UMR INRA-ENESAD
CESAER
Centre d'Economie et Sociologie
appliquées à l'Agriculture et aux Espaces Ruraux

Working Paper

2005/5

Can Information-Based Policies Do More Harm Than Good?

Douadia Bougherara
Gilles Grolleau
Naoufel Mzoughi

INRA-ENESAD
UMR CESAER
Centre d'**E**conomie et **S**ociologie appliquées à l'**A**griculture et aux **E**spaces **R**uraux
BP 87999 – 26, Bd Dr Petitjean – 21079 DIJON cedex

Can Information-Based Policies Do More Harm Than Good?[1]

Douadia Bougherara (Co-author)
INRA ESR
4, Allée Adolphe Bobierre CS 61103
35011 RENNES CEDEX France
Tel: + 33 2 23 48 56 03 - Fax: + 33 2 23 48 53 80
Douadia.Bougherara@rennes.inra.fr

Gilles Grolleau (Corresponding author)
UMR INRA-ENESAD CESAER
26 Bd Dr Petitjean BP 87999 21079 DIJON CEDEX France
Tel: + 33 3 80 77 24 43 - Fax: + 33 3 80 77 25 71
grolleau@enesad.inra.fr

Naoufel Mzoughi (Co-author)
UMR INRA-ENESAD CESAER
26 Bd Dr Petitjean BP 87999 21079 DIJON CEDEX France
Tel: + 33 3 80 77 24 39 - Fax: + 33 3 80 77 25 71
mzoughi@enesad.inra.fr

Abstract: Environmental policy has intensively focused on information-based instruments that seek to change agents' behavior through information provision. This information provision is generally considered as likely to ultimately improve environmental quality. We suggest a new and complementary way to consider information-based instruments. We formalize the insight that information provision differs from information impact by introducing the concept of informational elasticity. We show that beyond an optimum level, an additional information load, regardless of the information quality, could do more harm than good. Indeed, some perverse effects could occur, resulting in a worse overall impact. Several policy implications are stressed.

Key words: Voluntary approaches, Information provision, Policy valuation

JEL Classification Numbers: Q50, D80, K20

Abstract: Environmental policy has intensively focused on information-based instruments that seek to change agents' behavior through information provision. This information provision is generally considered as likely to ultimately improve environmental quality. We suggest a new and complementary way to consider information-based instruments. We formalize the insight that information provision differs from information impact by introducing the concept of informational elasticity. We show that beyond an optimum level, an additional information load, regardless of the information quality, could do more harm than good. Indeed, some perverse effects could occur, resulting in a worse overall impact. Several policy implications are stressed.

Key words: Voluntary approaches, Information provision, Policy valuation

JEL Classification Numbers: Q50, D80, K20

[1] The authors gratefully acknowledge Keith Brouhle, Catherine Laporte, Stéphan Marette and the participants of the sixth annual Heartland Environmental and Resource Economics (HERE) Workshop (held in Ames, Iowa, on September 19 and 20, 2004) for their helpful comments and suggestions. The usual disclaimer applies.

Can Information-Based Policies Do More Harm Than Good?

"Very simply put, if every instance of adultery had to be disclosed, there would probably be less adultery."
(Sommer 1976, quoted in Paredes, 2003, p. 463)

1. Introduction

During the last two decades, environmental economists turned their attention to information-based policies in response to dysfunctional markets. According to Tietenberg (1998), the conceptual economic foundation for disclosure strategies is the Coase Theorem, which asserts that socially optimal risk sharing can be obtained if all stakeholders can negotiate at a very low cost. Information asymmetries constitute an impediment to such private bargaining. Removing or at least attenuating such information asymmetries may enable to reach a Pareto-optimal outcome (Kleindorfer and Orts, 1998; Case, 2001). In line with economists' arguments "preaching" the good impact of information provision, environmental policy has intensively focused on information-based instruments developed in order to support or replace existing instruments, i.e. command-and-control and market-based instruments. These informational policies encompass a broad range of instruments from mandatory disclosure programs such as the Toxic Release Inventory (TRI[2]) in the USA or the New Economic Regulation Act in France to voluntary programs such as ecolabeling schemes implemented in numerous countries. A common feature of these informational approaches is their aim to change directly or indirectly the behavior of economic agents, such as consumers, insurers, investors and other stakeholders. According to Harrison and Antweiler (2001, p. 1), "informational strategies for environmental protection are predicated on the assumption that firms will respond to pressure from consumers, workers, investors, and communities armed with more complete information about those firms' environmental practices". By disclosing information, agents who have it can make informed decisions and better protect their interests, whatever they may be (Paredes, 2003). The potential for such an increasing role for disclosure strategies is reinforced by the continual decrease of the cost of information collection, aggregation and dissemination.

Several economic studies are devoted to the informational disclosure impact on the environment. For example, several recent empirical studies (Hamilton, 1995; Konar and Cohen, 1997; Khanna et al., 1998) use TRI data to look at the effect of publicizing information on firms' stock market performance, which in turn influence firms' emissions. However, the results are mitigated. While some economists pointed out the good impact of information disclosure, some others stressed its uselessness (for comprehensive surveys of the growing literature, see Magat and Viscusi, 1992; Tietenberg, 1998; Case 2001; see also Wynne, 1994 for an application to ecolabeling schemes). In this paper, we attempt to reconcile divergent views on the environmental effectiveness of information-based instruments, by suggesting a complementary way to consider them. This paper differs from several to date by formalizing the insight that *information provision differs from information impact*. Access to information is not a substitute for abilities to process it. Little attention has been paid to how information is used by the demand side. If deciders do not or can not process information effectively, information disclosure may be counterproductive (Paredes, 2003). Another

[2] "The Toxics Release Inventory (TRI) is a publicly available Environmental Protection Agency (EPA) database that contains information on toxic chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities. This inventory was established under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and expanded by the Pollution Prevention Act of 1990." (http://www.epa.gov/tri/, visited on November, 4th, 2004).

major point of this contribution is to consider that information overload can be instrumentalized in order to disadvantage rivals or other agents, e.g. public authorities overwhelmed with huge quantities of true but useless information. Such a strategy is likely to increase transaction costs.

We introduce the concept of informational elasticity and show that beyond an optimum level, an additional information load, regardless of its qualitative dimensions, could do more harm than good. Indeed, while providing more information, until information symmetry, is generally considered as likely to ultimately improve environmental quality, we argue that some adverse effects could occur, resulting in a worse overall impact than before information provision[3]. In some cases, information overload[4] may lead individuals to make worse decisions compared to a situation with less information. Let us briefly expose some examples stressing the relevance of studying such a topic. When the Environmental Protection Agency (EPA, 1995[5]) considered expanding the type of information that must be reported under the Toxic Release Inventory program, the Chemical Manufacturers Association (CMA) "stated that collecting and reporting volumes of use would not necessarily measure source reduction efforts. In addition to causing "information overload", the CMA claimed that collected materials accounting data would not be complete enough to produce an accurate picture of what was really happening inside a facility's many processes." The debate was clearly stated as follows: "A key public policy question is "How much information should government provide?" Is there some minimum amount or type of information to which people have a moral or legal right? Is there an upper limit to the amount of information that people can use? At what point does the cost of collecting and providing access to information outweigh the value of the information use? Answers to these questions are likely to range widely, depending on one's philosophy of government and on the perceived value of an informed citizenry. Stakeholders in the TRI expansion debates have been observed to argue both sides of the issue: TRI provides too little information, on the one hand, and too much, on the other. Environmentalists and public health interest groups strongly support TRI expansion to include data on more chemicals, more industries, and more industrial processes. (…) Currently, some reportedly complain, TRI information gives people a false sense of understanding and power, but no real understanding, because TRI only reports releases, not the contextual information needed to evaluate potential effects of those releases on human health or the environment. (…) Others maintain that TRI expansion will provide too much data and overwhelm the public's ability to comprehend or use it. "Information overload" may be avoided, however, if data are well organized and made available in simple formats for viewing or manipulating." (CSR, undated[6]). According to O'Rourke (2004, p. 25), "with hundreds of corporations now producing reports, a wide range of laws being implemented around the world, and dozens of nongovernmental initiatives on transparency and reporting emerging, there is staggering variation in what is reported, in what forms, and for which audiences. The Lawyers Committee for Human Rights reports over 2000 different indicators of labour standards used in corporate codes and monitoring systems. This range and variation in reporting can cause information overload and actually increase difficulties for comparing factories, brands, or countries. (…). CSR reporting is in fact in some danger now of reporting too much data that is not meaningful to critical stakeholders. The many audiences for CSR information are overwhelmed with information, and simultaneously over-stretched for time and resources to evaluate this information (see also Paredes, 2003 for an extensive discussion about information overload in the context of securities regulation)[7]".

[3] More information may cause other unintended and negative effects such as increasing compliance costs and costs to process information, opportunity costs and chilling risk-taking (Paredes, 2003).

[4] "A useful way of thinking about the concept of information overload is that it arises when the incremental decreases in decision effectiveness due to additional information quantity are greater than the incremental increases in decision effectiveness due to the additional information quality" (Keller and Staelin, 1987, p. 202).

[5] EPA, 1995, Toxics Release Inventory (TRI) Program, Issues Paper #2, http://www.epa.gov/tri/programs/p3-ip2.htm, visited on October, 29th, 2004.

[6] Congressional Research Service, Toxics Release Inventory: Do Communities Have a Right to Know More? III, http://www.ncseonline.org/NLE/CRSreports/pesticides/pest-9b.cfm, visited on October, 29th, 2004.

[7] Another example about the risks of environmental information releases is developed in McLauchlan and McLaughlin (1998).

Information provision may be legitimated on several grounds such as the public desire for transparency and access to information, the bureaucratic impetus for centrally available and reliable information and the rise in public concern about particular environmental hazards. A kind of 'technology push' may also partially explain the development of information-based policies (McLauchlan and McLaughlin, 1998). Information provision is said to enable agents with environmental preferences to make fully informed decisions. Note that we analyze information provision from an economic efficiency viewpoint rather than from an ethical standpoint such as the so-called right-to-know principle. Assuming such restriction, we focus our attention on whether more information is always desirable or not.

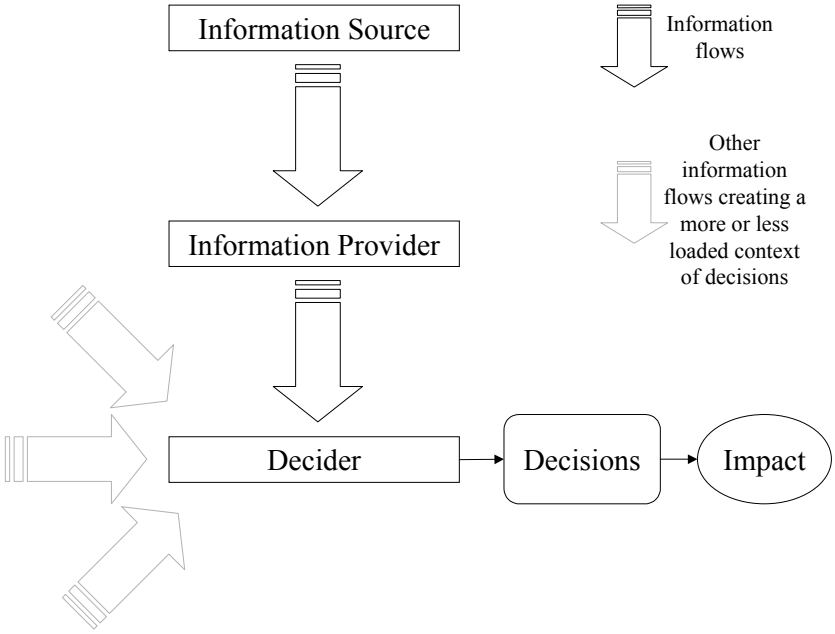
The remainder of the paper is as follows. In next section we propose a diagrammatic description of information-based policies. We define the concept of informational elasticity and suggest some methods to measure it. In section III, we present a simple model that shows under which conditions more information may lead to perverse effects in terms of the expected environmental improvement. Section IV presents policy implications that can be derived from our analysis. Section V concludes.

2. Informational elasticity and the classification of information-based policies

We provide a general description of information-based policies before introducing the concept of informational elasticity. Information-based policies involve the intervention of several agents. To make the exposition simple, we provide a diagrammatic view of the general mechanism sustaining those policies in figure 1. The *Information Source* is the party that holds private information to be delivered to the *Information Provider*. The latter gathers information, standardizes it and releases it to the *Decider*. The *Decider* is the target of the policy whose decision is to be influenced. The *Decider* usually takes decisions in a context more or less loaded with information[8]. Moreover, his decisions may vary in quality. Quality of decisions may be defined as the accurateness of the decider's behavior aimed at leading to a given impact depending on the quantity of information. The concept of decision quality or decision effectiveness and its operationalization has been extensively debated in the literature (see Jacoby, 1977, Jacoby, 1984 and Keller and Staelin, 1987 for discussions devoted to this question). The extensive review of this literature is out of scope of our contribution but we cannot omit the seminal work of Simon (1982). Simon (1982) points out that individuals are boundedly rational and have limited cognitive abilities to store, process and interpret information. Moreover they are vulnerable to several cognitive biases. Agents will satisfice rather than optimize. They economize on cognitive efforts by adopting heuristics but are also subject to biases (Tversky and Kahneman, 1974). Nevertheless, without purporting to resolve the question, we consider that decision quality can be considered as the concordance between the ideal choice according to the agent's preferences among a set of available alternatives and the real choice achieved after information releases. Moreover, we consider that the operationalization of decision quality is far from easy and may include several items such as decision accuracy, time costs, uncertainty reduction and so on (Jacoby, 1984, p. 433).

[8] The context is a fuzzy and multidimensional concept used to characterize the informational environment. From a given point corresponding to the sum of past information released, this information environment can be considered as the number of impulses that compete to capture the attention of agents.

Figure 1: General mechanism for information-based policies



For ease of exposition, we distinguish several categories of agents, i.e. the information source, information provider and decider. Such distinctions are rather diagrammatic because the dividing line is frequently fuzzy in the real world. Sometimes the information source and the information provider are confounded such as in the New Economic Regulation Act. Moreover, the final decision can be influenced through several channels, more or less direct. Indeed, in several situations certain agents are the end-deciders, e.g. a pollutant firm, in the sense that they undertake the technical actions that will change the environmental quality. However, their decision more or less favorable to the environment can be influenced by intermediate deciders, such as investors. For example, investors may select firms where they want to invest according to their environmental performance. Therefore, they can push polluting firms to improve their environmental results by undertaking actions favorable to the environment. Lastly, note that a more complex model can enable us to take into account several feedback effects, e.g. when deciders influence the information collected and provided.

Information-based policy	**Toxic Release Inventory**	**New Economic Regulation Act**	**European Ecolabel**	**Advertising Campaign on Energy Savings**
Country	USA	France	Europe	France
Information Source	Firms	Firms	Firms	-
Information Provider	Environmental Protection Agency	Firms	Firms	French Agency for the Environment and The Energy
Information	Report the locations and quantities of chemicals stored on-site	Report on how the firm takes account of social and environmental aspects	Labels on products pointing at the environmental attributes	Benefits of saving energy in terms of economic saving and environmental protection
Deciders	Investors	Investors	Consumers	Households
Decision	To hold or not companies accountable	To invest or not in those firms	To purchase or not ecolabeled products	To turn off the lights when leaving the room
Impact	Impact on the decrease in chemical emissions	Impact on the quality of the environment	Impact on the quality of the environment through a change in consumption style	Impact on energy savings

Table 1: Some information-based policies in environmental regulation

At this point, we introduce the informational elasticity ε , which measures the responsiveness of a given decider, namely the quality of its decisions, to a given change in the quantity of information released by the information provider. In the case of the Toxic Release Inventory, it measures the quality of investors' decisions to a given change in the quantity of information released by the EPA. The operationalization of the variable 'information quantity' is not analyzed here. Obviously, this necessary task is far from easy and interested readers can usefully refer to Jacoby (1977), Jacoby (1984) and Lurie (2004) for different methods potentially applicable to our example. In the case of the New Economic Regulation Act, the informational elasticity measures the quality of decisions of investors to a given change in the quantity of information released by firms through their annual report. Quality of decisions may then measure the ability of investors to process information and take the right action leading to an environmental improvement in accordance with their preferences. It refers to the comparison between the current decisions taken by the decider and the decision he would have taken if his processing abilities were infinite and information was complete. Of course, we implicitly postulate that the decider has eco-friendly preferences. Information provision should therefore entail a positive impact, i.e. an environmental improvement.

Using the conventional equation in the case of a continuous and derivable function, the informational elasticity ε is given by:

$$\varepsilon = \frac{\frac{dD}{D}}{\frac{dQ_I}{Q_I}} \quad (1)$$

dD corresponds to the variation in the quality of decisions. For a discrete function, it is the difference between the quality of decisions after (D_a) and before (D_b) the release of information ($\Delta D = D_a - D_b$).

dQ_I corresponds to a change in the quantity of information released by the information provider. For a discrete function, it is the difference between the quantity of information after (Q_I^a) and before (Q_I^b) the release of information ($\Delta Q_I = Q_I^a - Q_I^b$). Note that $\Delta Q_I > 0$ because we postulate an increase in the quantity of information released by the information provider.

According to the concept of informational elasticity, we propose an intuitive classification of information-based policies in table 2. Increasing the quantity of information is usually considered as a way to improve the quality of decisions ($\varepsilon > 0$). However, in some cases, it may lead to a decrease in the quality of decisions. For example, Wynne (1994) is rather skeptic about Environmental Report Cards that are labels listing the impact of a product for several environmental fields. The aim of report cards is to provide raw information without any judgement value to enable consumers' sovereign choice. However, such a huge amount of information may be difficult to process for consumers and decrease the quality of their decisions ($\varepsilon < 0$). Informational elasticity may also be nil ($\varepsilon = 0$). If prior perceptions of deciders correspond to the released information, the TRI may have no impact. Khanna et al. (1998) note that "the greater the prior environmental information that investors have about a firm, the smaller the impact of the provision of additional information on their stock market returns".

Value of the elasticity		Quality of decisions	Effect of an increase in the quantity of information Q_I on the quality of decisions D
$\varepsilon < 0$	$\varepsilon < -1$	elastic	D decreases proportionally more than the proportional change in Q_I
	$\varepsilon = -1$	unit elasticity	D decreases proportionally as much as the proportional change in Q_I
	$-1 < \varepsilon < 0$	inelastic	D decreases proportionally less than the proportional change in Q_I
$\varepsilon = 0$		perfectly inelastic	No change in the quality of decisions D
$\varepsilon > 0$	$0 < \varepsilon < 1$	inelastic	D increases proportionally less than the proportional change in Q_I
	$\varepsilon = 1$	unit elasticity	D increases proportionally as much as the proportional change in Q_I
	$\varepsilon > 1$	elastic	D increases proportionally more than the proportional change in Q_I

Table 2: Types of information-based policies according to their informational elasticity

The classification of information-based policies according to their informational elasticity is particularly relevant for policy makers who aim at maximizing the efficiency of funds invested in such policies. This point is briefly developed in section IV. An empirical way to determine the environmental elasticity of information-based policies is to realize well-designed surveys to simulate the reaction of deciders to an increase in the release of information. Another way is to exploit data related to the impact of an information-based policy on behaviors. A third way to test this informational elasticity could be to achieve pilot studies in small areas where information is released and subsequent changes recorded. Finally, experiments enabling the control of the informational context may bring insights on the value of the informational elasticity. These different ways are neither exhaustive nor mutually exclusive and can be combined to get better results.

3. An analytical framework

We are interested in determining the overall impact[9] (or policy effectiveness) I of a change in the release of information. I is a function of the quantity of information Q_I, the quality of decisions made by the decider D, and the informational load of the context in which decisions are made C so that we can write $I = I(Q_I, D, C)$. Thus, the total differential of I is:

$$dI = \frac{\partial I}{\partial Q_I} dQ_I + \frac{\partial I}{\partial D} dD + \frac{\partial I}{\partial C} dC$$

In information-based policies, the released information is designed so as to influence the decider's behavior leading to an increase in the overall impact (a decrease in pollution). The more the quantity of information is, the higher the overall impact is ($\frac{\partial I}{\partial Q_I} > 0$). Moreover, the higher the quality of decisions is, the higher the overall impact is ($\frac{\partial I}{\partial D} > 0$). Finally, the more loaded the context is, the

[9] The higher the overall impact is, the lower the pollution is.

harder it is to process specific information among increasing flows of information, the lower the overall impact is ($\frac{\partial I}{\partial C} < 0$).

One important contribution of our paper is to consider that *the quality of decisions is a function of the quantity of information*. Since the context is also a function of the quantity of information, we write $D = D(Q_I)$ and $C = C(Q_I)$.

Then, $dD = \frac{\partial D}{\partial Q_I} dQ_I$ with $\begin{cases} \frac{\partial D}{\partial Q_I} > 0 \text{ if } \varepsilon > 0 \\ \frac{\partial D}{\partial Q_I} = 0 \text{ if } \varepsilon = 0 \\ \frac{\partial D}{\partial Q_I} < 0 \text{ if } \varepsilon < 0 \end{cases}$

and $dC = \frac{\partial C}{\partial Q_I} dQ_I$ with $\frac{\partial C}{\partial Q_I} > 0$.

We rewrite I as $I = I[Q_I, D(Q_I), C(Q_I)]$, then:

$$dI = \frac{\partial I}{\partial Q_I} dQ_I + \frac{\partial I}{\partial D} \frac{\partial D}{\partial Q_I} dQ_I + \frac{\partial I}{\partial C} \frac{\partial C}{\partial Q_I} dQ_I \qquad (2)$$

Equation (2) shows that the variation in the overall impact due to an increase in Q_I ($dQ_I > 0$) is an addition of three effects:

A Direct Effect

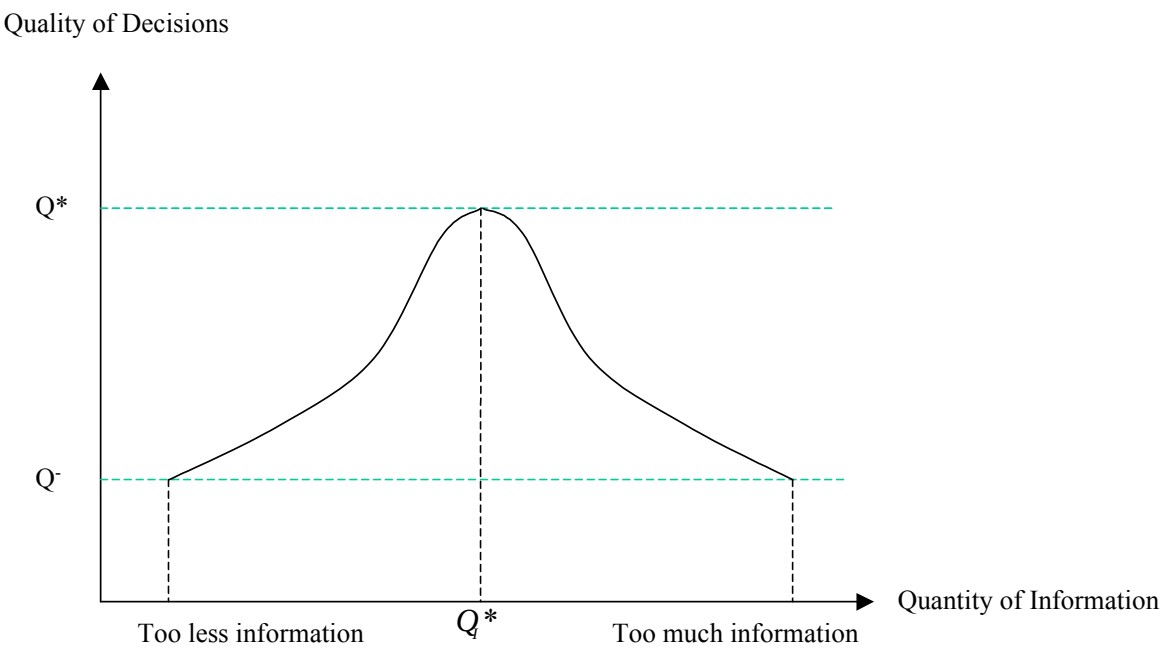
The first term of equation (2), $\frac{\partial I}{\partial Q_I} dQ_I$, describes the effect on the overall impact I of an increase in the quantity of information. The *Direct Effect* is positive, which means an increase in the overall impact I.

A Quality of Decisions Effect

The second term of (2), $\frac{\partial I}{\partial D}\frac{\partial D}{\partial Q_I}dQ_I$, corresponds to the effect on I of a variation in the quality of decisions due to an increase in the quantity of information. The sign of the *Quality of Decisions Effect* depends on the sign of $\frac{\partial D}{\partial Q_I}$ and may be positive, nil or negative.

We use the psychological law of Yerkes-Dodson (1908) to determine the sign of the *Quality of Decisions Effect*. The essence of this law is the relationship between performance, e.g. quality of decisions and pressure, e.g. the information load (Leibenstein, 1997). If we visualize the quality of decisions on the ordinate and the quantity of information on the abscissa, the Yerkes-Dodson law may be represented by a roughly inverted-U curve (figure 2). As informational load increases, quality of decisions comes closer to maximization. Beyond some point informational load may be so high that decision-makers find it rather difficult to cope.

Figure 2: The Yerkes-Dodson law



A Context Effect

The third term of (2), $\frac{\partial I}{\partial C}\frac{\partial C}{\partial Q_I}dQ_I$, is the effect on I of an increase in the informational load of the context due to an increase in the quantity of information. The *Context Effect* is negative[10].

[10] We make an implicit assumption. Namely, as soon as information is released, the *Context Effect* becomes negative. We could have considered the case where the *Context Effect* is nil up to a threshold of the quantity of information. Above this threshold, the *Context Effect* becomes negative. If the *Context Effect* is nil, the overall impact is a trade-off between two forces: the *Direct Effect* and the *Quality of Decisions Effect*. A perverse effect appears where the *Quality of Decisions Effect* is negative ($\varepsilon < 0$) and higher than the *Direct Effect* (positive). To make things simple, we do not consider this case.

We summarize the three effects in table 3:

Effects on I	**Value of the environmental elasticity**					
	$\varepsilon < 0$		$\varepsilon = 0$		$\varepsilon > 0$	
Direct Effect	+		+		+	
Quality of Decisions Effect	-		0		+	
Context Effect	-		-		-	
Total Effect	+	-	+	-	+	-
	(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**

-: Decrease in the overall impact I , 0: No change in I , +: Increase in I

Table 3: Total effect of an increase in Q_I on the overall impact I according to the informational elasticity

A perverse effect on the overall impact[11] may appear each time negative effects exceed positive ones. In table 3, several cases appear among which 3 cases reveal to be perverse effects (b, d and f).

Cases c and d
Let us first consider the simplest cases – c and d – where only two effects play a role. The more the quantity of information, the more the load of the informational context so that there appears a threshold above which added information becomes counter-productive. The *Context Effect* may then overcome the *Direct Effect* and lead to a perverse effect (case d).

Cases e and f
In cases e and f, the effect described in the Yerkes-Dodson law is added to the effects in cases c and d. A higher quantity of information improves the overall impact not only through the *Direct Effect* but also through a better quality of decisions. A perverse effect appears only if the informational context is so loaded that the *Context Effect* overcomes the *Direct Effect* and the *Quality of Decisions Effect* (case f).

Cases a and b
The Yerkes-Dodson law implies a negative effect on the quality of decisions. The *Quality of Decision Effect* adds to the *Context Effect* and these both effects may overcome the *Direct Effect* and lead to a perverse effect on the overall impact (case b).

Our analysis shows that the Quality of Decisions Effect reinforces either the positive direct effect of providing more information or the negative effect of the context informational load. Its effect is crucial in determining the effect of information-based policies. [12]

[11] Note that we do not consider the overall impact from the decider viewpoint, but from the state viewpoint. The state wants to maximize the overall impact.

[12] Note that while the overall impact on the environment is obviously the end objective for information-based policies, the mechanism through which information affects the environment constitutes the real object of interest (how do consumers/investors respond to information?). Indeed, information-based policies attempt to change individual behavior. Thus, it may be natural to add a model which focuses more on individual behavior. One possible direction is to model consumer choice as a function of both the quantity of information and the context. The context, then, affects the overall impact, but does not directly affect the decision of an individual. One suggestion is to think about setting up a problem where consumer choice is a function of the quantity of information as well as his/her decision-making environment or context. This formulation, then, would allow the "quality" of a consumer's decision to depend on both the quantity of information and the context. This is an important point as the same quantity of information can have different effects on the agent decision depending on the context in which the agent uses the information.

4. Policy considerations for introducing information-based instruments

The policy implications developed are necessarily tentative. Introducing information-based policies can ultimately motivate polluters to reduce their emissions. Under a *ceteris paribus* clause, informational elasticity allows to compare different scenarios where the informational elasticity (and the subsequent environmental improvement) varies among sectors and/or among groups of deciders. Computing the informational elasticity can guide policymakers in selecting sectors and/or deciders for which information based-instruments would make the most significant environmental improvement (environmental effectiveness) for a given amount of resources (economic efficiency). More concretely, if we postulate that the ultimate aim of information provision is an overall environmental improvement (and not only ethical considerations such as the 'right to know'), is it better to provide information to investors, consumers or firms? Indeed the information design and dissemination varies according to the targeted agents and therefore the implied costs. Different users can be expected to become overloaded at different levels and to different extents, stressing the importance of tailoring disclosure (Paredes, 2003). Informational elasticity provides a partial reply to the previous question by indicating to what extent 1$ invested in information provision will change the targeted agents' behavior and therefore improve the environment quality. The empirical tests suggested in the second section can help policy designers to better allocate scarce resources and generate higher environmental improvement, or at least avoid some hidden perverse effects by introducing an information-based policy for an inappropriate sector or targeting less sensitive deciders. Our analysis does not conclude that policy makers have to ban information dissemination in certain circumstances, but stresses the possible need of complementary measures e.g. educating deciders or increasing their processing capacities[13]. Information spillovers are likely to occur and information provision can affect more than the targeted population, e.g. consumers' information can also influence investors' decisions. These indirect effects should be integrated in a more complex model where they can strengthen or weaken the overall effectiveness of the information-based policy.

The model proposed above allows the integration of the effects of the informational context *ex ante*, i.e. the state of the information context before the introduction of the information-based instrument. It can also be computed by simulating different scenarios of manipulation of this context by strategic agents. Indeed, some agents can provide additional information in order to overload information recipients. The potential effectiveness of an information-based instrument can be weakened by the strategic use of information overload, which may increase deciders' satisfaction but decrease the quality of their decisions (O'Reilly, 1980). Indeed, once the informational threshold of deciders is exceeded, additional information, regardless of its reliability, may generate some perverse effects, by decreasing the quality of decisions. Strategic agents can inundate or overload the targeted deciders of the information-based instruments by true but inappropriate information, making deciders less sensitive (or not sensitive at all and maybe counter-sensitive) to public provision of appropriate environmental information. Such information overload may be used to raise rivals' costs or lower rivals' revenues (Salop and Scheffman, 1998; See Hilke and Nelson, 1984 for an insightful application to ‘noisy advertising’). For example, a strategic incumbent threatened by the launch of an ecolabeled product can raise switching costs of consumers by releasing additional information on the 'ecofriendliness' of the competitor[14]. Such questions generate product "fear, doubt and uncertainty" (the so-called FUD strategy in computer markets) among consumers and may force the ecofriendly competitor to bear extra costs to convince consumers.

According to Simon, "what information consumes is rather obvious: it consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention, and a need to allocate that attention efficiently among the overabundance of information sources that might consume it[15]."

[13] Technological devices such as information filters can be used to reduce the overall amount of information that a decider has to process.

[14] Such strategy often relies on two mechanisms – rather difficult to disentangle – the use of information overload but also on the questioning of the competitor's reliability.

[15] Herbert Simon, in Scientific American, September 1995, p. 201.

Consequently, creating such a 'noisy informational context' may lead to 'anaesthetize' deciders. Recently, the German Federal Environmental Agency has stressed the negative effects of huge amounts of environmental information aiming at influencing the consumer, among other impulses for attention: "The flood of other ecolabels also poses a problem for the first environmental label [Blue Angel]. A great deal of packaging is meanwhile emblazoned with half-a-dozen badges all of them courting the customer's favour. Attracting attention has become more difficult. (…) The average person is confronted daily with 3000 advertising impulses" (German Federal Environmental Agency, 2002[16]). Indeed, once their attention is consumed by other information, it is not available for environmental information. Such strategic behaviors can legitimate the intervention of public authorities to define and enforce 'rules of the game' aiming at regulating information release. Such rules can enter in conflict with other principles, based on ethical grounds such as the 'right to know' or the 'freedom of speech'. Training and education may improve processing abilities. Note that some groups or specific devices such as associations, experts, information systems or competitors equipped with higher processing abilities may decipher strategic complex information or reduce the information flows aiming at 'destabilizing' deciders.

5. Conclusion

We have introduced the concept of informational elasticity that may help policy makers in designing and implementing more effective information strategies for environmental protection. We have also showed that the information symmetry of 'walrasian' markets is not always desirable and how information-based instruments can generate some perverse effects on the environment. The considered source of the 'perverse effect' differs from the previous literature (mainly focused on asymmetric information), notably by introducing psychological considerations (limited processing capacities, divergence between desired information load for satisfaction and optimal performance) in the decision making process. In certain plausible circumstances, deliberate ignorance may be rational. Although we have focused our attention on information strategies for environmental protection schemes, the framework and the results are generic and can be easily applied to numerous similar situations.

Moreover, by postulating that policy makers seek to improve the environment, information-based policies can be more efficient and environmentally effective for certain sectors and/or deciders (positive and high information elasticity) than others. In other words, the selection of targeted sectors and/or deciders matters. In some cases, information-based instruments schemes can need complementary devices to achieve their promises such as decider education to process available information or devices susceptible to increase the informational threshold of targeted deciders[17].

The main results have been derived under very simplifying assumptions. Many extensions can be analyzed such as the combination of other related effects mentioned above. Indeed, this paper has assumed the provision of uniform information from a quantitative viewpoint without really taking into account its qualitative and reliable dimensions. For example, information disclosure can be also considered as a device increasing the self-awareness inside the firm without being mediated through external pressures. Determining the optimal information load in a given context remains to do. Reducing the information may constitute a solution, but a question remains: what information to suppress and to which market participants? Moreover, individuals may be reluctant to have less information available, regardless of the overall efficiency, because of a mental ‘lock-in’. In short, suppressing information in order to improve decision effectiveness and economic efficiency may be

[16] Federal Protection Agency, 2002, The Blue Angel Makes a Fresh Start - New Paths to Public Awareness, Umweltzeichen Newsletter, 5: 1-2.

[17] Note that the information technology can be considered as an element of the problem because of ‘technology-push’ effect with a kind of self-enforcing mechanism and as an element of the solution by providing devices susceptible to help decision makers to process more information.

unwelcome. It is worthwhile to note that some agents may legitimate their fight against the expansion of information-based policies by the likelihood of information overload and subsequent effects, such as the Chemical Manufacturers Association advocating for a non-extension of the TRI[18]. The contribution has also considered homogeneous agents with the same processing abilities, but agents differ in their abilities[19], opportunity costs and heuristics to process increasing information flows. Because of agents' differences, information overload and the optimal level of information is somewhat an agent specific phenomenon. If environmental information-based approaches produce an inhibiting level of information overload, they may only manage to engage an elite class, e.g. activists and bureaucrats (McLauchlan and McLaughlin, 1998). Distinguishing subgroups inside a targeted population may help to provide more adequate amounts of information. Integrating the previous dimensions of information itself and information recipients, spillover effects, presence of information intermediaries and interactions with other public and private instruments will make the model closer to the real world. Extending this setting and testing it empirically constitutes a challenging topic for future research.

References

Case, D.W., 2001, The Law and Economics of Environmental Information as Regulation, *Environmental Law Reporter*, 31: 10773-10789.

Harrison, K. and W. Antweiler, 2001, Environmental Regulation vs. Environmental Information: A View From Canada's National Pollutant Release Inventory, Working Paper, University of British Columbia, CA.

Hamilton, J.T., 1995, Pollution as News: Media and Stock Market Reactions to the Toxic Release Inventory Data, *Journal of Environmental Economics and Management,* 28: 98-113.

Hilke, J.C. and P.B. Nelson, 1984, Noisy Advertising and the Predation Rule in Antitrust Analysis, *American Economic Review*, 74(2): 367-371.

Jacoby, J., 1977, Information Load and Decision Quality: Some Contested Issues, *Journal of Marketing Researc*h, 14(4): 569-573.

Jacoby, J., 1984, Perspectives on Information Overload, *Journal of Consumer Research*, 10(4): 432-435.

Keller, KL.; Staelin, R., 1987, Effects of Quality and Quantity of Information on Decision Effectiveness, *Journal of Consumer Research*, 14: 200-213.

Kleindorfer, P.R. and E.W. Orts, 1998, Informational Regulation of Environmental Risks, *Risk Analysis*, 18(2): 155-170.

[18] Congressional Research Service, Toxics Release Inventory: Do Communities Have a Right to Know More? III, http://www.ncseonline.org/NLE/CRSreports/pesticides/pest-9b.cfm, visited on October, 29th, 2004.

[19] Such abilities may include several parameters such as the education and interest of the agents related to the released information.

Khanna, M., W.R.H. Quimio, and D. Bojilova, 1998, Toxic Release Information: A Policy Tool for Environmental Protection, *Journal of Environmental Economics and Management,* 36: 243-266.

Konar, S. and M.A. Cohen, 1997, Information as Regulation: The Effect of Community Right to Know Laws on Toxic Emissions, *Journal of Environmental Economics and Management,* 32: 109-124.

Leibenstein, H., 1987, *Inside The Firm*, Harvard University Press, Cambridge, MA.

Lurie, NH., 2004, Decision Making in Information-Rich Environments: The Role of Information Structure, *Journal of Consumer Research*, 30(4): 473-486.

Maget, W.A. and W.K. Viscusi, 1992, *Informational Approaches to Regulation*, Cambridge (MA), MIT Press.

McLauchlan and McLaughlin, 1998, Environmental Democracy and Stewardship through Land and Resource Information: The Case of the Land Gazette, in Proceedings of the International Conference on Land Tenure in the Developping World, Cape Town, 27-29 January 1998, 572-585.

O'Reilly, CA.,1980, Individuals and Information Overload in Organizations: Is More Necessarily Better?, *Academy of Management Journal*, 23(4) : 685-696.

O'Rourke, D., 2004, Opportunities and Obstacles in CSR Reporting in Developing Countries, Staff Report of the World Bank Group.

Paredes, T.A., 2003, Blinded by the Light: Information Overload and its Consequences for Securities Regulation, *Washington University Law Quarterly*, 81: 417-485.

Salop, S. and D. Scheffman, 1983, Raising Rivals' Costs, *The American Economic Review*, 73:267-271.

Simon, J., 1982, Models of Bounded Rationality: Economic Analysis and Public Policy, Vol. 1 and 2, MIT Press, Cambridge, MA.

Tietenberg, Tom, 1998, Disclosure Strategies for Pollution Control, *Environmental and Resource Economics*, 11 (3-4): 587-602.

Tversky A.; Kahneman, D., 1974, Judgment under uncertainty: heuristics and biases, *Science,* 185:1124-31.

Wynne R., 1994, The Emperor's New Ecologos? A Critical Review of the Scientific Certification Systems Environmental Report Cards and the Green Seal Certification Mark Programs, *Virginia Environmental Law Journal*, 14:51-149.

WORKING PAPER

Can Williamson's Analysis of Discrete Structural Alternatives Help Regulators to Choose Between Environmental Policy Instruments? Douadia Bougherara, Gilles Grolleau, Naoufel Mzoughi (UMR INRA-ENESAD CESAER Dijon), **2005/1**, 10 p.

Measuring social capital for local economic development studies: the case of French rural areas**.** Jean-Marc Callois (CEMAGREF, Clermont-Ferrand), Bertrand Schmitt (UMR INRA-ENESAD CESAER Dijon), **2005/2**, 16 p.

On Coasean Bargaining with Transaction Costs: The Case of Vittel. Christophe Déprés, Gilles Grolleau, Naoufel Mzoughi (UMR INRA-ENESAD CESAER Dijon), **2005/3**, 16 p.

Fourniture non publique de biens publics : diversité des arrangements. Christophe Déprés, GillesGrolleau, Naoufel Mzoughi (UMR INRA-ENESAD CESAER Dijon), **2005/4**, 16 p.