

5. Self-enforcing Voluntary Approaches with Incomplete Information and Environmental Uncertainty

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INTRODUCTION

With the diffusion of voluntary approaches (VAs), environmental protection has entered a new era. Initially, environmental policy was exclusively driven by public concerns about pollution abatement. The reason for public intervention was clear both from the point of view of theorists and policy-makers: after more than a century of widespread industrialization, the quality of the environment was deteriorating more and more because of market failures in internalizing the social costs of human activities. The need to impose environmental regulation was then perceived as an important issue by an increasing amount of the population. New economic tools like environmental taxes and subsidies were adopted, as well as environmental liability and standards, in order to achieve the public goal of pollution abatement.

The increasing concerns about environmental quality have thus modified even consumer preferences, while huge environmental regulations were creating unavoidable constraints for firms. In the meantime, technological progress has proved able to provide some economically feasible solutions for environmental problems, both as a result of demand pull and technology push (Ashford, 1999). Due both to green preferences and the regulatory threat, environmental issues are no longer just a question of negative externalities arising from private consumption and production activities, but can be internalized to a certain extent by firms and markets. In our opinion, VAs are just a tool (one of the tools) useful to support this internalization process in market economies.

A central issue concerning corporate environmentalism is the credibility of firms' claims concerning both higher environmental quality and lower pollution abatement costs. Due to asymmetric information between firms and

consumers concerning costly efforts of pollution abatement and between firms and the government concerning pollution abatement costs across firms, credibility is distorted by adverse incentives and adverse selection, respectively.

A typical feature of VAs, which poses a challenge to traditional environmental economics, is over-compliance with respect to mandatory regulation. During the nineties a growing amount of literature has started to analyse the economic foundations of VAs. Despite the variety of approaches characterizing the contributions to the economic literature devoted to this topic (see Khanna, 2001, and Khanna and Ramirez, this book, for recent surveys), one can find a widespread consensus concerning two main motivations of corporate environmentalism: stakeholders' green preferences and the regulatory threat.¹ One limit of these contributions is that they discuss over-compliance in the framework of complete information about the environmental performance of firms. On the contrary we would like to deal with stakeholders' green preferences and the regulatory threat in the framework of imperfect information. In fact, even taking for granted that consumers internalize environmental externalities – being willing to pay a premium for environmental friendly goods – one must also consider that environmental quality is very difficult to ascertain by consumers. For example, product differentiation as such may not be enough to reap gains due to environmental reputation, if consumers cannot test firms' claims concerning the environment. Thus firms need public recognition concerning their environmental efforts in order to successfully carry out their product differentiation strategies. Even governments and regulators are imperfectly informed about environmental technologies. Not only are regulatory agencies less informed than firms when setting environmental standards or imposing environmental taxes, but these agencies may also find it difficult to ascertain the environmental performance of each firm ex-post. Furthermore a pollution control agency may not know the different compliance costs that characterize firms competing on the same market.

Imperfect information is a challenge for energy saving policies to the extent that consumers before purchase cannot be able to select products on the basis of energy consumption, especially considering that energy saving appliances can be more costly than less efficient products for the same use. Thus climate change policies based on the diffusion of energy saving durable goods must take account of information asymmetries between firms and consumers in order to be successful. Public voluntary programmes in the field of climate change, such as for example the Energy Star programme and Green Lights in the USA, can be analysed as a response to market failures due to imperfect information. 'Green pricing' by US public utilities may be another example: utilities that generate electricity from renewables are able to

sell it at higher prices and green power purchasers by other firms are given public recognition by the Environmental Protection Agency (EPA).²

Given strategic interaction between consumers and firms, a reputation issue arises because of asymmetric information about environmental product quality. A firm wants to build an environmental reputation in order to extend its market share or gain a quality premium, thereby increasing its mark-up. If we consider strategic interaction between firms and the government, a signalling issue is at stake. Firms with lower compliance costs may over-comply in order to signal their cost advantage to the regulator, so that this same advantage can be exploited through market competition if regulatory standards are changed accordingly. Thus both reputation and signalling require 'burning money' by over-compliance with respect to mandatory regulation. As we shall see, investments in reputation may explain 'product over-compliance', while investments in signalling may explain 'process over-compliance'.

Furthermore, in some cases even firms are uncertain about pollution abatement and energy saving costs, due to the incompleteness of scientific and technological knowledge that affects environmental innovations. Climate change issues are a good example of environmental uncertainty. In these cases information sharing among firms forming an oligopoly can create additional benefits to the industry. Negotiated agreements between governments and trade associations can then be analysed as an information-sharing device, whose effects on profits, consumer surplus and environmental damage can be discussed from a theoretical point of view. As we shall see, such a discussion can provide some foundations for the scepticism concerning the environmental effectiveness of VAs, given that many VAs are said to imply too small an amount of over-compliance with respect to what would be optimal from the point of view of social welfare, especially when we consider the anticompetitive effects of information-sharing activities.

In the following section we point out that information can play an essential part within voluntary approaches. The issue of environmental choice with asymmetric information is discussed in the next section. The reputation effect as a solution to asymmetric information concerning environmental product quality is analysed in the following section. Then we explore the issue of asymmetric information concerning pollution abatement costs between firms and the regulator and analyse signalling issues. The following section extends the analysis to the issue of technological uncertainty to discuss negotiated agreements as an information-sharing device. Some conclusions follow in the last section.

INFORMATION AND VOLUNTARY APPROACHES

The challenge of imperfect information for environmental policy has been recognized by Xepapadeas (1991), who points out the fact that a pollution control agency cannot efficiently monitor emissions or abatement efforts by a single polluter. With asymmetric information, environmental policy requires the use of optimal (incentive compatible) contracts between firms and public agencies. Optimality can be achieved by the appropriate use of subsidies and fines to achieve pollution abatement. Tietenberg (1998) recognizes the shortcomings both of environmental standards and traditional economic instruments when information is costly. He provides some foundation on the grounds of economic efficiency for disclosure strategies implemented either by private firms or by pollution control agencies for apparent ethical reasons: the right to know of citizens. Tietenberg highlights the fact that, even accepting the conclusions of the Coase theorem, pollution control may be difficult to implement without any standard procedure to disclose information about the environmental performance of firms. Moreover, disclosure strategies cannot be effective when there are no contractual relationships that are useful to convey information to stakeholders. It may then be feasible to convey information to consumers about the reduced environmental impact of products exploiting the opportunity of a purchase contract. On the contrary, it is more difficult to convey information about the reduction of emissions to the people living near a dangerous plant. In fact in this last case there is no contractual relationship linking the firm operating the plants and people directly affected by pollution.

Imperfect information about environmental quality calls both for contractual arrangements and information standardization in order to reach the goal of pollution control. VAs can create explicit contractual relationships between polluters and polluted agents that would not exist otherwise. For example public voluntary programmes like the European Environmental Management and Audit Scheme (EMAS) require that firms declare the impact of their plants on the population living nearby, and such a declaration is essential to successfully enter the programme. VAs can actually be seen as a contract containing monitoring and controlling procedures that satisfy the aim of information standardization consistent with efficient disclosure policies. Any environmental certification programme generally provides information standardization, be it softer like the ISO 14001 or more demanding like the European EMAS. Storey, Boyd and Dowd (1997), while analysing VAs as a flexible tool for achieving reductions in greenhouse gas emissions (GHG) from industry, find that monitoring and reporting activities in one form or another characterize all VAs devoted to this aim. Furthermore, some types of VAs do not have targets as such but rather commitments to

monitor and report information. Moreover, in the USA, monitoring and reporting requirements are one of the primary costs faced by industry adopting VAs. A research report concerning the European Union (European Commission, 1997) reaches the same conclusions as to the need for credibility and transparency in VAs, especially considering that in most cases they are weak from the point of view of sanctions. Thus information disclosure seems to be important in order to get a satisfactory incentive structure in VAs. A recent communication from the European Commission (2002) points out that monitoring and reporting activities are an essential requirement for VAs, be they unilateral commitments or binding agreements arising from 'coregulation' between industries and the Commission.

Information standardization concerning energy consumption is a result achieved by voluntary programmes for climate change in the USA, like Energy Star and Green Lights. Howarth, Haddad and Paton (2000 and this book) ascribe the success of these programmes on their ability to reduce market failures related to imperfect information. Concerning these programmes, one should nevertheless consider the distinction between information provision to firms aiming to save energy in their buildings or within their production process, and the provision of information to consumers concerning the energy saving standards.

In the first case the direct provision of technical and financial information is a benefit that helps firms entering the programme to achieve the cost reductions implied by energy saving. There is, in fact, a potential to improve energy efficiency at zero cost. Howarth, Haddad and Paton ascribe the fact that such a potential was not exploited to organizational failures inside firms, affecting the managerial relationships and essentially due to imperfect information. The direct provision of information can restore the appropriate incentives to finance energy saving investments, which are nonetheless characterized by very high rates of return.

When the relationship between firms and consumers is affected, a market failure is at stake, but this is still due to imperfect information. To the extent that producers of appliances participate in the 'Energy Star Products' programme they can use the 'Energy Star' label and simplify the process of identifying energy-efficient products, reducing information costs. The label is a substitute for direct information provision to consumers, as it avoids processing technical information. Consumers just have to trust the body charged with label awards.

Once a contractual relationship is in place, subsidies and fines may not be necessary to get a reduction of environmental damages, provided that firms have private incentives that lead them to internalize (at least partially) the externalities. Such incentives may give rise to implicit contracts between stakeholders and firms or between firms and the regulatory agency. Such

contracts can be self-enforcing to the extent they are neither enforced by the law nor do they require any subsidy or fine to be implemented. Thus, within such implicit contracts, over-compliance can be identified as an investment cost, to get returns either from reputation or from signalling

ENVIRONMENTAL QUALITY CHOICE WITH ASYMMETRIC INFORMATION

In what follows, we shall adopt Lancaster's (1966) approach and suppose that any environmental impact of products represents a characteristic of the product itself, which affects consumer utility. We call this characteristic 'environmental quality', and for simplicity we do not consider other product characteristics. Consumers generally lack information about the environmental quality of products. In some cases consumers before purchase can ascertain quality. Products of this type are called 'search goods', to highlight the fact that there is nevertheless a search cost for consumers who want to find the best deal in terms of both quality and price. From the point of view of environmental quality, products are seldom search goods (an example could be paper bags substituting plastic bags in supermarkets). In most cases products are 'experience goods' (Nelson, 1970) or even 'credence goods' (Darby and Karni, 1973) from the environmental point of view. Products can be classified as experience goods if their quality can be ascertained only after purchase: for example energy saving is an experience attribute of appliances, to the extent that consumers can directly test it after use. In the case of credence goods quality remains uncertain even after purchase and to be ascertained some complex expertise or quality tests are required. For example, the amount of energy saving that assures a significant reduction of GHG can only be established by an environmental agency. Smaller energy savings can still produce economic benefits to consumers and thus justify a higher selling price for appliances; however, only significant efforts by firms are useful to obtain the energy star label, as they produce corresponding benefits from the environmental point of view. In fact it has been noted that the Energy Star Products programme helps protect manufacturers of energy saving equipment from having prices undercut by less expensive, but also less efficient equipment (Howarth, Haddad and Paton, 2000, p. 481).

Participation in VAs in many cases assures firms about independent monitoring and reporting procedures concerning the real effort of firms to achieve the aims of the programme. So, even if from the point of view of environmental quality, products are generally credence goods, participation in VAs can assure firms of a procedure to produce and diffuse information

about achievements of environmental goals from period to period, so that products can be compared to experience goods. When a label is awarded to manufacturers, as in the case of the Energy Star programme, one can say that products become search goods from the energy-environmental point of view. Moreover as energy saving appliances can be immediately identified through a label, search costs become close to zero.

The adverse effects of asymmetric information in the product market have been analysed by Akerlof (1970) in his pioneering work. The case he considers (used cars) is relevant when quality is exogenously given, both for consumers and sellers. Sellers being more informed than buyers, an adverse selection problem arises to the extent that buyers are willing to pay lower prices and average quality decreases, so that market exchanges (paradoxically) can even shrink to zero: the market fails. But similar results are also obtained when considering quality as an endogenous variable (Klein and Leffler, 1981). Moral hazard in quality selection arises when consumers are imperfectly informed about quality before purchase and producing high quality goods is costly. In fact, the potential gains from trade are increasing in terms of the quality chosen by the firm, but – information being asymmetric – the producers' incentives prevent the potential gains from trade from being fully exploited in equilibrium, since firms maximize profits by producing low quality goods while claiming that quality is high.

Excluding legally binding contracts and quality regulation as a solution to this market failure, implicit contracts with consumers concerning product quality are another option. In this case a firm can be bound to supply high quality products just on the basis of a self-enforcing agreement: the credibility of firms' claims to environmental quality depends on the profitability of this strategy. As we shall see in the next section, to acquire a reputation for environmental quality is just a way for a firm to implement an implicit and self-enforcing agreement with consumers concerning environmental product quality.

ENVIRONMENTAL REPUTATION

As far as the quality of an experience good is concerned, and as long as strategic interaction between consumers and firms takes place repeatedly in the market, buyers are able to observe product quality after purchase. In this case a monopolist could choose to stick to high quality if the discounted stream of future profits emanating from this choice were to be greater than the maximal profit that can be obtained in just one period by cheating (producing low quality goods and claiming that quality is high). This

discounted stream of profits is precisely the advantage of acquiring a reputation (Klein and Leffler, 1981; Shapiro, 1982; Shapiro, 1983).

This kind of reputation model assumes that the horizon of economic agents is infinite. In fact, in a finite horizon when strategic interaction is ending, firms can revert to cheating because there are no more future gains from reputation, simply because the contractual relationship will not be carried on anymore. But if cheating takes place in the last period, even in the next to last period consumers expect firms to cheat. By this logic (Selten, 1978), even in the first period consumers expect firms to cheat and the gains from trade cannot be fully exploited. Thus, if the horizon of economic agents is finite, the existence of reputation seems to be excluded from the theoretical point of view.

However, the reputation effect (Kreps and Wilson, 1982) is widespread in many markets and can render many economic exchanges easier, which otherwise would be rather difficult to carry out since reputation is a good substitute for direct information, which not only would be costly to process by consumers but also untrustworthy. Some empirical foundations for the existence of returns associated with environmental reputation are given by Khanna and Damon (1999), who examine the motivation for participation in a VA and the economic performance of firms in the US chemical industry. In the absence of any financial incentive for participation, the long-term feasibility of such programmes depends on their impact on firms' profitability. While the effect of the programme on the return of investment was significantly negative in the short-run, improvements in consumer goodwill (together with gains in input use efficiency) have proved to offset the cost of pollution control in the long run, thus increasing the expected profitability of firms. Moreover, there is theoretical and empirical evidence about the existence of a reputation effect concerning not only consumers, but also other stakeholders of the firms, such as shareholders and workers (see Khanna, 2001, and the references she quotes). Shareholders may be particularly sensitive to environmental reputation to the extent that financial markets have proved to react to environmental accidents, discounting financial losses that depend on firm liability.

In order to give a satisfactory theoretical explanation for the reputation effect even in a finite horizon, especially considering that many negotiated agreements are actually contracts with a finite duration, we must consider some further issues relating to consumer information. We assume that consumer information is not only asymmetric with regard to environmental quality, but also incomplete with respect to some institutional features that affect firms' behaviour in markets.

Consumers, operating in so many markets, are usually considerably less informed than firms about the constraints that competitors actually face in

each market. This assumption is particularly true for environmental constraints, either at the institutional or at competition level. Consumers can thus put a probability (even very small) on the occurrence of some constraints on firms' behaviour that render the production of lower quality products unprofitable. If these constraints were really binding, the firm would always choose to increase the environmental quality of its products simply because the alternative choice was not feasible. However, consumers are not completely informed about the fact that the low quality choice is actually feasible for firms. On the contrary, firms may know much better if they can afford to sell lower quality products.

In order to give an insight concerning these kinds of consumer beliefs, we can state that people may be (naively) confident about the fact that sooner or later there will be a public intervention to reduce the external (dangerous) effect of economic activities on the environment, while firms know much better the likelihood of such an intervention in their industry. Even if consumers also exclude a potential threat of environmental regulation, they may think that a firm would not produce goods of low environmental quality in order to maintain brand loyalty, because it faces the threat of potential entry by a competitor with a product of higher environmental performance. Therefore, even if in the case of climate change the government is not expected to implement carbon taxes or tighter regulatory standards, the public opinion may either be uninformed about environmental policy or think that firms may be committed to sell products with a low impact on GHG in order to avoid competition by potential entrants.

From the theoretical point of view (Cavaliere, 1999; Cavaliere, 2000), the reputation effect is identified by observing that these kinds of consumer beliefs – that is, the probability that a firm will stick to high environmental quality – are confirmed as strategic interaction reveals to consumers that the firm has actually chosen to produce goods of higher environmental quality in each period. If, after purchase, consumers find that environmental quality is high they will be lead to think that a monopolist is actually constrained by regulation or by competition to supply high quality goods. Therefore, the ex-post probability that a firm is forced to supply goods of higher environmental quality is greater than the prior probability. This is exactly the reputation effect. However, the actual choice of the firm must be certified by monitoring and reporting procedures that provide for information standardization and that are a typical feature of credible VAs. Then a credence good (environmental quality) is turned into an experience good and – if a label is provided – even into a search good. Therefore the 'pure' reputation effect must be supported by active information disclosure in order to operate.

It is nonetheless risky to rely on VAs as environmental policy tools, as firms are incited to milk their reputation at the end of the period. In a

reputation model with a finite horizon, a firm is expected to revert to the low quality strategy in the last period of strategic interaction. Concerning VAs, the risk is that firms will give up their environmental concerns with the expiration of the contract, when reputation is established – consumer beliefs are ‘stable’ – and rents from reputation can be exploited without incurring the related costs. If there are sunk costs connected to the adoption of a new environmental technology, such a risk would be less important as technology switching may not be convenient. On the contrary, if environmental quality depends more on variable inputs use, then environmental effectiveness may be at risk. Beyond the renewal of the agreement, one way to react to this kind of risk would be to set mandatory standards that are consistent with the environmental records already achieved by firms. The provision of a label, as in the case of the energy star programme (‘Energy Star Products’) can be a good substitute for a mandatory standard. Moreover in the specific case of the ‘Energy Star’ programme, energy saving standards have become so widespread in the industry that no firm will consider in practice switching to an older technology.

OVER-COMPLIANCE AS A SIGNAL OF LOWER COMPLIANCE COSTS

There can be cases in which firms over-comply with respect to existing standards but their choice leads to the adoption of green technologies that remain unknown to consumers. This may occur, for example, when firms sell intermediate products to other firms and the final consumers are not directly involved in the contractual relationship. Also in the case of energy efficiency and global climate change there are VAs that lead to process over-compliance. Concerning the US case, EPA programmes like the ‘Coalbed methane outreach programme’, the ‘Natural gas star programme’ and the ‘Voluntary aluminium industrial partnership’ are examples in the field of climate change. All these programmes concern the reduction of GHG in industries whose final product is an input for other industries. In these cases, we are no longer concerned with product over-compliance; rather, we have process over-compliance. Therefore the link between consumers and firms is an indirect one and environmental reputation represents a weaker motivation for over-compliance. However, public recognition from other stakeholders like workers and shareholders could still explain corporate environmentalism and the need to build an environmental reputation. Moreover, the aversion of the US administration towards carbon taxes and the Kyoto Protocol lead us to exclude that such programmes are implemented because of the existence of a regulatory threat, which is not credible nowadays in the USA (Segerson and

Roti Jones, this book; Lyon and Maxwell, this book). Therefore there must be other motivations for firms' behaviour.

Denicolò (2000) points out that both the 'green-consumerism' and the 'regulatory-threat' approach share a common limit to the extent they suppose that tightening environmental regulation reduces firms' profit. This is actually the case when firms are symmetric (their compliance costs are equal). But when firms are asymmetric and competition is tough, the profit of each firm depends on its rivals' costs as well as on its own costs and any firm enjoying a comparative advantage in complying with regulations may also gain from tightening environmental standards. However, to understand how such gains may arise, we have to assume asymmetric information between firms and the government (or a regulatory agency) concerning costs associated with the adoption of green technologies.

Due to innovation efforts, firms can reduce compliance costs. Let us suppose that any public agency that maximizes social welfare would be willing to enforce stricter environmental standards if compliance costs were low while with higher costs it would prefer to stick to existing regulations. As compliance costs are private information, firms characterized by lower costs would wish to signal their competitive advantage to the regulator in order that a stricter standard be implemented and rivals' costs be raised. Over-compliance is then just a way to signal a lower compliance cost, as firms with lower costs will be able to recover their initial 'investment' in signalling through the profit gain obtained as a result of reduced market competition while competitors with higher compliance costs could not afford over-compliance to the extent that they are net losers in the competition game.

Denicolò (2000) also shows some examples of market competition leading to environmental over-compliance in equilibrium. Assuming that firms compete in prices (Bertrand duopoly) and costs are constant, a limit pricing equilibrium obtains where the low cost firm serves the whole market at a price slightly lower than the higher cost of its competitor. Thus in the case of price competition profits are maximized by the low costs firm not only by raising its rivals' costs – thanks to environmental regulation – but by being even able to exclude it from the market. If firms compete in quantities (Cournot duopoly), competition is less fierce and both firms can maintain a positive market share in equilibrium, although the low cost firms gain the greatest share. Considering also the issue of market entry, one can show that over-compliance by an incumbent can lead to entry deterrence to the extent that a fixed entry cost must be paid (this assumption creates an asymmetry *per se*) and such a cost can be recovered by the entrant only if there is no tightening of environmental regulation. By over-complying, the low cost incumbent can induce the government to set stricter standards in order to be

able to maintain its monopolistic position. In this case, over-compliance works as a pre-emptive strategy.

Public agencies observing over-compliance may find it convenient to tighten environmental regulation to the extent that compliance costs seem low and social welfare can increase. Assuming that social welfare is given by the sum of producer surplus (industry profit) and consumer surplus minus environmental damages, when choosing to tighten regulation or not the government must trade-off the social benefits due to the reduction of environmental damages and the social costs due to the output contraction leading to a reduction in consumer surplus. However, one can show that for a plausible set of parameter values, over-compliance increases social welfare.

NEGOTIATED AGREEMENTS AND ABATEMENT COSTS UNCERTAINTY

Environmental issues are often characterized not only by information asymmetries between firms and consumers or between firms and the government, but also by uncertainties concerning both parties of a contractual relationship involving environmental issues. Even firms belonging to the same industry can share some uncertainty about pollution abatement costs and the impact of new technologies devoted to environmental preservation. The question of the validity of scientific knowledge is particularly intriguing in the case of climate change, but it is not the only source of uncertainty that characterizes such issues. Technological uncertainty is widespread to the extent that one wonders not only about what technical change will appear to reduce the cost of climate change mitigation but also about the different options that will become available and their costs (Heal and Kriström, 2002).

In a framework of shared uncertainties, all social actors can be interested in producing and sharing information in order to improve collective learning. In this case we do not deal anymore with the strategic use of information: as we shall see, firms are incited to share information firstly and then to behave strategically at the competition level. In the meantime, one wonders about the impact of information sharing on the competition process. If firms are uncertain not only about their own cost of pollution abatement but also about the cost of their competitors, a VA promoted by a trade association may be helpful in improving information about abatement costs. Provided that firms compete in an oligopolistic setting, information sharing can affect their output strategies. As firms will adjust their output, both the distribution of output between firms and market prices will be affected.

Negotiated agreements between a trade association and a public agency or the government can thus also represent a device to share information about

pollution abatement costs, in order to eliminate (reduce) uncertainty, provided that sharing information increases profits, thereby explaining over-compliance with respect to existing mandatory regulations.

Negotiated agreements are more widespread in Europe than in the USA. OECD (1999) attributes the scarce diffusion of negotiated agreements in the USA to institutional reasons, that is, to the limited discretionary powers of the EPA. In contrast to European environmental agencies, EPA can neither issue a credible threat of regulation nor promise regulatory relief to motivate firms to participate in a negotiated agreement. However, OECD (1999) also points out that the scope for trade associations' actions is to a considerable extent constrained by US antitrust laws. There is some evidence in the antitrust practice that trade associations may be an implicit device in restraining competition through information-sharing activities. A strand of the literature, devoted to information sharing in oligopoly, has also widely discussed this issue in order to ascertain the impact of sharing information – either about market demand or firms' costs – on expected profits and, in some cases, also on expected consumer surplus and social welfare.³

Even excluding explicit collusion by firms, negotiated agreements may have some indirect effect on the final oligopolistic equilibrium, through the process of information sharing about pollution abatement costs. The manifold relationships between VAs and market competition have been surveyed by Brau and Carraro (this book). They point out both that VAs can have strategic effects that increase market concentration and that very concentrated market structures are more likely to lead firms to participate to adopt VA. However, their analysis does not consider firm uncertainty about emission abatement costs. This kind of uncertainty can affect firm behaviour especially when new technologies have been adopted.

In a duopolistic model where firms compete in quantities (*à la* Cournot) and are uncertain about costs, Fried (1984) shows that information production (learning about one's own costs) and disclosure (revealing one's costs to one's competitor) eliminate production errors and modify the distribution of output among firms. In particular, after information sharing each firm will be able to exactly counter-adjust its output to the output produced by its opponent, in order to maximize profits accordingly and produce the Cournot output at the industry level.⁴ To the extent that firms' costs are very different this (collusive) effect of information sharing becomes prominent. On the contrary, if firms' costs exhibit a high degree of correlation, output counter-adjustments following information sharing become less important: output revisions will not significantly change the distribution of output between firms in order to maximize profits.

Cavaliere, Frontoso and Tanasso (2001), in order to evaluate private incentive to enter VAs, consider a market framework similar to Fried (1984),

where firms are uncertain about pollution abatement costs and just comply with the existing regulatory standard. In such a framework a negotiated agreement can be introduced that leads to costly over-compliance but enables firms to eliminate cost uncertainty and reap the benefits of information sharing too. Firms deciding to enter or not into a negotiated agreement must trade-off the benefits of information sharing arising in market competition with the costs of over-compliance with respect to existing standards. As firms are asymmetric, due to different costs of pollution abatement, their incentives to enter VAs may be different, even if they belong to the same trade association.

Analytical results lead us to state that a trade association is more likely to enter a negotiated agreement with the public administration in two different cases: 1) if the regulatory standards are not very tight and the additional effort in pollution abatement required by a negotiated agreement is below a given threshold; 2) if the regulatory standard is already quite tight. The first case seems to be consistent with the existing experience to the extent that VAs are criticized because of their scarce environmental effectiveness as the scale of over-compliance is considered to be too small (Higley and Lévêque, 2001). Firms involved in VAs may just be able to reach those environmental targets that would have been reached even without entering a VA (Business as usual scenario), for example, just because of the effects of technical progress. Such a critique can also concern the case of climate change to the extent that in many countries significant CO₂ taxation or related standards either are lacking or are weak and thus over-compliance can be very easy to achieve. If a VA implies some benefits (as those arising from sharing information about abatement costs), compliance costs can be easily balanced by these same benefits and some 'gains from trade' may easily arise. The case of the German CO₂ agreement is usually quoted as an instructive example. The 'Declaration by German industry and trade on global warming prevention' stated the objective to reduce CO₂ emissions or energy intensity by 20 per cent, between 1990 and 1995. Even if the target appeared as an ambitious one, it actually involved very little reduction beyond what would have happened anyway, given that the major restructuring of German industry after 1990 made CO₂ emissions from East German plants drop by 65 per cent between 1989 and 1995, leading to a substantial reduction for Germany as a whole. However, it must also be said that some industry sectors were able to attain almost 100 per cent of the target, while others did show a less satisfactory performance (OECD, 1999).

Information sharing about pollution abatement costs may benefit firms but not necessarily consumers. When evaluating the welfare effects of VAs that affect market competition, one must always consider that output restraints at the industry level cause a loss of consumer surplus, but in the meantime the

reduction of environmental damages increases social welfare.⁵ However, concerning the negotiated agreement we are considering, it can be shown that social welfare always increases with information sharing, because the positive impact on industry profits dominates any other effect. It is nevertheless worthwhile pointing out that consumer surplus may decrease when uncertainty is eliminated and firms carry out output counter-adjustments that are 'collusive', to the extent they imply a higher price and a lower industry output. Furthermore, the reduction of environmental damages does not necessarily compensate consumer surplus losses.

Cavaliere, Frontoso and Tanasso (2001) show that if the correlation between firms' costs is very high, then the extent of output counter-adjustment is weak and output revisions due to information sharing will not imply output restraints at the industry level that negatively affect consumer surplus. Therefore, there can be further social benefits from VAs beyond those related to the reduction of environmental damages that depend on the scale of the additional abatement effort required by the industry. On the contrary, if cost correlation is weak and output counter-adjustments are carried out in opposite directions (that is, they are 'collusive') consumers can still benefit from the negotiated agreement, provided that environmental standards settled by regulation are not very tight and the additional effort in pollution abatement required by the agreement implies a significant reduction of environmental damages. In fact, in this last case the information sharing effect negatively affects consumer surplus because of the output restraints at the industry level. Therefore, net consumer benefits can increase only if the reduction of environmental damages due to VAs is substantial. Of course, if the environmental standard were already very tight, there would be no additional pollution abatement effort that could compensate consumers for the negative effect due to output restraints, since the reduction of environmental damages is supposed to be bounded upwards.

These conclusions seem to be consistent with the guidelines of the European Commission concerning the anticompetitive effect of VAs (European Commission, 1997), to the extent that even if such effects are recognized, an exemption clause can be granted to the industry, provided that the environmental benefits due to VAs are proved to be large and effective for consumers.

CONCLUSIONS AND POLICY IMPLICATIONS

In this chapter, we emphasized the role played by information in VAs considering these as self-enforcing contracts. The increasing diffusion of VAs in the field of climate change during the last decade has shown that

there is a potential for GHG reduction even in the absence of carbon taxes or tighter environmental regulations. To the extent GHG reductions depend on energy saving, environmental programmes like Green Lights and Energy Star have been able to exploit part of this potential in the USA. These public voluntary programmes were effective in overcoming market failures due to imperfect information that worked as a barrier to the exploitation of energy saving by firms and consumers. Awarding labels helps to reduce the information cost for consumers, by transforming credence goods into search goods, and can be considered one of the reasons for the success of the US programmes. On the contrary, the Eco-labelling scheme of the European Union, while more ambitious in its scope, can be considered as a failure to the extent that most industries did not adopt it. Such a difference could also be ascribed to the fact that the US programmes were less demanding, since just one environmental characteristic of products was considered – energy saving. On the contrary, the Eco-labelling scheme is based on products' LCA (life cycle assessment) and aims to consider all environmental impact of products, following the 'cradle to the grave' approach.

One policy lesson concerns thus the adoption of labelling schemes that consider just one type of environmental impact. Such an approach is less demanding for firms and easier to communicate to consumers. Broader approaches to 'green products' not only are too generic but also more difficult to implement, to communicate and to control. A similar failure has characterized green advertisement in the past. Firms' claims contained in 'green' advertising messages have been attacked by environmentalists, underlining the fact that even those products that incorporated some ecological improvements were still contributing to pollution in many other ways (McDougall, 1993). The repercussions concerning consumers' perceptions about environmental quality of products can be very dangerous, even for firms that are actually contributing to the protection of the environment. On the contrary, when asked about the incentives offered to industry for participating in voluntary approaches, both industry and public authorities place a great weight on the 'positive publicity' afforded by VAs that address environmental protection by focusing on specific issues (European Commission, 1997, p. 34).

Nowadays, the European Union is trying to recover its gap with the USA by focusing its attention on product policies. An example is given by the green paper on Integrated Product Policy, whose aims are summarized in Albrecht (this book). The diffusion of different energy saving standards certified by label awards with different requirements could also affect international trade. In the long run, appliances with the best record concerning reduced energy consumption can displace other products. Thus even if national countries do not impose carbon taxes in order to avoid their

negative effect on competitiveness, concerns about energy savings and GHG reduction that motivate VAs can indirectly operate as a driving force for product achievements within international competition.

When there are GHG reduction policies that are profitable for firms, VAs can represent an instrument to deal with market failures that hamper their implementation. It is then useless to compare the environmental objectives that seem to be reached because of VAs with those results that firms could have probably reached anyway, without subscribing to any agreement (business as usual scenario). On the basis of the arguments developed in this chapter, such a comparison appears useless to the extent that any firm wanting to reach some environmental record in order to acquire an environmentally friendly reputation needs an independent verification and monitoring procedure to make its claims credible.

Concerning the self-enforcing character of most VAs and the issue of product and process over-compliance with respect to mandatory regulations, rational explanations concerning the apparent irrational behaviour of firms can be found when considering the theory of incentives in the framework of asymmetric information. Firms need to 'burn money' by over-compliance if they want to build an environmental reputation or if they want to signal lower compliance costs to the regulator. As 'burning money' is costly, one can think that VAs lead to inefficient allocations. However, considering efficiency one must take account of the fact that over-compliance reduces environmental damages and thus improves social welfare.

Turning to environmental effectiveness, one must distinguish the case of reputation from that of signalling. Concerning VAs that are supported by the reputation effect and are characterized by a finite horizon, the risk is that when the agreement is expiring, firms reduce their environmental concern and revert to the production of lower quality goods. If environmental improvements are incorporated in sunk costs, reverting to the production of lower quality goods may not be a convenient strategy. However, plants can be operated at different levels and thus the risk of reduced compliance is not completely eliminated by the existence of sunk costs. In order to avoid this risk, either VAs must be renovated or environmental achievements must give rise to tighter regulatory standards. Label awards proved to be a good substitute for regulatory standards. In the case of signalling, over-compliance should lead to tighter environmental regulation *per se*, and thus environmental effectiveness merely depends on the technology that was adopted.

Environmental issues like those connected to climate change are often characterized by uncertainty, even on the part of firms, concerning both the environmental effectiveness of new technologies and their costs. Information sharing and learning about costs may also create incentives for firms (and

governments too) to enter VAs, when we also consider the impact on competition in oligopoly. Some negotiated agreements between trade associations and the public administration have captured the attention of the European Competition Authority because of the suspicion of anti-competitive practices. Even the scarce diffusion of negotiated agreements in the USA has also been connected to the fear of antitrust interventions given the attention paid to trade associations as a collusive device.

Even excluding explicit collusion by firms, we have shown that competition is affected by information sharing about pollution abatement costs. If negotiated agreements are a device to share information about environmental technologies, the additional cost of over-compliance may be compensated by the increase in profits due to the reduction of uncertainty in competition. The elimination of cost uncertainty benefits firms to the extent that output counter-adjustments, put in operation after correct cost signals are received, lead to higher profits. On the contrary, consumers may be hurt by output contractions, but if the decrease in environmental damages is significant, then it can offset consumer surplus losses. Thus we found a theoretical foundation for the policy prescription concerning exemptions from European competition laws granted to VAs producing significant environmental benefits.

In the meantime the conclusions of our theoretical analysis also account for the fact that over-compliance, while present, may not imply a significant reduction of environmental damages when the regulatory standard of departure is either weak or not even set out by environmental policies. The case of climate change may be a useful example in this respect. To the extent that many countries have not adopted significantly tighter standards for GHG reductions (or significant carbon taxes), any effort on the part of firms to go beyond environmental regulations may imply profit gains by firms, but environmental effectiveness may be scarce if over-compliance is related to a non-existing standard or carbon tax.

NOTES

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1. For example Arora and Gangopadhyay (1995) ascribe environmental over-compliance by firms to product differentiation strategies based on the willingness to pay for environmental friendly goods. Garvie (1999), without assuming product differentiation, shows that partial internalization of environmental externalities by firms is due to enhanced market demand caused by green preferences. Segerson and Miceli (1999) and, from a different perspective,

Maxwell, Lyon and Hackett (2000) explain that firms over-comply in order to reduce the risk of tighter regulation, or to induce the government to choose a form of regulation more favourable to them.

2. See 'EPA Recognizes Green Power Purchasers' Press release, 09/30/2002. <http://yosemite.epa.gov/opa>
3. We can consider Ponssard (1979) as the seminal paper in this strand of the literature. Ponssard deals with common uncertainty and the incentives for information sharing about a parameter measuring the vertical intercept of market demand, as do the subsequent papers by Novshek and Sonnenschein (1982), Clarke (1983), Vives (1984) and Kirby (1988). Parallel works of Fried (1984), Gal Or (1986) and Shapiro (1986) deal instead with information sharing about firms' costs, that is, private value uncertainty.
4. Without information sharing, firms would use cost estimates to decide the optimal output and thus would incur in production errors and to the extent they would not be able to produce the Cournot output their profit is reduced.
5. See also the welfare analysis of Denicolò (2000) for similar conclusions.

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