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Regulatory conflict? Environmental and economic regulation of electricity generation

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Regulatory Conflict? Environmental and Economic Regulation of Electricity Generation.[1]

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TECHNICAL ABSTRACT

Implementation of policies aimed at reducing atmospheric emissions has drawn attention to the need to integrate policies aimed at protection of the environment into other policy areas such as energy. In this paper we are concerned with the interaction of environmental policies aimed at reducing pollution, and economic policies aimed at reducing market power, in the electricity generation industry. While our analysis focuses on the post privatisation experiences in England and Wales, the analysis is intended to be of a wider applicability. In a theoretical model we find that there are welfare gains to be made from a move from the current non-cooperative regulatory regime to cooperative regulation between the environmental and economic regulators - a result that holds for the alternative environmental policies of a technology standard and an emissions tax.

NON TECHNICAL ABSTRACT (32 lines)

In this paper we are concerned with the interaction of environmental policies aimed at reducing pollution, and economic policies aimed at reducing market power, in the electricity generating industry. Difficulties may arise as the aims of environmental and economic regulators may conflict. An economic regulator may desire a higher output of generated electricity than that of an environmental regulator. An environmental regulator will be concerned with the positive relationship between

industry output and emissions levels. In contrast, an economic regulator will associate a larger amount of electricity generated with larger benefits for consumers resulting from a higher level of electricity consumption at potentially lower prices.

The interaction of environmental and economic regulation is an increasingly important policy area, especially as energy markets around the world are subjected to privatisation and, often, liberalisation. Such policies have often given rise to a greater need for economic regulation of market power. Relatively little research has been undertaken regarding the simultaneous impact of economic and environmental regulation on firms with market power. Whilst models in which a firm faces more than one regulator have been developed in the economics literature, none are directly applicable to the English and Welsh electricity generating industry. Our analysis below was motivated by the post privatisation experience of this industry. However, it is hoped that the results will be of a more general applicability and prove useful to the design of regulatory regimes where environmental policy takes place against a background of other economic policies.

In this paper we outline a theoretical model in which we examine a change of regulatory regime from the current system of separate, simultaneous regulation by the environmental and economic regulators to a cooperative regulatory regime. Environmental regulation of electricity generation in the UK currently utilises technology standards. However, market based instruments such as taxes are important possible policy tools. Hence, we then examine the implications of a move to regulator cooperation given the imposition of either a technology standard or an emissions tax. We conclude that a potential welfare improvement is available as a result of a move to cooperation between the environmental and economic regulators. We find that this result can hold for the use of either a technology standard or an emissions tax as the form of environmental regulation.

1. INTRODUCTION:

The generation of electricity typically suffers from two problems that prevent electricity markets from resulting in optimal outcomes in the absence of government intervention. The first of these market failures is the ability of generation companies to exercise a significant degree of market power. Such market power may enable generators to raise the prices charged to the electricity supply companies[2], the higher prices then being passed on to final consumers. The generation companies may, therefore, in the presence of such market power, be able to increase profits at the expense of consumers. Secondly, the electricity generation sector is a significant contributor to emissions of a range of pollutants including sulphur dioxide, nitrogen oxides and carbon dioxide.[3] Action to date to reduce such emissions includes the EU's 1988 Large Combustion Plants Council Directive 88/609/EEC which required member states to draw up programmes for the progressive reduction of total annual emissions of sulphur dioxide and oxides of nitrogen. The EU's 1996 Progress Report on implementation of the 5th Environmental Action Plan (Commission of the European Communities, 1996) notes the importance of integrating environmental considerations into other policy areas. Following this progress report, the draft

[2] The Regional Electricity Companies (RECs) in the UK.

[3] In the UK electricity generation was responsible for 92 per cent of sulphur dioxide emissions, 28 per cent of nitrogen oxides emissions and 34 per cent of carbon dioxide emissions in 1990; as well as contributing to black smoke including particulates (Newbery and Pollitt, 1997).

Decision of the European Parliament and the Council on the Review of the Programme[4] identified the improved integration of environmental considerations into policy areas such as agriculture, transport, energy, industry and tourism as a priority.

In this paper we are concerned with the interaction of environmental policies aimed at reducing pollution and economic policies aimed at reducing market power in the electricity generation industry. Problems may arise as the aims of the environmental and economic regulators may conflict. The economic regulator may desire a higher output of generated electricity than that of an Environment Agency (EA). The EA will be concerned with the positive relationship between industry output and emissions levels. In contrast, the economic regulator will associate a larger amount of electricity generated with larger benefits for consumers resulting from a higher level of electricity consumption at potentially lower prices.

The interaction of environmental and economic regulation is an increasingly important policy area, especially as energy markets around the world are subjected to privatisation and, often, liberalisation. Such policies have often given rise to a greater need for economic regulation of market power. Our analysis outlined below was motivated by the post privatisation experience of the electricity generation industry in England and Wales. However, it is hoped that the results will be of a more general applicability and prove useful to the design of regulatory regimes where environmental policy takes place against a background of other economic policies.

[4] adopted on 24th January 1996

In this paper we outline the results of theoretical modelling work in which we examine a change of regulatory regime from the current system of separate, simultaneous regulation by the two regulators to a cooperative regulatory regime. Environmental regulation of electricity generation in the UK currently utilises technology standards. However, market based instruments such as taxes are important possible policy tools. Hence, we examine the implications of a move to regulator cooperation given the imposition of either a technology standard or an emissions tax.

2. REGULATION OF ELECTRICITY GENERATION IN ENGLAND AND WALES:

The electricity generation sector in England and Wales is subject to both environmental and economic regulation. Environmental regulation relates, as noted above, to pollutants produced as by-products of electricity generation. The Environment Agency is required to prevent, minimise, remedy or mitigate the effects of pollution of the environment. The main policy instrument currently used by the EA is regulation requiring the installation of abatement technology in accordance with the BATNEEC rule – best available technology not entailing excessive cost. However alternative policy instruments, such as a tax on emissions could also be used to reduce emissions. Both of these policies will lead to a rise in the marginal private costs of generation and will therefore reduce incentives to generate electricity. If lower levels of electricity are produced, total emissions consequently fall.

Economic regulation relates to generators' market power. Despite the break up of the electricity industry in England and Wales, significant market power has remained in both the generation and supply sectors, necessitating the use of economic regulation. While the generation of electricity has not been continuously subject to price regulation, the economic regulator (OFFER) imposed a price cap on electricity pool purchase prices for the financial years 1994/5 and 1995/6. National Power and PowerGen also gave voluntary undertakings to divest of plant in both 1996 and 1998 to satisfy OFFER's concerns about the extent of their market power. Further, first OFFER and now the Energy Regulator (ER)[5] continue to constantly monitor the generators (Littlechild, 1995), and proposals are currently being discussed to change the structure of the pool market to encourage greater competition in the generation of electricity (OFFER, 1998). The scale of initial investment costs associated with entering this industry in any country may provide a significant barrier to entry. Hence, it can be expected that some economic regulation of electricity generators may often be required. The electricity generation sector can, therefore, be argued to be subject to both environmental and economic regulation.

[5] The Energy Regulator is now the economic regulator with responsibility for the electricity and gas industries in the UK, formed through the merging of OFFER and the gas regulator OFGAS.

3. THEORETICAL FRAMEWORK:

There is an extensive economics literature on the optimal methods of regulating firms with market power (see Armstrong *et al.* (1994) for a summary of many of the significant models). Similarly, existing literature describes the implications of differing methods of reducing market failures associated with the pollution that can emerge as part of a production process. This research spans the production of pollution by firms under a range of market structures including competitive, oligopolistic and monopolistic firms.[6] However, relatively little work has been undertaken regarding the simultaneous impact of economic and environmental regulation on firms with market power. Whilst common agency models in which an agent (firm) faces more than one regulator have been developed in the economics literature (Armstrong, Cowan and Vickers, 1994), none are directly applicable to the English and Welsh electricity generating industry. Baron (1985) describes the impact of economic and environmental regulation on a single monopolistic producer of a non-localised pollution externality in the US, studying the implications of both cooperative and non-cooperative policy making by the two regulatory bodies concerned. Fullerton *et al*. (1997) model the implications of alternative methods of economic regulation on the costs of sulphur dioxide compliance under the US Clean Air Act Amendments of 1990 which provide for a system of tradeable emissions permits.

[6] See, for example, Perman *et al.* (1996) for a review of economic policies for pollution reduction. See Buchanan (1969), Endres (1978) and Dnes (1981) for discussion of pollution control with monopolistic production; and Levin (1985) for discussion of pollution control with oligopolistic production.

The analyses by Baron and Fullerton *et al.* rest on assumptions intended primarily to reflect the US electricity industry, which is made up of a number of vertically integrated local monopolies, and subject to 'cost-plus' regulation[7] by the economic regulator. Hence, it may not be directly applicable to the electricity generating industries of other countries, including the UK, where the electricity industry is not vertically integrated and where regulation to date has taken the form of price-cap[8], rather than cost-plus, regulation. In addition, both Baron and Fullerton *et al.* discuss possible forms of pollution regulation that differ from those applied in, for example, England and Wales.

The discussion below is based on a theoretical model that can be used to illustrate the implications of the economic and environmental regulators acting together to maximise their joint objectives, rather than acting non-cooperatively and simultaneously. The first results presented are for the case where the EA sets a technology standard, as is the case currently in England and Wales. We then consider the case of an emissions tax[9]. We compare the non-cooperative and cooperative outcomes under both forms of environmental regulation. In this paper we examine regulation at the industry level, our aim being to highlight the welfare implications of alternative methods of environmental regulation and a move to cooperation between the environmental and economic regulators. We therefore assume that the generation

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[7] Cost-plus regulation is also known as rate-of return regulation. The regulator specifies an allowable level of return i.e. the covering of costs plus a (potential) mark-up Y.

[8] Price-cap regulation, as used widely in UK utility industries, involves specification of a maximum price according to an RPI – X formula, where the regulator specifies X.

[9] In the UK it would be HM Treasury that would be responsible for raising an emissions tax, in consultation with the EA. In order to maintain a simple exposition of the model we assume that HM Treasury will set a tax in line with the EA's wishes and therefore discuss a tax as if applied directly by the EA.

companies act together to maximise profits and the case of a single monopolist is mimicked.

4. MODEL:

In order to simplify our exposition, we assume that the Environment Agency is concerned with only one pollutant that is produced as a by-product of electricity. We take the case of sulphur dioxide emissions, as a large proportion of electricity generation remains dependent on coal. Emissions are modelled as synonymous with the environmental damage from electricity generation. Initially, the EA regulates using the BATNEEC rule and so specifies a technology standard (such as the fitting of desulphurization equipment or the use of clean coal technology). In this static analysis we assume that the generators do not have the ability to switch generation capacity to additional gas or nuclear plants.

We model the economic regulator as aiming to maximise a weighted average of a) consumer surplus[10] plus producer profits, and b) producer profits. In the analysis below, this is achieved by imposing an explicit price ceiling on electricity generation prices.[11]

The results presented are based on a 'one-shot' game, in which each player moves only once, and both regulators are assumed to have full information. A further simplifying assumption is that the model focuses exclusively on a single pool market for electricity;[12] hence, generation price is an average pool purchase price.[13]

It is initially assumed that the regulators act non-cooperatively. This may be an appropriate assumption to make for England and Wales as:

> "...the House of Commons Trade and Industry Committee heard during its recent inquiry into energy regulation, there is no effective dialogue between the economic regulators (OFGAS and OFFER) and the environmental regulators (Environment Agency)."
>
> John Chesshire (1997) p.12

4.1. Environmental Regulation:

[10] Consumer surplus represents consumer welfare as it refers to the difference between the price paid and the price that consumers are willing to pay for a product.

[11] The authors believe that in the UK, the ER continues to implicitly impose a price ceiling. If this price level is exceeded, an explicit price restraint may be imposed on the generators. If prices rise above this explicit ceiling, the regulator can take further action, such as a referral to the relevant competition agency. See Acutt and Elliott (1998) for further details of the ER's regulation of electricity generation, including discussion of implicit price caps.

[12] A long term contract market is not considered.

If the Environment Agency sets a technology standard based on BATNEEC which requires the best available technology not entailing excessive cost, then its objectives can be modelled as the minimisation of emissions[14] plus a proportion of abatement costs (and any increased production costs arising from the new technology). The EA takes this proportion of costs into account in order to avoid the firm incurring excessive costs. The EA's objective function given technology standard regulation can, therefore, be stated as:

$$Min. Z = X(Q,t) + \delta[A(Q,t) + C(Q,t)] \quad 1)$$

where:

X = sulphur dioxide emissions;

Q = industry output;

t = an index of the 'cleanliness' of electricity generation technology;

d = the proportion of the burden of additional abatement and production costs faced by generators that the EA takes into account, $0 \leq \delta \leq 1$;

A = total abatement costs that derive from fitting a plant with a cleaner technology;

C = industry total costs of production.

It is assumed that emissions rise with output and fall with the technology standard, and both abatement and production costs rise with the technology standard. That is:

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[13] Note that the industry is modelled as comprising the generating companies and electricity supply companies; but these are modelled as distinct, with attention focusing on the generation market in this paper.

[14] Emissions may be considered a proxy for damage costs.

$$\frac{\partial X}{\partial Q} > 0 \quad \frac{\partial X}{\partial t} < 0 \quad \frac{\partial A}{\partial t} > 0 \quad \frac{\partial C}{\partial t} > 0$$

Minimisation of the EA's objective function with respect to *t* results in 2), according to which the EA will set a technology standard.

$$\mathrm{d}\left(\frac{\partial A}{\partial t} + \frac{\partial C}{\partial t}\right) = -\frac{\partial X}{\partial t} \qquad 2)$$

This level occurs where the marginal benefits of the technology standard are equal to the proportion of marginal abatement and production costs (with respect to a change in technology) that the EA takes into account.

4.2. Economic Regulation:

As noted above, we model the ER as aiming to maximise a weighted sum of a) consumer surplus plus profits, and b) profits, taking account of the costs of abatement incurred by the industry in order to satisfy the EA. The ER then achieves these objectives by imposing an explicit price cap on electricity generation prices. These objectives enable the ER to maximise both current benefits to consumers in terms of consumer surplus, but also allows firms at least to cover costs. If firms are permitted to make profits, this may encourage investment and aid the achievement of dynamic efficiency.

The ER's objective function is, therefore, defined as:

$$Max.V = (1-\beta)\left[\int_0^Q P(Q)dQ - C(Q,t) - A(Q,t)\right] + \beta\left[P(Q)Q - C(Q,t) - A(Q,t)\right] \quad 3)$$

where:

P = the industry price faced by the regional electricity companies[15], who then charge final consumers of electricity a price equal to P plus their (regulated) increment to generators' prices;

b = a parameter to reflect the relative weight the regulator places on consumer surplus and producer profits, $0 \le \beta \le 1$.

It is assumed that both production and abatement costs rise with output, that is:

$$\frac{\partial C}{\partial Q} > 0 \qquad \frac{\partial A}{\partial \mathrm{Q}} > 0$$

Maximisation with respect to Q gives rise to equation 4) and the ER will set a price ceiling accordingly:

$$P - \beta bQ = \frac{\partial C}{\partial Q} + \frac{\partial A}{\partial Q} \quad 4)$$

[15] It is assumed that demand for generated electricity can be represented by a linear inverse demand schedule, P = a - bQ.

The resulting optimal price ceiling will be set where the generators' price is equal to the sum of the marginal costs of production and abatement when b, the weight placed on producer profits, is zero. As b increases towards unity the price ceiling rises, enabling generators to increase profits. Ultimately, when b takes its maximum value of one, the price ceiling is set at the level where profits are maximised.

When b = 0:

$$P = \frac{\partial C}{\partial Q} + \frac{\partial A}{\partial Q} \qquad 5)$$

and, when b = 1:

$$\frac{d(PQ)}{dQ} = \frac{\partial C}{\partial Q} + \frac{\partial A}{\partial Q} \qquad 6)$$

4.3. Implications of the Non-cooperative Regulatory Regime:

Minimisation of the EA's objective function is achieved when the technology standard imposed is higher than the optimal level of abatement technology. The optimal level would be achieved by setting the marginal reduction in emissions resulting from the installation and use of 'cleaner' technology equal to the marginal costs of installing and using the 'cleaner' technology. However, the EA will set the technology standard where the marginal benefits of the standard are equal to only a proportion of marginal abatement and production costs. This is because the EA is only taking a proportion of the costs involved into account, in order to avoid excessive costs.

The generators will, as a result of the technology standard, now face increased marginal costs and so will reduce output. The price at which the generators' output can be sold is constrained by the economic regulator's price ceiling. Assuming that the economic regulator correctly estimates the technology standard imposed by the EA (and therefore its associated costs), when b = 0 the generators will only be able to cover their costs. Output is lower than in the absence of regulation, and price is greater than in the absence of environmental regulation because costs have increased as a result of the imposition of the technology standard.

4.4. Cooperation:

Let us now assume that the two regulators cooperate. Their combined objectives can be modelled as maximising a weighted average of a) consumer surplus plus profits, and b) profits, minus emissions. The proportion of generators' profits taken into account must now be agreed between the two regulators. As noted above, the ER may prefer generators to make some positive level of profits. However, the EA would only wish to take account of increased costs resulting from technology regulation if they are 'excessive'.

The joint objective function given a technology standard can be defined as:

$$
\begin{aligned}
Max.U &= (1-\gamma)\left[\int_0^Q P(Q)dQ - C(Q,t) - A(Q,t)\right] \\
&\quad + \gamma\left[P(Q)Q - C(Q,t) - A(Q,t)\right] - X(Q,t)
\end{aligned}
\qquad 7)
$$

where:

γ = a parameter reflecting the relative weight the two regulators place on consumer surplus and producer profits, $0 \leq \gamma \leq 1$.

Optimal conditions for the maximisation of the joint objective function are:

$$P - \gamma bQ = \frac{\partial C}{\partial Q} + \frac{\partial A}{\partial Q} + \frac{\partial X}{\partial Q}$$
$$\frac{\partial C}{\partial t} + \frac{\partial A}{\partial t} = -\frac{\partial X}{\partial t} \qquad 8)$$

Therefore, when $\gamma = 0$:

$$P = \frac{\partial C}{\partial Q} + \frac{\partial A}{\partial Q} + \frac{\partial X}{\partial Q} \qquad 9)$$

and, when $\gamma = 1$:

$$\frac{d(PQ)}{dQ} = \frac{\partial C}{\partial Q} + \frac{\partial A}{\partial Q} + \frac{\partial X}{\partial Q} \qquad 10)$$

Welfare gains can be shown to derive from cooperative, as opposed to non-cooperative, regulation. From 8) it can be seen that the technology standard imposed will no longer be as severe once the regulators cooperate, as the full marginal costs of abatement and production are now taken into account.[16] This results in increased emissions and so a reduction in welfare. However, the price ceiling imposed on generators can be expected to be less stringent than when regulation was non-cooperative. Consumers benefit from a greater output being produced, and producers will always enjoy positive profits. These welfare benefits counteract the reduction in

[16] Provided that d < 1 when the regulators did not cooperate.

welfare that results from the higher level of pollution. Overall welfare gains from cooperation compared to non-cooperation depend on the size of the increase in consumer surplus plus producer profits compared to the change in the environmental costs resulting from an increase in pollution. However, as pollution levels remain below the theoretically optimal level, there will be an overall welfare gain from cooperation.

4.5. Emissions tax:

Taxes on emissions have often been suggested as an alternative form of environmental regulation. Faced with a tax on emissions, generators can choose between paying the tax and/or installing technology to reduce the amount of emissions produced as part of the production process. Assuming the generators operate efficiently to minimise their costs as a result of the tax, it is expected that they will install technology until the marginal cost of installation and use equals the marginal cost of paying the tax.

Given an emissions tax rather than a technology standard, the EA's objectives can be modelled as the minimisation of emissions plus a proportion of abatement and tax costs (and any increased production costs arising from the use of improved abatement technology) minus a proportion of any tax revenues. The proportion of tax revenues can be between zero and one and reflects the account taken of tax revenues, which have a positive value to the government and may be traded off against the level of emissions and abatement costs.

The EA's objective function, given an emissions tax rather than a technology standard, can be stated:

$$Min.Z = X[Q(\vartheta), t(\vartheta)] + \delta [C(Q(\vartheta), t(\vartheta)) + A(Q(\vartheta), t(\vartheta)) + R(X(Q(\vartheta), t(\vartheta)))] \\ - \rho R[X(Q(\vartheta), t(\vartheta))] \qquad 11)$$

where:

ϑ = the tax rate, $0 \le \vartheta \le 1$;

R = tax revenue accruing to the government;

ρ = the account taken by the EA of tax revenues; $0 \le \rho \le 1$.

$\frac{\partial Q}{\partial \vartheta} < 0 \quad \frac{\partial t}{\partial \vartheta} > 0 \quad \frac{\partial R}{\partial X} > 0$

Minimisation with respect to ϑ results in:

$$\frac{\partial X}{\partial Q}\frac{dQ}{d\vartheta} + \frac{\partial X}{\partial t}\frac{dt}{d\vartheta} = (\rho - \delta)\left(\frac{\partial R}{\partial X}\frac{\partial X}{\partial Q}\frac{dQ}{d\vartheta} + \frac{\partial R}{\partial X}\frac{\partial X}{\partial t}\frac{dt}{d\vartheta}\right) \\ - \delta\left(\frac{\partial C}{\partial Q}\frac{dQ}{d\vartheta} + \frac{\partial A}{\partial Q}\frac{dQ}{d\vartheta} + \frac{\partial C}{\partial t}\frac{dt}{d\vartheta} + \frac{\partial A}{\partial t}\frac{dt}{d\vartheta}\right) \qquad 12)$$

If the government is concerned about tax revenues, then it will be willing to trade higher emissions for positive tax revenues.

The objective function of the ER is now:

$$
\begin{aligned}
Max.V = (1-\beta)\left[\int_0^Q P(Q)dQ - C(Q(\vartheta),t(\vartheta)) - A(Q(\vartheta),t(\vartheta)) - R(X(Q(\vartheta),t(\vartheta)))\right] \\
+ \beta\left[P(Q)Q - C(Q(\vartheta),t(\vartheta)) - A(Q(\vartheta),t(\vartheta)) - R(X(Q(\vartheta),t(\vartheta)))\right]
\end{aligned} \qquad 13)
$$

When the regulators do not cooperate, the ER imposes a price ceiling equal to the marginal costs of production plus tax payments if $\beta = 0$. Again, as β rises towards unity, the price ceiling will rise until the profit maximising price is reached.

Under cooperation between the economic and environmental regulators, their joint objective function will now be:

$$
\begin{aligned}
Max.V = (1-\gamma)\left[\int_0^Q P(Q)dQ - C(Q(\vartheta),t(\vartheta)) - A(Q(\vartheta),t(\vartheta)) - R(X(Q(\vartheta),t(\vartheta)))\right] \\
+\gamma\left[P(Q)Q - C(Q(\vartheta),t(\vartheta)) - A(Q(\vartheta),t(\vartheta)) - R(X(Q(\vartheta),t(\vartheta)))\right] - X[Q(\vartheta),t(\vartheta)] \\
+ \rho R[X(Q(\vartheta),t(\vartheta))]
\end{aligned} \qquad 14)
$$

Once again there is a further welfare gain as a result of regulator cooperation. As was true of the move to regulator cooperation when environmental regulation took the form of a technology standard, economic regulation can be weaker, in which case price is permitted to be greater than marginal cost and producers make positive profits. Again we would expect the joint regulator to set a lower tax rate as the EA acting alone takes no account of consumer benefit which increases as the tax rate decreases, given simultaneous economic regulation.

5. CONCLUSIONS:

This paper has outlined a theoretical model delineating the basic characteristics of the electricity generation industry in England and Wales. The model is used to analyse and compare the implications of the two regulators – the Energy Regulator and the cooperating and acting non-cooperatively. This analysis, relating to the interaction between environmental and other policy objectives, may be seen as particularly timely due to current national and EU policy agendas. At the national level the UK government has recently been conducting a consultation process on utility regulation following the publication of a 'Green Paper' in this area (Department of Trade and Industry, 1998). Meanwhile at an EU level, the draft Decision of the European Parliament and the Council on the Review of the 5th EAP adopted on 24th January 1996 highlighted the importance of the integration of the environment into other policy areas including energy.

Our modelling work suggests that a potential welfare improvement is available as a result of a move to regulator cooperation. Under a cooperative regime, whilst welfare is reduced as a result of less investment in cleaner technology by firms, welfare is simultaneously increased as industry output and consumer surplus plus producer profit will be greater than under non-cooperation. The overall impact on welfare depends on the relative size of the two welfare changes. However, as the cooperative outcome results in lower levels of production and pollution than the optimal level of both of these outputs, the increase in consumer surplus plus producer profits will outweigh the increase in pollution costs, making cooperation welfare improving. We find that these results hold for the use of either an emissions tax or a technology standard as the form of environmental regulation.

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