On the economics of corporate social responsibility*

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Abstract

This paper seeks to explore the economic mechanisms behind corporate social responsibility (CSR) in a micro-economic model of the firm. The motivation of this study is to shed some light on the potential causes of the observed phenomena of voluntary over-compliance among firms. We consider a few different models, both static and dynamic, to investigate how various assumptions about costs and benefits may affect CSR behavior through a stock of goodwill capital. Our analysis show that in optimum, the profit maximizing firm must balance costs and benefits of CSR. From a cursory look into the CSR literature, we find evidence that some of the hypotheses that can be derived from the models in this paper can be verified empirically.

Keywords: corporate social responsibility, dynamics, goodwill, uncertainty.

JEL: D21, D62, Q01, Q2.

1. Introduction

According to conventional economic theory, firms maximize profits subject to technological and other constraints. Without economic incentives like taxes or quantitative regulations, the firm might, for example, ”pollute too much”, or engage in some other environmentally or socially detrimental behavior. Only a cursory look around business environments today suggests that this point of view might be a trifle old-fashioned. Indeed, firms spend resources to convince potential consumers and other stakeholders that they are more socially and environmentally responsible than what the authorities or society demand. This paper seeks to explore the economic mechanisms behind corporate social responsibility (CSR) from a micro-economic perspective of the firm. The objective of this study is to shed some light on the observed voluntary over-compliance among some firms. To this end, we aim to provide relevant and well-founded economic mechanisms to explain this behavior.

Since the publication of the report "Our Common Future" (1987) by the World Commission on Environment and Development, the terms sustainability and sustainable development have become prominent in the public debate. A part of the sustainability debate has been devoted to what companies can do to facilitate sustainable development, so called corporate social responsibility (CSR). A clear-cut and undisputed definition of CSR is not available. One of the first attempts to bring CSR into the public debate was Milton Friedman who in his article in the New York Times Magazine argues that "*the corporate social responsibility of* *firms is to maximize its profits"* (Friedman, 1970). While this statement may be appealing to neoclassical economists, it may seem provocative and without nuance to others. But as we shall see, profit maximization does not have to be in conflict with social responsibility. Since Friedman's statement many definitions of CSR has been suggested. One recent definition was proposed by Paul R. Portney in Hay et al (2005). He defines CSR as " *a consistent pattern, at the very least, of private firms doing more than they are required to do under applicable laws and regulations governing the environment, worker safety and health, and investments in the communities in which they operate."*[1] This definition requires CSR to be actions that, at least to some degree, implies beyond-compliance behavior. Compared to many other definitions, which loosely refers to sustainable development and other fuzzy concepts, this is concrete and leaves fairly little to imagination. From hereon, when we refer to CSR, we think of Portney's definition.

Many empirical studies of the effects of CSR on firm performance, either economic or financial (but mostly the latter), have been performed during the last two or three decades. The number of studies are now so vast that there exists at least 10-15 reviews, many of them reviewed in Margolis and Walsh (2001),

[1]See also McWilliams and Siegel (2001) for a similar definition.

together with the almost 100 separate studies which the latter comprises.[2] Moreover, Reinhardt (2000) and Lyon & Maxwell (2004) summarize to a large extent the bulk of empirical CSR literature that is available up to date. Hey et al (2005) also offer a comprehensive review from the fields of economics, law and business. The evidence from the above listed review studies are not conclusive, but they seem to be "in favor" of CSR; that is, CSR is positive for the financial performance of the firm.

But what about CSR and economic performance? Of course, economic and financial performance are inter-linked,[3] but there are some interesting differences worth pointing out. The *Journal of Productivity Analysis* has recently published a theme issue on CSR and economic performance (C. J. M. Paul and D. Siegel (eds), 2006). They note that the vast amount of studies of CSR and the effect on financial measures is, from an economic perspective, unfortunate. Instead, they suggest that a more salient issue is the relationship between economic performance and CSR behavior, where economic performance entail technological and economic inter-actions between production of output and input demand, recognizing the opportunity costs of inputs and capital formation. Their conclusion is that the

[2] See also Hay et al (2005) for an extensive up to date appraisal of the CSR literature with perspectives from business, law, and economics.

[3] If, for example, economic efficiency is improved by CSR this will most likely show in financial performance through higher profits.

cost of CSR must be balanced by benefits to motivate firms to carry out such activities.

Paul R. Portney, in Hay et al (2005), points out that none of the plentiful individual studies (referring to the studies aimed at analyzing CSR and financial performance) have derived testable hypoheses from a theoretical model of the firm, and few of them are very clear on the mechanisms behind how socially responsible behavior is supposed to work to their financial advantage. He goes on to to sketch how such a model should look like; by engaging in CSR, output price (price differentiation), wages (higher worker productivity or lower wages), and rental price of capital (lower risk) become to some degree endogenous to the firm (Hayes et al, 2005, p 114, footnote 18), and thus profits would not depend solely on the cost of engaging in CSR, but also on the benefits. The purpose of this paper is to build such a model with dynamics and goodwill capital. Before proceeding, a brief review of some of the existing theoretical models in the literature.[4]

Not many attempts have been made to formally model causes and mechanisms behind voluntary over-compliance at firm level. There are, nevertheless, a few examples of papers discussing the cause and mechanisms of CSR from an economists point of view. Bergman (1995) provide several interesting simple sta-

[4] For more theoretical investigations, see references in papers reviewed here.

tic micro-models, in terms of environmentally friendly firms, which give rationale for CSR. A game theoretical model of voluntary over-compliance is proposed by Aurora and Gangopadhyay (1995). Their basic idea is that firms play a game where they can signal "greeness", and if consumers prefer to buy products from a "greener" firm, then the cost of being environmentally friendly may be justified by higher revenues. McWilliams and Siegel (2001) take a cost-benefit approach to CSR, which is promising, and they also provide several hypotheses regarding CSR activity; provision of CSR depend on product diffentiation, advertising intensity, consumer characteristics, the labor market, etc. However, they do not provide a formal micro-economic argument using a formal model, which is the aim of this paper. Lundgren (2003) and Kriström and Lundgren (2003) formally introduce goodwill capital in a micro-economic setting. While Lundgren (2003) concentrate on uncertainty in goodwill evolution and abatement investment timing, Kriström and Lundgren (2003) develop a dynamic model where voluntary abatement investments (which is one dimension of CSR) create a stock of goodwill capital which enables the firm to differentiate their product.[5] This model also allow for possible "crowding out" effects generated by abatement investments. investments.[6] Other

[5]This study also provide an empirical illustration of their model which show that there may be a price premium for less polluting firms in the Swedish pulp industry during the period 1985-1989.

[6]Or as they call it; adjustment costs. Empirical testing show, however, that this is probably

product differentiation and green consumerism models include Rodriguez-Ibeas (2007) and Eriksson (2004), which both apply a game theoretic framwork (in line with e.g. Aurora and Gangopadhyay, 1995). Maybe the most comprehensive and "complete" theoretic discussion can be found in Heal (2005). He examines CSR from both economic and financial perspectives, and propose how it is reflected in financial markets. CSR is defined as actions to reduce externalized costs or to avoid distributional conflicts (which is similar to Portney's definition). He suggests that there may be a resource allocation role for CSR programmes in cases of market failure through private–social cost differentials. He argues that in sectors where social and private costs are not in line, or where distributional conflicts are common, CSR can play a valuable role in ensuring that "the invisible hand" acts, as intended, to produce the social good. It can also act to improve corporate profits and guard against reputational risks. As comprehensive and enlightening Heal's discussion may be, it still lacks the formal analysis to sort out the micro-economic mechanisms of CSR.

With Portney's brief model sketch in mind (see Hey et al, 2005, p 114, footnote 18), and Heal (2005), we set out to model CSR behavior at firm level. We will introduce various costs and benefits which act on profits in both a static and

not a big problem in the Swedish pulp industry in the late 1990's.

intertemporal model framwork. The key concept will be the notion of an intangible asset we denote goodwill, an asset which can be augmented by investing in CSR projects. The models presented here aims to summarize the key components of CSR behavior suggested in the literature so far into a micro-economic model of the firm.

The paper is organized as follows. We start by presenting a simple static model of CSR. Next we sophisticate the analysis to include more costs and benefits to CSR, intertemporal features, and explicitly modeling goodwill capital as driving force for benefits. We then proceed to link the some of the hypotheses that can be derived from the models in this paper to the empirical literature on CSR. Finally, we offer some concluding comments.

2. Models of the CSR-firm

Below we discuss a few models that shed light on potential mechanism behind CSR. First a simple static model showing that with consumers rewarding CSR the cost of CSR may very well be balanced by benefits in terms of higher profitability. The analysis proceeds to include dynamics, a pertinent feature of CSR, and the notion of a goodwill stock that acts upon a firm's profits in different ways. This section ends with a exploration of the effects of uncertainty on the decision to invest in CSR.

2.1. Optimal CSR in a static setting

This first simple model, that we use as starting point for the discussion, partially explain why a firm would like to incur costs by being socially responsible. Throughouit the paper we need to consider models where the firm has some market power; i.e. there must be some form of imperfect competition.Consider a standard type of model for a firm with some degree of market power, where we disregard the actions taken by other firms (as opposed to models where firms consider each others strategies). The firm can affect demand by chosing how much to invest in CSR projects, g, at a unit cost, p^{CSR}. More realistically, g is a vector of many different types of CSR investments, but here we treat CSR as one-dimensional to simplify the exposition. We define the profit function as,

$$\Pi = PY(P, g, s) - C(Y(P, g, s)) - p^{CSR}g, \tag{2.1}$$

where P is price of output, Y is demand, C is the cost function, and s represents some quality characteristics of the product.

The first-order conditions are (with respect to the choice variables P and g)

$$\begin{aligned} Y + PY_P - C_Y Y_p &= 0, \\ (P - MC)Y_g &= p^{CSR} \end{aligned} \tag{2.2}$$

Dividing the first-order condition for g level by P and Y and multiplying by g on both sides, we have

$$\frac{\varepsilon(P - MC)}{P} = \frac{p^{CSR} g}{PY}, \tag{2.3}$$

where MC is marginal cost with respect to output, C_Y. Thus, in optimum, the CSR expenditures, $p^{CSR}g$, as a proportion of total revenue, PY, depends on the elasticity of demand with respect to g, $\varepsilon = Y_g \frac{g}{Y}$, and the difference between price and marginal cost, $P - MC$. The model is silent on the relationship between g and s. For given s, the firm can parametrically affect the demand for its product by simply investing more in CSR. This could be motivated by some information gap; there is a set of customers who are not sufficiently aware of the product. Those potential customers may be convinced to buy the product, even if its quality characteristics remains constant (as measured by s).

If we replace CSR investments, g, with advertising efforts, say a, this converts to the standard result in advertising in the classic article by Dorfman & Steiner

(1954). That is, advertising expenditures as a proportion of sales are positively related to the price mark-up and the elasticity of output with respect to advertising. However, that model also consider product quality, a feature the simple model presented here is silent on.

In sum; if the market's sensitivity to CSR increase, i.e. the elasticity ε goes up, then the expenditure of CSR in relation to revenues will also increase. This result is reasonable if the market discriminate between socially responsible firms and socially irresponsible firms.

2.2. CSR, goodwill, and dynamics

Now we proceed to introduce dynamics, both linear and non-linear. An intertemporal setting is reasonable when dealing with CSR and goodwill captial. CSR builds goodwill capital which can be seen as an intangiable asset, a type of "reputation" that is built up over time, and, if not maintained, it deteriorates over time.

2.2.1. Linear dynamics

The above simple static model can be extended to include dynamics, an extension of particular interest here since the problem of optimally investing in CSR essentially is an intertemporal problem. In a dynamic model, we distinguish between the flow of CSR expenditures and the stock of CSR, where we interpret the latter as "goodwill", which we denote G.[7] The firm's management problem is to invest in CSR projects to augment goodwill in an optimal way. That is, the firm can build up a stock of goodwill by CSR, and given that the CSR efforts are signaled properly to the market, the firm can differentiate its product and create a price premium. This, again, raises the issue about s, quality characteristics, in the model. Is it possible for the firm to increase its goodwill even if it keeps the quality characteristic constant? It seems natural in the dynamic formulation of the model to subsume s under G. In other words, there is an implicit relation between s and G, written as $s(G)$, which means that we could suppress the explicit dependence of Y on s in the sequel.[8]

In the dynamic case, the firm is therefore taken to maximize the following

[7] The notion of goodwill as an intangible asset was first used in the advertising/marketing literature (for excellent reviews of quantatitive advertising models see Sethi, 1977, and Feichtinger et al, 1994).

[8] See Nerlove and Arrow (1962) for a seminal paper on advertising and goodwill. The model here follow their model closely, but with focus on CSR policy instead of advertising as control variable for the firm.

functional (top dot indicate time derivative),

$$\begin{aligned} V &= \max_{P,g} \int_0^\infty e^{-rt}(PY(P,G) - C(Y(P,G)) - p^{CSR}g)dt, \\ \dot{G} &= g - \delta G, \\ G(0) &= G_0, \end{aligned}$$

where g is the gross investment in the stock of goodwill G, $Y(P,G)$ is the demand function, $C(Y(P,G))$ is the production cost function. We assume that these functions have properties that are solution-friendly.[9] Furtermore, p^{CSR} is as before the unit cost of CSR investments, r is the discount rate and δ is a depreciation factor. We can interpret δ in several ways; without any investment in goodwill, knowledge of the firms historic CSR policies and appreciation of the product deteriorates, perhaps due to consumer ignorance or "CSR"-competition from other firms. It should be noted, as in previous section, that g more realistically is a vector of many different types of CSR investments, but here we treat g as one-dimensional to simplify the exposition. However, it is straightforward to include multi-dimensional CSR (environment, human rights, community investments, etc). Note that the objective functional is linear in the control variable, g. This means that the opti-

[9]In the next section we elaborate more on functional properties and conditions necessary for a steady state solution.

mal solution is characterized by bang-bang, that is, the firm will, without delay, invest in the amount of CSR that is needed to obtain the desired level of goodwill. The firm does not benefit from a "little-by-little" strategy when investing in CSR, since it comes to no extra cost to jump directly to an optimal level of goodwill. But as we shall see in next section, if CSR costs are convex in the investment rate, the optimal solution will not be bang-bang.

To solve this dynamic optimal control problem, we define the current value Hamiltonian,

$$H = PY(P, G) - C(Y(P, G)) - p^{CSR}g + \lambda(g - \delta G), \tag{2.4}$$

where λ is the shadow price of goodwill. The first-order conditions are given by;

$$\begin{aligned} H_P &= 0 \Leftrightarrow P = MC - \frac{Y}{Y_P} \\ H_g &= 0 \Leftrightarrow \lambda = p^{CSR}, \\ \dot{\lambda} &= r\lambda - H_G, \end{aligned} \tag{2.5}$$

where $MC = C_Y$. Since p^{CSR} is given and constant, then $\dot{\lambda} = 0$, and we can find the corresponding formula to the static case analyzed above. By combining the first-order conditions for CSR and dividing by P and y, and multiplying by G on both sides, we have

$$\frac{\varepsilon\left(\frac{P-MC}{P}\right)}{r+\delta}=\frac{p^{CSR}G}{PY}. \tag{2.6}$$

This requires that the ratio of the market value of the CSR goodwill stock to sales is determined by the price-cost margin and the elasticity of sales to goodwill, $\varepsilon = Y_G \frac{G}{Y}$. The difference is now that CSR (through goodwill) is related to the interest rate and the rate of discount. We can interpret this as the return on a constant infinity stream of revenues generated by goodwill, discounted at the rate $r+\delta$.

Suppose that the demand function is isoelastic, $Y = P^{\alpha}G^{\varepsilon}$, with $\alpha < 0$ and $\varepsilon > 0$, and that MC is constant. Then the steady state value of the stock of CSR goodwill, G^*, is given by,

$$G^* = \left[\frac{P^{1+\alpha}\varepsilon\left(\frac{P-MC}{P}\right)}{p^{CSR}\left(r+\delta\right)}\right]^{\frac{1}{1-\varepsilon}}$$

We see that the optimal level of the steady state stock of goodwill is, not surprisingly, negatively related to price of CSR, p^{CSR}, and also to the discount rate, $(r+\delta)$. The effect of changes in the elasticity of output with respect to goodwill is positive if $\varepsilon < 1$. For $\varepsilon > 1$, the sign is unclear.

2.2.2. Nonlinear dynamics, compensating wage differentials, reduced risk, and crowding out

The model described in this section is based on the green firm framework developed in Kriström and Lundgren (2001, 2003) and Lundgren (2003), which, in turn, are inspired by early advertising models in Dorfman and Steiner (1954), Nerlove and Arrow (1962) and Gould (1970). Nerlove and Arrow formally introduce the goodwill concept in a dynamic setting applied to an advertising problem.

Again, the firm's management problem is to invest in CSR projects to augment goodwill in an optimal way. That is, the firm can build up a stock of goodwill by investing in CSR projects. Here we introduce nonlinearity in the control variable, CSR investments, and add some further reasonable features to the model (accept the price premium). We begin by describing the main assumptions of how benefits and costs of CSR arise.

Three benefits of CSR are recognized and modeled specifically here; 1) consumers reward CSR efforts by a price premium (product differentiation), or they buy more at the same price, thus, all else equal, increasing revenuses and profits for the firm; 2) wage is to some degree endogenous to the firm, that is, people are willing to accept lower wage to work at a CSR firm, or work more productively at market wage (see e.g. Bergman, 1995); 3) cost of capital is reduced since the financial sector, banks and portfolio managers, etc, assign lower risk to a CSR firm due to lower probability of conflicts with stakeholders in the future (see e.g. Heal, 2005, or Hey et al, 2005). Costs of CSR arise through; a) actual investment costs in CSR-projects; b) costs of promoting these CSR-investments to market (advertising); c) and costs due to CSR-investments crowding out productive investments. a) and b) can be considered the constant unit cost of investing in CSR (linear in g), while c) is a cost that increase per unit of CSR (convex in g).[10]

Define firm profits, Π, at time t as

$$\Pi = P\left(G, Y\right)Y - C\left(G, Y\right) - A(g), \tag{2.7}$$

where $P\left(G, Y\right)$ is the inverse demand function for the firm's product, Y is output level, $C\left(G, Y\right)$ are the production costs, and $A(g)$ are costs associated with invest-

[10] The model is now encompassing all the features Portney suggested were relevant in Hay et al (2005), p 114, footnote 18, plus dynamics and adjustment costs or crowding out effects.

ments in CSR.[11] Denoting investment in CSR g,[12] and the stock of goodwill G, we define the following functions and function properties for $P(G,Y)$, $C(G,Y)$, and $A(g)$,

$$P = P(G,Y), P_G > 0, P_{GG} < 0, P_Y < 0, \tag{2.8}$$

$$\begin{aligned} C &= C(G,Y) = C\left[w(G), q(G), Y\right], \\ w &= \text{wage}, \\ q &= \text{cost of capital}, \\ C_G &= \underset{(-)}{C_{wG}} + \underset{(-)}{C_{qG}} < \ 0,\ C_{GG} > 0, \\ C_Y &> \ 0,\ C_{YY} \geq 0, \end{aligned} \tag{2.9}$$

$$A = A(g),\ A_g > 0,\ A_{gg} \geq 0, \tag{2.10}$$

These functional form assumptions govern how revenues and costs are affected

[11] We have implicitly assumed that the firm has already optimized production with respect to primary and intermediate inputs such as capital, labor, energy, materials, etc. The model could also include these inputs as choice variables, and potential links to CSR investments and goodwill, but here we want to keep it fairly simple to capture the essential features of the real world.

[12] This control variable can be considered multi-dimensional as CSR can take many forms. However, for simplicity, we treat CSR investment as a one-dimensional control variable. This does not change the basic idea we want to convey here.

by CSR investments, g, and goodwill, G, and ultimately the behavior of the firm. Price is an increasing function of G, however, the second derivative tells us that it is increasing at a decreasing rate. One feasible functional form is $P = P^{avg} + premium(G)$, where P^{avg} is some industry average price, and $premium(G)$ is a function governing the size of the price premium depending on the size of G (see e.g. Kriström and Lundgren, 2003). There is a cost of CSR investments in addition to the actual investment cost; CSR "steals" resources from productive activities at an increasing rate.[13] This feature is apparent as the second derivative of $A(g)$ with respect to g suggests that costs of CSR investment are increasing at an increasing rate, indicating that small investments in CSR are "cheaper" than large investments as result of convex adjustment costs. This assumption introduces non-linearity which, as we shall see, generate an interior solution to the problem instead of bang-bang. Furthermore, we see that costs are decreasing at a decreasing rate in G, due to the beneficial effects on wages and cost of capital.

Given the above functional forms, the value function for the management

[13] This is similar to what in the dynamic investment literature is called adjustment costs. See for example Lundgren and Sjöström (2001) for a discussion.

problem is postulated as,

$$V = \max_{Y,g} \int_0^{\infty} e^{-rt} \left[P\left(G, Y\right) Y - C\left(G, Y\right) - A(g) \right] dt, \tag{2.11}$$

where V is the value function of the firm at time t, and e^{-rt} is a discount factor where r is the rate of return or discount rate. Note that V is also the value of the firm since it is defined as the perpetual discounted stream of profits. The management problem is to chose g as to maximize the future stream of discounted profits given an equation describing how goodwill evolves over time. In general, it is assumed that goodwill develops over time according to the following function,

$$\begin{aligned} \dot{G} &= f(g, G), \qquad (2.12) \\ G(0) &= G_0, \end{aligned}$$

where $f(g, G)$ maps CSR investments and current goodwill capital into changes in goodwill, and G_0 is a given starting value for goodwill at time $t = 0$. For simplicity, we impose the same dynamics to the goodwill stock as conventional dynamics of a capital stock in investment analysis, and also the dynamics in previous section,

$$\dot{G} = g - \delta G, \tag{2.13}$$

where δ is the decay rate of goodwill, and $\dot{G}$ denotes the time derivative of goodwill. In steady state, $\dot{G} = 0$, we see that investment in CSR is equal to the decay in goodwill, keeping the goodwill stock unchanged.

From equation 2.11 together with 2.12 and 2.13, we construct the following current value Hamiltonian,

$$H = P(G,Y)Y - C\left(G,Y\right) - A(g) + \lambda\left(g - \delta G\right), \tag{2.14}$$

where λ is the shadow price of goodwill (or adjoint variable). The shadow price of goodwill is the "theoretically correct" price of goodwill should it be traded in a competitive market. That is, λ is the marginal cost of goodwill (as we shall see).

The optimality conditions given by the maximum principle are,

$$H_Y = 0, \tag{2.15}$$

$$H_g = 0, \tag{2.16}$$

$$\dot{\lambda} = r\lambda - H_G. \tag{2.17}$$

When certain concavity conditions are satisfied for the Hamiltonian, the conditions 2.16 and 2.17 are sufficient for maximization (see e.g. Mangasarian, 1966, Arrow, 1968, or Kamien and Schwartz, 1971). In short, these conditions require that the current value Hamiltonian is concave in the controls, g and Y, and in the stock, G, jointly; that is, the Hessian of the current value Hamiltonian is negative semi-definite. For the functional properties assumed for $P(G,Y)$, $C(G,Y)$, and $A(g)$, this condition holds, and there exists an interior solution to this problem.

Equation 2.15 can be expanded to read,

$$P_Y Y + P = C_Y, \tag{2.18}$$

that is, the usual "monopoly price" condition. Equation 2.16 can be written,

$$\begin{aligned} -A_g + \lambda &= 0 \\ &\Longleftrightarrow \\ \lambda &= A_g, \end{aligned} \tag{2.19}$$

which simply states that the shadow price of goodwill is equal to the marginal cost of investing in CSR. Optimal condition 2.17 is stated as,

$$\dot{\lambda} = r\lambda - (P_G Y - C_G - \lambda\delta) \qquad (2.20)$$

$$= (r+\delta)\lambda - (P_G Y - C_G),$$

which is the differential equation for the shadow price of goodwill. Now we can use 2.19 and 2.20 to extract the differntial equation for CSR, g. First, take the time derivative of 2.19 and substitute the result for $\dot{\lambda}$ in 2.20, then substitute λ for $C_g - PY_g$ in 2.20 (i.e., equation 2.19). Then we have, after isolating changes in CSR, $\dot{g}$, on the left-hand side, the following differential equation for CSR investments (plus and minus indicate the sign of the different terms in the expression),

$$\dot{g} = \frac{\overbrace{(r+\delta) A_g}^{(+)} - \overbrace{(P_G Y - C_G)}^{(+)}}{\underset{(+)}{A_{gg}}} \qquad (2.21)$$

The development over time for g is a function of both g and G. From 2.21 we can see that what governs changes in CSR investments over time is the difference between costs and benefits. We see that

$$
\begin{aligned}
\overbrace{\left(P_G Y - C_G\right)}^{(+)} &\gtrless \overbrace{\left(r+\delta\right) A_g}^{(+)}, \\
\overbrace{\frac{P_G Y - C_G}{(r+\delta)}}^{(+)} &\gtrless \overbrace{A_g}^{(+)} \\
&\Longrightarrow \\
\dot{g} &\lessgtr 0,
\end{aligned}
\tag{2.22}
$$

which suggests that CSR investment/disinvestment will occur when the discounted benefits - discounted by the rate of return and the depreciation rate of goodwill - are smaller/larger than the marginal cost of investing in one extra unit of CSR. This means that when costs are larger/smaller than benefits, the firm invests/disinvests to the point where benefits equal costs.

The system is in steady state when $\dot{g} = 0$ and $\dot{G} = 0$, then

$$A_g = \frac{P_G Y - C_G}{(r+\delta)}, \tag{2.23}$$

$$g = \delta G. \tag{2.24}$$

The marginal cost of investing in one extra unit of CSR is equal to the benefits associated with the goodwill it creates, instantly and in the future, discounted by the rate of return plus the rate of depreciation of goodwill. According to 2.24, the level of goodwill is kept unchanged if the firm invests an amount of CSR equal to the decay of goodwill.

Now, let us investigate the steady state properties of CSR investments for this problem. Assume that the inverted demand function and the production cost function are isoelastic; $P(G,Y) = G^{\varepsilon}Y^{\alpha}$, $C(G,Y) = G^{\theta}Y^{\gamma}$, with $\varepsilon, \gamma > 0$ and $\alpha, \theta < 0$. Furthermore, assume that the cost of investing in CSR is given by, $A(g) = p^{CRS}g + \frac{1}{2}\beta g^2$. The first term is the unit cost of investing in CSR, and the second term represents costs due to crowding out of other productive investments or activities. The cost of investing in CSR is increasing at an increasing rate with the size of the CSR investment.[14] These parametrizations all satisfy the assumed functional properties that ensures an interior solution.

The Hamiltonian is now written,

$$H = G^{\varepsilon}Y^{\alpha}Y - G^{\theta}Y^{\gamma} - pg - 0.5\beta g^2 + \lambda(g - \delta G). \tag{2.25}$$

With the properties assigned to the functions of the Hamiltonian above, the

[14] See for example Lundgren and Sjöström (2001) for a discussion and application of different types of adjustment costs.

Hessian is defined as,

$$\begin{bmatrix} H_{gg} & H_{gG} & H_{gY} \\ H_{Gg} & H_{GG} & H_{GY} \\ H_{Yg} & H_{YG} & H_{YY} \end{bmatrix}, \tag{2.26}$$

which is negative semi-definite, a condition that must hold for an interior steady state solution to exist (the Mangasarian conditions mentioned earlier).

Substituting in these functions in 2.23 and 2.18, and isolating g and Y on their respective left-hand side generates, gives the steady state equations for g and Y,

$$g^* = \frac{\varepsilon\left(G^*\right)^{\varepsilon-1}\left(Y^*\right)^{\alpha+1} - \theta\left(G^*\right)^{\theta-1}\left(Y^*\right)^{\gamma} - p^{CRS}\left(r+\delta\right)}{\beta\left(r+\delta\right)}, \tag{2.27}$$

$$Y^* = \frac{\gamma\left(G^*\right)^{\theta}\left(Y^*\right)^{\gamma-1} - \left(G^*\right)^{\varepsilon}\left(Y^*\right)^{\alpha}}{\alpha\left(G^*\right)^{\varepsilon}\left(Y^*\right)^{\alpha-1}} = \left[\frac{\left(1+\alpha\right)\left(G^*\right)^{\varepsilon-\theta}}{\gamma}\right]^{\frac{1}{\gamma-\alpha-1}}. \tag{2.28}$$

Recall that $G^* = \delta^{-1}g^*$, since $\dot{G} = 0$ implies that $g - \delta G = 0$. Now we have a system of equations determining steady state levels of Y, g, and G. Doing comparative statics for g^* show, for example, that $\frac{dg^*}{d\varepsilon} > 0$ if $\alpha + \gamma - 1 < 0$ and $\gamma\left(1+\alpha\right) + \alpha^2 - 1 > 0$, as well as $\frac{dg^*}{dp^{CRS}}$ and $\frac{dg^*}{d(r+\delta)} < 0$. Other partial derivatives of g^* are no easy to sign. To be able to sign all partial derivatives of g^* in steady state, assume the following parameter values,

$$
\begin{aligned}
\varepsilon &= 0.75 \rightarrow \text{elasticity of price with respect to (wrt) goodwill,} \\
\alpha &= -0.75 \rightarrow \text{elasticity of price wrt output,} \\
\beta &= 0.25 \rightarrow \text{parameter measuring "crowding out"-effect,} \\
\theta &= -0.66 \rightarrow \text{elasticity of costs wrt goodwill (wage and capital cost effects),} \\
\gamma &= 1.2 \rightarrow \text{elasticity of costs wrt output,} \\
p^{CSR} &= 1 \rightarrow \text{unit cost of CSR investment and promotion of it,} \qquad (2.29) \\
r &= 0.03 \rightarrow \text{interest rate,} \\
\delta &= 0.1 \rightarrow \text{depreciation rate of goodwill.}
\end{aligned}
$$

For these values we can plot $g = \delta G$ and 2.27 to illustrate the optimal levels of g and G graphically (where the functions cross). See below for a graphical illustration of the steady state. The lower curve, or line, represents $\dot{G} = 0$, and the bent curve $\dot{g} = 0$.

[Figure 1 here]

In the figure above we see that net investment in CSR, the distance between the bent curve and the linear line, will decrease with level of goodwill stock, meaning that firms with small goodwill capital will invest relatively more in CSR than firms with large goodwill capital.

Let us now look at some comparative statics for g^* for a given G^* (given by parameters above);

$$\begin{aligned}\frac{dg^*}{d\varepsilon} &> 0, \frac{dg^*}{d\alpha} > 0 \\ \frac{dg^*}{d\beta} &< 0, \frac{dg^*}{dp^{CSR}} < 0, \\ \frac{dg^*}{d\theta} &< 0, \frac{dg^*}{d\gamma} > 0 \\ \frac{dg^*}{dr} &< 0, \frac{dg^*}{d\delta} < 0.\end{aligned} \tag{2.30}$$

At these parameter values and functional forms the model seems to predict reasonable results. We see that if consumer sensitivity to changes in goodwill, ε, increase, then CSR investments also increase. If the cost of CSR goes up, either through "crowding out" effects, β, or through the unit price of CSR, p^{CSR} (which includes promotion cost), then CSR decrease. Should the sensitivity of costs with respect to goodwill decrease, then, not surprisingly, CSR behavior is dampened. Increases in th rate of interest and depreciation rate of goodwill will decrease CSR. The direction of change for CSR investment with respect to changes in "output" parameters, α and γ, are less intuitive; that is, CSR increase if the sensitivity of price with respect to output increase from a negative elasticity to a less negative, and CSR also increase should the sensitivity of costs with respect to output increase.

At this point we want to alert the reader to another useful result we can derive from optimal control theory; the change in the value of the firm is directly related to the change in goodwill. This comes from a general result derived by Brock (1998) where he shows that the time derivative of the value function in an optimal control problem of such type that we skecth above is directly related to the net changes in all stocks in the model in the following way,

$$\dot{V} = \sum_i \lambda_i \dot{S}_i,$$

where λ_i is the shadow price of stock i, and S_i is the i^{th} stock. Since in the control problem we analyze here only has one stock, goodwill, we can write

$$\dot{V} = \lambda \dot{G}. \tag{2.31}$$

This result suggest that all changes in goodwill, positive or negative, as a result of investing or disinvesting in CSR, will have direct effect on the value of the firm given that there is a non-negative shadow price of goodwill capital.

2.2.3. What does empirical evidence tell us?

Let us state some possible hypotheses drawn from the model that have been, or possibly could be, tested empirically. Then we take a look in the literature on CSR and see what it can tell us.

H_1: *An increase in goodwill capital have positve effect on product price.*

Is there a price premium for CSR firms? Just a cursory look around suggests this; e.g. certification of forest products leads to higher price. Kriström and Lundgren (2003), which proxy goodwill stock with abatement capital, find weak evidence for a premium for "green" pulp in Swedish pulp industry. Furthermore, empirical results in Blend and van Ravenswaay (1999) suggests that american consumers are willing to pay a premium for eco-labeled apples, but not too much. Similar examples from the literature abound.

H_2: *An increase in goodwill capital have negative effect on wage and cost of capital.*

A lot of talk about possible wage differentials for CSR firms, but actual empirical evidence is scarce. Bolvig (2005), *Int. J. of Manpower* - finds evidence of compensating wage differentials in CSR firms in a sample 2000 US firms. When it comes to cost of capital and CSR the empirical evidence is also scarce. Derwall and Verwijmeren (2006) find that environmental performance and corporate governance affect cost of capital negative, while human rights issues increase cost of capital. The net effect is ambigous.

H_3: *CSR investments cause crowding out effects.*

Kriström and Lundgren (2003) try to measure crowding out effects (and/or adjustment costs) due to abatement investments in the Swedish pulp industry during the period 1985-1990, but statistical analysis can not support this.

H_4: *Firms with low level of goodwill capital invest relatively more in CSR.*

This implies that if firms operate under similar conditions, i.e. with similar pressures and incentives from stakeholders, "convergence" in levels of goodwill across firms (over time) should be expected. In a recent study by Hassel and Semenova (2007) it is shown that firms in high risk sectors (like chemical or steel) and which are associated with high rankings with respect to social responsibility (high "goodwill"), are rewarded with relatively higher stock prices. This would suggest that these firms are more motivated to invest in CSR to get higher rankings, i.e. if the firm is at a low level, as many high risk firms are, it is profitable to invest in CSR, while if the firm is in a low risk sector, e.g. banking, investment in CSR is not very common and in general these firms have low social responsibility rankings. However, the existence of "convergence is yet to be empirically tested more thouroughly.

H_5: *Changes in firm value is proportional to changes in goodwill capital* (as long as the shadow price of goodwill is larger than zero, $\lambda > 0$).

The bulk of the empirical work can be found within this cathegory. See e.g. Margolis and Walsh (2001) or Hay et al (2005) for excellent reviews. The results are somewhat ambigous. However, as mentioned in the introduction, most studies show a positive relationship between firm value and different measures of social responsibility. This could be a result of "publication bias", i.e. mainly "positive" results are submitted and subsequently published. But a certain amount of heterogenous results would be expected according to the models presented here. The models would predict that some firms are positively affected by engaging in CSR, while others are not. It depends on if such behavior is rewarded by its stakeholders or not.

3. Concluding remarks

This paper provides theoretical underpinnings to help understand the mechanisms and incentives behind the behavior of a socially responsible firm. Profit maximizing firms consider both costs and benefits of CSR. The implications of these findings are that firms will engage in CSR activities if stakeholders, such as the government, the financial sector, consumers, NGO:s, etc, reward or pressure firms to engage in such behavior. The link between profitability and different dimensions of CSR is therefore likely to differ across countries, sectors and even firms. The models in this paper provide a useful theoretical background for the understanding of CSR incentives and for constructing relevant hypotheses in empirical applications.

Future research should include uncertainty - what are the effects of e.g. environmental incidents that arrive over time in some stochastic manner? The obvious way to model this would be to include a stochastic element to the evolution of goodwill capital.[15] Another possible route of research would be to allow for possible "Porter"-effects; that is, some types of CSR investments, e.g. green technology, will have positive effects on long term efficiency and spur innovative processes. This would imply a connection between man-made capital and some types of CSR. This link could be modeled within the framework presented here.

[15] As suggested by Kriström and Lundgren (2001) the models of Tapiero (1975,1978) and Bismut (1975) could perhaps be adapted and modified to tell the story of CSR under uncertainty.

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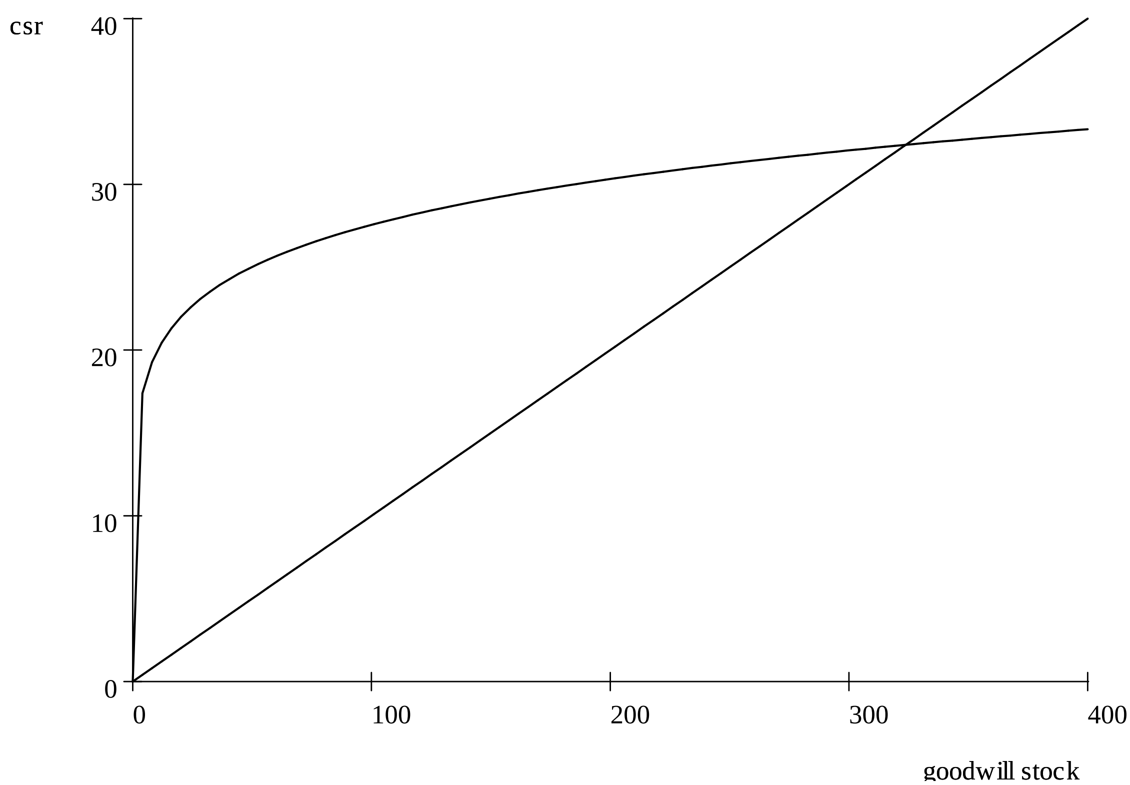

Figure 4.1: CSR investments and goodwill stock dynamics. The inter-section defines the steady state when changes in g and G are zero.