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Private *vs.* Public Regulation: Political Economy of the International Environment

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Abstract

Minimum standards set by a 'World Environmental Organisation' (WEO) and NGO labelling are promoted as alternative approaches to international environmental protection. We explore the potential inter-play between these two approaches when the WEO is subject to pressure from producers. We find that if WEO and NGO schemes are mutually exclusive then the existence of an NGO 'alternative' increases industry resistance to WEO proposals and this may reduce welfare. If, however, the schemes are run in parallel, existence of the NGO lessens producer opposition to WEO activities. This allows the WEO to be 'bolder' in its proposals, which is good for welfare.

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1 Introduction¹

When environmental protection is an international public good the incentive for national governments to set excessively lax domestic environmental requirements is well-understood, and the case for a supernational agency, a ‘World Environmental Organization’ (WEO), setting and policing international environmental standards has long been made.

The exact form of a WEO is the subject of considerable debate in the area of law and public policy.² Biermann (2000) explores alternative forms that such an organization might take, including what he calls the ‘hierarchization model’ in which “a world authority for the protection of the global environment ...is entrusted with enforcement powers against states that fail to implement certain standards (possibly agreed on by majority vote).” Esty and Ivanova (2001) put forth a more decentralized model of what they call a global environmental organization with four key capacities including (1) decision-making, (2) implementation, (3) monitoring, and (4) dispute resolution. They propose a double-majority voting mechanism for dispute resolution mechanism that would prevent disproportional power to either developed and developing nations.³ Whalley and Zissimos (2001) propose a WEO with a focus on the internalization of trans-boundary (and possibly intra-national) externalities based on

¹ We thank participants at Indiana and Helsinki Universities, at the BIOECON Workshop on ‘Trade, Biodiversity and Resources’ held in Tilburg 5-6 September 2002, Cees Withagen, Tim Swanson and Juuso Valimaki for helpful comments. Heyes is at Royal Holloway College, London University (a.heyas@rhul.ac.uk). Maxwell is at the Kelley School of Business, Indiana University (jwmax@indiana.edu).

² Several recent proposals on the structure and powers of a WEO are available at Yale Center for Environmental Law and Policy website <http://www.yale.edu/gegdialogue/analyticfoundations.html>.

³ Developed nations view a one-country one-vote model as handing an effective veto to developing countries, while the latter view a one-dollar one vote model as handing an effective veto to developed nations.

Private *vs.* Public Regulation: Political Economy of the International Environment

the principle of Coasian bargaining.⁴ Naturally, issues of sovereignty and willingness of nation states to accede to any proposed WEO are important ones. Though our analysis points to an individual environmental issue, the usual presumption is that the Organization would have discretion or influence in sufficient policy areas to allow it to encourage participation through issue-linkage ('horse-trading'). France has been amongst those countries that have taken a lead in trying to progress towards a more coercively-oriented WEO, as Juma (2000) reports: "At a recent meeting of the World Bank in Paris, Lionel Jospin, the French prime minister, called on the United Nations to establish a world environment organisation to both *create* and *enforce* environmental regulations".

Regardless of the specifics of various proposals for a WEO most have the following common features. The WEO will be charged with a goal of reducing global environmental externalities subject to the limitation that its action should not unduly harm economic growth. We view this as shorthand for the optimization of global economic welfare. The WEO should have a dispute resolution mechanism that may involve a form a majority voting or may be based on the an interpretation of international law.⁵ The WEO should have monitoring enforcement powers. These powers may be held centrally within the organization or may be delegated to national authorities that report to the WEO. In the latter case the WEO should have the power to sanction governments that fail to comply with mandated standards

⁴ The studies of the form and function of a WEO arise as an alternative to extending the mandate of the WTO to take an more active role in deciding "trade and environment" issues. The popular case for such an extension is pragmatic - that through its 'ownership' of trade sanctions the WTO has a ready-made and effective mechanism for enforcing its rules, at least in the context of traded goods. More generally it is argued that the established procedures for dispute resolution could readily be reformed to incorporate trade versus environment trade-offs. Weinstein and Charnovitz (2001) and Rao (2000) provide good analysis.

⁵ International laws may take the form of the United Nations Convention on the Law of the Sea.

Private *vs.* Public Regulation: Political Economy of the International Environment

(in the context of biodiversity protection, for example, CITES determines threatened species and then imposes trade bans upon parties). Our model of the WEO is highly simplified but is intended to capture these basic features.

A second option - and one that has gathered in credibility over the past several years - is to rely on non-governmental environmental groups (NGO's) such as the WWF to operate labeling schemes. In a world populated by 'green' consumers a sub-set of producers can be expected to take voluntary steps to improve their environmental performance in order to obtain a label and extract a green premium. Various voluntary schemes already exist - the Seafood Eco-Label issued by the Marine Stewardship Council and validated by the WWF, for example, and the WWF's Timber Product Eco-Label (Baron (2001)).

Our aim in this paper is to take some steps in comparing the environmental and welfare implications of what we will short-hand as the 'WEO' and 'NGO' approaches, and to investigate how WEO policy-making will be influenced by the existence of non-governmental alternatives both when a political-economic pressures from producers are present (which seems realistic) and when they not.

We investigate the relative merits of these two approaches, and the interplay between them. For example, when the WEO faces producer opposition to its actions, how might that affect the actions of the NGO? Will standards developed by the WEO lead to higher or lower levels of social welfare when label-setting NGO's are present?

In focusing on the interaction we intentionally abstract from a detailed model of the nature of trade. In Section 2 we set-up a simple framework in which goods are traded and

Private *vs.* Public Regulation: Political Economy of the International Environment

sold to consumers willing to pay a premium for ‘green’ goods. The environmental attributes of a good cannot be directly observed by consumers, however, so the green premium will be paid only if either trade in the undesirable good is banned, or the good carries a reputable label testifying to its greenness. We assume that the tool available to the WEO is the former, while the latter tool - which doesn’t require powers of coercion - is used by the NGO. Since the WEO is an organization of government we assume that it would aim to maximize social welfare, whilst the environmental NGO’s goal is to maximize environmental quality. A more general approach of having players maximize a weighted form of social welfare would add little further insight.

In Sections 2 and 3 we consider the two alternatives on an ‘either/or’ basis. We characterize the outcome under an NGO-run voluntary label scheme, and a WEO-run mandatory scheme. We find conditions under which each of aggregate environmental damage, producer surplus and welfare might be higher under either the WEO regime or under the NGO alternative.

We explore the impact of political pressure on the WEO in Section 3. Those influences are themselves shown to depend upon the existence or non-existence of a non-governmental alternative. We adopt the ‘resistance function’ approach, preferred by Lewis (1996) and others, and recently used in the context of environmental instrument choice by Lyon and Maxwell (2002).

For any WEO-proposed policy we find that the level of industry resistance to the standard is (weakly) greater when there exists an NGO than when there does not. This is because the

Private *vs.* Public Regulation: Political Economy of the International Environment

gains to producers from defeating any particular WEO proposal are higher when the NGO exists than when it does not, because the ‘fall-back’ position - with the voluntary labels available for those who wish to procure them - is now more attractive. The stakes, from the point of view of industry, are raised, and that generates extra willingness to resist. While the anticipation of industry resistance tends to lead the WEO to decrease the stringency of the standard it proposes (thereby raising the likelihood of the proposal’s passage) we find that the NGO may serve a ‘back-stop’ function and encourage the WEO to be bolder in what it proposes.

In Sections 4 and 5 we re-evaluate the results in a setting in which the WEO and NGO schemes may coexist. In that case all firms must meet the WEO’s environmental requirements in order to sell their good, but a sub-set will also choose to do what is required to obtain the NGO label. The criterion set by the NGO for award of a label may be increasing or decreasing in the mandatory minimum standard set by the WEO - it being positive (negative) where the threshold for participation in labelling scheme is comparatively sensitive to changes in the former (latter). In contrast to the ‘either/or’ case the existence of the NGO unambiguously improves welfare. In the face of political resistance, where a voluntary and mandatory scheme may co-exist, the existence of an NGO raises expected social welfare. The existence of the NGO, with the scope to run a co-existent label, has three effects, each of which is welfare-improving. It (a) raises welfare in the event that the WEO’s proposal is implemented and, (b), in the event that it is not. By improving the level of surplus delivered to producers in the event of implementation it also, (c), increases the probability of

implementation, which further raises expected welfare.

Section 6 concludes.

2 A Model

For simplicity we assume that the global industry consists of a large number of firms - one located in each of a large number n of countries - each produce a single unit of some good. Production costs are assumed equal to zero. In the absence of regulation production of each unit of the good imposes environmental damage Z . Firm i can reduce that damage by an amount x by spending on cleaner production practices and/or redesigning its product. It can do this at unit cost θ_i . where θ is distributed $f(\theta)$. A low (high) value of θ , then, would be associated with a technologically-able (technologically-feeble) country such as the US (Philippines) which would find clean production comparatively cheap (expensive).

The market is populated by a large number $m > n$ of consumers, each wishing to purchase at most one unit of the good. Consumers are ‘green’. Without offering a fully-fledged micro-founded theory of green consumption we capture this by assuming that each consumer has a willingness-to-pay for the good $p(x)$ where $p(0) > 0$, $p' > 0$, $p'' < 0$. The good is a credence good, however, such that consumers will only pay a premium for environmental enhancement - and firms will only spend on such enhancement - when it is verified by a credible third-party.⁶ We assume that $p(0) < Z$, unregulated production is socially undesirable.

⁶ It is assumed that product quality can be verified by either the WEO or the NGO. The process of verification, naturally, would vary with product type, and could include process inspections and/or product testing. Since a green premium arises from certification it is plausible that firms would be willing to incur the cost of certification. In this case the green premium that we model below could be thought of as net of certification costs. For more on the role of certification for credence goods see Feddersen and Gilligan (2001).

Private *vs.* Public Regulation: Political Economy of the International Environment

We assume that two sources of credible information exist. The first is the WEO and the second is an international NGO. Interestingly, these two organizations are likely to provide information in different ways. While NGO's tend to provide information by setting up voluntary codes of conduct and then providing labels or seals of approval to firms that comply, the WEO has the possibility to exclude from trade products deemed to fall short of its standard.

We model these as follows. The WEO, if called upon to do so, sets and enforces a minimum environmental standard. To sell its product a firm must comply with the standard. The NGO, on the other hand, sets a standard and operates a voluntary labelling scheme, awarding labels to firms that comply with its standards. Both the WEO and NGO are credible in the eyes of consumers, and complying with a standard (voluntary or mandatory) set by either generates a 'green premium' for the seller. The size of the premium depends upon the stringency of the standard and the form of the willingness to pay function of the representative consumer. We do not specify concrete functional forms for p and f , but throughout most of the analysis focus our attention to specifications that yield turning-point interior solutions to the WEO's and NGO's problems. We regard these as the richest and most interesting cases, though we note here that there may exist alternative specifications which yield outcomes characterized by corner solutions.

In addition to the differences in labelling tools, we assume that the two organizations face

The credibility of information given by the NGO may be underpinned by the NGO's need to maintain reputation, if for example it would lose its status if it were 'exposed' as a purveyor of inaccurate information. Alternatively, private parties might have legal redress against an NGO that provides false information about a product, or withholds labels from a firm which should be entitled. For current purposes we simply assume that the NGO behaves honestly.

Private vs. Public Regulation: Political Economy of the International Environment

different objectives. As noted in the introduction, we assume that the WEO is motivated to maximize global social welfare, while the NGO maximizes environmental quality. Since environmental quality is a component of social welfare our assumption locates us as a special case of a more general set-up in which both organizations maximize a differentially-weighted social welfare function.

In the remainder of this section we describe, as benchmark cases, the optimal behaviors of the NGO and the WEO in environments that are free of pressures from producers. Since the impacts of these pressures are the focus of the present paper, we leave out much of the mathematical details of these benchmark cases. These are elaborated in a fuller version of the paper, available from the authors upon request.

2.1 NGO run regime

In this subsection we describe the behavior of the NGO in a setting where the WEO does not operate. Under the NGO labelling scheme product i is entitled to carry the label if it (or its method of production) satisfy the criteria for award, $x_i > s^n$.⁷

Firm i will label iff $p(s) - \theta_i s^n > p(0)$, *i.e.* iff $\theta_i < \theta'$ where

$$\theta' = \frac{p(s^n) - p(0)}{s^n}. \quad (1)$$

An interval of low-cost firms acquire the label. We note in passing that $sgn\left(\frac{\partial \theta'}{\partial s^n}\right) = sgn(p'(s^n) \cdot s^n - (p(s^n) - p(0)))$ which is negative under the assumptions made in the paper

⁷ We ignore enforcement and administrative costs, which could straight-forwardly be inserted into a fuller version.

Private vs. Public Regulation: Political Economy of the International Environment

(the concave-linear specification). This is the ‘natural’ sign - increasing the stringency of the labelling criterion will reduce the set of firms that acquire it.⁸

The NGO is motivated by environmental protection. In establishing and operating a labelling scheme, therefore, it chooses the labelling criteria s^n to minimize

$$D(s^n|vol) = \int_0^{\theta'} (Z - s^n) \cdot f(\theta) d\theta + \int_{\theta'}^{\infty} Z \cdot f(\theta) d\theta. \quad (2)$$

Recall that $Z - s^n$ is the level of environmental damage resulting from production by producers of labelled goods while Z is the that generated by producers of non-labelled goods.

In raising s^n the NGO trades-off the lower damage from labelled goods against the environmental cost due to reduced participation. Aggregate producer surplus is then:

$$\Pi(s^n|vol) = \int_0^{\theta'} [p(s^n) - \theta_i s^n] \cdot f(\theta) d\theta + \int_{\theta'}^{\infty} p(0) \cdot f(\theta) d\theta \quad (3)$$

both components of which are positive. Given (1) these profits exceed $p(0)$, thus, the voluntary NGO scheme increases aggregate producer surplus versus the no intervention scenario. The NGO scheme also reduces the aggregate level of environmental damage by $\int_0^{\theta'} s^n f(\theta) d\theta$. It follows immediately that the NGO’s labelling scheme raises social welfare (where $W(s^n|vol) = \Pi(s^n|vol) - D(s^n|vol)$).

⁸ It is worth noting that, under a more general specification, $\partial\theta'/s^n > 0$ cannot be ruled out. If the willingness-to-pay function is rising faster than the marginal cost of adoption, it might be the case that raising the standard will raise the levels of adoptions.

2.2 WEO run regime

Consider, now, a model absent the NGO but in which a supernational regulator such as the WEO sets a minimum criteria, s^w , that must be satisfied by any seller. Analytically it makes no difference whether s^w is set by decree or, probably more likely, by its judgements in a sequence of test cases.

Firm i will comply with the WEO standards iff $p(s^w) - \theta_i s^w > 0$, *i.e.* iff $\theta < \theta''$ where

$$\theta'' = \frac{p(s^w)}{s^w}. \quad (4)$$

An interval of low-cost firms will comply. Note that for $s^w = s^n$ more firms choose to comply. In this case the firm's only alternative is to drop out of production altogether, since the WEO standard is mandatory. This contrasts with the NGO-operated scheme under which the firm's next best alternative was to continue selling an (unlabeled) 'brown' good at price (and therefore profit) $p(0)$.

The WEO acts to maximize global welfare,⁹ that is s^w maximizes

$$W(s^w|man) = \int_0^{\theta''} [p(s^w) - \theta_i s^w - (Z - s^w)].f(\theta)d\theta. \quad (5)$$

Compared to the NGO case in (2.1), the impact of the WEO's imposition of a minimum

⁹ We choose the maximization of social welfare as a reference case. Plausible arguments exist for alternative objective functions. If we were thinking about this entity corresponding to a WTO with enhanced powers, for example, one might posit the maximization of industry profits (or at least place greater weight on those profits) as an objective function, based on the status of the WTO as a trade promotion body. We address the influence that corporations might have over the WEO later.

Private vs. Public Regulation: Political Economy of the International Environment

standard on industry profits,

$$\Pi(s^w|man) = \int_0^{\theta''} [p(s^w) - \theta_i s^w].f(\theta)d\theta, \quad (6)$$

is less clear. The mandatory nature of the standard means that producers who choose not to comply are excluded from trade and therefore exit production. Exiting firms clearly lose from the imposition of the standard, but adopting firms may lose or gain depending on the level of the green premium generated. Recall these firm will adopt as long as their profits remain positive, their adoption decision does not involve a comparison between *ex ante* and *ex post* profits.

The impact of the standard on both aggregate environmental damages

$$D(s^w|man) = \int_0^{\theta''} (Z - s^w).f(\theta)d\theta. \quad (7)$$

and aggregate social welfare is clear, however. Environmental damages must fall under the standard since exiting firms no longer pollute and adopting firms produce less pollution. Social welfare must be (weakly) higher.

2.3 WEO vs NGO

Since the two organizations face different objective functions straight-forward comparisons are difficult. We will initially compare the regimes under the assumption that each organization would pick the same standard. In general this will not be the case, but these comparisons help us motivate the main proposition of this section which presents the conditions under which the WEO's optimal standard will deliver higher social welfare than the NGO's chosen standard.

Private *vs.* Public Regulation: Political Economy of the International Environment

We note first that when $s^n = s^w$ it is true that $\theta' < \theta''$. If the two organizations choose the same standard more firms will adopt the standard under the WEO regime. This is because the alternative under the WEO regime is exit (and zero profits) while the alternative under the NGO regime is continued trade in the dirty product (profits $p(0)$).

Let us first examine the impact of the two regimes on profits. We see from (3) that industry profits under the NGO regime, given $s^n = s^w$ are

$$\Pi(s^n = s^w | vol) = \int_0^{\theta'} [p(s^w) - \theta_i s^w] \cdot f(\theta) d\theta + \int_{\theta'}^{\infty} p(0) \cdot f(\theta) d\theta \quad (8)$$

while profits under the WEO given the same standard are given by (6). Subtracting (6) from (3) we see, after some simple algebra, that

$$\begin{aligned} \Pi(s^w | man) - \Pi(s^n) &= s^w | vol = \int_{\theta'}^{\theta''} [p(s^w) - \theta_i s^w - p(0)] \cdot f(\theta) d\theta \\ &\quad - \int_{\theta'}^{\infty} p(0) \cdot f(\theta) d\theta \end{aligned} \quad (9)$$

Clearly the second term on the right-hand side of (9), which denotes the profits of firms that would exit the industry under the WEO regime, is negative. The first term, which represents the difference in profits under the WEO regime and the NGO regime for those firms that would adopt under the WEO regime but would choose not to under the voluntary scheme, is also negative. This follows directly from the definition of θ' , which given our assumption of equal standards is $\theta' = (p(s^w) - p(0))/s^w$.

Thus we have shown that industry profits are lower under the WEO regime than under

Private vs. Public Regulation: Political Economy of the International Environment

the NGO regime if each regime lead to the same standard. *If the two organizations choose the same standard* any firm that is efficient enough to adopt under either regime will also receive the same green premium and therefore the same profits. All firms that would choose not to adopt under the WEO scheme lose. One group loses because they incur the costs of adoption for which the green premium does not fully compensate. The other group loses because they are obliged to exit, forgoing positive profits.

Not surprisingly there would be less environmental degradation under the WEO regime. The extra environmental benefits from the WEO regime arise from the fact that some firms are forced to exit and from the fact a set of firms that would, in the absence of coercion, have continued to trade in the ‘brown’ good, comply under the WEO scheme.¹⁰

In summary, under the assumption that the NGO and WEO standards are equivalent, industry profits are higher under the NGO voluntary labelling scheme while aggregate pollution is lower under the WEO mandatory scheme. This sets the stage for a possibly ambiguous result concerning social welfare. Indeed, it is not difficult to show that under the restriction that $s^n = s^w$ no social welfare ordering of the two schemes can be established. Exits that occur under the WEO scheme are welfare-enhancing, and the welfare impact of the adoptions by the sets of firm that adopt under both schemes are the same. However the welfare impact of adoptions that would occur only under the WEO scheme are less clear. For this group of firms the adoptions decrease profits, but lower environmental damages.

¹⁰If the WEO regime led to a higher standard than the NGO regime the former would unambiguously deliver lower pollution. Firms adopting would pollute less, and any non-adopters exit causing them to stop polluting altogether. If the NGO regime chose the higher standard the relative impact on pollution is less clear. Firms that would adopt under either regime would be polluting less under the NGO regime. However, the WEO would hold the environmental benefit associated with the forced exit of non-adopters.

Private vs. Public Regulation: Political Economy of the International Environment

While we are unable in general to develop a social welfare ordering of the two regimes when they are assumed to lead to the same standard, the proceeding analysis leads to the following (proof in Appendix):

Proposition 1 *If WEO induced adoptions are socially desirable the level of welfare under the optimal WEO standard exceeds social welfare under the optimal NGO standard.*

It is worth noting that the proposition does not restrict the relative levels of s^{w*} and s^{n*} . At the level s^{n*} the mandatory WEO regime will induce more adoptions than the voluntary NGO regime, because the mandatory regime at any level of standard holds the threat of exit. The only condition placed on the proof is that such adoptions would be socially desirable. This condition places no constraint on the ultimate *level* of s^{w*} .

It is also worth noting that the condition is a sufficient but not necessary one. It is possible that the adoption induced under the mandatory regime could have a negative social impact (that those adoptions be, in themselves, undesirable) but that overall the welfare ranking would still hold provided the social welfare benefits of the induced exits dominated.

3 The Political-Economy of WEO in the Presence of Non-Governmental Alternatives

In the exposition so far we have treated the WEO as a global social welfare maximizer and the NGO as being concerned with the minimization of environmental damage. This characterization of the NGO accords with the reality that NGO's must cater to the desires of members to ensure future funding, and is one commonly made in the literature. Objections, however, may be raised over the characterization of the WEO's objective. The WEO is

Private *vs.* Public Regulation: Political Economy of the International Environment

likely to be subject to pressures from industries (perhaps via national governments, perhaps directly). If we were to regard the WTO as being charged with these extended powers this is most evidently likely to be true. It is frequently asserted (certainly by protestors on the streets of Seattle and elsewhere) that the WTO is subject to capture by producer interests. We model these pressures in this section by modelling the WEO as a welfare maximizer subject to political constraints.

We follow the approach of Lewis (1996), recently applied by Lyon and Maxwell (2002), in assuming that the probability that the WEO will be successful in implementing a policy described by the mandatory minimum standard s will be a concavely decreasing function ρ of industry resistance to the standard, with $\rho(\Delta) < 1, \forall \Delta > 0$. Also following Lewis (1996) we treat the level of industry resistance Δ as equalling the aggregate decrease in producer surplus implied by the regulation, measured against an appropriate benchmark. Since, here, Δ may be positive or negative (which would imply industry support) we qualify the approach of these authors by assuming that $\rho(\Delta) = 1$ for all $\Delta \leq 0$.

The resistance function is meant to capture the impact of political battles that might take place between nations as their respective domestic industries are helped and harmed by WEO proposals. As we show below, this political constraint will generally cause the WEO to distort what it proposes. The WEO might weaken (or possibly strengthen) what it proposes in order to improve the probability of passage. Alternative approaches would have been to simply have the WEO fully captured by industry interests (which some would claim to be realistic) and hence either maximizing aggregate producer surplus or acting to maximize the

Private *vs.* Public Regulation: Political Economy of the International Environment

interests of the median firm type, a contest model (Heyes (1997)) or a common agency model (Grossman and Helpman (1994)).

In the absence of an alternative prospective policy actor, resistance would simply be the difference between the proposed WEO rule, say s' , and the level of profit without policy intervention. In other words, in that case:

$$\Delta(s) = \int_0^{\infty} p(0) \cdot f(\theta) \cdot d\theta - \Pi(s' | man) \quad (10)$$

Define $\hat{\theta} = (p(s^w) - p(0))/s^w$, we can then write

$$\begin{aligned} \Delta(s) &= \int_0^{\hat{\theta}} [p(0) - \{p(s^w) - \theta s^w\}] f(\theta) d\theta \\ &+ \int_{\hat{\theta}}^{\theta''} [p(0) - \{p(s^w) - \theta s^w\}] f(\theta) d\theta \\ &+ \int_{\theta''}^{\infty} p(0) f(\theta) d\theta \end{aligned} \quad (11)$$

The first term on the right hand side of (11), is negative and represents the profits of those firms that would gain from the imposition of a WEO imposed standard of s^w . These firms gain because their adoption costs are lower than the green premium they will collect. The second term is positive. For this group of firms adoption costs exceed the green premium, however the firms will adopt since their post-adoption profits are positive. The final term denoted the profits of all those firms that will exit under the WEO standard, and is therefore positive. Thus, in general Δ cannot be signed. Regulation here does not simply add to costs, the existence of a green premium which can only be reaped if regulation occurs means that

Private vs. Public Regulation: Political Economy of the International Environment

the impact of a WEO minimum standard on producer surplus may be positive or negative (in the spirit of Rege (2000)).

While our result is not necessarily surprising (regulation, in general, creates winners and losers) it is interesting to note that the likelihood of political opposition to the WEO standard (the probability that $\Delta(s) > 0$) falls with the responsiveness of the premium, dp/ds .

This result suggests that we might expect more resistance to WEO standards in industries that are further removed from end consumers, since green premium responsiveness will likely be low in those industries. This result also suggests that rather than proposing alternative standards, which we consider directly below, environmental groups might wish to engage in the promotion of awareness of WEO standards.

WEO behavior with no NGO labelling alternative

For the moment we will maintain our assumption that the WEO operates in a world where NGOs do not exist. Under political economic constraint a forward-looking WEO will recognize that industry-resistance is endogenous, and take account of that endogeneity in formulating its policy proposal. It will thus propose a policy to maximize expected welfare

$$E(W|\emptyset) = \rho(\Delta(s')).W(s'|man) + (1 - \rho(\Delta(s'))).W(\emptyset). \quad (12)$$

where $W(\emptyset)$ denotes welfare in the absence of any intervention (the status quo welfare level).

We will denote by $s^{w'}$ the solution to that problem - the *second best* policy that the

Private vs. Public Regulation: Political Economy of the International Environment

WEO will choose to *try* to implement under political constraint. An interior solution to the problem will be implicitly described by $\partial E(W|\emptyset)/\partial s = 0$ or¹¹

$$\rho \cdot \frac{\partial W(s^{w'}|man)}{\partial s} - \rho' \cdot \frac{\partial \Pi(s^{w'}|man)}{\partial s} \left(W(s^{w'}|man) - W(\emptyset) \right) = 0 \quad (13)$$

In the absence of political considerations, recall, the WEO would choose a standard such as to make $\partial W(s^w|man)/\partial s = 0$, so the second composite term in (13) captures the distortion due to the potential for producer opposition. Rearranging, we can see that under political constraint,

$$\frac{\partial W(s^{w'}|man)}{\partial s} = \underbrace{\frac{\rho'}{\rho}}_{<0} \cdot \frac{\partial \Pi(s^{w'}|man)}{\partial s} \cdot \underbrace{\left(W(s^{w'}|man) - W(\emptyset) \right)}_{>0} \leq 0 \quad (14)$$

The direction in which the political considerations distort the WEO's choice of (proposed) standard is determined by the sign of the second term on the right side of (14). Combined with concavity of the WEO's problem this implies:

$$\frac{\partial \Pi(s^{w'}|man)}{\partial s} < 0 \implies s^{w'} < s^w \quad (15)$$

¹¹Space constraints preclude characterization of the attendant corner solutions.

The two candidate corners are those in which the WEO sets $s^w = 0$ or sets s^w at an arbitrarily high level. The first corresponds to not regulating (setting a criteria that all firms can satisfy at zero cost), the latter to trying to close down the industry (setting a standard that no firm will choose to meet). Given our assumptions on $p(0)$ and Z we note that the latter corner necessarily yields higher welfare than the former, so we can discount $s^w = 0$ as a solution to the WEO's problem here.

We focus on contexts in which the solution to the WEO's problem is an interior one - in which it would wish to set a criterion that, if implemented, atleast 1 firm would choose to satisfy.

Private vs. Public Regulation: Political Economy of the International Environment

and *vice versa*. If aggregate profits under mandatory regulation are locally *decreasing* in the stringency of that regulation then the proposed minimum standard will be set below the socially optimal level. If, on the other hand, these are locally increasing political realities will lead to the proposed standard being revised upward. We can establish the following (proof in Appendix):

Proposition 2 *The threat of industry resistance leads the WEO to decrease its standard so as to raise the likelihood of implementation. In doing so the level of expected social welfare falls from its no resistance level.*

Although it is apparent that producers as a whole benefit from the distortion in the WEO's choice of standard we can also observe the distribution of benefits across the sector. For marginal changes in s , evaluated in the vicinity of equilibrium we can write,

$$\frac{\partial \Pi(s^{w'} | man)}{\partial s} = \int_0^{\theta''} [p'(s^{w'}) - \theta'] f(\theta) d\theta \quad (16)$$

Since we know that $s^{w'} < s^{w*}$ and $\Pi(s^{w'} | man) > \Pi(s^{w*} | man)$ it follows that

$$\begin{aligned} & \int_0^{\theta''(s^{w*})} [(p(s^{w'}) - p(s^{w*})) - \theta(s^{w'} - s^{w*})] f(\theta) d\theta \\ & + \int_{\theta''(s^{w*})}^{\theta''(s^{w'})} [p(s^{w'}) - \theta s^{w'}] f(\theta) d\theta \end{aligned} \quad (17)$$

is positive. We can see that the second term in (17) is unambiguously positive. Thus, the distortion of the standard works to the benefit of moderately efficient firms. The sign of the first term is ambiguous, and depends on the shape of the willingness-to-pay function. While

Private vs. Public Regulation: Political Economy of the International Environment

the green premium will be lower at a lower standard, firms save money in compliance. Thus if the green premium is sufficiently unresponsive highly efficient firms might also benefit from a lower standard.

In the previous section we derived conditions under which a standard imposed by the WEO would lead to a higher level of welfare than would a labelling scheme operated by an NGO. The WEO scheme was preferable because it induced both more adoptions and more exits. Proposition 2 dictates that we qualify this support. In face of political opposition the WEO will wish to weaken the standard. The weakening diminishes social welfare, and it is possible that if opposition is sufficiently high (or the level of resistance sufficiently responsive) the standard proposed by the WEO might lead to a lower level of social welfare than might arise from a voluntary NGO scheme.

WEO behavior in the face of an NGO labelling alternative

To this point we have analyzed the impact of political opposition when industry or national governments face no alternative to the standard proposed by the WEO. We now study how the WEO's choice of standard is affected by the possibility of a voluntary NGO supported standard. Assume, initially, that the WEO and NGO programs are mutually exclusive. There is no reason in general - in the absence of regulatory constraint, of the sort proposed in the context of genetically-modified (GM) foods - for the two schemes not to be able to run in parallel, and we drop the assumption of mutual exclusivity in Sections 4 and 5. It is worth noting, however, that we have not explicitly modelled the costs associated with setting up and operating these schemes. For both schemes there will be (fixed and variable)

Private vs. Public Regulation: Political Economy of the International Environment

certification costs as well as (largely fixed) costs associated with publicity. The existence of such costs raises the plausibility of the assumption of mutual exclusivity.

In this case industry resistance to any proposed WEO rule s' can be represented:

$$\Delta(s') = \Pi(s^{n*}|vol) - \Pi(s'|man) \quad (18)$$

It is useful to compare (18) with (10), where the first term on the right-hand side represents $\Pi(\emptyset)$, status quo industry profits. Although we have shown above that there must be a positive level of resistance under the assumption that the WEO and NGO standards are equal, this condition of equality will not hold in general.

Again, in principle there is nothing to stop Δ being negative. If $\Pi(s^{n*}|vol) < \Pi(s^{w*}|man)$ then the political constraint is non-binding. More interesting, though, are those (perhaps more plausible) cases in which the voluntary regime that the NGO would run if it got the chance is preferred by producers *in aggregate* to the WEO's preferred mandatory rule. Because the NGO scheme is voluntary it must be the case that

$$\Pi(s^{n*}|vol) \geq \Pi(\emptyset) = \int_0^\infty p(\theta)f(\theta)d\theta \quad (19)$$

That is, industry in aggregate can do no worse under the NGO scheme than it would under no scheme. If the NGO scheme is such that at least one firm participates then the expression holds with strict inequality. It is straight-forward to confirm that for any $f(\cdot)$ the NGO will indeed set s^n to ensure at least one firm participates (we can rule out a corner solution to the NGO's problem). This observation leads directly to the following proposition.

Private vs. Public Regulation: Political Economy of the International Environment

Proposition 3 *For any WEO-proposed policy the level of industry resistance to the standard is (weakly) greater when there exists an NGO than when there does not.*

The gains to producers from defeating any particular WEO proposal are higher when the NGO exists than when it does not, because the ‘fall-back’ position no longer implies aggregate profits $\Pi(\emptyset)$ but the higher level of profits $\Pi(s^n|vol)$. The stakes, from the point of view of producers, are raised, and that generates extra willingness to resist.

Thus, in proposing a standard the WEO, faced with the possibility of an alternative NGO voluntary standard will propose a policy s' to maximize

$$E(W|vol) = \rho(\Delta(s'|vol)).W(s'|man) + (1 - \rho(\Delta(s'|vol))).W(s^{n*}|vol). \quad (20)$$

We will denote by $s^{w'vol}$ the solution to (20). Again we can investigate the second best solution to the WEO’s problem here. An interior solution will be implicitly defined by $\partial E(W|vol)/\partial s = 0$ or¹²

$$\rho \cdot \frac{\partial W(s^{w'vol}|man)}{\partial s} - \rho' \cdot \frac{\partial \Pi(s^{w'vol}|man)}{\partial s} \left(W(s^{w'vol}|man) - W(s^{n*}|vol) \right) = 0 \quad (21)$$

The second composite term in (38) again captures distortion. Rearranging, we can see that under political constraint,

¹²We again omit characterization of the associated corner outcomes, focussing on contexts in which the solution to the WEO’s problem is an interior one - in which it would wish to set a criterion that, if implemented, at least 1 firm would choose to satisfy. We note them as possibilities, however (refer back to footnote (11)).

Private vs. Public Regulation: Political Economy of the International Environment

$$\frac{\partial W(s^{w'_{vol}}|man)}{\partial s} = \underbrace{\frac{\rho'}{\rho}}_{<0} \cdot \frac{\partial \Pi(s^{w'_{vol}}|man)}{\partial s} \cdot \underbrace{\left(W(s^{w'_{vol}}|man) - W(s^{n^*}|vol) \right)}_{>0} \leq 0 \quad (22)$$

Again we see that the direction of the distortion is dictated by the impact on aggregate industry profits. By arguments similar to those used in establishing Proposition 2 we see that the WEO will lower its choice of standard in order to raise the likelihood of its passage, resulting again in lower welfare than would be achieved in the absence of political opposition. The more interesting question to ask, however, is what impact does the (potential) existence of the NGO's program have on social welfare. As the following proposition points out the impact is ambiguous (proof in Appendix):

Proposition 4 *In the face of industry resistance, the existence of an NGO labeling scheme as an alternative to the WEO standard may increase or decrease the proposed standard, and has an ambiguous effect on expected social welfare.*

Absent political resistance, we have shown that the WEO's optimal standard leads to a level of social welfare that is strictly greater than that under an NGO standard, given the NGO's preferred choice of labeling criterion. In this section, however, we have shown that political resistance will cause the WEO to lower its standard and in so doing lower social welfare (relative to the no resistance case).

The introduction of the NGO scheme as a potential alternative, in a setting of political resistance, has an ambiguous affect on both the level of the standard and the resulting level of social welfare. While the NGO scheme will raise the level of resistance facing any *given* WEO proposal, the fact that the NGO's scheme has a positive impact on welfare means

Private vs. Public Regulation: Political Economy of the International Environment

that the WEO obtains less expected benefit from lowering its standard. The existence of the NGO as a ‘back-stop’ - because recall that $W(s^{n*}|vol) > W(\emptyset)$ - also has the effect of allowing the WEO to be ‘bolder’ in its proposals, making proposals closer to the solution to its problem absent constraint.

4 The WEO and NGO in Parallel: Coexistence

In Section 3 we have treated the NGO as a potential *alternative* to the WEO. This has been formalized in the modelling by assuming that the NGO would only step into the breach in the event that the WEO - by choice or because of resistance from producers - failed to implement a mandatory regulatory standard.

It may well, however, be more realistic to think of the possibility of the two coexisting. The WEO setting - or seeking to set - a mandatory minimum standard, the NGO operating a voluntary labelling scheme. This is what we consider here. The behavior of each will, naturally, be inter-dependent. The analysis also allows us to shed light on the question of whether the WEO should be given monopoly in the domain, or whether NGO’s should be allowed to operate in parallel.¹³

In setting up the game between WEO and NGO it is natural to think of the former moving first, the NGO following. This is the sequence of moves that we adopt for the purposes of modelling the rest of the paper. We believe this to be the most natural (perhaps the only natural) timing of moves for this game. While it may be the case that some

¹³There has been discussion of these sorts of issues in the context of the private labeling of genetically modified (GM) foods. If the WTO, for example, chooses not to apply GM labels or ban trade in GM products, should individual firms or national governments be allowed to apply labels of their own? United States interests have claimed not.

Private vs. Public Regulation: Political Economy of the International Environment

NGO schemes may predate development of a WEO, the modelling issue here relates more to the adjustability of standards set by the two bodies. The WEO set rules are likely to be subject to complex perhaps lengthy processes of political ratification and may even emerge as embodied in case law and precedent. As such these rules, once set, are likely to be very difficult to change quickly, if at all. The NGO labelling criteria, on the other hand, are likely to be things that can be change comparatively quickly and straight-forwardly. The NGO is a private agent and whilst it may not want to chop and change too much (because it needs to establish reputation, or for other reasons) there is likely to be little restriction on it changing how it chooses to set the hurdle for acquisition or retention of a label.¹⁴

With a slight adjustment of the notation used earlier we can represent aggregate industry profits, environmental damage, and welfare as $\Pi(s^w, s^n)$, $D(s^w, s^n)$ and $W(s^w, s^n)$ respectively. The NGO-only and WEO-only outcomes characterized above are then the special cases associated with $s^w = 0$ and $s^n = 0$ respectively.

4.1 No Political Constraints

In the event that a WEO-set mandatory standard and an NGO-set voluntary standard co-exist it must trivially be the case that $s^n > s^w$. Defining $\theta'(s^w, s^n) = [p(s^n) - p(s^w)]/s^n$ and $\theta''(s^w) = p'(s^w)/s^w$, firms can be considered in three classes. If $\theta_i \leq \theta'$ the firm will both comply with the WEO standard and engage in the additional enhancement needed to secure

¹⁴Even in a model involving simultaneous announcements of standards it would make sense to allow the NGO to “adjust” *ex post* at low cost. This would amount to the same thing as appointing it follower. NGO’s are unlikely to have access to perfect commitment mechanisms, even if they wished to use them, whilst WEO decisions are likely to have a “putty-clay” flavour by virtue of the institutional/political environment in which the WEO has to operate.

Private vs. Public Regulation: Political Economy of the International Environment

the NGO's label. If $\theta' \leq \theta_i \leq \theta''$ the firm will comply with the WEO standard (which it must do to be allowed to trade) but not label. If $\theta_i > \theta''$ the firm will exit. Everything on the "supermarket shelf" will be understood to embody the WEO's minimum standards. The NGO's label will find itself attached to a sub-set of products with "premium" environmental characteristics.

We can observe that the interval of firms choosing to sign-up for any voluntary labelling scheme is decreasing in both s^n and s^w . Though space precludes a full characterization of the game between NGO and WEO, we can sketch its elements. The NGO moves second, taking s^w as given, and chooses the criterion to set for award of a label. It is straight-forward to establish that $dD(s^w, s^n)/ds^n$ is necessarily negative such that the NGO will always wish to run a labelling program (we can rule out the corner solution) and s^n will then be chosen to minimize

$$dD(s^w, s^n)/ds^n = \int_0^{\theta'(s^w, s^n)} (Z - s^n).f(\theta).d\theta + \int_{\theta'(s^w, s^n)}^{\theta''(s^w)} (Z - s^w).f(\theta)d\theta. \quad (23)$$

Optimization of (23) implicitly defines the NGO's reaction function, that is s^n as a function of s^w , $\gamma(s^w)$. After some algebra one can show that the NGO's choice of s^n may be increasing or decreasing in the mandatory minimum standard set by the WEO. It will be positive (negative) when the threshold for participation in the labelling scheme is comparatively sensitive to changes in the former (latter).

The dependence of s^n upon s^w gives the WEO the opportunity to influence the characteristics of the labelling scheme set-up by the NGO. The WEO's problem, then, is to choose

Private vs. Public Regulation: Political Economy of the International Environment

s^w - anticipating what the NGO will do in following - to maximize $W(s^w, \gamma(s^w))$. It can be shown that the endogeneity of the NGO's decision-making will cause the WEO to weaken its standard if the indirect impact of a such weakening - via induced changes in s^n - increases welfare. This can happen either if (a) γ' is negative and the NGO tends to set s^n lower than is socially optimal or (b) if γ' is positive but the NGO tends to set s^n to high. Otherwise the WEO will respond to the endogeneity of the characteristics of the labelling scheme by toughening the standard it itself sets.

Despite the ambiguities inherent in the interaction between the WEO and the NGO, however, it is comparatively straight-forward to establish the following (proof in Appendix):

Proposition 5 *Absent political pressure from producers the existence of the NGO raises welfare.*

5 Political Resistance in the Co-Existence Case

We can conduct the same sort of exercise in the co-existence case as we did when the WEO and NGO were considered on an either/or basis.

In the earlier analysis the WEO, anticipating the threat of producer opposition, was in effect proposing a standard s^w to maximize

$$\rho(\Delta(s^w)).W(s^w, 0) + (1 - \rho(\Delta(s^w))).W(0, s^n). \quad (24)$$

If implementation was successful the WEO's proposed rule would pass into law and usage and the NGO would be excluded.

Private vs. Public Regulation: Political Economy of the International Environment

The WEO's problem is now somewhat different - as is the opposition that any particular proposal will dominate. If it is successful in implementing its proposed mandatory standard it anticipates that the NGO may choose to establish and operate a voluntary labelling scheme. If it is unsuccessful the outcome is the same as before - the NGO runs a labelling scheme in isolation. In this circumstance the WEO, then, will propose a standard to maximize:

$$\rho(\Delta).W(s^w, \gamma(s^w)) + (1 - \rho(\Delta)).W(0, \gamma(0)) \quad (25)$$

where industry resistance will be

$$\Delta = \Pi(0, \gamma(0)) - \Pi(s^w, \gamma(s^w)). \quad (26)$$

In light of earlier results, and noting that $\Pi(s^w, \gamma(s^w)) > \Pi(s^w, 0)$ we can observe that:

Lemma 6 *Producer opposition to any given WEO proposal will be less when the NGO exists, and less when the WEO and NGO can co-exist than in the 'either/or' case.*

How will the WEO distort its decision making in these circumstances? The first-order condition characterizing the solution to the WEO's problem can be written:

$$\frac{\partial W}{\partial s^w} + \frac{\partial W}{\partial s^n} \cdot \gamma' = \underbrace{-\frac{\rho'}{\rho}}_{>0} \cdot \underbrace{(W(s^w, \gamma(s^w)) - W(0, \gamma(0)))}_{>0} \cdot \left(\frac{\partial \Delta}{\partial s^w} + \frac{\partial \Delta}{\partial s^n} \cdot \gamma' \right). \quad (27)$$

In the absence of political considerations $\rho = 1$ and $\rho' = 0$, any WEO proposal is implemented without hurdle. In that case, recall, the WEO sets the welfare-maximizing

Private vs. Public Regulation: Political Economy of the International Environment

standard - taking account of the fact that the NGO as follower will supplement it with a voluntary scheme of its own - to equate the full marginal impact of a change in s^w upon welfare *given* implementation and taking account of induced changes in the design of the NGO's voluntary offering, equal to zero. Under political constraint the distortion will depend upon the sign of the final term on the right-hand side of (27), which is the full (direct plus indirect) marginal impact of changes in s^w upon aggregate producer surplus. Again, and in the same spirit as earlier results, the political realities will lead the WEO to bias its proposals in favor of producers.

We can, though, proceed to the following (proof in Appendix):

Proposition 7 *In the face of political resistance, where a voluntary and mandatory scheme may co-exist, the existence of an NGO raises expected social welfare.*

The existence of the NGO, with the scope to run a co-existent label, has three effects, each of which is welfare-improving. It (a) raises welfare in the event that the WEO's proposal is implemented and, (b), in the event that it is not. It also, (c), increases the probability of implementation, which further raises expected welfare.

This result contrasts with the earlier proposition which pointed to the ambiguity of the welfare impact of the NGO in the 'either/or' setting. It says that in a world in which political pressures upon the WEO are a reality, the WEO will be more effective in pursuing its own aims - global welfare maximization - when the private labeling is not presented as an alternative but as a complementary mechanism. Under political constraint private regulation will complement public.

6 Conclusions

We have taken some significant steps towards understanding the interplay between public (mandatory) and private (voluntary) regulatory schemes in the context of environmental protection. A feature of the analysis has been the explicit characterization of the interplay between the alternatives, both directly (where co-existence was admitted) and through politico-economic channels.

Section 2 presented a straight-forward comparison of outcomes under the alternative regimes, leading to an ambiguous welfare ranking. Section 3 showed how the existence of an NGO ‘competitor’ would harden producer resistance to WEO proposals, lead the WEO to reduce the stringency of its proposals below their socially preferred levels, and could reduce expected welfare. The ‘either/or’ approach of Sections 2 and 3 was in the spirit of the traditional instrument choice literature (taxes *vs.* standards, etc).

In Sections 4 and 5 we revisited the analysis under the assumption that NGO and WEO activities could coexist. With or without producer resistance it was established that the existence of the NGO raises expected welfare.

7 Bibliography

Baron, David. 2001. “Private Politics” *Research Paper No. 1689*, Graduate School of Business, Stanford University.

Biermann, Frank, 2000. “The Case for a World Environmental Organization”. *Environment* 42(9): 22-31.

Private vs. Public Regulation: Political Economy of the International Environment

Droege, Susanne 2001. "Ecological Labeling and the WTO", *Aussenwirtschaft* 56(1): 99-122.

Esty, Daniel C. and Maria H. Ivanova, 2001. "Making International Environmental Efforts Work: The Case for a Global Environmental Organization". Working paper 2/01, Yale Center for Environmental Law and Policy.

Fedderson, Timothy J. and Thomas W. Gilligan, 2001. "Saints and Markets: Activists and the Supply of Credence Goods". *Journal of Economics and Management Strategy*, 10(1): 149-171.

Grossman, Gene M. and E. Helpmann, 1994. "Protection for Sale" *American Economic Review* 84: 833-50.

Heyes, Anthony G. 1997. "Environmental Regulation by Private Contest" *Journal of Public Economics* 63: 407-428.

Juma, Calumus. 2000. "Stunting Green Progress", *Financial Times*, July 6

Lewis, Tracey R. 1996. "Protecting the Environment when Costs and Benefits are Privately Known" *RAND Journal of Economics* 27(4): 819-47.

Lyon, Thomas P. and John W. Maxwell, 2002. "Self-Regulation, Taxation and Public Voluntary Environmental Agreements" *Journal of Public Economics*.

Mason, Charles F. 2001. "The Economics of Eco-Labeling", *Discussion Paper*, Department of Economics & Finance, University of Wyoming.

Neumayer, Eric. 2000. "Trade and the Environment: A Critical Assessment and Some Suggestions for Reconciliation" *Journal of Environment and Development* 9(2): 138-59.

Private vs. Public Regulation: Political Economy of the International Environment

Rao, P. K. 2000. *The WTO and the Environment*. MacMillan Press: London.

Whalley, John and Ben Zissimos, 2001. “An Internalization Based World Environmental Organization”, University of Warwick Discussion Paper, June 2001.

Weinstein, Michael W. and S. Charnovitz, 2001. “The Greening of the WTO”, *Foreign Affairs* 80(6): 147-157.

Rege, Mari. 2000. “Strategic Policy and Environmental Quality: Helping the Domestic Industry to Provide Credible Information”, *Environmental & Resource Economics*, 15(3): 279-96.

8 Appendix

Proof. (Proposition 1). Let s^{n*} denote the solution to the problem in (2), that is the optimal standard of the NGO. Recalling our assumption that unregulated production is socially undesirable, $p(0) < Z$, we see that

$$\begin{aligned} W(s^w = s^{n*}|man) - W(s^{n*}|vol) &= \int_{\theta'}^{\theta''} \left[\begin{array}{c} \{p(s^{n*}) - \theta s^{n*} - (Z - s^{n*})\} \\ -\{p(0) - Z\} \end{array} \right] f(\theta) d\theta \\ &\quad - \int_{\theta''}^{\infty} [p(0) - Z] f(\theta) d\theta, \end{aligned} \tag{28}$$

which is positive under the assumption stated in the proposition. Thus, $W(s^w = s^{n*}|man) > W(s^{n*}|vol)$. But it is true by definition that $W(s^{w*}|man) - W(s^w = s^{n*}|man)$, where s^{w*} denotes the socially optimal choice of the standard under the mandatory regime. These relations together imply that $W(s^{w*}|man) > W(s^{n*}|vol)$. ■

Private vs. Public Regulation: Political Economy of the International Environment

Proof. (Proposition 2). The results of (13) and (14) indicated that political resistance causes a distortion away from the social welfare optimum that would be chosen absent political resistance. It follows from (14) that the purpose of the distortion is to raise profits under the standard, and hence lower political resistance to it. Thus it must be true that $\Pi(s^{w'}|man) > \Pi(s^{w*}|man)$. Note, however, that if $s^{w'} > s^{w*}$ environmental damage would be lower at $s^{w'}$. This would mean that $W(s^{w'}|man) > W(s^{w*}|man)$ but this is false by the definition of s^{w*} . Thus it must be the case that the distortion caused by political resistance is to lower the standard. This in turn raises profits but also raises environmental damage and ultimately lowers social welfare from the level that would be achieved absent political resistance. ■

Proof. (Proposition 4). We see from (22) that the distortion under an NGO alternative is of the same form as when no alternative exists (14). The extent of the distortion is affected by the level of industry resistance and the level of welfare in the event the WEO standard fails to pass. As we have shown, industry resistance is higher when an NGO alternative exists. This will have the effect of increasing the extent of the downward distortion in the WEO standard. The second effect, however, works as a counter balance. Observe the final brackets in (22) and (14). Since we know that welfare is higher under an NGO scheme than under no scheme, it follows that bracketed term in (22) is smaller than its counterpart in (14), which has the effect of reducing the distortion in the WEO's proposal. In effect the marginal benefit to reducing the standard from s^{w*} is lower when the possibility of the NGO scheme exists. This causes the WEO to be more bold in its proposal. The ambiguity

Private vs. Public Regulation: Political Economy of the International Environment

regarding the impact on welfare is not dependent simply on ambiguity in the level of the proposed standard, but also because the welfare function $W(s|man)$ need not be monotone in s . ■

Proof. (Proposition 5). Let $s^{w\sim}$ be the value of s^w that maximizes $W(s^w, 0)$. It must be the case that $\Pi(s^{w\sim}, \gamma(s^{w\sim})) > \Pi(s^{w\sim}, 0)$ (by implication of voluntary participation) and $D(s^{w\sim}, \gamma(s^{w\sim})) < D(s^{w\sim}, 0)$ (by NGO design) and hence $W(s^{w\sim}, \gamma(s^{w\sim})) > W(s^{w\sim}, 0)$. If the solution to the problem in is something other than $s^{w\sim}$ (as will generically be the case) then the resulting level of welfare can only, by definition, exceed $W(s^{w\sim}, \gamma(s^{w\sim}))$. ■

Proof. (Proposition 7). Let $s^{w\#}$ be the value of s^w that maximizes

$$\rho(\Delta(s^w, 0)).W(s^w, 0) + (1 - \rho(\Delta(s^w, 0))).W(0, 0) \quad (29)$$

Then note that $W(s^{w\#}, 0)$ must exceed $W(0, 0)$ by definition. We also know that (a) $W(s^{w\#}, \gamma(s^{w\#})) > W(s^{w\#}, 0)$, (b) $W(0, \gamma(0)) > W(0, 0)$. Together with the first part of Lemma 6 these imply that if the WEO proposes $s^{w\#}$ expected welfare is greater when there exists an NGO than when there does not. If the solution to the problem in (25) is something other than $s^{w\#}$ (as will generally be the case) then the resulting level of welfare can only, by definition, be higher still. ■