payoffs and price for the \( DD \)-subgame:

\[
\begin{align*}
    x_{PM}^{DD} &= \frac{(-\theta + D - 2)(a - c)}{4b}, &
    x_{PM}^{DD} &= \frac{2((\theta - 4)\theta - 4)(a - c)}{b(\theta(\theta + D) - 2(D + 6))} \\
    \pi_{PM}^{DD} &= \frac{-2(\theta - 1)^2(a - c)^2}{b(\theta(\theta + D + 2) - 4(D + 3))} \\
    \pi_{SR}^{DD} &= \frac{2((\theta - 5)\theta^2 + 4)(a - c)^2}{b(12(D + 4) + \theta(\theta + D) - 6D - 28)} \\
    V_{SR}^{DD} &= \frac{(\theta(\theta(6\theta - 35) + 56) + 16)(a - c)^2}{b(24(D + 4) + \theta(3\theta + 3D - 8) - 2(9D + 16))} \\
    p^{DD} &= \frac{a(3\theta + D - 6) + c(\theta - D - 6)}{4(\theta - 3)}
\end{align*}
\]

The same procedure yields the equilibrium outcomes for the other subgames.

For the \( NDND \)-subgame, we obtain:

\[
\begin{align*}
    x_{PM}^{NDND} &= \frac{(a - c)(\theta - 1)}{b(\theta - 3)}, &
    x_{SR}^{NDND} &= \frac{(a - c)(\theta + 1)}{b(\theta - 3)} \\
    p^{NDND} &= \frac{2(a - c)}{\theta - 3} + a
\end{align*}
\]
\[
\pi_{PM}^{NDD} = \frac{(a - c)^2(\theta - 1)^2}{b(\theta - 3)^2}, \quad \pi_{SR}^{NDD} = -\frac{(a - c)^2(\theta^2 - 1)}{b(\theta - 3)^2}
\]
\[
V_{SR}^{NDD} = -\frac{(a - c)^2((\theta - 2)\theta - 1)}{b(\theta - 3)^2}
\]

For the subgame \textit{NDD}, we obtain:
\[
x_{PM}^{NDD} = \frac{(a-c)(t-1)}{b(\theta - 4)}, \quad x_{SR}^{NDD} = -\frac{(a-c)(\theta + 2)}{b(\theta - 4)}
\]
\[
p^{NDD} = \frac{3(a-c)}{\theta-4} + a
\]
\[
\gamma_{SR}^{NDD} = \frac{1-\theta}{2\theta+4}
\]
\[
\pi_{PM}^{NDD} = \frac{(a - c)^2(\theta - 1)^2}{b(\theta - 4)^2}, \quad \pi_{SR}^{NDD} = -\frac{(a - c)^2(\theta - 1)(\theta + 2)}{b(\theta - 4)^2}
\]
\[
V_{SR}^{NDD} = -\frac{(a - c)^2(2\theta + 1)}{2b(\theta - 4)}
\]

For the subgame \textit{DND}, we obtain:
\[
x_{PM}^{DND} = -\frac{(a-c)(\theta - 1)}{2b}, \quad x_{SR}^{DND} = \frac{(a-c)((\theta - 2)\theta - 1)}{2b(\theta - 2)}
\]
\[
p^{DND} = \frac{a(\theta - 1) + c(\theta - 3)}{2(\theta - 2)}
\]
\[
\gamma_{PM}^{DND} = -\frac{(a-c)(\theta - 1)^2}{2c(\theta - 2)}
\]
\[
\pi_{PM}^{DND} = -\frac{(a - c)^2(\theta - 1)^2}{4b(\theta - 2)}, \quad \pi_{SR}^{DND} = \frac{(a - c)^2(\theta^3 - 3\theta^2 + \theta + 1)}{4b(\theta - 2)^2}
\]

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\[ V_{SR}^{DND} = \frac{(a - c)^2(3\theta - 2)\theta - 1}{8b(\theta - 2)} \]

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