Part II

MOVING FROM THEORY TO PRACTICE—IMPLEMENTATION OF ENVIRONMENTAL TAXES AND OTHER ECONOMIC INSTRUMENTS

Political Acceptability

2

SOME QUASI-BEHAVIOURAL ARGUMENTS FOR ENVIRONMENTAL TAXATION

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2.01 For decades, economists have advocated for the adoption of environmental taxes to reduce pollution at the lowest social cost. This campaign has succeeded in Europe, where a wide variety of environmental taxes are in effect, but failed in North America, where environmental taxes are rare.[1] Economists have failed to persuade North American policy-makers to make any significant policy use of

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[1] Not only do taxes generally make up a smaller percentage of GDP in North America, but environmental taxes make up a smaller percentage of tax revenue. For example, in the US, Canada, and Mexico, respectively, gasoline taxes are 10, 11, and 25 cents (US) per litre, respectively, less than any of the 26 other countries surveyed by the International Energy Administration in 2000. Environmental tax revenues in the US, Canada, and Mexico constitute approximately 0.9%, 1.45%, and 1.5% as a percentage of GDP. T Sterner and G Köhlun, 'Environmental Taxes in Europe' (2003) 3 *Public Finance And Management* 117, 125 figure 1, 129 table 2.

environmental taxes.[2] This chapter presents three arguments that draw upon the behaviouralist and organizational literatures, and augment the economic arguments proffered thus far in favour of environmental taxes. Taken together, the old and new arguments provide a compelling case for the wider adoption of environmental taxes, and a more critical assessment of the traditional North American approach—a technology-oriented, 'command-and-control' approach to environmental regulation.

2.02 In this chapter, 'command-and-control' regulation means regulation that is defined in terms of *minimum pollution standards*, whether this is by reference to industry practices, or to standards of performance, such as a maximum pollution rate per unit of input. While command-and-control regulations do not generally command a specific type of pollution control equipment, they are typically derived by reference to the performance of a known method of pollution control.[3] While the working definition adopted here is susceptible to debate, it suffices as a juxtaposition against environmental taxation for purposes of presenting these three quasi-behavioural arguments.

2.03 First, environmental taxation creates conditions under which firms undertake creative processes to innovate in pollution reduction. Most pollution regulation schemes in North America, of the command-and-control type and predicated upon pollution control technologies, make compliance a matter of technological

[2] In a 2004 report, the OECD noted Canada's reluctance to embrace economic instruments generally: 'Despite the introduction of a number of economic instruments for environmental policy purposes, mainly at the provincial level, limited use has been made of economic instruments for environmental management at any level of government. A number of constraints affect greater uptake of economic instruments. Industry is concerned about day-to-day competitiveness pressures, especially in relation to cost competitiveness with the US. It has difficulty understanding how to implement new instruments such as trading. Within governments, economic agencies have supported economic instruments in principle, but resisted specific proposals for targeted incentives on allocative efficiency grounds. The public is wary of new fees and charges, and of the allocation of the 'right to pollute'. There is general resistance to external pressure to change consumption patterns. Small but influential groups have blocked some proposals.' OECD, *Environmental Performance Review of Canada* (2004).

[3] Some argue that the phrase command-and-control is overly pejorative in this sense, in that some flexibility is usually allowed. D Driesen, *The Economic Dynamics of Environmental Law* (MIT Press, 2003) 51–52. There are, however, still some provisions that obviously contemplate the use of a specific technology, eg of the Clean Air Act, s 407 and regulations thereunder set forth specific limitations for each of six types of coal-fired boilers, 40 CFR. §§76.5–76.7 (1996). The emissions limitations are those emissions rates that are typically achieved after the installation of low NO_x burner technology. Section 407 of the Act further states that the '[EPA] may set a rate higher than that listed if [it] finds that the maximum listed rate for that boiler type cannot be achieved using *low NO_x burner technology*', 42 USC §7651F(b)(1) (emphasis added). Section 407 goes on to provide that a regulatory authority '*shall*, upon the request an owner or operator . . . authorize an emission limitation less stringent than the applicable limitation established [s 407] upon a determination that [the unit] cannot meet the applicable limitation using low NO_x burner technology . . . ' 42 USC §7651F(d) (emphasis added).

obedience, where creativity, innovation, and collaboration are not encouraged. By contrast, market-based regulatory tools such as environmental taxes link pollution directly to profits, making pollution reduction a *challenge*, harnessing creative energies. And importantly, environmental taxes do not limit the options available to meet this challenge, providing greater incentives to overcome organizational barriers to innovation and recruit creative energies in the mission of pollution reduction.

2.04 Secondly, environmental taxation can induce pollution reduction without creating perverse incentives to preserve polluting capital. Environmental taxes at appropriate levels send price signals to polluters, causing them to evaluate the present and future costs of pollution, including their cost of capital. Command-and-control regulation, by forcing polluters to add expensive pollution control equipment to their capital base, only causes polluters to protect and preserve their polluting facilities more vigorously. The effect is to increase the longevity of polluting capital. Thus, while the pollution control equipment will reduce emissions of the controlled pollutant in the short run, the expense of the equipment will extend the life of the polluting capital and prolong the imposition of other environmental externalities. It may even, in the long run, increase emissions of the controlled pollutant.

2.05 Thirdly, environmental taxation can help to redirect public discourse towards the environmental damages of pollution. Debate over command-and-control regulation focuses upon the pollution control equipment itself, and has focused discourse upon the ability of polluters to meet command-and-control mandates. This comes at the expense of discourse on the effects of pollution upon the environment. As Pigouvian environmental taxes are supposed to be set at the level of marginal pollution damages,[4] a precisely drafted statutory mandate for Pigouvian taxation—one that directs agencies *only* to consider the environmental damages in setting taxation levels, and *not* industry compliance costs—can keep regulatory agencies and public discourse focused on the environment, and not on the economic circumstances of polluters.

2.06 These quasi-behavioural arguments have not been widely considered up to this point, perhaps because behaviouralism has only recently made its way into the economic literature and the environmental literature.[5] To some extent,

[4] A C Pigou, *The Economics of Welfare* (Macmillan & Co, 1928) 131–5. Taxes that reflected the extent of negative externality thus became known as 'Pigovian' taxes. WJ Baumol and WE Oates, *The Theory of Environmental Policy* (Cambridge University Press, 2nd edn, 1988) 21–3.

[5] While pioneers such as Simon, Tversky, Kahneman, and Knetsch have been writing on behavioural aspects of economic activity, applications to economic research still seem to lag behind those employing more traditional economic precepts. For a pioneering work on behaviouralism as applied to environmental problems, see BH Thompson, 'Tragically Difficult: Obstacles to Governing the Commons' (2000) 30 Environmental Law 241.

these arguments are atheoretical. Nevertheless, such arguments are based on actual observations, and may reflect reality more than many theoretical arguments. They should be considered seriously by academics and policy-makers.

A. Traditional Economic Arguments

2.07 The economic case for environmental taxes typically includes the following: (1) Pigouvian,[6] or per-unit-of-pollution taxes, levied at an appropriate level, internalize externalities by equalizing the marginal social damages and marginal social benefits of the polluting activity;[7] (2) environmental taxes will produce incentives to innovate in ways that reduce pollution;[8] and (3) environmental taxes will induce pollution reduction at those facilities that can reduce pollution most efficiently and cheaply, accomplishing pollution reduction at the lowest overall cost.[9] Acceptance of these arguments is by no means universal, but there is wide acceptance of these arguments and their variants as the primary economic justifications.

2.08 Other arguments that sound in economics have also been made in favour of environmental taxes. It has been asserted that enforcement might be less problematic under a taxation scheme than traditional command-and-control regulation.[10] This is only true if the resources and devices are available for monitoring and measuring emissions.[11] Technological advances have been made such that some pollutants are now more easily monitored and measured. Alternatively, some

6 Pigou (n 4 above).

7 T Tietenberg, *Environmental and Natural Resource Economics* (Harper Collins, 3rd edn, 1992) 367–371; D Duff, 'Tax Policy and Global Warming' (2003) 51 *Canadian Tax Journal* 2063, 2069–70.

8 R Gerlagh and W Lise, 'Induced Technological Change Under Carbon Taxes', Fondazione Eni Enrico Mattei, Working Paper No 84.2003 (2003), available at <http://ssrn.com/abstract=464841>; D Popp, 'Induced Innovation and Energy Prices' (2002) 92 *American Economic Review* 160.

9 Tietenberg (n 7 above); W J Baumol and W E Oates, 'The Use of Standards and Prices for the Protection of the Environment' (1971) 73 *Swedish Journal of Economics* 43, 46.

10 Buchanan and Tullock asserted in their 1975 paper that: 'The . . . tax remains the preferred instrument on strict efficiency grounds, but, perhaps more significantly, it will also facilitate the enforcement of results once they are computed.' JM Buchanan and G Tullock, 'Polluters' Profits and Political Response: Direct Controls Versus Taxes' (1975) 65 American Economic Review 139, 140. This assertion has become almost a truism, as many others have parroted this argument. M Faure and S Ubachs, 'Comparative Benefits and Optimal Use of Environmetnal Taxes' in *Critical Issues in Environmental Taxation, Vol I* (2002) 41–44. There is also the sense that taxation schemes are less vulnerable to rent-seeking and political mischief, due to the presumptive uniformity of taxes. S Smith, 'Environmental and Public Finance Aspects of the Taxation of Energy' (1998) 14 *Oxford Review of Economic Policy* 64, 67.

11 DH Cole and PZ Grossman, 'When Is Command-and-Control Efficient?' (1999) 1999 Wisconsin Law Review 887.

pollutants may be taxed on the basis of some proxy, such as the quantity of some input to the polluting process.[12] In summary, however, it is not easy to generalize about the ease of enforcing environmental taxes versus command-and-control schemes.

2.09 Environmental taxes have also been suggested as a revenue-raising mechanism.[13] However, revenue raising and pollution reduction are inconsistent goals. A revenue-raising tax would contemplate low price elasticity, so that revenues would not change very much due to the tax; a pollution reduction tax would contemplate high price elasticity, so that the tax actually changes polluting behaviour.[14] Revenue raising can be considered a side benefit but not a primary argument for environmental taxes.

2.10 There are other non-economic justifications for environmental taxes, such as the 'polluter pays' principle, which posits that the cost of pollution should be borne by polluters.[15] However, it is not clear how the principle adds anything to the theory of Pigouvian taxation, since it tells us nothing as to why, as a normative matter, the cost of polluting should be borne by the polluter. If the principle stems from tort law, then it is hard to see how it adds anything to simple tort law.

2.11 A tremendous amount of scholarly work in several disciplines has been devoted to environmental taxation, and a wealth of rigorous research has provided an overwhelming case for environmental taxes. But it has not gained traction in North American policy circles.

[12] The idea would be that the quantity of polluting input serves as an approximation of the actual amount of pollution emitted. A gasoline tax could be considered a close-to-Pigouvian tax, in that the amount of gasoline used is very close to the amount of pollution emitted by a motor vehicle. A tax on the carbon content of coal is sometimes proposed as a close-to-Pigouvian tax on Co_2. Somewhat less accurate would be a fertilizer tax to capture the costs of water pollution created by agricultural practices. Of course, if the proxy is not proportional to the quantity of pollutant, the scheme may produce perverse incentives. BS Cournede and SJ Gallon, 'Input Versus Output Taxation of Electricity in France: How Choosing the Wrong Tax Instrument Can Lead to Environmental Damage' in Janet Milne *et al* (eds), *Critical Issues in Environmental Taxation* (2002) ch 13.

[13] D Burtraw and PR Portney, 'A Carbon Tax to Reduce the Deficit' in RD Morgenstern and PR Portney (eds), *New Approaches on Energy and the Environment* (Resources for the Future, 2004) 19.

[14] K Määttä, 'Finnish Energy Taxation: How Well Has It Worked? 'in J Milne *et al* (eds), *Critical Issues in Environmental Taxation* (Richmond Law & Tax Ltd, 2002) 12, 177.

[15] Duff (n 7 above) 2070; J Milne, 'Environmental Taxation: Why Theory Matters' in J Milne and *et al* (eds) (n 14 above) 1, 5–9.

B. Environmental Taxation and Decentralized Trading Programmes

2.12 Arguments for environmental taxation overlap considerably with arguments for emissions trading programmes, or decentralized trading programmes (a phrase I consider more accurately descriptive).[16] A protracted discussion comparing environmental taxation and decentralized trading programmes is beyond the scope of this chapter, but it is worth noting a few important differences.[17] First, to the extent that decentralized trading programmes tend to grandfather pollution rights by allocating them on the basis of historical emissions, there is a distribution issue. Whereas environmental taxes confer an entitlement upon society at large to be free of pollution (an entitlement that can be purchased by the polluter), decentralized trading programmes that allocate permits by grandfathering confer an entitlement upon polluters to pollute, albeit within the quantity limits established by the programme. While the distribution issue is complex—depending on the elasticity of the product, polluters may or may not pass additional costs on to customers—polluters clearly benefit from grandfathered pollution rights.

2.13 A second important difference between decentralized trading and environmental taxation programmes is that the latter are more economically efficient if tax proceeds can be used to reduce other taxes that have distorting effects.

[16] 'Emissions trading' is a label that has been used to describe programmes in which government authorities adjudicate the right to emit a quantity of pollutant, based on some demonstration that a pollution reduction, or *offset* has been achieved elsewhere. In these programmes, there is no 'cap' on emissions, but some judgment that a reduction has been achieved from a business as usual case. For example the South Coast Air Quality Management District, responsible for reducing pollution in the Los Angeles basin, implemented a programme to allow excess emissions at a Long Beach marine terminal in exchange for the undertaking of an automobile scrapping programme. Not only do these programmes potentially generate 'hot spots', but they are a fertile source of rent-seeking. This is distinguished from true trading programmes, where a 'cap' is imposed, and trading takes place among regulated entities, rather than between a regulated entity and a regulatory authority. Opportunities for rent-seeking in such cases are minimized by the lack of regulatory involvement with trading activity. S-L Hsu, 'Fairness Versus Efficiency in Environmental Law' (2004) 31 Ecology Law Quarterly 303, 369–370. Caps can also be adjustable, as under emissions 'intensity' programmes, whereby the allocation of permits is keyed to the amount of productive output of a facility. Thus, facilities can emit more if they can increase the pollution efficiency with which they produce.

[17] Some theoretical early work set out conditions under which uncertainty meant that price mechanisms (such as taxes) or quantity mechanisms (such as tradable permit schemes) would yield smaller deadweight losses in case of error. M Weitzman, 'Prices vs. Quantities' (1974) 41 Review of Economic Studies 477; H Gruenspecht and L Lave, 'The Economics of Health, Safety, and Environmental regulation' in R Schmalensee and R Willig (eds), *Handbook of Industrial Organization Vol 2* (Elsevier, 1989) 26.

This 'double dividend' argument has been the subject of robust debate,[18] but is relatively uncontroversial in that most reasonable uses of environmental tax proceeds would yield at least two types of economic benefits, making environmental taxation superior to grandfathered emissions permits.[19] Of course, it is certainly possible to allocate permits by auction, simulating a tax, but this is not a widespread practice.

2.14 For the most part, the arguments presented in this chapter in favour of environmental taxes are also applicable to decentralized trading programmes. This chapter will draw extensively upon findings from the study of decentralized trading programmes, and use them in support of the arguments in this chapter for environmental taxes. To the extent that both environmental taxes and decentralized trading programmes impose a marginal cost on polluting, they induce the same kinds of behaviour that can lead to pollution reduction.

[18] It has been argued that environmental taxes increase the cost of goods, such that reducing distortionary income taxes may not offset the excess burden of the environmental tax. LH Goulder, 'Effects of Carbon Taxes in an Economy with Prior Tax Distortions: An Intertemporal General Equilibrium Analysis' (1995) 29 *Journal of Environmental Economics and Management* 271. However, this fails to account for the fact that the income tax system, by allowing deductions, creates distortions by favouring certain kinds of spending; thus if environmental taxes can reduce income taxes, they can also reduce these distortions. IWH Parry and AM Bento, 'Tax Deductions, Environmental Policy, and the "Double Dividend" Hypothesis' (2000) 39 *Journal of Environmental Economics and Management* 67. See also, EL Giménez and M Rodriguez, 'Pigou's Dividend versus Ramsey's Dividend in the Double Dividend Literature', Fondazione Eni Enrico Mattei Working Paper No 85.2006 (2006) available at <http://www.feem.it/Feem/Pub/Publications/Wpapers/default.htm>, for a discussion of how both of these viewpoints may be incorrect in their baseline assumptions, and that environmental taxes may be Pareto improving under relatively weak conditions.

[19] In a 1997 analysis of CO_2 abatement policies, researchers at Resources for the Future (RFF) found that a carbon tax that recycles tax revenues to reduce income taxes was superior in almost all circumstances to a decentralized carbon trading programme that allocated permits by grandfathering. IWH Parry, RC Williams, and LH Goulder, 'When Can Carbon Abatement Policies Increase Welfare? The Fundamental Role of Distorted Factor Markets' (1999) 37 *Journal of Environmental Economics and Management* 52. In a more recent RFF study of the US electricity market, researchers found that the allocation of emissions permits by grandfathering, as opposed to allocating them by auction, is at least 50% more costly, and is even better *from the emitter's point of view*. The reason for this is that grandfathered permits create allocative inefficiencies by artificially suppressing the price of electricity. This effect is so powerful that the lower price of electricity substantially reduces the asset value of power plants. D Burtraw *et al*, 'The Effect of Allowance Allocation on the Cost of Carbon Emission Trading', Resources for the Future Discussion Paper 01–30 (2001) available at, <http://www.rff.org/Documents/RFF-DP-01–30.pdf>; D Burtraw, 'Carbon Emission Trading Costs and Allowance Allocations: Evaluating the Options' (2001)145 Resources 13 available at, <http://www.rff.org/Documents/RFF-Resources-145-c02emmis.pdf>.

C. Opposition to Environmental Taxes

2.15 Resistance to environmental taxes has not been based so much on argument but on raw political opposition, predictably from the industries that would pay them. Although regulated industries also have to pay for pollution control equipment, economic theorists suspect that industries favour technology-based schemes because expensive pollution control technologies can act as barriers to entry.[20] Also, there is a theory that regulated firms believe they can exert more influence over technology-oriented regulation than they can over the level of environmental taxes,[21] a theory that has been borne out by several experiences.[22] Opponents of environmental taxes often profess to be concerned for consumers, who would pay higher prices for gasoline and electricity, and exploit scepticism as to whether an environmental tax programme could truly accomplish redistributive goals. Redistributive schemes that would ease burdens on low-income consumers are mis-characterized,[23] feeding a persistent and uniquely North American sense that nobody, least of all the poor, can ever be made better off by any programme that contains the word 'tax'. Environmental organizations, afraid politically of being associated with higher taxes, have distanced themselves from environmental taxes.

2.16 In North America, a number of academics have also objected to environmental taxes on deontological grounds. Some environmental ethicists reject the notion

[20] G Stigler, 'The Theory of Economic Regulation' (1971) 2 *Bell Journal of Economics and Management* 3.

[21] Buchanan and Tullock (n 10 above).

[22] eg, the command-and-control regulation under the 1977 Clean Air Act Amendments were supported by a coalition of coal producers and environmentalists that supported legislation that required the installation of 'scrubbers,' expensive sulphur dioxide-reducing end-of-pipe equipment that would make the burning of coal considerably less polluting, but would prevent utilities from switching to cleaner sources of fuel, such as natural gas. BA Ackerman and WT Hassler, *Clean Coal/Dirty Air* (Yale University Press, 1981) 117–18. Another example stems from the 1990 Clean Air Act Amendments, which were supposed to feature a market-based emissions trading scheme for both sulphur dioxide (SO_2) and oxides of nitrogen (NOx). This plan was derailed by an agreement made behind closed doors between environmentalists and representatives of coal-burning utilities. While SO_2 was governed by an emissions trading scheme, the closed-door deal did away with NOx emissions trading and instead established a complicated schedule of NOx rate standards that would allow all coal-burning plants to stay in operation, as long as they obtained a specific piece of pollution control technology. S-L Hsu, 'Fairness Versus Efficiency in Environmental Law' (2004) 31 Ecology Law Quarterly 303, 361 n 235; B Swift, 'How Environmental Laws Work: An Analysis of the Utility Sector's Response to Regulation of Nitrogen Oxides and Sulfur Dioxide Under the Clean Air Act' (2001) 14 Tulane Environmental Law Journal 309, 355–6 n 231. See n 3 above for a discussion of the NO_x limitations.

[23] RH Frank, 'A Way to Cut Fuel Consumption That Everyone Likes, Except the Politicians' *New York Times*, 16 February 2006, C3.

that the quality of the environment can be priced.[24] Some have argued that polluting is akin to tortious activity that imposes collective harm upon society, or even criminal activity insofar as it leads to risk of death—and hence that it should be outlawed, not licensed.[25] For these academics, pollution is a moral question, not an economic one, rendering the very notion of pollution taxation anomalous.

2.17 As a result, environmental tax advocates have had no political allies in North America. Consider the example of the gasoline tax, indisputably the most efficient means of reducing carbon dioxide emissions from the transport sector. Reducing carbon emissions from transport is most effectively accomplished by reducing demand for gasoline, which is most effectively accomplished by raising its price at the pump. Recent rises in gasoline prices—not unlike the effects of a gas tax—achieved savings in gasoline usage and boosted sales of hybrid electric vehicles.[26] And yet, none of the national environmental organizations in the United States or Canada have made a gasoline tax a significant part of their policy platform. Instead, they have latched onto corporate average fuel economy standards as a way to reduce gasoline consumption. This is a reasonable response, but does not address the core problem of excessive driving.

D. Some Quasi-behavioural Arguments

2.18 Advocates and opponents of environmental taxation have not broken new intellectual ground in a way that has engaged policy-makers.[27] This chapter aims to inject some new arguments into the instrument choice debate.

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[24] M Sagoff, *The Economy of the Earth* (Cambridge University Press, 1988) 16–17; VB Flatt, 'The Human Environment of the Mind: Correcting NEPA Implementation by Treating Environmental Philosophy and Environmental Risk Allocation as Environmental Values Under NEPA' (1994) Hastings Law Journal 85, 97–103.

[25] L Heinzerling, 'Knowing Killing and Environmental Law' (2006) 14 NYU Environmental Law Journal 521, 522; SP Kelman, *What Price Incentives?* (1981) 44.

[26] Cambridge Energy Research Associates, 'Gasoline and the American People 2007' (Overview) available at <http://www2.cera.com/gasoline/summary/>; JG Collier, 'Toyoto Camry Hybrid Rolling Down Main St.' (27 October 2006) available at <http://www.mercurynews.com/mld/mercurynews/15862159.htm>; Matt Nauman, 'Crossover-utility vehicles, Fuel Efficiency Highlight SF Event' (17 November 2006) available at <http://www.mercurynews.com/mld/mercurynews/business/industries/automotive/16035850.htm>; T Jackson, 'Gas Prices, Interest Rates Spark Big Auto Changes' (15 November 2006) available at <http://www.bankrate.com/brm/news/pf/YIRguide06-07/nov06_auto_review_2006_a1.asp>.

[27] 'The National Roundtable on the Environment and the Economy remarked in its June 2005 report on Ecological Fiscal Reform and greenhouse gas mitigation strategies that [a]dvocacy for and against the use of broad-based price signals (emissions charges such as taxes and broad-based tradable permits) to achieve environmental objectives is an old (some would say tired) debate. In Canada, the debate is characterized by entrenched positions and little interest on the part of politicians.'

Inducing innovation by engaging the entrepreneurial energies of the firm

2.19 The traditional economic argument that market mechanisms, such as environmental taxes, provide economic incentives to find ways to reduce pollution has become almost platitudinous. How exactly does this occur? It is not easy to explain exactly how a government policy translates into corporate action to innovate and find new ways to reduce pollution.

2.20 Part of the answer can be found in the intersection of the fields of business management and industrial ecology.[28] Industrial ecology has focused on the interaction of productive activity with the environment, expanding the concept of an ecosystem to include not only humans (what is considered 'human ecology'), but the industrial activities of humans. This field of study has theorized the means of integrating environmental considerations into business decision making, such as environmental accounting systems,[29] waste management integration,[30] and intra-firm information systems.[31] While industrial ecology has provided a framework for the integration of environmental considerations, it has not yet modelled the details of exactly how it comes about within the firm.

2.21 Management literature has examined organizational dynamics and innovation, but has not yet modelled how environmental innovations take place, or what regulatory instruments are most conducive to innovation.[32] Researchers have examined traditional research and development programmes, which still account for most acquisition and exploitation of new knowledge, but few have studied

National Roundtable on the Environment and the Economy, *Economic Instruments for Long-term Reductions in Energy-based Carbon Emissions* (2005).

[28] T Graedel, 'Industrial Ecology: Definition and Implementation' in RH Socolow *et al* (eds), *Industrial Ecology and Global Change* (Cambridge University Press, 1994) 28; DJ Richards, BR Allenby, and RA Frosch, 'The Greening of Industrial Ecosystems: Overview and Perspective' in BR Allenby and DJ Richards (eds), *The Greening of Industrial Ecosystems* (National Academy of Engineering, 1994) 1.

[29] R Todd, 'Zero-Loss Environmental Accounting Systems' in Allenby and Richards (eds) (n 28 above) 191.

[30] M Braungart, 'Product Life-Cycle Management to Replace Waste Management' in Socolow *et al* (eds) (n 28 above) 335; DT Allen and N Behmanesh, 'Wastes as Raw Materials' in Allenby and Richards (eds) (n 28 above) 68.

[31] J Carberry, 'Using Environmental Knowledge Systems at DuPont' in DJ Richards, BR Allenby, and WD Compton (eds), *Information Systems and the Environment* (National Academy of Engineering, 2001) 81; DJ Richards and MR Kabjian, 'Improving Environmental Knowledge Sharing' in Richards, Allenby, and Compton (eds) (above) 59.

[32] Professor Michael Porter has famously argued that capturing waste and avoiding polluting thereby is efficient, since the waste itself should be considered an unused resource. ME Porter, *The Competitive Advantage of Nations* (The Free Press, 1990). This notion has come under attack, and is considered by most economists to apply only in a narrow set of conditions. See, K Palmer, WE Oates, and PR Portney, 'Tightening Environmental Standards: the Benefit-cost or No-cost Paradigm?' (1995) 9 *Journal of Economic Perspectives* 119.

larger, cross-departmental, and less formal initiatives. Most pollution innovations require these less formal and more creative processes, fewer organizational barriers, and an atmosphere of collaboration across departments.[33] Studying these dynamics has not traditionally been the bailiwick of management science.[34]

2.22 Between industrial ecology and management lies a theory, as yet unarticulated, that would explain why the kinds of creative search processes necessary for pollution innovation are best induced by a policy instrument that does not interfere with the process. Interference with the process, narrowing the compliance possibilities, imposes psychological constraints on innovation. This not only runs the risk of ruling out unforeseen but effective compliance options, but creates intra-firm factions that may hamper development. Environmental taxes create the right conditions for innovation by avoiding this kind of interference.

Some anecdotal evidence

2.23 While statistical evidence is lacking, some anecdotal evidence lends some support for this thesis. One case in point is the Swedish nitrous oxide (NOx) tax, approximately (4.3 per kilogramme of NOx[35] (the equivalent of about US$5.40), on energy producers. NOx emissions from facilities covered by the Swedish NOx tax programme declined by 42 per cent over an eight-year period,[36] a striking result when compared with NOx emitters in the United States, which achieved very little in the way of emissions reductions for a period of over a decade.[37] One reason NOx emitters in Sweden emitted less was that firm managers awarded bonuses to employees who discovered ways of reducing NOx emissions, an unlikely firm policy under a command-and-control scheme.[38] This is the kind of recruitment of the engagement of employees with first-hand knowledge of ways of reducing NOx emissions that is accomplished by environmental tax programmes. And, importantly, the tax does not dictate how NOx emissions

33 H Nystrom, *Creativity and Innovation* (Wiley, 1979) 43–46.

34 JR Baldwin and P Hanel, *Innovation and Knowledge Creation in an Open Economy* (Cambridge University Press, 2003) 73, 87–90. One commonly cited management strategy is to allocate some research time to individuals' pet projects, a strategy pioneered by 3M and currently adopted by firms such as Yahoo! and Google. Harvard Business School Publishing Corporation, *Harvard Business Essentials: Managing Creativity and Innovation* (Harvard Business School, 2003) 108–9; J Roberts, *The Modern Firm* (Oxford University Press, 2004) 258–60, 268.

35 'The Swedish Charge on Nitrous Oxides' (26 November 2006) <http://www.internat.naturvardsverket.se/>.

36 Smith (n 10 above) 72.

37 NOx emissions from electricity generation were relatively flat for the period 1990 to 1998, when they moved from 6663 to 6232 tons per year. Thereafter, NOx emissions commenced a 25% decline, from 6232 to 4700 in 2002, which coincided with the implementation of a decentralized NOx trading programme within just the north-eastern US states.

38 Määttä (n 14 above).

may be reduced, allowing firms to take advantage of the wide range of knowledge of line employees.

2.24 Another case in point is the Acid Rain Program of the 1990 Clean Air Act Amendments, which provided that electricity generation emissions of sulphur dioxide (SO_2) are subjected to a decentralized trading programme. Not coincidentally, SO_2 emissions declined sharply, while, as noted above, NOx emissions were flat. Researchers at the Environmental Law Institute (including this author) studied compliance patterns at electricity generating firms throughout the United States, and found an unexpectedly large menu of SO_2 emissions reduction options were discovered and put into place, while NOx control technologies stagnated and adoption lagged. For SO_2 control, firms experimented with blending high- and low-sulphur coals, a practice previously believed to be technically impossible. At least ten compliance strategies that were unknown prior to the advent of the SO_2 decentralized trading programme were subsequently discovered and implemented.[39] The price of SO_2 emissions permits, an indicator of the marginal cost of reducing SO_2 emissions, was as high as US$500 per ton for early trades, but dropped as low as US$65 per ton.[40] Only through substantial innovation could the price of emissions reduction have fallen so dramatically. This is an astonishing result for an industry with an otherwise dismal innovation record.[41]

2.25 Another side benefit of the market orientation of the Acid Rain Program was that it induced innovation in pollution control industries, particularly for 'scrubbers' that reduce SO_2 emissions. By creating a competitive environment for compliance alternatives, the decentralized SO_2 trading programme spurred the scrubber industry to deliver cheaper, more effective scrubbers, more carefully tailored to the needs of the evolving electricity industry.[42] While this is a cost-saving innovation, not an environmental innovation, it is still an example of collaboration—between customer and vendor[43]—an interaction that would not have taken place under a command-and-control scheme. Some environmentalists are unimpressed

[39] Swift (n 22 above) 333.

[40] AD Ellerman *et al*, *Markets for Clean Air* (Cambridge University Press, 2000) 172–3.

[41] From 1920 to 2000, combustion efficiency in the electricity generation industry increased from 20% to a still-measly 33%. Northeast-Midwest Institute, *The Clean Air-Innovative Technology Link: Enhancing Efficiency in the Electricity Industry* (1999) 29 figure 5.

[42] This argument has been made in D Burtraw, *Cost Savings, Market Performance, and Economic Benefits of the U.S. Acid Rain Program*, 4 (Resources for the Future Discussion Paper 98-28-REV 1998) <http://www.rff.org/disc_papers /PDF_files/9828rev.pdf>; Swift (n 22 above) 332–3.

[43] As some in the management field have noted, much innovation comes from a customer or client that not only passes along a description of their changing needs, but some ideas on how a producer can meet them. Harvard Business School (n 34 above) 42; M Dodgson, 'Technological Collaboration and Innovation' in M Dodgson and R Rothwell (eds), *The Handbook of Industrial Innovation* (Edward Elgar, 1994) 22.

by innovations that are cost-saving, rather than pollution-reducing, as if these two characteristics were mutually exclusive. Not only is this assumption unwarranted, but it overlooks the economic reality that the cheaper the pollution reduction technology, the more likely its adoption.

2.26 What these examples illustrate is that market mechanisms create markets within firms for information. Environmental taxation creates conditions under which information can be brought to bear to produce new processes or products. It is not necessarily natural for different parts of large firms to cooperate in producing new processes or new products, but that is just what is needed to integrate disparate pieces of information and use them to reduce pollution.[44]

A red herring

2.27 It has been argued that the difference between market mechanisms (decentralized trading and environmental taxes) and command-and-control regulation is overstated. An 'incentive' to reduce emissions need not be introduced in the form of a tradable emissions permit or a tax, or any other type of market mechanism. Environmental performance standards provide the same incentives to innovate as market mechanisms, since both present economic incentives to innovate and save money by reducing pollution.[45] In the former case, the cost of a permit or the tax presents the incentive, while in the latter, some fee or penalty presents the incentive. Given this way of thinking, it is no worse, and perhaps better, to promulgate 'technology-forcing' regulations that set performance standards *beyond* current capabilities to abate pollution, thereby presenting a very strong incentive to do better.

2.28 But the mistake in this way of thinking (apart from its tendency to invite litigation) is to ignore the effects that regulation has on firm innovation processes. It is too crude to simply say that environmental regulation must provide an 'incentive' to reduce pollution. Some 'incentives' backfire. Does the imposition of liability after the fact of an accident create an incentive to avoid such accidents in the future? Yes, but it also creates incentives to engage in unproductive defensive behaviour. If the goal is to encourage innovative thinking, fear of liability is a particularly clumsy 'incentive'.

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[44] PS Dillon, 'Implications of Industrial Ecology for Firms' in BR Allenby and DJ Richards (eds) (n 28 above) 202–5. Dillon also lists other conditions precedent for the development of revolutionary pollution reduction practices, such as commitment of senior management, company-wide strategies and goals, harmonization of environmental goals with other company goals, and establishment of a systematic and iterative development process. These other conditions are also better served by a market mechanism such as environmental taxation.

[45] MR Taylor, E Rubin, and D Hounshell, 'Regulation as the Mother of Innovation: the Case of SO_2 Control' (2005) 27 Law and Policy 348.

Narrowing options

2.29 Command-and-control-type regulation need not be particularly onerous to foreclose important pollution reduction options. Even modest regulatory interferences will foreclose unforeseen options. Technology-forcing regulation in the electricity industry might produce better pollution control devices, but it will not induce electricity firms to explore the possibilities for renewable, non-fossil technologies. Environmental taxes, by contrast, leave open all options. Switching to wind energy, for example, is left open as an alternative to end-of-pipe devices.

2.30 One example of an errant technology-forcing regulation is the California Air Resources Board (CARB) electric vehicle mandate. In 1990, the California Air Resources Board created a technology-forcing programme, the Low-Emissions Vehicle Program (the 'LEV Program'), to induce the introduction of cleaner motor vehicles, particularly electric vehicles.[46] The LEV Program added four new classes of vehicles to its regulatory structure, each based on the demonstrated exhaust emissions rates, including a new class of electric vehicles that would have zero exhaust emissions.[47] The LEV Program mandated that each carmaker could produce any mixture of these classes of vehicles as long as the overall average emissions were below a certain level. This bow to market philosophy, while pushing carmakers to do more than they had previously done, seemed to provide the right combination of flexibility and impetus. The one binding requirement was that, starting in 2004, 10 per cent of a carmaker's fleet had to be 'zero-emissions vehicles', or ZEVs, or electric vehicles.[48]

2.31 The problem is that the LEV Program did not have a way of accounting for the pollution benefits of the most popular emerging automobile technology: hybrid electric vehicles. Hybrid electric vehicles can, under the right driving patterns, achieve much higher fuel efficiencies than conventional gasoline vehicles,[49] and

[46] 13 Cal Admin Code §§1956 *et seq*., particularly §1961 (2006). For a summary of the original programme, see California Environmental Protection Agency, Air Resources Board, 'Staff Report: Low-Emission Vehicle and Zero-Emission Vehicle Program Review' (November, 1996) available at <http://www.arb.ca.gov/msprog/levprog/levsr3.pdf>.

[47] This, of course, ignores the fact that the source of electricity may produce emissions. With most electricity in California generated by natural gas-fired power plants, the net emissions effect of an electric vehicle is considerably lower, but not zero.

[48] 13 Cal Admin Code §1962(b) (2006).

[49] The Environmental Protection Agency and the Department of Energy estimate that the Honda Civic Hybrid Electric vehicle obtains 49 miles per gallor (mpg) for city driving, 51 mpg for highway driving, while the Toyota Prius obtains 60 mpg and 51 mpg, respectively, both earning the 'highest in class' distinction for their vehicle classes. The Ford Escape Sport Utility Hybrid Electric Vehicle is estimated to obtain 36 mpg and 31 mpg, respectively, also the most fuel-efficient vehicle in the sport utility vehicle class. Environmental Protection Agency and the Department of Energy, 'Fuel Economy Guide, Model Year 2006 7, 9, & 14' (2005) available at <http://www.fueleconomy.gov/feg/FEG2006.pdf>.

concomitantly lower exhaust emissions rates. But how would CARB measure the exhaust emissions of a vehicle that is sometimes emitting as a conventional gasoline vehicle, and sometimes emitting nothing? CARB'S answer was to create yet another class of vehicle that would include hybrid electric vehicles, called 'Partial ZEV Allowance Vehicles,' giving carmakers a partial credit for a ZEV. The credit fraction is determined by a complicated formula that includes battery recharging capacity, vehicle range while running on batteries, 'electric drive system peak power output', 'traction drive system voltage', and other technical factors.[50]

2.32 This regulatory patch may yet give carmakers some comfort as they try to improve hybrid electric vehicle technology. However, it is impossible to be an automotive engineer and not notice the regulatory environment. To what ends does the engineering team attempt to boost the 'electric drive system peak power output'? And should electric vehicles be the gold standard of clean vehicles? Electric vehicles still produce emissions if they draw electricity from fossil fuel-fired power plants,[51] while hybrid electric vehicles only capture otherwise wasted energy.

2.33 The original LEV Program seemed to be a reasonable one. The regulatory world in 1990, when the LEV Program was conceived, had only passing knowledge of hybrid electric vehicle technology, so it was understandable that the LEV Program would be structured around constant exhaust emissions rates. But the well-intentioned LEV Program did not encourage the development of hybrid electric vehicles.

2.34 This is not to say that innovation never occurs under command-and-control regimes.[52] But market mechanisms such as emissions trading and environmental taxation leave open a wider range of pollution reduction possibilities, and are thus more effective than command-and-control mechanisms for inducing innovation.

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50 13 Cal Admin Code §1962(c) (2006).

51 Electric vehicles in California would reduce some pollutants but have negligible effects on other pollutants, such as NOx. California represents the best case scenario, because the electricity used to power electric vehicles is mostly generated by natural gas-fired power plants, which pollute much less than coal-fired power plants. See, Q Wang and D Santini, 'Magnitude and Value of Electric Vehicle Emissions Reductions for Six Driving Cycles and Four U.S. Cities With Varying Air Quality Problems' (1992) 1416 *Transportation Research Record* 33; Q Wang, M Delucchi, and D Sperling, 'Emission Impacts of Electric Vehicles' (1990) 40 *Journal of Air and Waste Management* 1275. With electricity deregulation, and California purchasing electricity from a variety of sources, the conclusions reached in these papers may no longer be accurate.

52 For a study of technology innovation under command-and-control-type programmes, see D Popp, 'International Innovation and Diffusion of Air Pollution Control Technologies: the Effects of NO_x and SO_2 Regulation in the US, Japan, and Germany' (2006)51 *Journal of Environmental Economics and Management* 46.

Reducing perverse incentives to preserve polluting capital

2.35 A second quasi-behavioural argument pertains to the capitalization effects of command-and-control regulation. Since command-and-control regulation generally requires the installation of some pollution control equipment, it typically requires substantial capital outlays. Requiring the installation of expensive pollution control equipment increases the capital base of polluters, and increases the life expectancy of polluting facilities. While the pollution control equipment may reduce emissions of one specific pollutant, it does nothing to reduce emissions of other pollutants, and by extending the life of the plant, prolongs these other pollution problems. It may even, by extending the life of the plant, increase emissions of the controlled pollutant in the long run. To the extent that this capital sluggishness delays the introduction of newer, more efficient, and cleaner technologies, it is an environmental as well as an economic problem.

2.36 This problem arises because once a firm spends a substantial amount of money on pollution control equipment that attaches to a polluting facility, it will not soon thereafter abandon that facility, and will resist the adoption of new technologies. Consider, for example, modern pollution control equipment for coal-fired power plants, perhaps costing roughly US$150 million for a US$600 million plant.[53] Once such expensive equipment is purchased, the facility to which the equipment attaches acquires a new lifespan. Estimates of capital expenditures attributable to pollution control equipment vary greatly, of course, across time and across industries, but there is no doubt that pollution control is a multi-billion industry that affects decision making on a large scale. In 1994 (the most recent year for which these statistics are recorded), US businesses spent US$76.6 billion on pollution control,[54] while less than US$2 billion was spent on research and development.[55] The capital fixity of the pollution control equipment plays an important role in determining the life of plants.

2.37 There are at least two ways in which pollution control equipment makes polluting capital more sluggish. First, consider how an individual consumer views durable good replacement decisions. Individuals tend to forestall durable good replacement decisions in such a way as to spread out large investments, even if

[53] An estimate from ES Rubin *et al*, 'Integrated Environmental Modeling of Coal-fired Power Systems' (1997) 47 *Journal of Air and Waste Management* 1180 cited in 'The Interim Report of the Committee on Change in New Source Review Programs for Stationary Sources of Air Pollution' (National Research Council, 2005) available at <http://www.nap.edu/books/0309095786/html> 111–12.

[54] Bureau of Economic Analysis, 'Current-Dollar Spending for Pollution Abatement and Control by Type and by Sector, table 2' <http://www.bea.gov/bea/an/0996eed/table2.htm>.

[55] ibid.

more immediate replacements might be warranted.[56] While economic theory posits that people ignore sunk costs, a substantial amount of research has demonstrated that individuals have a great deal of difficulty doing so.[57] Do firms suffer from the same inability to ignore sunk costs? This is an open empirical question, but it is not hard to imagine how that might be the case, especially since firms invest in personnel to operate and service fixed capital. Acquiring a scrubber costing over US$100 million also means acquiring the staffing and expertise necessary to service and maintain a scrubber. There would be substantial transaction costs to abandoning such an investment.

2.38 A second reason for the capital sluggishness effect of command-and-control regulation is that polluting firms often recoup capital costs by selling a large number of units of the product at low margins, and *over a long period of time*. For example, large-scale electricity generation requires at least several hundred millions of dollars of capital investment, which is recouped by selling electricity in small amounts to a large number of customers, and over a long time period—the more units sold, the greater the return on capital achieved. Mandating the installation of expensive pollution control equipment, by increasing the amount of capital investment, increases the time horizon for recouping capital costs.

2.39 To illustrate, consider a simple economic illustration, shown in Figures 2.1 to 2.4. The vertical axis represents profits, and the horizontal axis represents time. A heavy black line represents the cumulative level of profit at any given time, the firm's profit path of a certain technology. At $t = 0$, a large capital expenditure C is undertaken, instantly sinking profits by C. As the firm sells many units of its product, C is recouped gradually, breaking even at $t = b$. At any given time, profitability over a period of time is given by the slope of the ray from the origin to the profit line, shown by the dotted line in Figure 2.1. Over time, the slope of this ray increases, indicating increasing profitability, assuming continued production with constant efficiency.[58]

Consider now at some point either a command-and-control regulation or an environmental tax is imposed. In Figure 2.2, say this occurs at time d. A command and control regulation will result in another capital expenditure of amount

[56] JD Cripps and RJ Meyer, 'Heuristics and Biases in Timing the Replacement of Durable Products' (1994) 21 *Journal of Consumer Research* 304.

[57] R Thaler, 'Toward a Positive Theory of Consumer Choice' (1980) 1 *Journal of Economic Behavior and Organizations* 39; H Arkes and C Blumer, 'The Psychology of Sunk Cost' (1985) 35 *Organizational Behavior and Human Decision Processes* 124.

[58] A rigorous economic analysis of this problem would involve the solution of a dynamic optimization problem, a maximization of a stream of revenues discounted over time. For such an economic analysis to shed more light than this stylized example would require some estimates of the capital and variable costs, and some empirical testing of hypotheses. This is beyond the scope of this chapter.

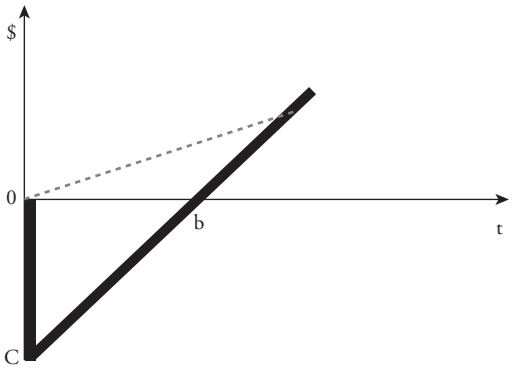

Figure 2.1 Profit path for typical polluting facility.

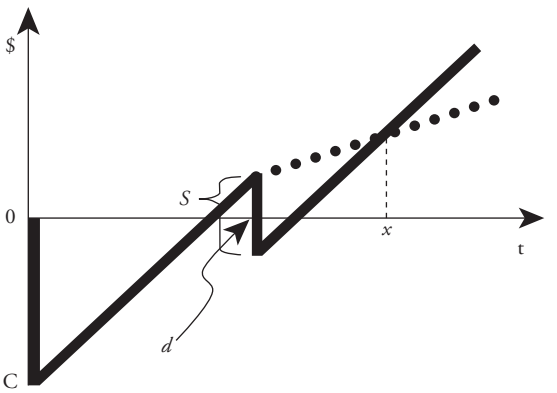

Figure 2.2 Profit path for typical polluting facility with command-and-control mandate and with environmental tax.

S, followed by a return to the same rate of profit-making, assuming that the addition of the mandated pollution control equipment does not impose additional variable costs.[59] Contrast this with the profit path if an environmental tax is imposed instead, shown by the dotted line in Figure 2.2. An environmental tax levied on a quantity of pollution would raise the variable costs and reduce the rate of profit-making (at least relative to the installation of pollution control equipment), resulting in greater profitability for a time, then inferior profitability after time *x*.

[59] This is not a realistic assumption, but insofar as pollution control technology would impose lower variable costs than would an environmental tax, it does not change the result.

2.40 But suppose there emerges a new technology at some future time that results in even lower variable costs, but requires an additional capital investment? For example, what if developments in wind turbine technology improve so that a wind turbine strategy would create an even steeper profit-making path than the original technology? Or, as was the case in the 1990s, what if the deregulation of the natural gas industry caused a sharp drop in natural gas prices, making the economics of gas-fired power plants much more favourable? Under what circumstances would the firm adopt this new technology?

2.41 Consider in Figures 2.3 and 2.4, that at $t = r$, $r > d$, this new technology emerges and becomes available. The profit path of the new technology, if adopted, is shown by the striped line in both Figures 2.3 and 2.4. Another capital expenditure is required to adopt the new technology, but thereafter, the slope of the profit path is even greater because of the even lower variable costs of this new technology. In Figure 2.3 the firm is assumed to have installed pollution control equipment under a command-and-control mandate, while in Figure 2.4 the firm is assumed to operate under an environmental tax scheme, and to have eschewed pollution control equipment and opted instead to pay the environmental taxes. The question is whether the firm is more likely to adopt the new technology in Figure 2.3 or Figure 2.4. If the polluting firm is considering adoption of the new technology at time *r* when it becomes available, the firm is likely to ask how soon the new technology will become more profitable than the status quo. In other words, the firm will ask when the striped line representing the profit path of the new technology will cross over and exceed the existing profit path. Clearly, this cross-over point occurs earlier in Figure 2.4 than in Figure 2.3, indicating that the new technology will pay for itself much earlier if the firm had not installed pollution control technology back at time *d*. This suggests that adoption is more likely

Figure 2.3 New technology adoption under command-and-control.

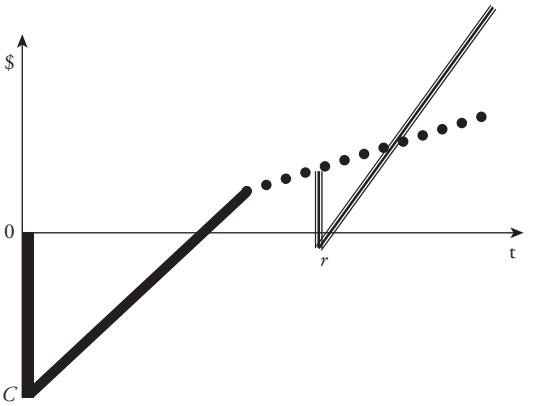

Figure 2.4 New technology adoption under environmental taxation.

if a command-and-control regulation had not mandated the installation of expensive pollution control equipment. A capital replacement decision is obviously much more complicated than depicted in this stylized example; but it must be true that the earlier payback of new technology, the greater the chances of its adoption.

2.42 The intuition behind this simple illustration is that command-and-control regulation forecloses certain capital options. Forcing the installation of pollution control equipment pushes polluters into an economic scenario in which replacement of the polluting facility becomes economically less favourable than if the firm had been able to forestall that decision. This may distort economic decisions by preventing firms from considering variable costs, present and future. It is possible that, faced with an environmental tax, a number of polluting firms may choose to install pollution control equipment even without a command-and-control mandate. But command-and-control mandates this for all firms, thwarting some that might have waited and then later undertaken a more fundamental change, if only given the flexibility to do so.

2.43 All of this boils down to the still simpler intuition that a pollution control equipment requirement gives polluters another asset to protect, and another reason to think of environmental protection as an erosion of capital, and to think of further regulation as a threat to that capital. Pollution taxes might impose exactly the same cost on polluters, but do so in a way that creates a continuing incentive to change over capital stock. A polluter that is continuously paying pollution taxes will be vigilantly looking for ways to reduce its pollution tax bill.

Public discourse effects

2.44 A third quasi-behavioural argument in favour of environmental taxes draws upon the effect of regulation on public discourse. The way that the general public and its law-makers conceive of pollution reduction has been circumscribed by the end-of-pipe solutions that have made their way into public policy and law. As a result, these end-of-pipe solutions have become ensconced as a baseline approach, and public discourse has centered upon whether or not this baseline approach is superior to doing nothing. This, in turn, has moulded the debate into a comparison of the economic costs with the environmental benefits of these solutions. For the most part, when a cost-benefit analysis is performed, most of these technologically-oriented regulations pass muster. But this has not prevented a mode of discourse in which policy-makers pass judgment on these regulations, and judgments can be unfair when jobs and profits are at stake.

2.45 In this climate, it has become too easy to marshal evidence of the economic costs of regulation. All an affected industry need do is to estimate the job losses and economic costs putatively attributable to the regulation,[60] and it can effectively put the regulation on trial. And these industry estimates are difficult to dispute *ex ante* because the information needed to make them is within the control of the affected industries. But the biggest problem with this discourse is not the accuracy of industry claims of compliance costs and job losses, it is with the fact that we are discussing them at all. This mode of discourse has

[60] eg debate over some provisions of the 1990 Clean Air Act Amendments focused, predictably, on how much it would cost constituents: 'North Dakotans have spent over $175 million in capital investment and over $23 million in annual operating costs for utility plant scrubbers. Seventy-five percent of North Dakota's coal-fired electric generation is produced by scrubbed power plants. North Dakota emits about 130,000 tons of sulfur dioxide from its powerplants annually. In comparison, one State emits over 2 million tons annually and currently scrubs only 3 percent of its coal-fired electric generation. Because many Midwestern utilities have avoided adding air pollution controls or switching to lower sulfur fuels, they have enjoyed huge cost savings over the last decade. In many instances, the amounts saved in just the last 5 years exceeds their estimated cost of compliance under the acid rain title of this bill . . .' 136 Cong Rec S 82 (23 January 1990) Statement of Senator Burdick. 'The reason we worry about our consumers should be apparent. Achieving the stringent goals set by this legislation will require many utilities in our region to install expensive technology . . . A state-of-the-art, flue-gas scrubber can cost $100 million to put in place. It has annual operating costs of $10 million a year. Money doesn't grow on trees. It has to come from somewhere. The funds for the additional technology will come, one way or another, from the ratepayers . . . Electrical rates for consumers in some States could increase by 13 to 20 percent. For a homeowner, the annual utility bill could increase by $120 to $200. That is no trifling sum for a senior citizen receiving the minimum Social Security benefit of $184.20 each month, or for a minimum wage earner bringing home $558.33 each month. A sudden jump in utility bills is not going to make the daily struggle to get by and get ahead any easier.' 136 Cong Rec S 3327 (23 January 1990) Statement of Senator Heinz.

distracted policy-makers from the other side of the equation—the environmental benefits.[61]

2.46 How do we re-orient discussion of environmental law to focus on the environment? The answer lies in a return to Pigou. If environmental taxes were to be set in accordance with Pigou's theory to the amount of marginal social damages external to the polluter, at the optimum level of pollution, then agencies would be sent off for a search to obtain this quantitative information.

2.47 Some detractors argue that the information needed to set Pigouvian tax rates is so speculative that it is hardly worth pursuing.[62] Finding marginal damages and setting Pigouvian tax rates thereby is such an impossible task as to make the process arbitrary. This criticism, apart from being unduly pessimistic, also misses the point. The most important thing that a Pigouvian taxation scheme can do is not to produce precise estimates of marginal social damages, but to force people and agencies to debate what those marginal social damages are. Even if it is difficult to ascertain marginal social damages, and difficult to ascertain the optimal level of pollution, the mere focusing of attention on environmental effects would be an improvement over the present mode of discourse, which focuses on the costs of regulation.

2.48 Detractors might also argue that it is naive to think that a Pigouvian tax rate would ever be set according to environmental considerations. But the theoretical point of a Pigouvian taxation scheme is that costs need not be considered, because the tax is merely a mechanism for making the polluter bear the full costs of her activity. If a Pigouvian tax completely erases profits, then the productive activity was not worth the pollution in the first place, from a societal point of view, so Pigou's theory goes. If the polluting activity can survive the Pigouvian tax, then

[61] Occasional recognitions of this occur in politics: 'Besides the gains to human health, reduced air pollution would mean increased crop yields, reduced materials damage, improved visibility and reduced aquatic damage—significant benefits to agriculture, fisheries, industry and the quality of life of every American. Quantifying these benefits is more difficult than adding up the costs of pollution control equipment. And therein lies the crux of the political problem. Some in our society have opposed every major environmental law ever proposed. Rather than spend $1 to prevent pollution, they have spent millions of dollars to prevent the passage of laws to reduce pollution. Their principal weapon is the exaggerated claim that if anything is required of them to prevent pollution—anything at all—the cost will be so high that whole industries will have to shut down, whole States will suffer, whole regions will decline. They have been helped by the fact that while it is often easy to precisely calculate the cost of cleaning up, it is impossible to precisely calculate the value of cleaning up. We know to the penny the cost of installing a scrubber. But what is the value of a human life? What is the cost of a premature death? How much is it worth to a family to have a child with healthy lungs, rather than scarred and damaged lungs? Is there a single Member of the Senate who can place a dollar value on his child's health, or life?' 134 Cong Rec S 14455 (4 October 1988) Statement of Senator Mitchell.

[62] Kelman (n 25 above) 54–55.

that is a signal that this activity is important enough to society that we should tolerate the pollution. This is an important advantage of Pigou's theory—regulatory agencies need not bother with trying to wrestle information out of regulated entities, and need not set regulatory policy based on this manipulated information; markets that incorporate environmental costs into production decisions—including the decision as to whether to produce at all—determine which productive activities survive and which do not.

2.49 A detractor would respond that even if a statute were drafted to require EPA to consider only environmental damages in setting Pigouvian tax rates, it is naive to believe that this scheme could ever be observed in practice. But this is also unduly pessimistic, given recent judicial history. Section 109 of the US Clean Air Act requires the Environmental Protection Agency (EPA) to set ambient air quality standards for certain air pollutants at a level 'requisite to protect the public health, with an adequate margin of safety'.[63] In *American Trucking Associations, Inc v EPA*,[64] a panel of the District of Columbia. Circuit Court of Appeals found that the EPA had interpreted section 109 to be unconstitutionally lacking in an 'intelligible principle' for determining how much to protect the public health. In other words, the three-judge panel simply could not believe that the EPA was supposed to set ambient air quality standards without considering *any* non-health considerations, such as economic cost. The US Supreme Court overturned the DC Circuit Court ruling, holding that indeed, the EPA was not permitted to consider costs but only health considerations in setting ambient air quality standards.[65]

2.50 It is thus entirely plausible that a statute could mandate the establishment of Pigouvian taxes and that they be set by consideration of *only* the marginal social damages of pollution. Of course, environmental taxation is not immune from sympathetic interventions at the law-making level. Many environmental tax schemes still exempt whole industries,[66] often on the grounds that a high environmental tax burden would adversely affect international competitiveness.[67]

63 42 USC §7409(b)(1).

64 175 F 3d 1027, 1034 (CADC 1999).

65 *Whitman v American Trucking Associations* 531 US 457 (2001).

66 Finland exempts from its carbon tax the burning of fossil fuels for electricity generation. Määttä (n 13 above) 181. Norway exempts from its carbon tax industries that collectively account for 60% of CO_2 emissions. MS Andersen, 'CO_2 Taxation in the Nordic Countries: Results and Methodological Caveats' in Milne *et al* (eds) (n 14 above) 10, 164–5.

67 D Boeshertz and M Rosenstock, 'Energy Taxes in the EU: a Case Study of the Implementation of Environmental Taxation at a Supranational Level' in J Milne *et al* (eds) (n 14 above) 9, 154 (describing German concerns with the impact of an environmental tax on competitiveness); ibid 153 (describing concerns in the EU with the impact of an environmental tax on competitiveness); Kees A Heineken, 'The History of the Dutch Regulatory Energy Tax: How the Dutch Introduced and Expanded a Tax on Small-scale Energy Use' in J Milne *et al* (eds) (n 14 above) 12, 191–2 (describing Dutch concerns with the impact of an environmental tax on competitiveness).

This is clearly not what economists had in mind when arguing for environmental taxes, but in the grand scheme of things, at least some markets have been liberalized in the sense that polluters are required to pay at the margins for some of the costs of their polluting activities. While environmental taxes will not put an end to rent-seeking and sympathy-mongering, at least a statutory mandate may put the force of law behind an effort to *help* to refocus discussion of environmental measures on environmental effects, rather than the economic effects of environmental measures.

E. Conclusion

2.51 Behaviouralism introduces an entirely new set of factors to consider when making instrument choice decisions. The way that individuals and firms behave under different regulatory regimes is of great importance in determining the success or failure of these regimes. The traditional North American debate has not only been beset by political shenanigans, but also by an academic and policy debate that has been missing this key ingredient. The economic case for environmental taxes is a compelling one, but what may ultimately spur North American policy-makers to consider environmental taxes more seriously is a more searching inquiry into how people and firms behave. A call for more innovation and entrepreneurship in pollution reduction, and consideration of which instruments bring about this kind of desirable behaviour, may help to provide the necessary additional impetus for the wider adoption of environmental taxes.