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Pollution Policy: the Role for Publicly Provided Information[1]

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This paper identifies a market failure in the provision of information about polluting consumer products and argues that there is a role for public information provision if no other policy instruments are available. The market failure arises because the individual consumer does not take full account of the benefit she bestows on other consumers if acquired information leads her to reduce her consumption of the polluting product. If a corrective tax is available then the role for public information provision is reduced to one of ensuring that the corrective tax is informationally consistent with the equilibrium it induces. © 1994 Academic Press, Inc.

I. INTRODUCTION

This paper examines the role for government in providing public information about polluting consumer products. The notion that such a role exists appears to be gaining support among some policymakers and their advisors. For example, in their recommendations to the government of the United Kingdom, Pearce *et al.* [4] argue that

> For green consumerism to be effective consumers must be informed about the pollution profile of the products they buy. Government has a role, with other agencies, in extending the amount and quality of this information. (p. 155)

A number of environmental agencies have already embraced this idea. For example, the Canadian Ministry of the Environment has recently stated that

> Environmental information must be readily accessible to all Canadians. The Government is considering a number of options to meet this need, including a national environmental library. [1]

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Canada has also recently introduced a government-sponsored labeling scheme to enable consumers to identify "ecologically friendly" products.[2] Similarly, the United States Environmental Protection Agency (EPA) has argued for some time that information provision should be included among its operations:

> EPA's job should grow from primarily the "enforcer" to include greater emphasis on helping citizens make informed choices in their daily lives. [7]

The EPA's mandate has recently been expanded in this direction. The National Environmental Education Act (activated on October 1, 1991) has authorized expenditures of $65 million over the next 5 years for environmental education; this is to be administered by EPA.[3]

Despite this widespread acceptance of a role for government in providing environmental information (accompanied by a growing commitment of resources to the task), the normative foundations for government intervention have not been formally studied. In particular, the question of whether and under what circumstances environmental information should be publicly provided has not been adequately addressed. The purpose of this paper is to fill that gap. We attempt to provide some guidance to policymakers on the appropriate nature and scope of public information provision. We examine a situation in which the government possesses information on the pollution profile of a consumer product and must decide whether to provide this information publicly or rely on the market to provide it. We identify a market failure in the provision of information and argue that there is a role for government provision under some circumstances. We then examine the scope of that role as a function of what other policy instruments are available.

It is well known that the public nature of information can lead to a free-rider problem in information provision, the resolution of which may require government intervention. However, this problem is not peculiar to environmental information and it is not the issue of interest in this paper. We identify a different market failure that arises because the individual consumer, in deciding whether or not to purchase information about a product's pollution profile, may not take full account of the benefit she bestows on other consumers—in the form of reduced environmental damage—if the information leads her to reduce her consumption of the polluting product. This unpriced external benefit associated with an information purchase can lead the market to under-provide information.

The idea that information provision may have associated positive externalities is not new. For example, the rationale for public support of education is based largely on externality arguments: educating people may lead them to engage in activities that have external benefits. The externality we identify is of a similar nature. Our main contributions are twofold: we characterize this externality in the case of environmental information, and we examine its implications for the role of public information provision in an integrated policy framework.

The paper is organized as follows. Section II presents a simple model of a market with imperfect information about environmental quality. Section III characterizes the optimal information policy when the government has no other policy

[2]Germany has had a similar scheme in place for some time. Its "ecologo" is popularly known as the "Blue Angel."

[3]See US EPA [8] for a report on the expanded mandate.

instruments available to it. Section IV examines the optimal policy when a corrective tax can be imposed on the polluting product. Section V concludes.

II. THE MODEL

There are $m > 1$ consumers each with preferences represented by the utility function

$$u_i = x_i z_i - e, \tag{1}$$

where x_i is the consumption of the polluting good by consumer i, z_i is the consumption of a numeraire non-polluting good, and e is environmental damage.[4] Each consumer has income y and pays a price p for each unit of x. The product x is supplied competitively at a constant marginal cost of production c. Hence, in equilibrium, $p = c$. Environmental damage is linked to the consumption of x in the following way:[5]

$$e = \theta \sum_{i=1}^{m} x_i, \tag{2}$$

where $\sum_{i=1}^{m} x_i$ is the aggregate consumption of x, and θ is an unknown parameter which captures consumer uncertainty about the link between the consumption of x and the associated environmental damage. This uncertainty stems from the difficulty that consumers face in acquiring existing scientific knowledge about environmental pollutants, and relating this knowledge to their everyday consumption choices. All consumers have beliefs over θ represented by a non-degenerative density $f(\theta)$ with support $[0, \theta^+]$ and expected value μ.

Exact information on the value of θ can be provided to a consumer at a cost $r \geq 0$, regardless of whether it is privately or publicly provided. Under market provision, information is sold to a consumer at a price q. The information market is competitive and so $q = r$ in equilibrium. We assume that a consumer who purchases information cannot then sell it or otherwise communicate it to another consumer. We make this assumption so as to abstract from the public nature of information and any associated free-rider problem that arises when exclusion is not possible. This allows us to focus on an issue which is quite distinct from that problem.[6]

[4]Note that this specification of utility does not preclude the possibility of some form of "environmental altruism" on the part of consumers. The environmental damage term can potentially reflect both the direct effect of environmental damage on the individual and any indirect effects stemming from the damage done to other sentient beings.

[5]We have assumed that pollution is generated by the consumption of the commodity, but the model applies equally well to cases where environmental damage stems from production or disposal activities.

[6]Moreover, it is not clear that information is truly public. A consumer will usually have to bear some private cost even to acquire the information from a friend or neighbor.

III. INFORMATION POLICY IN THE ABSENCE OF OTHER INSTRUMENTS

In this section we assess the role for public information provision in instances where no other policy instruments are available to the government.[7] There are two main reasons why other instruments are often not available. The first relates to technical feasibility in the particular situation. For example, consider the emission of nitrous oxides (NO_x) and volatile organic compounds (VOCs) from automobiles. Emission volumes for these pollutants (which are catalytic in the formation of tropospheric ozone) are not closely correlated with fuel consumption and so cannot be easily targeted with a gasoline tax. The most important factors affecting these emissions are engine tuning, and engine temperature profile over the trip (as determined largely by driving style and trip characteristics); but difficulties with monitoring make it virtually impossible to target these aspects of automobile use. In other instances, the use of corrective policy may be constrained for political reasons. For example, a corrective tax on disposable diapers is too much like a tax on babies from a political perspective.

In instances where corrective policy is not available, the government may not be able to affect consumption of the polluting product other than through information policy. This means that the consumption distortion associated with the pollution externality will persist even if consumers are perfectly informed.[8] The role for public information provision must therefore be assessed with respect to the uncorrected Nash equilibrium consumption levels.

Welfare-Improving Information Provision in Nash Equilibrium

We will first characterize the informed and uninformed Nash equilibria and then determine when information provision—which induces a shift from the uninformed to the informed equilibrium—will be welfare-improving. Let $\hat{x}(\theta)$ and $\hat{x}(\mu)$ denote the equilibrium consumption of x by an informed consumer and by an uninformed consumer, respectively. Let $\hat{\alpha}$ denote the equilibrium proportion of informed consumers.[9] Then $\hat{x}(\theta)$ and $\hat{x}(\mu)$ are determined by the simultaneous solution to (3) and (4),

$$\hat{x}(\theta) = \underset{x_i}{\operatorname{argmax}} \left[x_i(y - cx_i) - \theta\left[x_i + E\hat{x}_{-i}\right]\right] \tag{3}$$

$$\hat{x}(\mu) = \underset{x_i}{\operatorname{argmax}} \int_0^{\theta^+} \left[x_i(y - cx_i) - \theta\left[x_i + E\hat{x}_{-i}\right]\right] f(\theta)\, d\theta, \tag{4}$$

[7]Intervention in the provision of information could take the form of subsidized private provision or pure public provision. If the government and the market have access to the same provision technology, then from an efficiency viewpoint there is no difference between the two schemes. For this reason we confine consideration to public provision.

[8]Note that it may be possible for the government to effectively correct the consumption externality by deliberately providing false and exaggerated information about the product's environmental impact. However, legal constraints are likely to prevent the government from using such a policy. We therefore restrict attention to the provision of truthful information.

[9]We later allow for the possibility of mixed strategies in private information purchase and so it is useful to adopt a congruent formulation here even though we are not for the moment concerned with partially informed populations.

where $E\hat{x}_{-i} = \hat{\alpha}(m-1)\hat{x}(\theta) + (1-\hat{\alpha})(m-1)\hat{x}(\mu)$ is the expected consumption of x by consumers other than i. Solving (3) and (4) yields

$$\hat{x}(\theta) = (y-\theta)/2c \tag{5}$$

$$\hat{x}(\mu) = (y-\mu)/2c. \tag{6}$$

Let $\hat{u}(\theta)$ and $\hat{u}(\mu)$ denote utility in the universally informed ($\hat{\alpha}=1$) equilibrium and universally uninformed ($\hat{\alpha}=0$) equilibrium, respectively. Using (5) and (6),

$$\hat{u}(\theta) = \hat{x}(\theta)[y - c\hat{x}(\theta)] - \theta m\hat{x}(\theta) = (y-\theta)[y-(2m-1)\theta]/4c \tag{7}$$

$$\hat{u}(\mu) = \hat{x}(\mu)[y - c\hat{x}(\mu)] - \theta m\hat{x}(\mu) = (y-\mu)[y+\mu-2m\theta]/4c. \tag{8}$$

Information provision (whether private or public) will be welfare-improving if the change in utility from providing the information is larger than the cost of providing it. This implies the following result.

PROPOSITION 1. *Information provision is welfare-improving at the uncorrected Nash equilibrium consumption levels* iff $r \in \mathscr{R}^E$, *where*

$$\mathscr{R}^E = \{r: r \leq (\theta-\mu)[(2m-1)\theta-\mu]/4c\}.$$

Proof. Information provision is welfare-improving if $\hat{u}(\theta) - \hat{u}(\mu) \geq r$. The result then follows from (7) and (8). □

This region is illustrated as the hatched area in Fig. 1, where $\delta(r)$ is the boundary of $\mathscr{R}^E$. Notice that information should not be provided when $\theta \in (\mu/2m-1, \mu)$ even if $r=0$; information has a negative social value over this range of θ. This is due to the uncorrected consumption externality. Informing consumers that $\theta \in (\mu/2m-1, \mu)$ will induce them to *increase* their consumption of x because their current consumption is based on μ. The external cost of this increased consumption more than offsets the welfare gain associated with shifting each consumer to her true private optimum. When $\theta \in (\mu/2m-1, \mu)$, it is better to let a consumer's pessimism about θ lead her to consume at levels closer to the true social optimum. However, if θ is much smaller than μ—such that $\theta < \mu/(2m-1)$—then the welfare cost of withholding information from a consumer, and thereby distorting her choice away from her true private optimum, outweighs the external cost of the increased consumption. In this situation, information has positive social value.

Of course information always has positive social value when $\theta > \mu$, because in this case a consumption level based on μ exceeds both the true private and social optima. Thus, shifting consumers closer to their private optimum will be welfare-enhancing. However, this is worthwhile only if information provision is not too costly. The higher the cost of information provision the larger the gap between θ and μ required to make provision worthwhile.

Market Provision of Information and the Role for Government

We now turn to the question of whether a competitive market can provide information efficiently or whether there is a need for government provision.

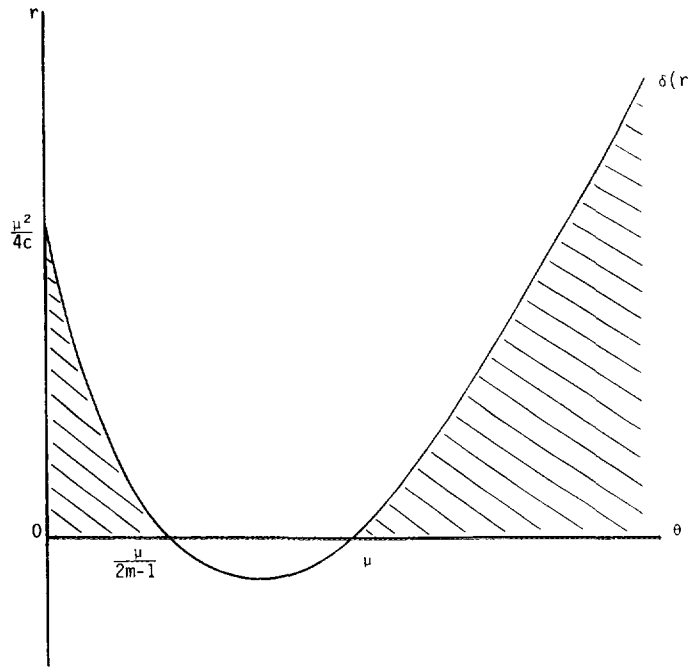

FIG. 1. Welfare-improving information provision.

Consider a situation where government makes information on θ freely available to firms for provision to the public at a price q. Competition in provision will ensure that $q = r$. Each consumer will assess the ex ante expected benefit to becoming informed (based on the uncorrected Nash equilibrium consumption levels) and decide whether or not to purchase information accordingly. Using (5) and (6), we can compute the ex ante expected utility for an informed consumer and an uninformed consumer, denoted $Eu(\theta)$ and $Eu(\mu)$, respectively:

$$Eu(\mu) = \int_0^{\theta^+} [\hat{x}(\mu)[y - c\hat{x}(\mu)] - \theta[\hat{x}(\mu) + E\hat{x}_{-i}]] f(\theta)\, d\theta$$
$$= [(y - \mu)^2/4c] - (m - 1)[(y - \mu)\mu - \alpha(E\theta^2 - \mu^2)]/2c \qquad (9)$$

$$Eu(\theta) = \int_0^{\theta^+} [\hat{x}(\theta)[y - c\hat{x}(\theta)] - \theta[\hat{x}(\theta) + E\hat{x}_{-i}]] f(\theta)\, d\theta$$
$$= E[(y - \theta)^2/4c] - (m - 1)[(y - \mu)\mu - \alpha(E\theta^2 - \mu^2)]/2c. \qquad (10)$$

A consumer will purchase information only if $Eu(\theta) - r \geq Eu(\mu)$. Let α denote the (mixed strategy) probability that information is purchased by a representative consumer. Then using (9) and (10),

$$\alpha = \begin{cases} 0 & \text{if } r > (E\theta^2 - \mu^2)/4c \\ \in (0,1) & \text{if } r = (E\theta^2 - \mu^2)/4c \\ 1 & \text{if } r < (E\theta^2 - \mu^2)/4c, \end{cases} \qquad (11)$$

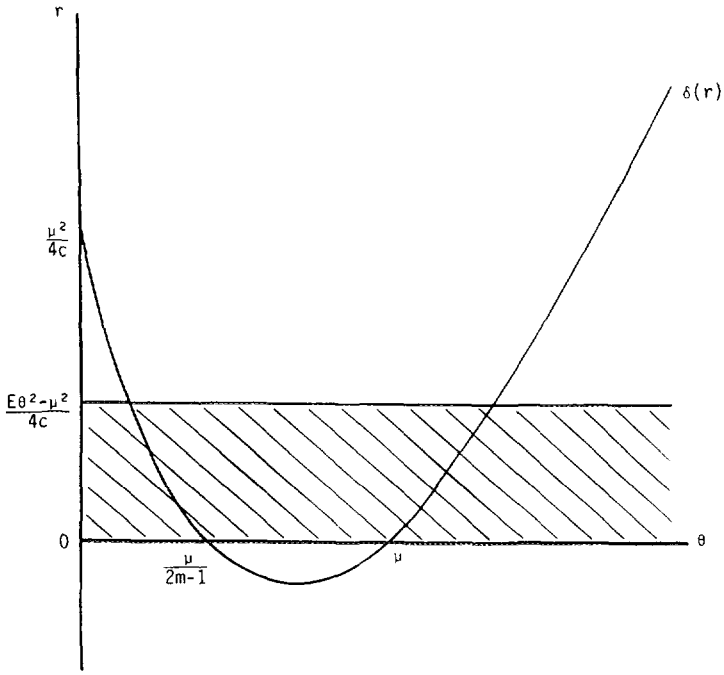

FIG. 2. Market provision of information.

where $(E\theta^2 - \mu^2) > 0$ for all non-degenerative distributions of θ. The market will provide the information if expected profit is non-negative for $\alpha > 0$. Expected profit is $E\Pi = m(\alpha q - r)$, where r is the cost of making information available to a consumer and αq is the expected revenue from that consumer.

PROPOSITION 2. *The market provides information at the uncorrected Nash equilibrium consumption levels* iff $r \in \mathscr{R}^M$, *where*

$$\mathscr{R}^M = \{r: r < (E\theta^2 - \mu^2)/4c\}.$$

Proof. Suppose $r > (E\theta^2 - \mu^2)/4c$. Then $\alpha = 0$. Suppose $r = (E\theta^2 - \mu^2)/4c$. Then $\alpha < 1$ and so $E\Pi < 0$. Finally, suppose $r < (E\theta^2 - \mu^2)/4c$. Then $\alpha = 1$ and $E\Pi \geq 0$. Therefore, information can be profitably provided iff $r < (E\theta^2 - \mu^2)/4c$. □

This region is illustrated as the hatched area in Fig. 2. Comparing Figs. 1 and 2, it is clear that the market provision of information is not necessarily efficient. Figure 3 highlights this market failure in information provision. The region of market failure has been partitioned into separate sub-regions according to the source of the failure. The solid curve is $\delta(r)$ drawn for $m > 1$, as in Fig. 1. The dashed curve is $\delta(r)$ drawn for $m = 1$; its relevance will soon become clear. In regions Ia, Ib, and II the market will fail to provide information when information provision would be welfare-improving. In regions III and IV the market will provide information, but in so doing will actually reduce welfare. Each of these regions will now be discussed in turn.

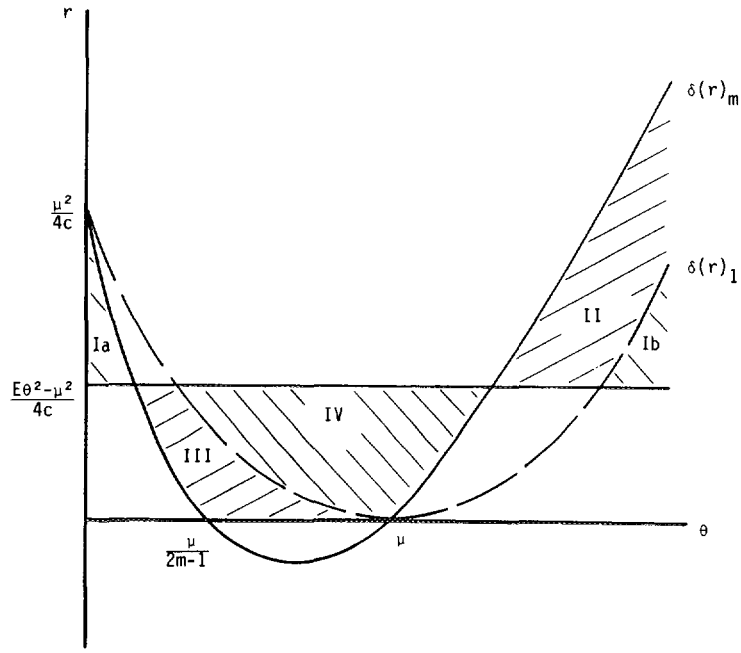

FIG. 3. Market failure in information provision.

The market failure in regions II and III is directly attributable to the uncorrected consumption externality. Note from Fig. 3 that these regions would vanish in the single consumer case since $\delta(r)_m$ and $\delta(r)_1$ would coincide; in the single consumer case, there is no consumption externality. But when $m > 1$, the consumption externality between consumers creates a failure in the information market. To see this, first consider region II. The market failure here arises because the individual consumer in deciding whether or not to purchase information, does not take full account of the external benefit that she will bestow on other consumers if the information leads her to reduce her consumption of the polluting product. Thus, region II represents the failure of the market to internalize an external benefit associated with information provision. There is an associated underprovision of information in this region. Conversely, region III represents the failure of the market to internalize an associated external cost. The individual consumer does not take full account of the external cost that she will impose on other consumers if she increases her consumption as a result of becoming informed. This leads to an overprovision of information in this region. Note that regions II and III both become larger as m increases, reflecting the underlying spillover effect.

Now consider regions I and IV. The market failure in these regions is independent of the consumption externality. (Note that these regions are bounded by the $\delta(r)_1$ curve). The market failure here arises because consumers make their decisions based only on the ex ante expected value of the information, not on the true value of the information. Consumers overestimate the private value of the information in region IV (where θ is actually relatively close to μ) and underestimate its

private value in regions Ia and Ib (where θ is actually very different from μ). This is a familiar market failure in the face asymmetric information about a product's value; it has nothing to do with the environmental aspect of the problem *per se*. Consumers purchase a commodity (the information on θ) whose value is observed only after trade has occurred, and as a result, the trading outcome need not be efficient.

The failure of the market to provide information efficiently suggests a role for government intervention.[10] The market failure represented by regions III and IV means that the market will sometimes provide information when it should not. One possible response to this problem is for the government to withhold the information from firms so that it cannot be provided to consumers. However, censorship of this type may be prohibited under access to information legislation. In such cases there may be little the government can do to correct the market failure.[11] Of more interest for our purposes is the under-provision of information reflected in regions I and II. Welfare can be improved in these cases through public information provision. This suggests the following policy prescription.[12]

PROPOSITION 3. *When no other policy instruments are available, information should be publicly provided* iff $r \notin \mathscr{R}^M$ *and* $r \in \mathscr{R}^E$.

This result offers some support for the government-sponsored information provision activities discussed in the introduction. If the government is unable or unwilling to use corrective policy to deal with a pollution externality then there will be some role for public information provision, in the circumstances indicated by regions I and II. Information provision in region Ia will lead to an increase in consumption because consumers are informed that the product is less harmful than they believed it to be. In contrast, information provision in regions Ib and II will lead to reduced consumption. Note, however, that information provision alone leaves the underlying pollution externality uncorrected and so cannot induce the socially optimal level of consumption. The provision of information will shift consumption from $\hat{x}(\mu) = (y - \mu)/2c$ to $\hat{x}(\theta) = (y - \theta)/2c$. In comparison, the social optimum is $x(\theta)^* = (y - m\theta)/2c$. For large values of m, $\hat{x}(\theta)$ and $x(\theta)^*$ will differ markedly. This does not mean that information provision is pointless when m is large. On the contrary, the value of public information provision in

[10]We assume that any public information provision is financed through lump-sum taxes. There will be a reduced role for public provision if distortionary taxes are required to finance the policy.

[11]The justification for censorship in matters of national security is based on an externality argument. The same argument can in principle be applied to the market failure represented by region III. However, region IV is more problematic. The market failure here is due not to an externality but to the government's information advantage over consumers. Censorship on these grounds may be more difficult to justify. We do not pursue the issue here.

[12]We assume that consumers cannot observe r unless information is privately provided (in which case r is revealed as the price of information). Otherwise consumers could potentially draw inferences about θ from the *absence* of public provision and this will imply an optimal policy slightly different from the one in Proposition 3. In particular, if r is observable and if the government follows the policy in Proposition 3 and does not provide information, then consumers can in principle infer that $\theta \in \{\theta: r \notin \mathscr{R}^E\}$. This will lead consumers to revise their beliefs about θ and choose a consumption level (in the uninformed equilibrium) higher than $\hat{x}(\mu)$. This will in turn reduce social surplus in the uninformed equilibrium, and for a given $\mathscr{R}^M$, expand the range of θ over which public information provision is optimal.

region II is increasing in m because of the positive spillover effect.[13] Nonetheless, information provision alone cannot effectively substitute for appropriate corrective policy. But is the converse true? Does there remain a role for public information provision if corrective policy is available? The next section examines this question.

IV. INFORMATION POLICY WHEN CORRECTIVE TAXES ARE AVAILABLE

In this section we show that the role for public information provision is sharply reduced if corrective taxes can be imposed on the polluting product. In many circumstances there remains no role at all for public provision in the context of this model.[14] The reason is straightforward. From its informed position, the government can simply impose a corrective tax that is appropriate for the uninformed equilibrium and thereby induce the true social optimum without any need for information provision. However, the policy design problem is complicated by the possibility of private information provision. Under some circumstances, a corrective tax that is tailored for the uninformed equilibrium will enhance the incentives for private provision and thereby induce an informed equilibrium. This will render the chosen tax inappropriate. Thus, the policy design problem must take explicit account of the effect of the corrective tax on the private incentive to purchase information.

To examine this problem we begin by deriving the appropriate corrective taxes.[15] Let t_0 denote the first-best tax for the uniformed equilibrium

$$t_0 = \underset{t}{\operatorname{argmax}}\, \hat{x}(\mu, t)[y - c\hat{x}(\mu, t)] - \theta m\hat{x}(\mu, t), \tag{12}$$

where, from (6), $\hat{x}(\mu, t) = (y - \mu)/2(c + t)$. This solves for

$$t_0 = c(m\theta - \mu)/(y - m\theta). \tag{13}$$

Let t_1 denote the first-best tax for the informed equilibrium

$$t_1 = \underset{t}{\operatorname{argmax}}\, \hat{x}(\theta, t)[y - c\hat{x}(\theta, t)] - \theta m\hat{x}(\theta, t), \tag{14}$$

where, from (5), $\hat{x}(\theta, t) = (y - \theta)/2(c + t)$. This solves for

$$t_1 = c(m - 1)\theta/(y - m\theta). \tag{15}$$

[13]Note that the size of region Ib is by definition independent of m, while region Ia becomes smaller for larger m because of the negative spillover associated with the increase in consumption following information provision.

[14]We later discuss other aspects of the issue not captured by our model.

[15]All tax revenue is returned to consumers in a lump-sum manner. We also assume that tax policy can only be used to correct the consumption externality. If instead the tax on x can be deliberately distorted to alter the private incentive to purchase information, then the design problem is somewhat more complicated. The problem becomes one of trading off the welfare cost of the consumption distortion against the cost saving achieved by preventing the provision of information. However, the results obtained from a consideration of this problem are not qualitatively different from those we present here.

The optimal implementation of the corrective tax requires that it be consistent with the equilibrium (informed or uninformed) that it induces. That is, setting a tax equal to t_0 should induce an uninformed equilibrium, while setting a tax equal to t_1 should induce an informed equilibrium. Any role for public information provision arises from this consistency requirement.

PROPOSITION 4. *If $\theta \geq \mu$ then the first-best taxes are consistent with the equilibria they induce. There is no role for public information provision in this case.*

Proof. To determine whether or not a tax is consistent with the equilibrium induced by it, we must examine the private incentives created by the tax. Suppose the government imposes a tax t. Then Proposition 2 implies that information will be privately provided if $r < (E\theta^2 - \mu^2)/4(c + t)$. Hence, consistency of t_0 requires

$$r \geq (E\theta^2 - \mu^2)/4(c + t_0) \equiv \bar{r}_0 \tag{16}$$

and consistency of t_1 requires

$$r < (E\theta^2 - \mu^2)/4(c + t_1) \equiv \bar{r}_1. \tag{17}$$

If $\theta \geq \mu$ then $t_1 \leq t_0$ and so $\bar{r}_1 \geq \bar{r}_0$. If $r \geq \bar{r}_0$ then the government can set $t = t_0$ and thereby induce the uninformed equilibrium. If $r < \bar{r}_0$ then the government can set $t = t_1$ and thereby induce private provision of information. Thus, at least one of the taxes is consistent for any value of r. There is no role for public provision in either case. □

PROPOSITION 5. *If $\theta < \mu$ then the first-best taxes are consistent with the equilibria they induce only if $r \notin [\bar{r}_1, \bar{r}_0]$. Public information provision is needed to ensure consistency* iff $r \in [\bar{r}_1, \bar{r}_0]$.

Proof. If $\theta < \mu$ then $t_1 > t_0$ and so $\bar{r}_1 < \bar{r}_0$. This means that neither (16) nor (17) can be satisfied if $r \in [\bar{r}_1, \bar{r}_0]$. In this case, setting $t = t_0$ will induce the informed equilibrium and setting $t = t_1$ will induce the uninformed equilibrium. Neither tax will be appropriate *ex post*. Consistency can only be achieved by providing information publicly and setting $t = t_1$. □

The intuition behind Propositions 4 and 5 is straightforward. When $\mu > \theta$, a tax based on μ will be smaller than one based on θ. This means that the incentive for an uninformed consumer to purchase information privately is greater when t_0 is imposed than when t_1 is imposed (since consumption under t_0 will be higher). It is therefore possible that t_0 will induce private information provision while t_1 will not, in which case both taxes will be inconsistent with the equilibria they induce. In such circumstances, the government can only ensure consistency by providing information publicly and choosing t_1.[16] Conversely, when $\theta \geq \mu$, $t_0 \geq t_1$ and so at least one tax will be consistent with the equilibrium it induces. In this case there is no need for public provision to ensure consistency.

[16]The government can always do better than this if censorship is possible since censorship allows the government to ensure that t_0 is consistent for any value of r. The first-best consumption level can then be implemented without any need for public or private information provision.

Note that the role for public information provision when a corrective tax is available is very different to its role when a tax is not available. In the latter case, information provision is useful as an instrument for shifting behavior closer to the first-best, given the absence of alternative policies. In contrast, when a corrective tax is available, the role for public information provision is limited to ensuring that consumers respond to the tax in a manner consistent with its design. Of course, information provision may be valuable as a companion to corrective policy for other reasons not captured by our model. In particular, information provision may be useful in convincing a distrustful and tax-averse public that corrective taxation is necessary. We have not attempted to model these political considerations but we do not mean to dismiss them as being unimportant.

V. CONCLUSION

We do not wish our results to be interpreted as unsupportive of information provision programs. On the contrary, we have identified a market failure in the provision of information about polluting products and we have argued that there is clearly some role for public information provision if no other policy instruments are available. That role is certainly diminished if corrective taxation is available, but even under these circumstances there may be additional political benefits from information provision. However, our results suggest that policymakers should be discriminating in their allocation of scarce information provision resources. In particular, public information provision should be relied upon most heavily in instances where corrective policy is not available. Where corrective taxation can be used, information provision should play only an adjunct role. Moreover, public information provision is not a panacea for pollution problems; information provision alone leaves the underlying consumption externality uncorrected. It may be tempting for governments to implement an information provision program as a visible and politically comfortable alternative to harsher measures, but information provision should not be relied upon as an adequate substitute for appropriate corrective policy.

There are a number of directions in which further research on public information provision could be taken. We have noted that public information provision may be valuable as a way of facilitating the public acceptance of corrective taxes. This aspect of information provision is worthy of closer examination. A proper treatment of this issue would require a model of policy implementation in a world where consumers do not fully trust the government to act in their best interests. This in turn requires a closer examination of the political economy of environmental policy.

A second direction for further research would be to examine more closely the private provision of information. In this paper we have assumed that information is provided privately by competitive profit-maximizing firms. The nature of the information provided is irrelevant to these firms. This is not true of all private providers of information. Many private sources of environmental information are sponsored by environmental groups whose objective is to change consumption behavior rather than to simply inform. Similarly, producers have a vested interest in providing information sympathetic to their products. These private incentives

will tend to bias the private provision of information. This will in turn affect the optimal public information provision policy.

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