Attracting responsible employees:

Green production as labor market screening

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March 30, 2007

Abstract

Corporate social responsibility can improve firms' ability to recruit highly motivated employees. This can secure socially responsible firms' survival in long-term equilibrium. We show that if both socially responsible (green) and non-responsible (brown) firms exist in equilibrium, workers with high moral motivation, who shirk less than others, will self-select into the green firms. If unobservable effort is sufficiently important for firm productivity, this can in fact drive every brown firm out of business, even in the case where many workers have no moral motivation whatsoever.

Keywords: Moral hazard, moral motivation, teamwork, corporate social responsibility, voluntary abatement.

JEL codes: D21, D62, D64, J31, Q50, Z13.

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Acknowledgements: Funding from the Research Council of Norway through the *SAMSTEMT* program is gratefully acknowledged. Part of this project was undertaken while Brekke was employed by the Center for Development and the Environment, University of Oslo. We wish to thank numerous seminar and conference participants for their helpful and encouraging comments.

1 Introduction

Corporate social responsibility has been defined by the EU Commission as "a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a *voluntary* basis" (EU Commission 2002, p.5, our emphasis). Indeed, many private firms make a considerable effort to be, or at least to appear, socially responsible; they contribute to charity, invest in costly abatement equipment even when pollution would have been legal, or commit themselves voluntarily to ethical principles increasing their production costs, such as abstaining from the use of child labor in developing countries.[1] But why would a private firm pay to promote social values? If a firm voluntarily incurs extra expenses for the sake of social responsibility, will it not be wiped out of business by less responsible competitors?

Previous research has pointed out that voluntary adoption of costly measures promoting social goals may be profitable if customers have an extra willingness to pay for products produced in a "responsible" way (Arora and Gangopadhyay 1995, Moon et al. 2002, Björner et al. 2004, Besley and Ghatak 2006), or if firms expect that such voluntary adoption can preempt the introduction of taxes or regulations (Maxwell et al. 2000). Moreover, investors and/or entrepeneurs may be willing to pay a premium to allow firms' costly promotion of social values (Cullis et al. 1992, Baron 2005). While we acknowledge the relevance of these explanations, we will disregard them in the analysis below, in order to focus exclusively on an issue which has hardly been touched upon in the economics literature on corporate social responsibility, namely employee motivation.

The logic of our argument is closely related to standard screening models (Stiglitz 1975). Our basic idea is simple: responsible employers attract responsible workers. In environments where individual effort and productivity are unobservable, the ability to recruit reliable workers, who do their best and are unlikely to shirk, may be of outmost importance for a firm's profitability.

Of course, if workers prefer responsible employers (all else given), socially responsible firms should be able to attract workers at a lower wage than other firms offer; and if workers' willingness to pay

[1] For example, Exxon, Chiquita, McDonald's, Coca-Cola and Ford Motor Company all have information concerning their corporate social responsibility committments figuring prominently on their homepages (January 2007), together with reports of costly measures taken to promote social and/or environmental values.

is sufficiently large, responsible firms may be able to survive only because of this wage difference. There is indeed some empirical evidence indicating that many people do prefer their employer to be socially responsible: Vitell and Davis (2004) concluded, based on a survey among management information system professionals, that job satisfaction was substantially higher when "top management was perceived as strongly supporting ethical behavior" (p.493). The employer branding firm Universum collects responses from roughly 180,000 economics, business and technology students in 28 countries in its annual Graduate Survey, and one of their questions is: "Which of the following do you find most important when you select you future ideal employers?" The response alternatives include, e.g., "exciting products/services", "financial strength", and "innovation", as well as "corporate social responsibility" and "high ethical standards".[2] In the 2006 US survey, 21.5 percent of respondents selected "corporate social responsibility", while 39 percent selected "high ethical standards"; the corresponding European averages were 19.9 (CSR) and 21.1 (high ethical standards). [3] Reinikka and Svensson (2003) found that religious non-profit primary health care facilities, providing more services with a public good element and charging lower prices than private for-profit facilities, hired qualified medical staff significantly below the market wage. Frank (2003), using data for Cornell graduates and controlling for sex, curriculum, and academic performance, found a large and statistically significant compensating salary differential among recent Cornell graduates, with the jobs rated as *less* socially responsible earning substantially *higher* wages. Frank also asked survey respondents to choose between pairs of hypothetical jobs, where the nature of the work was similar while the employers' social responsibility reputation was different. After picking their preferred job from each pair, subjects were asked to state the wage differential required to make them reverse their choice. The results were striking: For example, 88 percent preferred to work as an ad copywriter for the American Cancer Society rather than for Camel Cigarettes, and the average reported switching premium was, in this case, as high as $24,333 per year.

Nevertheless, as we will argue below, such magnitudes of employees' willingness to pay are hardly

[2] Respondents could pick a maximum of 3 items. In US, there were 23 response alternatives; in Europe, the number differered between countries but were between 12 and 23.

[3] Personal communication: Carlo Duraturo, March 29, 2007. See also www.universum.se.

required to ensure the survival of socially responsible firms: A small, but strictly positive willingness to pay is sufficient to allow labor market screening, causing the most productive workers to self-select into socially responsible firms. In the present paper, we will demonstrate that even when products are perfectly homogeneous, labor and product markets are perfectly competitive, and neither consumers nor investors are willing to pay for ethical production, socially responsible firms may be able to survive in long-term equilibrium, due to such labor market screening. If unobservable worker effort is sufficiently important for firm productivity, *every* non-responsible firm could in fact be driven out of business, even when a large number of workers have no moral concerns whatsoever.

Several scholars have studied the problem of identifying and attracting individuals who are particularly highly motivated. For example, Besley and Ghatak (2005) analyze matching of employers and employees with similar "mission" preferences, while Alger and Ma (2003) discuss optimal contracts between an insurer and a provider when the latter may be either of a "truthful" or a "collusive" type. Heyes (2005) points out that increasing wages might attract the 'wrong sort' of people into the nursing profession. In the present paper, we show that when cooperative behavior originates from an underlying general principle of ethics, this affects several aspects of individual behavior in a correlated way. This correlation allows for labor market screening. By combining a high level of social corporate responsibility (for example, environment-friendly production) with comparatively low wages, firms will only attract those workers who have a high moral motivation, and, as we will show below, these workers shirk less than others.

In what follows, our understanding of "moral motivation" will be closely related to that proposed in Brekke et al. (2003), although our formalization differs slightly. Individuals are assumed to have preferences for a good self-image.[4] To assess his self-image, an individual considers his own actual behavior and asks himself the hypothetical question: "What would happen to social welfare if everybody acted just like me?" The better the answer to this question, the better is his self-image. Provided that the strength of individuals' moral motivation differs, such preferences produces a (perfect) correlation between a worker's unobservable effort and his willingness to pay for a socially responsible

[4] Other papers incorporating concepts of self-image in economic models include Akerlof and Kranton (2000) and Bénabou and Tirole (2002, 2003, 2004).

employment. Although our analysis does hinge on the existence of such a correlation, the main argument requires neither a *perfect* correlation, nor that the correlation originates from the specific ethical principle we propose below.

2 The economy: Production, pollution, and wages

Consider an economy characterized by a large number of profit maximizing firms, a perfectly competitive labor market and full employment. Suppose that the cost-minimizing production technology is well-known and available to everyone. Then, entry and exit from the industry will ensure that in long-term equilibrium, there are no pure rents.

Assume that there is a large number of workers, N, with identical utility functions. The utility of worker i is assumed to be increasing in his consumption of private goods x_i and environmental quality E, decreasing in effort e_i, and, finally, increasing in S_i, his self-image as a socially responsible individual, in the following way:

$$U_i = x_i - c(e_i) + \gamma E + S_i \tag{1}$$

where $c'(0) = 0$, $c' \geq 0$, $c'' > 0$ (primes denote derivatives), and $\gamma > 0$. Linear separability and constant marginal utility of income is assumed for simplicity. We will return to the issue of self-image in the next section.

Production takes place in teams, and individual effort is unobservable. Employers observe the total level of production, but since they cannot distinguish the contributions of each worker, individual wages are equal for all workers within a given firm. Thus, workers have no pecuniary incentive to work hard, and the firm faces a moral hazard problem.[5]

For simplicity, assume that each firm hires exactly L workers, and that each firm's production is increasing in the average effort exerted by these L workers. Let e^τ denote expected average e_i among

[5] Holmstrom (1982) shows that moral hazard problems in teams could, in principle, be solved through incentive schemes involving group penalties. Below, we will assume that workers regard their own contribution to average productivity as negligible. This implies that, in contrast to Holmstrom's model, group penalties will not be effective.

workers in a firm of type τ. (Below, we will disregard random differences between expected and actual average effort.) Let production y^τ of a firm of type τ be given by

$$y^\tau = (1 + e^\tau)\mu L \tag{2}$$

where $\mu > 0$.[6] Firms are assumed to be large enough to make it infeasible for a single worker to notice the change in average productivity resulting from a change in his own individual effort. Workers consequently consider e^τ as exogenously given.

Capital costs are fixed and identical for each firm and will be disregarded below. However, each firm emits a fixed amount of hazardous pollution; and end-of-pipe cleaning equipment, eliminating the environmental damage caused by the firm's pollution, is available at a fixed cost A. This equipment can be purchased and installed by firms on a voluntary basis; no regulation enforcing the use of abatement equipment is assumed to be in place.[7] Consequently, there may potentially exist two types of firms in this economy: Green firms ($\tau = G$) choose to pay A and do not damage the environment, while brown firms ($\tau = B$) do not pay A, but do cause environmental damage.

Firms with negative profits cannot survive in the long run. Let π^τ be the (potential) profit of a firm of type τ in long-term equilibrium. Thus, we have

$$\begin{aligned} \pi^G &= (1 + e^G)\mu L - Lw(G) - A \leq 0 \\ \pi^B &= (1 + e^B)\mu L - Lw(B) \leq 0 \end{aligned} \tag{3}$$

where $w(\tau)$ is the wage per worker in firm type τ, and where firm type τ does not exist in long-term equilibrium if $\pi^\tau < 0$.

Environmental quality, which is a pure public good, is given by an initial level E^0 less the environmental damage caused by pollution, in the following (linear) way:

$$E = E^0 - bZ \tag{4}$$

[6] Hence, production is strictly positive even if $e^\tau = 0$. This can be interpreted as saying that there exists a level of effort below which marginal disutility is strictly negative (the worker becomes bored). Since every worker will exert at least this level of effort, we can use this as the starting point of our effort variable e_i. Hence, e_i can be interpreted as worker i's voluntary contribution of costly effort.

[7] Whether abatement eliminates or just reduces environmental damage is not essential. Later, we will relax the assumption that pollution is independent of the firm's production level.

where $b \in [0,1]$ is the share of brown firms, and $Z > 0$ is the fixed total environmental damage which would result if all firms were brown, i.e. if no firms installed abatement equipment. Workers consider E exogenously fixed (no worker has reason to believe that his individual choices will influence the share of brown firms in the economy).

A worker i's income is given by the wage offered by his employer.[8] Hence, individual i's budget constraint is given by

$$x_i = w(\tau_i) \tag{5}$$

where $\tau_i \in \{G, B\}$ is the type of the firm i chooses to work in.

In Brekke and Nyborg (2004), we derive all our main results within a model where workers' utility function is more general, firm size is endogenous, each firm's production function is strictly concave in effective labor input, and pollution is increasing in the firm's production. These generalizations complicate the formal analysis substantially, but – with the exception of the variable pollution assumption – provide little additional insight. To avoid cluttering the analysis, we will thus keep to the simplifications presented above. However, after characterizing long-term equilibrium, we will discuss the implications of production-dependent pollution, since this does provide an interesting additional insight; namely that corporate social responsibility does not only facilitate the recruitment of responsible types, it also increases the work motivation of every given employee with a strictly positive moral motivation.

3 Workers' preferences: Morally motivated utility maximizers

Workers maximize their utility by choosing in which firm to seek employment, and, given their employer, how much effort to exert while at work. Before proceeding, however, we need to discuss the issue of self-image and how to formalize this.

We assume that workers like to regard themselves as socially responsible individuals. To determine

[8] To keep the analysis simple, we will discuss this as if each individual works full-time in one and only one firm. Strictly speaking, the formal analysis below requires that the marginal worker can share his time between two employers.

his self-image, a worker evaluates his own behavior referring to some general moral principle. Here, we will assume that the individual asks himself the following hypothetical question (Brekke et al., 2003): "What would happen if everybody acted just like me?" Self-image is then determined according to the answer to this question: The better the social welfare consequences if everybody had (hypothetically) acted like him, the better is his self-image. This kind of "everyday moral reasoning" can be viewed as inspired by Immanuel Kant's categorical imperative: One should act only according to those maxims that can be consistently willed as a universal law (see Audi 1995, p. 403)).[9] Furthermore, it is consistent with other well-known and widely accepted ethical views, such as the Biblical assertion that you should treat others as you would want others to treat yourself (Matthew 7.12). Survey responses indicate that it is indeed common to take such considerations into account; for example, in a Norwegian survey conducted in 1999, 93 percent claimed to recycle at least part of their household waste, and as much as 88 percent of those agreed or agreed partly to the following statement: "I recycle partly because I think I should do what I want others to do" (see Bruvoll et al., 2002).

To judge the social welfare consequences had everybody acted like him, the individual must, of course, have some conception of what social welfare means. To make things as simple as possible, assume that every worker has the following utilitarian-type view of social welfare V:

$$V = \sum_{j=1}^{N} [x_i - c(e_i) + \gamma E]. \tag{6}$$

Although the worker considers his own impact on average effort, wage levels, and environmental quality to be negligible, the consequences for these variables could of course not be neglected had everybody behaved just like him. If everybody worked in green firms, for example, environmental damages would be eliminated. Similarly, if everybody increased their effort, this would increase the equilibrium wage, and thus consumption; it would also increase everybody's disutility of effort.

Let $\widetilde{Y}(e_i, \tau_i)$ denote the value of any variable Y in the hypothetical case that $e_j = e_i$ and $\tau_j = \tau_i$ for all $j \in \{1, ..., N\}$. Moreover, let $\alpha_i \in [0, \bar{\alpha}]$, where $\bar{\alpha} < 1$, be an individual-specific parameter indicating how important social welfare considerations are for individual i's self-image. We can now

[9] The workers modeled here are not Kantians, though, since they are in fact willing to trade the satisfaction of doing the right thing against increased consumption or leisure. A strict Kantian would adhere to the Kantian ethical ideals categorially, not allowing such tradeoffs.

specify our self-image function:

$$S_i = \alpha_i(\widetilde{V}(e_i, \tau_i)) \tag{7}$$

where

$$\widetilde{V}(e_i, \tau_i) = N[\tilde{x}(e_i, \tau_i) - c(e_i) + \gamma \tilde{E}(\tau_i)]. \tag{8}$$

That is, a worker i's self-image is proportional to the social welfare consequences *had everybody made the same choices as him (*i.e. if $e_j = e_i$ and $\tau_j = \tau_i$ for every $j = 1, ..., N$). The proportionality factor α_i differs between workers. If $\alpha_i = 0$, preferences correspond to the traditional Homo Oeconomicus case; if α_i were equal to 1, which is precluded by assumption, the individual would place just as much emphasis on each single individual's welfare (in the hypothetical situation where everyone acts like himself) as he does on his own actual utility.

Note that, just as the categorical imperative defines one's moral responsibility vis-a-vis society without referring to others' *actual* behavior, there is no presumption in our analysis that the worker thinks others will *in fact* follow his example. When evaluating the moral stance of his action, the worker does not consider the actual impact on social welfare, but the hypothetical impact if his choice was to be made a universal law.[10]

Note also that the social welfare function (6), which is the basis of individuals' self-image considerations, does not include self-image benefits. This can obviously be disputed: On the one hand, it may seem unreasonable to include the benefits of "doing good" in the very definition of "good". On the other hand, it is hard to argue that others' self-image benefits are somehow less "real" than other benefits. However, within our framework, using the social welfare measure (6) for making the self-image evaluations in (7) is *behaviorally equivalent* to using a classical all-inclusive utilitarian social welfare function. In the following, we will thus stick to the simple formulation used in equation (6).

[10] Our formalization here is slightly different from that of Brekke et al. (2003). There, the question "what would happen to social welfare if everybody acted like me?" was used to identify the *morally ideal contribution*, while self-image was determined by the distance between this ideal contribution and one's actual contribution. Here social welfare calculations enter more directly.

Lemma 1 *Using* $V = \sum_{j=1}^{N}[x_i - c(e_i) + \gamma E]$ *as the basis for self-image evaluations, as specified in equation (7), is behaviorally equivalent to using* $V^S = \sum_{j=1}^{N} U_j$*, if, with the latter specification,* $\sum_{j=1}^{N} \alpha_j < 1$.

Proof. See Appendix A. ■

4 Workers' effort

Differentiating (1) with respect to e_i, taking τ_i as given and using (5), (7) and (8), yields the following first order condition for an interior utility maximum:

$$\alpha_i \partial \widetilde{V}(e_i, \tau_i)/\partial e_i = c' \tag{9}$$

The worker will exert effort until the marginal benefit in terms of a better self-image just equals the marginal disutility of effort. The next question is what determines $\alpha_i \partial \widetilde{V}(e_i, \tau_i)/\partial e_i$: How would it affect social welfare if i worked slightly harder, and everyone followed his example? This depends on how important average effort is for production, that is, on μ, which determines the (potential) effect on wages in long-term equilibrium and thus on everyone's consumption benefits. Differentiating (8) with respect to e_i, taking (3) and (5) into account, gives

$$\partial \widetilde{V}(e_i, \tau_i)/\partial e_i = N[\mu - c']. \tag{10}$$

Inserting this into the first order condition (9) and rearranging, we get

$$\frac{\alpha_i N \mu}{(1 + \alpha_i N)} = c' \tag{11}$$

This condition will hold for all workers, since $c'(0) = 0$: Workers with $\alpha_i = 0$ maximize their utility by providing no costly effort; those with $\alpha_i > 0$ provide a strictly positive level of costly effort. Note that every worker thus provides less effort than that he would consider morally best: To maximize the hypothetical social welfare if everybody acted like him, he should choose e_i such that $\partial \widetilde{V}(e_i, \tau_i)/\partial e_i = 0$, while utility maximization for a worker with $\alpha_i > 0$ implies $\partial \widetilde{V}(e_i, \tau_i)/\partial e_i = c_e/\alpha_i > 0$. Hence, although a worker with $\alpha_i > 0$ does strive towards his conception of a morally ideal behavior, he stops

short of reaching that ideal. This implies that voluntary effort will never reach its first-best level, even in the extreme case where $\alpha_i = 1$ for all workers.

Now, a crucial point in our argument is that firms want to hire morally motivated workers because these are more productive; they work harder, or equivalently, shirk less. Since (11) holds with equality for all values of α_i, individual i's effort is given by

$$e_i = (c')^{-1}(\frac{\alpha_i N \mu}{1 + \alpha_i N}) \tag{12}$$

The next result follows directly from this:

Proposition 1 *Worker i's effort e_i is strictly increasing in i's moral motivation α_i.*

Hence, not unexpectedly, moral motivation alleviates the moral hazard problems in team production pointed out by Holmstrom (1982): Highly motivated workers, that is, workers with high values of α_i, work harder than others, ceteris paribus.

Note that for any given worker, effort is independent of the type of firm he works in. If a firm's emissions were increasing in production, any given worker with $\alpha_i > 0$ would work harder in a green than in a brown firm. This effect would reinforce our main result concerning labor market screening, but is not needed to obtain it. Thus, for the sake of simplicity, we will keep the assumption of fixed pollution per firm, but return to the case of variable emissions later.

5 Willingness to pay

Provided that abatement is in fact considered socially preferable to no abatement, working in a green firm provides, all else equal, a higher self-image than working in a brown firm. Morally motivated workers will thus have a strictly positive willingness to pay for working in a green firm. Hence, in equilibrium, green firms may be able to hire workers at a lower wage than brown firms.

Worker i's willingness to pay, let us denote it by ϕ_i, can be defined implicitly as the wage difference that would make i indifferent between working in a brown or a green firm. The only variables in i's utility function affected by i's choice of firm type are his consumption (since wages may vary between

firm types) and self-image. Since utility is linearly separable and effort is independent of firm type, as shown above, we can define ϕ_i implicitly as

$$w(B) - \phi_i + \alpha_i(\widetilde{V}(e_i, G)) = w(B) + \alpha_i(\widetilde{V}(e_i, B)) \tag{13}$$

or

$$\phi_i = \alpha_i(\widetilde{V}(e_i, G) - \widetilde{V}(e_i, B)). \tag{14}$$

Thus, a worker's willingness to pay will is positive only if he thinks social welfare would be higher if all firms were green than if all firms were brown; if abatement were socially wasteful, willingness to pay for working in a green firm would be negative. In the latter case, green firms would never be able to survive in equilibrium: They would have to pay both the abatement cost and higher wages, and, in accordance with the screening argument provided below, their workers would in fact be less hard-working. Thus, the interesting case is when abatement is socially beneficial and the willingness to pay is, consequently, positive.

The environmental improvement if everyone worked in a green firm, compared to the case where everyone works in a brown firm, is Z. The social value of this is $N\gamma Z$. However, if everyone worked in green firms, wages per worker would have to be A/L lower, in order to cover the abatement cost. This means that $(\widetilde{V}(e_i, G) - \widetilde{V}(e_i, B))$ is independent of α_i, implying, by (14), that whenever abatement is socially beneficial, ϕ_i is increasing in the worker's moral motivation:

Proposition 2 *Assume that $\gamma Z > \frac{A}{L}$, i.e. abatement is socially desirable. Then, i's willingness to pay for working in a green firm, ϕ_i, is a strictly increasing function of this individual's moral motivation α_i:*

$$\phi_i = \phi(\alpha_i) = \alpha_i N \left[\gamma Z - \frac{A}{L}\right]. \tag{15}$$

Proof. See the Appendix. ■

It is perhaps trivial to point out that a substantial willingness to pay for working in green firms can enable such firms to survive in the long run, in spite of abatement costs, due to lower wage costs. Our main conclusion, however, is actually much stronger than this. As we will demonstrate below, green firms may be capable not just of surviving, but possibly even of capturing the entire market, even if

workers' willingness to pay equals zero for a substantial share of the work force. The crucial feature is that for an equal wage, some fraction of the workers would strictly prefer green firms; and these workers exert more effort than the average worker. Even with a quite marginal level of willingness to pay, this allows for labor market screening. Consequently, green firms may survive not primarily due to lower wages, but because they are able to attract more productive workers. Let us now turn to this issue.

6 Attracting productive workers: Market equilibrium

All else equal, a profit maximizing firm prefers to hire workers with a high moral motivation, since these workers exert more effort. The problem is, of course, how can the firm attract employees who are morally motivated?

A worker i prefers working in a green firm if

$$w(G) + \phi(\alpha_i) \geq w(B). \tag{16}$$

Thus, if green firms pay a strictly lower wage than brown firms, the only applicants to jobs in green firms will be those who have a high moral motivation and thus a sufficiently high willingness to pay.

Let α be any threshold such that every i with $\alpha_i \geq \alpha$ prefers to work in a green firm, while every i with $\alpha_i < \alpha$ prefers a brown firm. Moreover, let $\Delta w(\alpha)$ denote the *brown firms' compensating ability*, i.e. the maximum wage differential $w(B) - w(G)$ brown firms are able to offer for any given threshold α.[11] Now, if there exists an i with $\alpha_i = \alpha^*$ such that $\Delta w(\alpha^*) = \phi(\alpha^*)$, then this will be a labor market equilibrium[12]. In such an equilibrium, every worker with $\alpha_i \geq \alpha^*$ will be employed by green firms, while any worker with $\alpha_i < \alpha^*$ is employed by a brown firm. Consequently, if $\alpha^* \in \langle 0, \bar{\alpha} \rangle$, workers will self-select into green and brown firms, according to the strength of their moral motivation.

[11] If green firms can in fact offer higher wages than brown firms – which can occur, due to the green firms' more productive workers – the maximum wage difference is negative, and all firms will be green. In the case where no brown firms exist, we define $\Delta w(\alpha)$ as the maximum extra wage an entrying brown firm *would be* able to offer, provided that it would only be able to hire workers with $\alpha_i = 0$. $\Delta w(\alpha)$ is similarly defined for $\alpha = \bar{\alpha}$.

[12] With only green or only brown firms in equilibrium, the equality may not hold. The formal equilibrium condition is stated in (21) below.

To understand the conditions under which green firms can survive in the long run, we need to explore the determinants of brown firms' compensating ability. This, in turn, depends on the productivity difference between the two firm types. For any distribution of α_i, we can write average effort in each firm type τ as functions of the threshold α, $e^\tau(\alpha)$, using (12):

$$\begin{aligned} e^B(\alpha) &= (c')^{-1}(\frac{\alpha_i N\mu}{1+\alpha_i N}) \text{ for all } i \text{ such that } \alpha_i \geq \alpha \\ e^G(\alpha) &= (c')^{-1}(\frac{\alpha_i N\mu}{1+\alpha_i N}) \text{ for all } i \text{ such that } \alpha_i < \alpha. \end{aligned} \tag{17}$$

Lemma 2 *Assume that there exist at least two individuals i and j such that $\alpha_i \neq \alpha_j$. Then, for every threshold $\alpha \in [0, \bar{\alpha}]$, average effort in green firms ($e^G(\alpha)$) is strictly higher than average effort in brown firms ($e^B(\alpha)$).*

Proof. See Appendix A. ■

If both firm types exist in long-term equilibrium, zero profits imply that wages must depend on average effort in the following way (see eq. 3):

$$w(G) = \frac{1}{L}[\mu(1+e^G(\alpha)) - A] \tag{18}$$

$$w(B) = \frac{1}{L}\mu(1+e^B(\alpha)) \tag{19}$$

This implies that brown firms' compensating ability is given by

$$\Delta w(\alpha) = \frac{1}{L}[A - \mu(e^G(\alpha) - e^B(\alpha))] \tag{20}$$

where $e^G(\alpha)$ and $e^B(\alpha)$ are given by (17).

In both firm types, average productivity varies with α, the moral motivation of the marginal green worker. However, note that the slope of $\Delta w(\alpha)$ may be positive or negative: A very high α, for example, means that there are only a few green firms, employing workers with unusually strong moral motivation; average productivity of green firms is thus high, and they can pay a lot. However, at the same time, brown firms' productivity is relatively high too, because brown firms employ a large share of the workforce, including workers with a relatively high moral motivation. The shape of $\Delta w(\alpha)$ depends on the specification of $c(e_i)$ and the distribution of α_i. As long as $\Delta w(\alpha)$ is decreasing, or is increasing less than $\phi(\alpha)$, the labor market equilibrium is unique.

Proposition 3 *Assume that the distribution of α_i can be approximated by a continuous probability distribution assigning strictly positive probability to every $\alpha_i \in [0, \bar{\alpha}]$, and that $\partial\phi(\alpha)/\partial\alpha > \partial\Delta w(\alpha)/\partial\alpha$ for every $\alpha \in [0, \bar{\alpha}]$. Then there exists a unique labor market equilibrium characterized by an equilibrium threshold α^*, such that every worker with $\alpha_i > \alpha^*$ is employed by a green firm, every worker with $\alpha_i < \alpha^*$ is employed by a brown firm, and the following holds:*

$$\begin{aligned} \textit{If } \alpha^* &\in (0,1): \ \Delta w(\alpha) = \phi(\alpha) \\ \textit{If } \alpha^* &= 0: \ \Delta w(0) \leq \phi(0) = 0 \\ \textit{If } \alpha^* &= \bar{\alpha}: \ \Delta w(\bar{\alpha}) \geq \phi(\bar{\alpha}) \end{aligned} \tag{21}$$

Proof. See Appendix A. ■

Proposition 3 implies that if the abatement cost is sufficiently small, and/or the importance of unobservable effort for production is sufficiently large, green firms can survive in long-term equilibrium; brown firms could even be wiped entirely out of the market.

The Proposition is derived under the assumption that the population is sufficiently large to make a continuous approximation meaningful. Furthermore, it assumes conditions which rule out the possibility of multiple equilibria. These assumptions are helpful in simplifying the exposition, but are not essential to the results. For the interested reader, this is elaborated in Appendix B.

Figure 1 depicts workers' willingness to pay (the thick broken line) as a function of α_i, whereas the solid line illustrates the maximum wage difference when $\alpha = \alpha_i$.[13] Here, all i with $\alpha_i > \alpha^*$ will be employed by green firms (in this case, about half of the workers), while the rest are employed by brown firms.

Figure 1 about here

There are two factors influencing brown firms' compensating ability, i.e. their ability to offer a higher wage than green firms: First, green firms must pay the abatement cost (the first term in (20)). Second, expected average effort differs between firm types, due to labor market screening (the last

[13] All figures below are based on the assumption that $c(e) = e^\theta$ with $\theta = 1.5$, that α_i is uniformly distributed, and $\mu = 1.2$. This secures a unique equilibrium. With very high θ, multiple equilibria could arise.

term in (20)). Without screening, green firms might still be able to survive, but this may require a substantial willingness to pay by workers: the second term in (20) would disappear, and brown firms' compensating ability would be constant and equal to $\frac{A}{L}$(see Figure 1). In other words, without screening, survival of green firms would require that each worker in a green firm is prepared to pay his full share of the abatement cost. For the parameter values used in the figure, willingness to pay is not that large, implying that without screening, all firms would be brown; it is labor market screening which secures the survival of a substantial number of green firms.

If abatement is too costly, relatively to the potential gains of being green, all firms will be brown in equilibrium. Similarly, however, it can also be the case that all firms are green in equilibrium. This will happen if the importance of unobservable effort for firm productivity is sufficiently large. In fact, *every* brown firm may be wiped out by competition even in the case where a substantial share of the workers have *no moral motivation whatsoever* (i.e. $\alpha_i = 0$). The reason is the following: Imagine one brown entrant in a world of only green firms, offering the same wage as the green firms. This firm can survive if its productivity is slightly lower than green firms, since it does not have to pay the abatement cost. However, the single brown firm would only be able to attract workers with $\alpha_i = 0$, that is, the *very least* motivated workers; consequently, it may well end up with a too low productivity to survive. If there had been no labor market screening, then a non-negligible share of workers with no moral motivation would always imply the existence of at least one brown firm.

The more important effort is for production, the larger is the importance of screening. In fact, a shift in μ, which measures how important effort is for firm productivity, can be sufficient to move the economy from an initial situation with no green firms to another with *only* green firms.

Figure 2 about here

This is illustrated in Figure 2a and b, where all parameter values are kept as in Figure 1, except μ, which is *lower* in Figure 2a and *higher* in Figure 2b.[14] The implication is that in the first situation (Figure 2a), there are only brown firms, while in the second case (Figure 2b), there are only green

[14] In Figure 2a, $\mu = 0.8$, while in Figure 2b, $\mu = 1.6$.

firms in equilibrium. Note that willingness to pay and abatement costs are the same in these two cases; only the importance of effort is different.

Consequently, if the importance of non-observable effort increases over time, one would expect social corporate responsibility to become more widespread. Similarly, one would expect to see a larger share of socially responsible firms in industries where production is crucially based on non-observable effort by employees.

Could this economy produce too much abatement? No: As noted above, willingness to pay for working in green firms is positive only if abatement is socially optimal. If $\gamma Z < \frac{A}{L}$, i.e. if the disutility of pollution is too small to justify the abatement cost, workers would in fact consider *brown* firms most socially beneficial, and there would be no green firms in equilibrium.

7 Policy analysis

Until now, we have assumed that there is no environmental policy. The government can, of course, use taxes, subsidies, or other instruments to stimulate abatement. However, if labor market screening provides a productivity advantage for green firms, less powerful policy instruments than otherwise will be needed to achieve a given environmental quality. In particular, the government can make all firms turn green simply by subsidizing abatement equipment, and, due to labor market screening, the required subsidy to achieve this is strictly lower than the abatement cost.[15]

Since highly motivated workers self-select into green firms, average productivity is always larger in green firms, provided that moral motivation differs between workers at all. This holds even when almost every firm is green, since brown firms will then only be able to recruit the very least motivated. Thus, a subsidy does not have to cover the entire abatement cost to drive brown firms out of business; it is sufficient that the subsidy covers the abatement cost less green firms' productivity advantage $\mu\left(e^G(0) - e^B(0)\right)$. Moreover, provided that abatement is indeed socially desirable, the subsidy per

[15] Since emissions per firm are fixed in the present model, and abatement is a discrete decision for the firm, a subsidy on abatement equipment is formally equivalent to a marginal emission tax combined with a lump-sum transfer to each firm.

firm required to make *every* firm green is strictly lower than the social value of the environmental disutility caused by each brown firm.

Proposition 4 *Assume that the conditions for Propositions 2 and 3 hold. Then, a subsidy* $\Omega < A < \gamma ZL$ *will be sufficient to make all firms green.*

Proof. See Appendix A. ■

There may also be another important role for policy in the current context. Above, we have implicitly assumed that workers have perfect knowledge about firms' social responsibility. However, information about such matters will in practice often be imperfect; and in that case, firms may have a strong incentive to pretend being green, but without paying the abatement cost A. If workers recognize this incentive, but are unable to distinguish truly responsible firms from cheaters, the screening mechanism described above could dissolve. Public disclosure of reliable information concerning firms' social responsibility may thus be crucial to allow labor market competition to favor green firms.[16]

8 Variable emissions

In the above analysis, green firms have two advantages over brown firms, which may or may not outweigh green firms' abatement costs: Firstly, green firms are able to pay lower wages and still attract workers; secondly, the workers they recruit are more productive.

The first of these advantages does not depend on the particular form of moral motivation assumed: If some workers, for whatever reason, prefer green employers, all else given, while no workers prefer brown firms, a lower equilibrium wage for green firms should be expected. The second advantage,

[16] This may provide one possible explanation for the widespread practice among regulators to use seemingly lax sanctions towards violators, such as informal warnings or very low fines (Russell 1990, Nyborg and Telle 2004). As long as these sanctions are made public, they imply disclosure of information discrediting the firm's social responsibility. We have shown above that a subsidy on green firms, or a corresponding tax on brown firms, can potentially make all firms green even when the subsidy does not cover the abatement cost. Correspondingly, a relatively small expected sanction could be sufficient to deter violation of environmental regulations when the more productive workers are drawn to firms with a reputation for high social responsibility.

however, is caused by labor market screening, which in turn depends on a correlation between individual's job preferences and their effort choice. In the present analysis, this was caused by the assumed underlying moral principle, which affects several aspects of worker behavior and thus produces the required correlation.

Above, we assumed that emissions per firm (before abatement) were fixed. If emissions had been increasing in the firm's production, however, green firms would have a third advantage: Any given worker with $\alpha_i > 0$ would then provide strictly higher effort in a green than in a brown firm.[17] When determining his effort level, the morally motivated worker asks himself: "What would happen if everybody exerted the same effort as me?" If he works hard, and everybody did so too, consumption for everyone would increase, and this encourages him to work harder. However, if he works in a brown firm, such increased effort by everyone would also lead to a deterioration of environmental quality, and this would at least partially offset the former encouragement effect.

Thus, assume now that pollution are given by zy^τ, where $z > 0$ denotes emission per unit of output and where y^τ is production in a firm of type τ as defined by eq. (2). Environmental quality is now given by

$$E = E^0 - bzy^B \tag{22}$$

where b is the share of brown firms, as above. It follows that

$$\partial \widetilde{V}(e_i, \tau_i)/\partial e_i = \begin{cases} N[\mu - \mu L\gamma z - c'] & \text{for } \tau = B \\ N[\mu - c'] & \text{for } \tau = G \end{cases} \tag{23}$$

Inserting this into the first order condition (9) shows that a given individual i will exert different effort in green and brown firms:

$$\begin{aligned} e_i^G &= (c')^{-1}\left(\frac{\alpha_i N\mu}{1+\alpha_i N}\right) \\ e_i^B &= (c')^{-1}\left(\frac{\alpha_i N\mu}{1+\alpha_i N}(1 - L\gamma z)\right) \end{aligned} \tag{24}$$

Since $L\gamma z > 0$, this implies that for any given α_i, effort is higher if the individual works in a green

[17] See Brekke and Nyborg (2004) for a full analysis.

than in a brown firm.[18] Variable emissions would thus reinforce the result that green firms are more efficient than brown firms, making the survival of green firms more likely.[19]

One implication of this is that even if there were, for some reason, no labor market screening, such that the average α_i were identical in brown and green firms, green firms would still have more productive workers: In a brown firm, the work motivation of any individual with $\alpha_i > 0$ would be reduced when he knows that working hard contributes to deteriorating the natural environment.

9 Concluding remarks

Our analysis has demonstrated that firms may be able to use their social corporate responsibility profile as a screening device to attract more productive workers. Consequently, green firms may be able to survive in the long run. The screening mechanism could even be powerful enough to drive all brown firms out of business, even when a substantial proportion of workers have no moral motivation at all.

Several researchers have attempted to identify an empirical relationship between firms' environmental and economic performance, with somewhat mixed results (see, for example, Telle (2006) and the references therein). Here, however, we have assumed that profitable firms (whether green or brown) are imitated by others, until the extra earning potential has been exhausted, while unprofitable firms will vanish. Consequently, if both green and brown firms exist in equilibrium, our model provides no reason to expect their profitability to differ.

Our model would predict, however, that the share of green firms in equilibrium is decreasing in the abatement cost, but increasing in the importance of unobservable effort for firm productivity. Hence,

[18] Note that if marginal utility of income were decreasing in the income level, this result would be reinforced. The intuitive reason is that brown firms pay higher wages. When considering the self-image benefits of working harder, the individual weighs the incremental consumption benefits if everyone worked a little harder against the disutility of effort which everyone would also experience in that hypothetical case. If the utility of income were decreasing, the marginal utility of an hypothetically increased consumption would be lower in brown than in green firms.

[19] Willingness to pay would in fact be influenced as well: Workers comparing the benefits of working in each firm type would have to take into account that their actual effort would depend on firm type. This complicates the equilibrium analysis considerably (see Brekke and Nyborg 2004), but does not change the main insight.

if unobservable effort becomes more important over time, for example due to an increasing reliance on employees' highly specialized know-how, we would expect the share of green firms to increase over time. Similarly, in industries where unobservable effort is particularly important for firms' profitability, we would expect a relatively large share of socially responsible firms.

In our model, corporate social responsibility leads to labor market screening because some workers strictly prefer to work in a green rather than a brown firm, and because the strength of this preference is positively correlated with worker productivity. The correlation arises because workers' self-image is based on a general principle of ethics, for which some workers care more than others. If a similar correlation originated from another ethical principle, or from an entirely different mechanism, the resulting market equilibria would still, of course, correspond to those described here. For example, a preference to be *important to others* (Brekke and Nyborg 2006) induces a similar correlation; an individual with such preferences will typically want to make choices that enhance environmental quality as well as team production.

One should not, however, draw the conclusion that workers' moral motivation provides an easy and satisfactory solution to society's environmental and/or shirking problems. Although morally motivated workers partially internalize external effects, the internalization will be less than perfect, perhaps substantially less than perfect. Above, we demonstrated that effort levels will, in spite of the moral motivation, be suboptimal; in a model with continuous abatement, abatement expenditures would presumably also, in general, be suboptimal.[20]

Our intention is thus not to argue that environmental policy is redundant in the presence of workers' moral motivation. We have shown that the government can make every firm become green through a subsidy on abatement, and that the subsidy required to achive this is strictly lower than the abatement cost, and also strictly lower than the social value of the environmental disutility caused by each brown firm. Information disclosure may be another important task for the government, since limited verifiability of firms' social responsibility efforts could severely limit the potential of screening mechanisms like the one described here.

[20] Within a slightly different model, Brekke et al. (2003) demonstrated that there is undersupply of public goods even if moral motivation is very strong.

A possible extension of our model is to look further into the issue of fairness. Above, we assumed that pure rents to capital owners are zero in the long-run equilibrium, implying that increased average productivity benefits workers through higher wages. However, in some contexts it seems plausible that workers would think, instead, that if productivity increased, capital owners (or CEOs) would reap the gains for themselves, which would not necessarily be considered equally socially desirable as a wage increase for all. Thus, within the logic of our model, the distribution of firm profits could have profound implications for employees' work morale.

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A Proofs

Proof of Lemma 1

Proof. Consider first the case where social welfare is given by $V^S = \sum_{j=1}^{N}[u(x_j) + \gamma E - c(e_j) + S_j]$. Using (7), we can write this as $V^S = \sum_{j=1}^{N}[u(x_j) + \gamma E - c(e_j) + \alpha_j \tilde{V}^S(e_i, \tau_i)]$, implying that

$$\tilde{V}^S(e_i, \tau_i) = \sum_{j=1}^{N}[u(\tilde{x}(e_i, \tau_i) + \gamma \tilde{E}(\tau_i) - c(e_i) + \alpha_j \tilde{V}^S(e_i, \tau_i).$$

Rearranging, we get

$$\left(1 - \sum_{j=1}^{N} \alpha_j\right) \tilde{V}^S(e_i, \tau_i) = \sum_{j=1}^{N}[u(\tilde{x}(e_i, \tau_i) + \gamma \tilde{E}(\tau_i) - c(e_i)]$$

implying that $k\tilde{V}^S(e_i, \tau_i) = \tilde{V}(e_i, \tau_i)$, where the constant $k = \left(1 - \sum_{j=1}^{N} \alpha_j\right) > 0$ (by assumption, $\sum_{j=1}^{N} \alpha_j < 1$, which rules out extreme altruism). Thus, hypothetical social welfare including self-image, if everybody acted like i, is just a rescaling of hypothetical social welfare excluding self-image, if everybody acted like i. Furthermore, since hypothetical social welfare enters the utility function only through self-image, replacing V by V^S is formally equivalent to a rescaling of the moral motivation parameter α_i. These two cases would thus be behaviorally indistinguishable. ■

Proof of Proposition 2:

Proof. If both firm types exist, (5) and (3) imply

$$\begin{aligned} \widetilde{x}(e_i, G) &= (1 + e^G)\mu - \frac{A}{L} \\ \widetilde{x}(e_i, B) &= (1 + e^G)\mu \end{aligned} \tag{25}$$

From (8), we have that $\widetilde{V}(e_i, \tau_i) = N[\tilde{x}(e_i, \tau_i) - c(e_i) + \gamma \tilde{E}(\tau_i)]$. Combining this with (14) gives

$$\phi_i = \alpha_i(N[\tilde{x}(e_i, G) + \gamma \tilde{E}(G)] - N[\tilde{x}(e_i, B) + \gamma \tilde{E}(B)]) \tag{26}$$

Combining this with (25) yields

$$\phi_i = \alpha_i N[(\mu(1 + e_i) - \frac{A}{L}) + \gamma \tilde{E}(G) - (\mu(1 + e_i)) - \gamma \tilde{E}(B)] \tag{27}$$

$$= \alpha_i N[-\frac{A}{L} + \gamma \tilde{E}(G) - \gamma \tilde{E}(B)] \tag{28}$$

Further, by (4), $\tilde{E}(B) = E^0 - Z$, while $\tilde{E}(G) = E^0$. Consequently, $\phi_i = \alpha_i N[\gamma Z - \frac{A}{L}]$. ■

Proof of Lemma 2:

Proof. Since there exist different individuals $i \neq j$ with $\alpha_i \neq \alpha_j$, and since effort is increasing in α_i (Proposition 1), it follows that $e_i \neq e_j$; hence there exists variation in effort between workers. Recall

that α is defined as any threshold such that every i with $\alpha_i \geq \alpha$ prefers to work in a green firm, while every i with $\alpha_i < \alpha$ prefers a brown firm. Thus, green firms will hire those workers who exert the highest effort, while brown firms hire those who exert the least effort. It follows that $e^G(\alpha) > e^B(\alpha)$ for any α. ■

Proof of Proposition 3:

Proof. Under the conditions of the theorem, $\phi(\alpha)$ and $\Delta w(\alpha)$ are continuous functions with $\phi'(\alpha) > \Delta w'(\alpha)$. $\phi(\alpha) - \Delta w(\alpha)$ is thus a strictly increasing function. It follows that either $\phi(\alpha) > \Delta w(\alpha)$ for all α, $\phi(\alpha) < \Delta w(\alpha)$ for all α, or there is a unique α^* such that $\phi(\alpha^*) = \Delta w(\alpha^*)$. In the first case, we have, in particular $\phi(0) > \Delta w(0)$. We know by eq. (15) that $\phi(0) = 0$; thus, if all firms were green, a potential brown entrant would be able to pay less than the green firms, and all workers would strictly prefer the green firm, which is an equilibrium. In a similar fashion, it follows that all firms being brown is an equilibrium when $\phi(\alpha) < \Delta w(\alpha)$ for all α. If there exists an $\alpha^* \in [0, \bar{\alpha}]$ such that $\phi(\alpha^*) = \Delta w(\alpha^*)$, then at this wage difference all individuals with $\alpha_i > \alpha^*$ have a willingness to pay $\phi(\alpha_i) > \Delta w(\alpha^*)$ and hence strictly prefer working in a green firm, every i with $\alpha_i < \alpha^*$ strictly prefers a brown firm, and every i with $\alpha_i = \alpha^*$ is indifferent. This proves the existence of an equilibrium.
To prove uniqueness, note that an α with $\phi(\alpha) < \Delta w(\alpha)$ cannot constitue an equilibrium if there are workers i with $\alpha_i > \alpha$: If α is an equilibrium value of the threshold, this means (by definition) that all workers with $\alpha_i > \alpha$ prefers working in a green firm; while we know that every i such that $\phi(\alpha_i) < \Delta w(\alpha)$ prefers working in a brown firm. Similarly, any α with $\phi(\alpha) > \Delta w(\alpha)$ cannot be an equilibrium if there are workers with $\alpha_i \leq \alpha$, since these workers will not prefer the brown firms.

■

Proof of Proposition 4:

Proof. In the case with no subsidy, we know from eq.(20) that $\Delta w(\alpha) = \frac{1}{L}[A - \mu(e^G(\alpha) - e^B(\alpha))]$. A subsidy Ω on the purchase of abatement equipment is, from firms' perspective, equivalent to a lower purchase price. Hence, in the case with a subsidy, brown firms' compensating ability is strictly negative if $A - \Omega < \mu(e^G(\alpha) - e^B(\alpha))$. We are considering the minimum subsidy required to drive *all* brown firms out of business. Denote this subsidy level Ω^G. If brown firms are driven out of

business, we must have $\alpha^* = 0$; moreover, brown firms' compensating ability in this situation must be negative. This holds whenever $A - \Omega^G < \mu\left(e^G(0) - e^B(0)\right)$. Due to Lemma 2, we know that $e^G(\alpha) - e^B(\alpha) > 0$; hence $e^G(0) - e^B(0) > 0$. Thus, all firms will be green at a subsidy level $\Omega^G > A - \mu\left(e^G(0) - e^B(0)\right) < A$.

Furthermore, from Proposition 2, we know by assumption that $\gamma Z > \frac{A}{L}$. It follows that $\gamma ZL > A$, and, consequently, that $\Omega^G < A < \gamma ZL$. To see that γZL is the value of the environmental damage caused by each brown firm, note first that the number of firms is N/L. The environmental damage caused by each brown firm is, by (4), $Z\frac{L}{N}$. The value of this for a single individual is $\gamma Z\frac{L}{N}$, and, consequently, its value for the entire society of N individuals is γZL. ■

B Extensions: Discrete distribution, multiple equilibria

Proposition 3 assumed that the distribution of α_i could be approximated by a continuous distribution with strictly positive probability for every $\alpha_i \in [0, \bar{\alpha}]$; further, that parameters were chosen such that $\phi'(\alpha) > \Delta w'(\alpha)$, ensuring a unique equilibrium. These assumptions prevent complications concerning the existence and uniqueness of equilibrium, but are not required for our main result; that brown firms may be driven out of the market if abatement cost is sufficiently small or the importance of effort sufficiently large. We state the more general result as a Proposition:

Proposition 5 *Assume that there exist individuals $i \neq j$ such that $\alpha_i \neq \alpha_j$. Then there exists an $\psi > 0$ such that there is a unique equilibrium with only green firms whenever $A < \psi\mu$.*

Proof. From Lemma 2, we know that when there exist individuals $i \neq j$ such that $\alpha_i \neq \alpha_j$, then $e^G(\alpha) > e^B(\alpha)$ for any α. Thus we can define

$$\min_{\alpha}\left(e^G(\alpha) > e^B(\alpha)\right) = \psi > 0.$$

Now for any α, it follows from (20)

$$\begin{aligned}\Delta w(\alpha) &= \frac{1}{L}[A - \mu(e^G(\alpha) - e^B(\alpha))] \\ &\leq \frac{1}{L}[A - \mu\psi] \leq 0\end{aligned}$$

for $\mu \geq A/\psi$. ■

In the main text we focused on the case with a unique equilibrium. If the assumption $\phi'(\alpha) > \Delta w'(\alpha)$ does not hold, multiple equilibria may occur, some of which may be unstable. This could happen for sufficiently convex costs of effort $c(e)$. However, the general insight is that a *unique* equilibrium with only green firms will always exist for sufficiently large μ.

Define an equilibrium as a situation in which all (existing) firms have zero profit, and no worker wants to move to another type of firm. Any equilibrium must be characterized by a threshold value α such that all i with $\alpha_i \geq \alpha$ prefer green and the rest prefer brown. (For $\alpha = \bar{\alpha}$, we assume that i with $\alpha_i = \alpha$ prefer brown.) A threshold $\alpha \in (0, 1)$ defines an equilibrium iff $\Delta w(\alpha) = \phi(\alpha)$. When $\alpha = 0$, there are no workers with $\alpha_i < \alpha$, and with $\alpha = \bar{\alpha}$ there are none with $\alpha_i > \alpha$. Thus in these cases the equilibrium condition is one-sided. The general equilibrium conditions are as stated in Proposition 3, eq. (21).

An equilibrium is unstable if a slight deviation will induce a larger deviation. If α is a stable equilibrium, then if the threshold for some reason moves to $\alpha' < \alpha$, then workers must have an incentive to move to brown firms, which requires that $\Delta w(\alpha') > \phi(\alpha')$. Thus, for a stable equilibrium α, if $\Delta w(\alpha) = \phi(\alpha)$ then $\phi(\alpha') - \Delta w(\alpha')$ must be increasing in α'.

Now if $\Delta w(\alpha) - \phi(\alpha)$ is declining, there can be only one equilibrium. And as $\phi(\cdot)$ is increasing, this will be the case unless $\Delta w(\cdot)$ is sufficiently increasing. It turns out that $\Delta w(\cdot)$ may be rapidly increasing when $c(e)$ is strongly convex. In this case the cost of effort is low for small values of e but then rapidly increases. Most workers, except those with $\alpha_i \approx 0$, will then exert about the same effort. In the entire population there will only be a few workers with markedly lower effort. These workers will never constitute a large share of the labor force in green firms; hence average effort in green firms is not very sensitive to changes in α. For brown firms, however, α matters a lot. With $\alpha \approx 0$, brown firms will only hire among those with low effort, while for high α, these low effort workers will constitute a small share of brown firms' employees. Hence, average effort in brown firms is rapidly increasing for small α. As a consequence, the wage difference would be rapidly increasing for small α, but would then flatten out. This is illustrated in Figure 3, where we have assumed that $c(e) = e^{\theta}$ as

in Figures 1-2, but in Figure 3, $\theta = 3$.

The case in Figure 3 exhibits three equilibria, one for $\alpha = 0$ (all firms are green), one for $\alpha \approx 0.1$, and one with $\alpha \approx 0.5$. The equilibrium at $\alpha \approx 0.1$ is unstable: If workers with a slightly higher value of α_i moved to brown firms, brown firms' compensating ability would increase, they would attract even more workers, and this process would continue until $\alpha \approx 0.5$. If μ increases, $\Delta w(\alpha)$ will shift down and eventually $\Delta w(\alpha) - \phi(\alpha) < 0$ for all α, and the only equilibrium will be that all firms are green, as stated in Proposition 5.

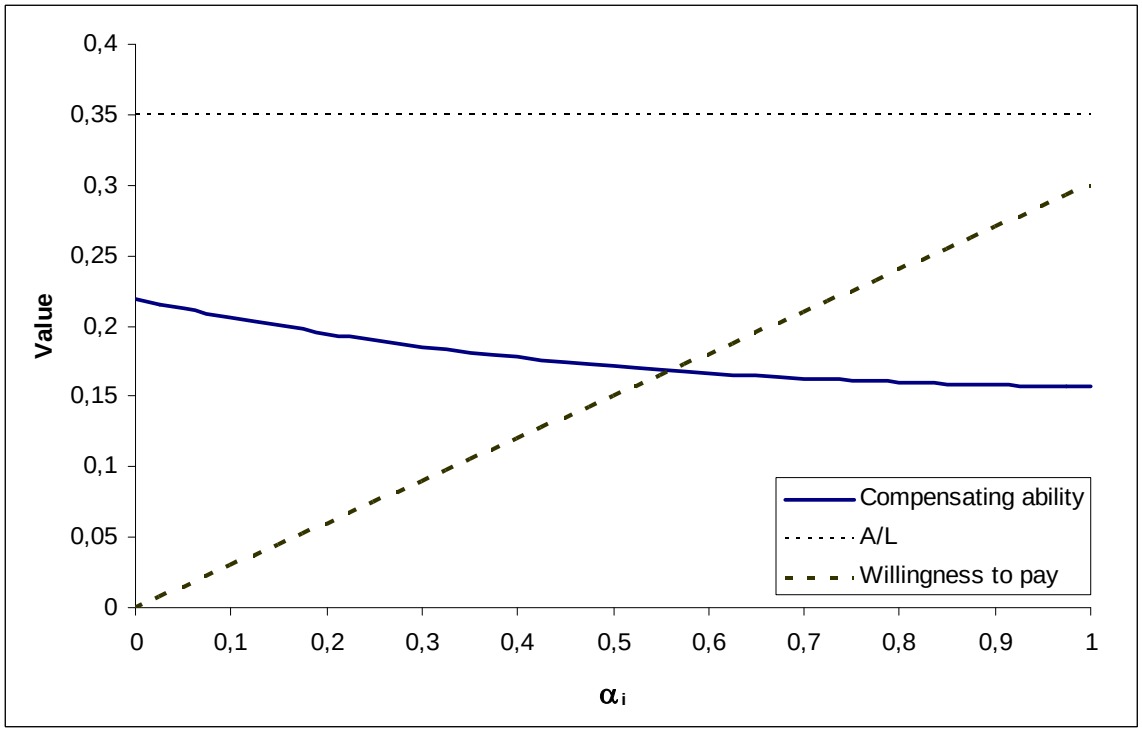
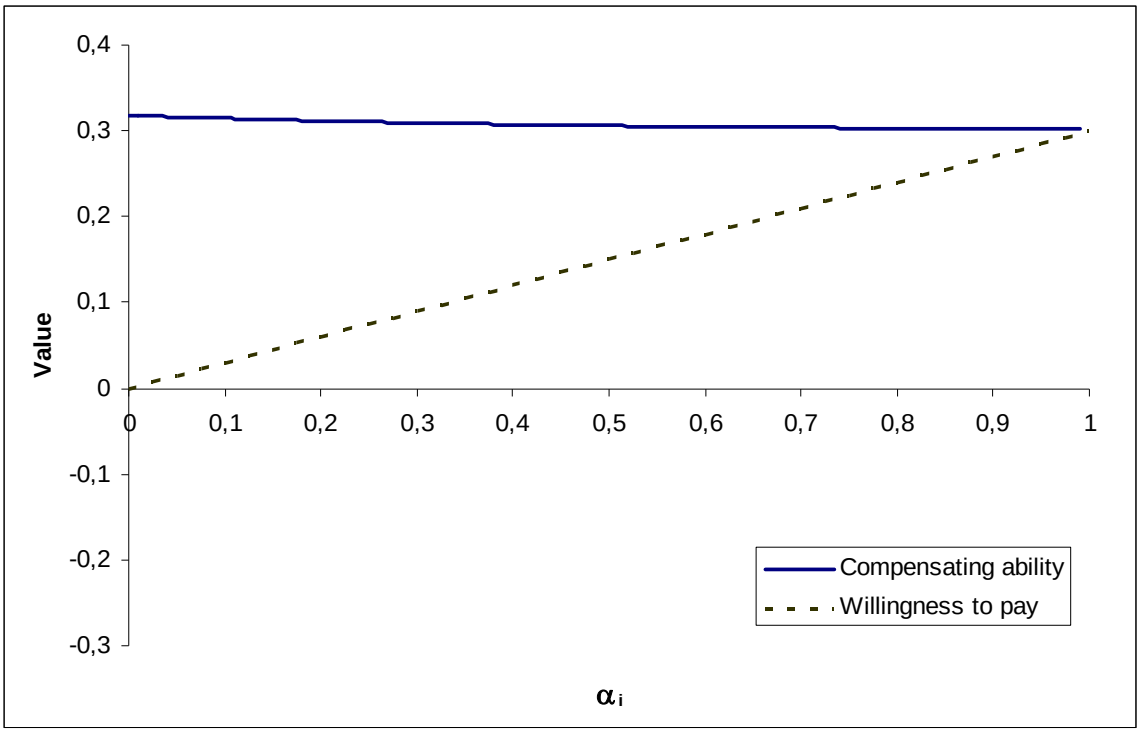


Figure 1: Brown firms' compensating ability, $\Delta w(\alpha)$, given $\alpha=\alpha_i$, and workers' willingness to pay, $\phi(\alpha_i)$.

a)



b)

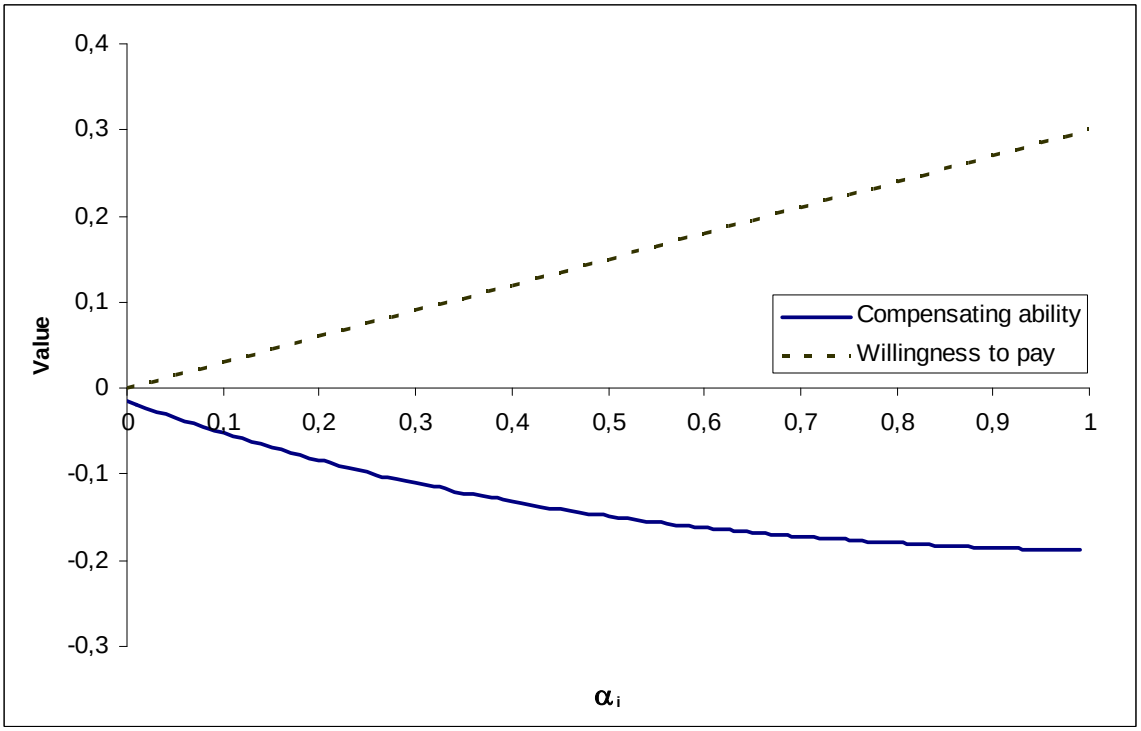


Figure 2: Brown firms' compensating ability, $\Delta w(\alpha)$, given $\alpha=\alpha_i$, and workers' willingness to pay, $\phi(\alpha_i)$, with varying importance of unobservable effort μ. In (a), $\mu=0.8$, and all firms are brown; in (b), $\mu=1.6$, and all firms are green.

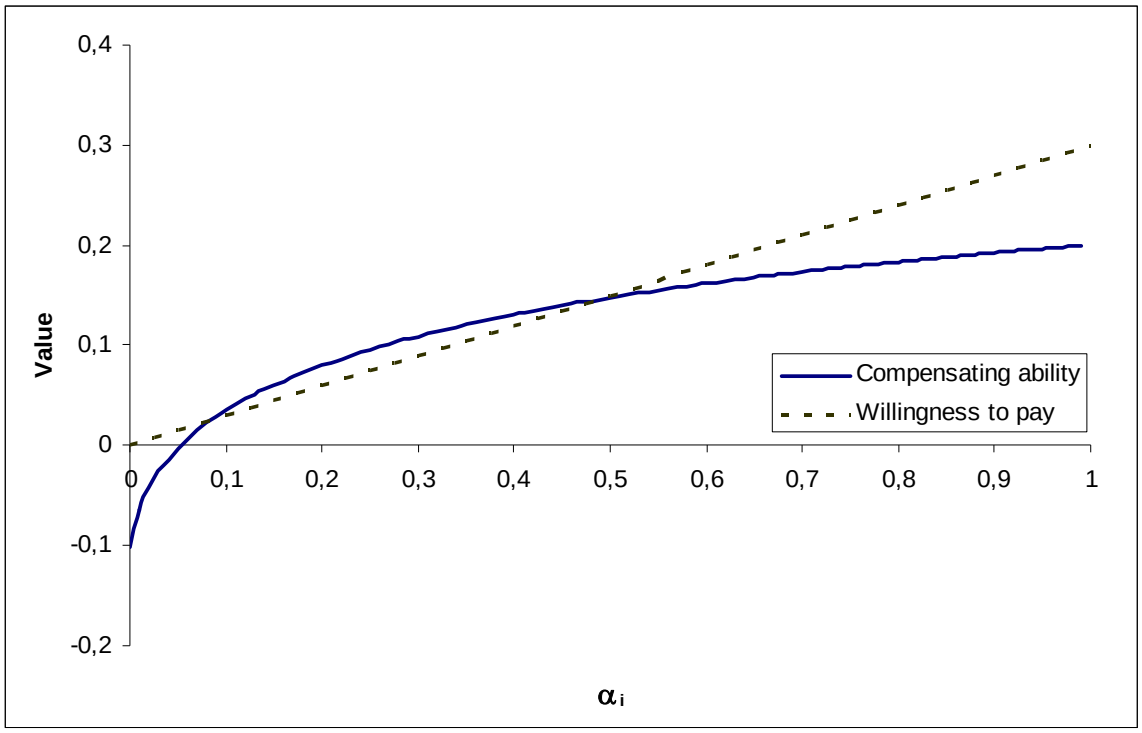


Figure 3: Multiple equilibria