Markets and the Environment

Free Market Solutions to Environmental Problems?

JOHN KROENCKE

The Centre for Enterprise, Markets and Ethics

Enterprise and Values Series

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The Centre for Enterprise, Markets and Ethics

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Introduction

At the launch of the Centre for Enterprise, Markets and Ethics, our founding chairman Lord Griffiths of Fforestfach remarked that:

> [W]hile a market economy is superior to other economic systems which have been tried, it is far from flawless. Financial stability, environmental sustainability and inequality in income and wealth are three critical challenges to the global economy in which we live. Free market economies left to themselves cannot be relied on to provide solutions to these problems.[1]

In the years since, environmental sustainability has continued to prove a critical challenge not just to the functioning of the global economy as we withstand increased climate challenges, but also to the attitudes towards markets that have in part enabled material progress. The Centre for Enterprise, Markets and Ethics engages in research across the overlapping and nested spheres of philosophy, faith, economics and policy. Rigorous thinking about environmental protection and the economics of environmental problems requires a broader context that considers the dynamics of markets and the realistic political economy of state action. This publication sets out the basic economics that underlie environmental policy discussions, situating them not just within narrow environmental economics but also within the context of thinking about markets and society. In doing so, it builds up from the standard content of an introductory economics course and adds aspects of economic theory and later economic policy crafted considering these developments.

Many students and professionals come away from their introduction to basic economic theory with an appreciation for the market system of allocating and generating resources. Within this theory there are situations where markets are deemed to fail. Over its course this publication will investigate the nature of environmental problems that limits the ability of free markets to result in solutions citizens find appealing, but will also show the problems with an impoverished dichotomy that assumes regulatory alternatives can be relied on to provide the best solutions.

Chapter 1, after restating the foundational conceptions of markets, looks at two core pieces of market failure theory: public goods and externalities. These are the foundational concepts on which much abstract thinking about the economics of the environment and the need for corrective action rely. The chapter shows the abstract solutions to these problems within welfare economics and relates these idealised solutions to those implemented by governments in the real world.

Chapter 2 takes this simplified idea about market failure and corrective policy back to the theoretical roots of the issue. The work of Ronald Coase lies at the core of this chapter, together with related ideas that stress the institutional context of both the problem and any potential solution, whether generated by the market, the state or individuals acting in groups somewhere in between. Coase, as opposed to market failure theorists, would stress that the inherent nature of the problem is one of property rights and transaction costs. This means that causality and harm aren't as clear-cut as we might think and that much can be gleaned from empirical studies of attempts by actors to deal with these issues. Related are ideas about commons and the institutions that govern collective goods. For instance, Garrett Hardin's famous notion of the 'tragedy of the commons' has guided half a century of thinking despite its short length, shallow depth and odious topic (forced population control).

Chapter 3 considers the rise of American national environmental policy, which began in the 1960s in response to the perceived failures of legal and state policy efforts to respond to the various environmental harms that seemed to be raging out of control. The chapter contextualises this social and legislative history in the earlier post-war resource economics and politics of resource abundance, which transformed into the economics of the environment. This transition was the result of themes still present in environmental discourse, including material limits, the unaccounted-for costs of environmental harm and the optimal response to environmental problems that would navigate trade-offs between that harm and economic growth. Despite the rise of this thinking, the first generation of policy was largely disconnected from and even opposed to it. It was over the following decades that the analytics and language of economics became central to the discussion of environmental policy. As budgets became tighter and the optimistic goals of early regulation were not achieved, policymakers turned to market-based mechanisms. Within economics this represented a turn from optimal theory to pragmatic policy proposals. Two core examples are realistic pollution taxes and emissions trading (cap-and-trade). In spite of agreement about the inefficiency of the mid-century regulatory framework among economists and evidence from empirical examples of narrow reforms, much of the regulatory framework remains in place. The chapter shows some potential policy reforms organised according to the level of transaction costs involved in establishing markets, and argues that establishing property rights in low transaction-cost settings can simply require the removal of government policy, while in higher transaction-cost settings, markets must be created. Clever policy design allows improvement on the status quo; optimal responses are more difficult to discern. Finally 'the greatest market failure ever known' – climate change – is discussed; it is related to many smaller environmental issues but suffers from the worst features of global public goods.

Notes to Introduction

1 'Extracts from a Speech by Lord Griffiths of Fforestfach at the Launch of the Centre for Enterprise, Markets and Ethics', n.d., https://theceme.org/wp-content/uploads/2015/05/Chairmans-speech-extract.pdf.

Chapter 1: Economic Theory and Market Failure: A Synopsis

To speak about economics as applied to environmental harms, one must know something about economics generally and its conceptual frameworks as applied to policy. While possibly seeming dry and abstruse, these fundamental concepts have direct relevance, including for those more interested in environmental than economic issues. However, this publication also covers issues relevant to people more concerned about questions of economics and public policy generally. In past decades, economics has provided much of the language in which environmental harms have been discussed. The purpose of this chapter is to introduce some of the basic terminology and concepts that will be useful later, attempting to limit jargon and eschewing graphs and mathematics (which do little for those trained in basic economics and risk turning off those who aren't).

This chapter runs through the basic functioning of markets as presented to beginner students of economics. Markets enable spectacular human feats and allow coordination across culture, geography and even time. While imperfect, the logic of this functioning is worth stressing prior to considering the ways in which markets can result in outcomes that call for intervention. Following an outline of these situations there follow some idealised policy responses to the externality problem at the heart of many environmental concerns (addressed in more detail in Chapters 2 and 3).

1.1 Markets at Work: An Ideal Type

One of the first tasks of an economics instructor is to illustrate the emergent benefits of self-interested behaviour by individuals. In the nineteenth century the pamphleteer and economist Frédéric Bastiat wrote of how Paris managed to get fed even though no one person or bureaucracy was tasked with ensuring this. This answer is obvious at a mundane level: the customer at the bakery and the person behind the counter are engaged in a positive-sum trade. The goods that appear in the shop only do so because of a series of profit-seeking – if not always profit-achieving – acts. Extending out these interconnecting and overlapping mundane relationships that populate our commercial life shows the rather amazing functions of markets to encourage social cooperation through the billions of voluntary acts that occur in markets every day.

This behaviour takes place in the face of scarcity. Resources are inherently limited, while human wants and needs are largely unlimited. This scarcity creates the need to make choices about how best to allocate resources. In a market society this is achieved through the process of commercial transactions. In the 1930s, Lionel Robbins formulated a definition of economics that is still popular: 'Economics is the science which studies human behaviour as a relationship between ends and scarce means which have alternative uses.'[1]

When making decisions, individuals must consider the opportunity cost; that is, the value of the next best alternative course of action. Gold may make a great conductor for electrical wiring but this inherent feature doesn't result in its being so used because alternative uses are more highly valued. Opportunity cost determines the trade-offs that individuals negotiate in how they and others use resources. Thinking about these trade-offs makes it clear there are opportunities for exchange if the value derived from holding a good is less than the value from trading it for something else. Voluntary exchange in markets is by its very nature mutually advantageous for buyers and sellers, and because of their exchange, society at large becomes wealthier.

The key to this process is the price mechanism. Individuals and firms engage in voluntary exchanges, buying and selling goods and services. As these transactions occur, prices naturally form based on the supply and demand for each product or service. These prices then serve as signals, informing both producers and consumers about what is valuable and how resources should be directed.

Some buyers may be willing to buy a pastry at £3, others at £5; some bakers may be willing to sell it for £3, others for £1. In this situation we can see that if the market price is £3, the consumer who values the pastry at £5 has garnered a consumer surplus of £2 (what they were willing to pay less what they did). A producer willing to sell a pastry for £1 has garnered a producer surplus of £2 when it is sold for £3. All gains from trade are exhausted when markets clear. This occurs in equilibrium at a price where the marginal benefit of buying the final good is equal to the marginal cost of selling it. Both buyers and sellers can vary in their valuations, but the basic point is that the diversity of valuations is what generates gains from trade, whereby resources flow to those who value them.

But prices do more than just allocate current resources: they also serve as beacons for potential profit opportunities. In this sense the price mechanism not only coordinates immediate economic activity but allows dynamic, long-term improvements in economic organisation with the help of interest rates and accounting practices that allow intertemporal calculation. The prospect of earning profits by introducing innovative products, services or institutional arrangements spurs experimentation and progress. Producers who do not create value do not garner profits. If the inputs cost more than consumers are willing to pay for a product, the business is unlikely to stay viable for long. The COVID-19 pandemic demonstrated the amazing resilience of markets, as they continued to operate in extreme circumstances.

As emphasised by Friedrich Hayek and then generally accepted towards the end of the last century, this decentralised, market-driven process of price formation allows for far greater social coordination than a centralised, top-down system could achieve, despite the numerous deviations of markets in practice from idealised models and idealised alternatives to markets.

In the proper institutional context, individuals do not need to know or trust one another to engage in these cooperative relationships – they can simply rely on the underlying incentives created by the price system. The prospect of mutual gain encourages people to specialise, innovate and coordinate their efforts, resulting in a far higher standard of living than could be achieved through isolated self-sufficiency.

Pareto efficiency – after the Italian economist and sociologist Vilfredo Pareto – occurs when resources are allocated such that no individual can be made better off without making another worse off. This matters because it gives us a straightforward way to evaluate economic outcomes that most people can agree on: if we can make someone better off without hurting anyone else, that's clearly a good change. The Pareto standard of efficiency set a high bar by requiring that economic changes help some people without hurting anyone, which proved impractical for most real-world policy decisions. The Kaldor-Hicks approach – after the economists Nicholas Kaldor and John Hicks – considers a change efficient when total benefits exceed total costs, even if some people end up worse off without compensation. It is this standard that is the basis of cost–benefit analysis covered later in this publication.

Adam Smith's famous 'invisible-hand' metaphor suggests that the pursuit by individuals of their self-interest in free markets can lead to socially beneficial outcomes. In ideal conditions, competitive markets tend towards Pareto efficiency, as if guided by an invisible hand. However, market failures can prevent this optimal allocation, necessitating careful analysis of real-world conditions and potential interventions to achieve efficiency.

1.2 Markets Aren't Perfect: Externalities and Public Goods

> In any industry, where there is reason to believe that the free play of self-interest will cause an amount of resources to be invested different from the amount that is required in the best interest of the national dividend, there is a prima facie case for public intervention.[2]
>
> *- Arthur Pigou*

The simple but counterintuitive world of commercial exchange resulting in social benefits is one whereby individuals acting in their own interest leads to the best outcomes for society at large. While Adam Smith was a more nuanced thinker than many suppose, he represented the paradigmatic turn. In *The Hesitant Hand*, Steven Medema sets out the aberrational nature of Smith's system as compared to earlier thinkers who little appreciated how the sifting process of markets could lead to social improvement.[3] As he shows, the general tendency of Anglo-American economics in the century after Smith was away from the simple world and towards one with special cases, in which the general case for markets did not hold.

As these special cases became more prevalent, ideas about the general performance of markets changed. Unsurprisingly this is also related to broader conceptions of the appropriate role of the state over time. Thinking about what we would consider theories of market failure started in the nineteenth century, as John Stuart Mill and Henry Sidgwick began writing in the shadow of this shift in attitudes. This perspective – that markets are generally beneficial but subject to market failures which create a prima facie case for intervention – is still widespread, despite additional developments within economics, as described in Chapter 2. Nevertheless the following outlines the conventional framework for understanding these issues.

The concept of externalities refers to impacts that spill over from economic activities but aren't captured in market prices. These effects involve people who aren't directly buying or selling in that market. When externalities exist, what's best for individual buyers and sellers doesn't match what's best for society as a whole. This happens because market prices only reflect the costs and benefits that matter to those directly involved in transactions, while ignoring wider impacts on others. A classic example is a factory that maximises profits without considering how its pollution affects nearby residents.

A basic finding from welfare economics is that when externalities are present, markets produce outcomes that aren't socially optimal. This means there is an inefficiency in how resources are used because decision-makers are responding to incomplete information about true social costs and benefits (i.e. when the third-party costs and benefits are included). In the standard analysis, understanding and addressing these spillover effects is essential for evaluating how well markets work and for designing policies that better serve society's interests. In the paradigmatic case of pollution from a factory, the true cost to society is higher than what the factory owner pays. If factory owners had to pay for the full pollution costs, they would account for all relevant social costs.

It's important to understand that the optimal use of goods with negative externalities isn't zero. Even if a product from a polluting factory creates social costs, it still provides value to buyers. The problem occurs when some units are produced that are worth less than their total cost to society. For example, if someone is willing to pay £30 for a steel pan that costs a supplier £20 to produce, but also creates £5 in pollution costs not borne by the supplier, the consumer should buy it because the value (£30) exceeds the total social cost (£25). On the other hand, optimal policy would mean that a consumer who values the pan at less than the full cost of the product (including the harm of the pollution) would no longer purchase it. This distinction matters when we think about policy solutions.

The same logic applies to goods with positive spillover benefits. For instance, flu vaccines protect the person getting the shot, which may be chief among the benefits they consider when deciding whether to get vaccinated. However, from society's perspective there are other benefits, namely reduced disease-spread, which protects others.

Another standard example, from the Nobel Prize winner James Meade, has to do with two agricultural producers.[4] Imagine an area of the countryside with both orchards and beehives. A farmer's orchard provides the resources honeybees need to make honey, but this benefit is external to the decision-making process of the orchard owner. The apiarist benefits from the decision of the farmer to plant an orchard, but without capturing this spillover, basic analysis suggests the orchard owner will underprovide. His private benefit from planting an additional tree is lower than the social benefit. If there were a way to capture the broader benefit (the honey produced by the bees as a result of the orchard), the farmer would plant more trees. In the basic theory, spillovers suggest that there may be a role for policy to improve market outcomes.

1.3 Public Goods, Clubs and Commons

The concept of externalities is closely related to the economic theory of public goods. While externalities refer to the unintended side effects that arise from the production or consumption of a good or service, public goods are specific types of good that inherently exhibit certain externality-like characteristics. In the 1950s the economist Paul Samuelson formalised the definition of public goods.[5] This built on previous ideas about the state provision of goods and was part of a broader, mid-century conceptualisation of the proper role of the state vis-à-vis markets.

Unlike standard consumer goods that are bought and sold in everyday markets, public goods possess two distinctive features identified by Samuelson: non-rivalry and non-excludability. Non-rivalry means that when one person uses the good it doesn't reduce its availability to others – in contrast to standard goods like shirts or cars, which can only be used by one consumer at a time. Non-excludability means that people can't be prevented from benefiting from the good, even if they haven't paid for it. Because of these twin attributes, markets typically underprovide public goods compared to what would be socially optimal, as private actors cannot capture the full benefits of their investments and thus have little incentive to provide them.

A classic example – originating in nineteenth-century English economic writing[6] and then used in twentieth-century textbooks – is a lighthouse that helps guide ships safely along a certain coast. Using language from the twentieth century, the light from the lighthouse is non-excludable: once operational its benefits can't be excluded from passing ships, whether they paid for it or not. The light is also non-rivalrous: one ship benefiting from it doesn't diminish its usefulness to others. This makes the lighthouse a quintessential public good.

This non-excludability creates a free-rider problem. Self-interested ship captains have an incentive not to pay for the lighthouse service since they cannot be prevented from consuming its benefits. But if everyone followed this logic, the privately funded lighthouse would not be built in the first place due to lack of demand, even though its presence increases maritime safety and benefits society. This free-rider problem helps explain why many public goods end up being underprovided by private markets alone.

The underprovision of public goods like lighthouses is a classic collective-action problem, stemming directly from the characteristic of non-excludability. Because the benefits of a lighthouse cannot be excluded from passing ships, whether they paid for it or not, each individual ship operator has a rational incentive to free-ride and not contribute funding. However, if everyone follows this individually rational strategy of free-riding, it leads to a collectively irrational outcome: the under-provision or non-provision of the socially beneficial lighthouse service. While it would be in everyone's collective interest to fund the lighthouse, this inability to exclude creates a disconnect between individual and group interests.

This misalignment, where pursuing narrow self-interest generates an equilibrium harming the group as a whole, defines a collective-action problem. The root cause is the public good's non-excludability. If exclusion were feasible, users could be forced to pay, aligning individual incentives with the collective good; but when it is not, cooperating for the group's interest becomes a challenge absent external interventions.

While pure public goods suffer from free-rider problems due to non-excludability, these issues are largely resolved for club goods.[7] Club goods are excludable, though non-rivalrous in consumption. They exclude non-payers from accessing the benefits, even though no single person's use diminishes the availability for others. A streaming service like Netflix is a common example: only fee-paying members can gain access. Before technology enabled excludability, this was a widely held argument for state regulation and consumer licence fees for radio and television broadcasting. With the excludability of club goods, free-riding is addressed since non-payers can simply be excluded. This allows suppliers to capture the benefits they create by getting users to pay fees or membership dues.

A common-pool resource is a type of good that is rivalrous, meaning one person's consumption diminishes availability for others, but it is also difficult to restrict access. Examples include fisheries, forests, irrigation systems and grazing lands. When open access allows overexploitation without any incentive to conserve the shared resource, it can result in the 'tragedy of the commons' that Garrett Hardin popularised.[8] The logic is not new to Hardin – the defence of private property has rested on the problems of common ownership since at least Aristotle – but the phrase stuck. It refers to the situation whereby individuals acting independently and rationally according to their own self-interest behave contrary to the best interests of the whole group by depleting the resource held in common.

The 'tragedy' arises because each individual receives the full benefit of their own use of the resource but the costs of overuse are dispersed among all those with access. Without any incentive to limit consumption and exclude others, the optimal response is to maximise personal exploitation before others do so. Inevitably this leads to overconsumption, degradation and depletion of the finite resource, leaving all parties worse off than if they had successfully cooperated and restricted their consumption.

1.4 Some Policy Responses to Market Failures: Command-and-Control *vs* Pigouvian Tax

Policymakers and citizens have instituted a full range of policies to regulate markets. In many cases those regulated fit roughly into the theories presented above about how certain features of markets will result in suboptimal outcomes. While politicians have sought to address markets that economists think are prone to problems, this doesn't mean policies are in line with the recommendations of economists.

Perhaps the most common approaches to environmental harms are direct regulation of pollutants, such as smoke, along with taxes aimed – at least in part – at correcting externalities. The benefits of the tax approach as opposed to command-and-control regulation are usually stressed by economists. The practicalities of other options and their rates of take-up will be discussed later. But first, why are economists generally less keen on regulation that simply bans the harmful acts?

The tax solution to externalities, namely Pigouvian taxes, are named after the twentieth-century British economist Arthur Pigou. A government can assess a tax on the sale of goods that have a negative externality in production. The easiest example is a coal-fuelled power station that spews out harmful emissions while powering factories producing things consumers want. By assessing a tax equal to the size of the harm, market participants will optimise their decisions in a way that leads to the optimal social outcome. Consumers will face a higher price and reduce consumption and producers will also make decisions about their methods of production in response to a tax. The consumers least willing to pay the higher price won't purchase the product and on the supply side the least efficient producers will reduce production.

Taxing externalities can generate 'double dividend' welfare benefits beyond just reducing harmful activities. Taxes that do this correct market distortions by making polluters pay the true social cost of their actions while simultaneously generating revenue that can replace other distortionary taxes – such as income and sales taxes – that create inefficiencies by discouraging productive economic activity. Taxing 'bads' not only reduces them, but in replacing taxes on 'goods' it generates additional benefits.

Unlike command-and-control regulations, Pigouvian taxes don't dictate specific solutions but instead harness the market's efficiency by allowing countless individual decisions collectively to determine the least-cost methods of reducing harmful activities. The tax simply ensures these decisions reflect true social costs rather than just private ones, enabling the market's invisible hand to arrive at the socially optimal outcome.

These benefits are more apparent in contrast to the kinds of command-and-control interventions one can imagine or see in the real world, such as requiring all coal-fuelled power stations to install a piece of technology like a scrubber to limit sulphur dioxide emissions, or requiring all stations to reduce emissions by a certain percentage. With these interventions the policy barely distinguishes the abatement costs between polluters: those who can achieve reductions relatively cheaply are not incentivised to continue doing so beyond the intervention required of all producers. Regulations that vary based on the age of the facility – as some do in the real world as a proxy of cost – result in the incentive to keep older facilities around. The outcome of these interventions is that emissions are reduced inefficiently; that is, at a greater cost than necessary.

Perhaps the most basic counterintuitive economic point about pollution is that the optimal amount of it in the real world is almost always not zero. In the example of a product whose production emits smoke pollution, this smoke is clearly the by-product of making goods valued by consumers. It may cause physical discomfort and financial losses for the owners of nearby land (as the harm of the disturbance is priced into the land as it works through the market), but this harm is just one side of the ledger, with the net value of the products to the consumers on the other.

Additionally, the diversity of users means many standard policy responses are likely to be less efficient than Pigouvian taxes. Some users are willing to pay more for a product than others; some suppliers are willing to sell them cheaper than others. Therefore a tax in line with the social cost means that goods will still be used by those who place the highest value on using them. Furthermore, the supply-side response elicited by the tax comes from the producers who can reduce pollution at the least cost (discussed in detail in Chapter 3).

1.5 Conclusion

This chapter has introduced a basic analytic framework for understanding how markets function: supply and demand and the idea that individuals' incentives can lead to social benefits. It has also discussed market failure – specifically in relation to externalities, public goods theory and the commons – which many draw on to critique market performance and suggest policies that can lead to better outcomes. Taken together, this has offered the type of view of the market that many hold; that is, in some cases it performs well, in others poorly and requires intervention. Chapter 2 builds on this cursory introduction with later economic theory and findings.

Notes to Chapter 1

1 Lionel Robbins, *An Essay on the Nature and Significance of Economic Science* (London: Macmillan & Co., 1932), p. 15.

2 Arthur C. Pigou, *The Economics of Welfare*, 4th edn (London: Macmillan & Co., 1932), p. 331; Steven G. Medema, *The Hesitant Hand: Taming Self-Interest in the History of Economic Ideas* (Princeton, NJ: Princeton University Press, 2009), p. 64, doi:10.1515/9781400830770.

3 Medema, *The Hesitant Hand*.

4 James E. Meade, 'External Economies and Diseconomies in a Competitive Situation', *The Economic Journal* 62, no. 245 (1952), pp. 54–67, doi:10.2307/2227173.

5 Paul A. Samuelson, 'The Pure Theory of Public Expenditure', *The Review of Economics and Statistics* 36, no. 4 (1954), pp. 387–9, doi:10.2307/1925895. Though contemporary historians argue that this attribution should be shared with Richard A. Musgrave; see Maxime Desmarais-Tremblay, 'Musgrave, Samuelson, and the Crystallization of the Standard Rationale for Public Goods', *History of Political Economy* 49, no. 1 (March 2017), pp. 59–92, doi:10.1215/00182702-3777158.

6 '… it is a proper office of government to build and maintain lighthouses, establish buoys, etc. for the security of navigation: for since it is impossible that the ships at sea which are benefited by a lighthouse, should be made to pay a toll on the occasion of its use, no one would build lighthouses from motives of personal interest, unless indemnified and rewarded from a compulsory levy made by the state', John Stuart Mill in *Principles of Political Economy*, as quoted in R. H. Coase, 'The Lighthouse in Economics', *The Journal of Law & Economics* 17, no. 2 (1974), p. 357.

7 James M. Buchanan, 'An Economic Theory of Clubs', *Economica* 32, no. 125 (1965), pp. 1–14, doi:10.2307/2552442.

8 Garrett Hardin, 'The Tragedy of the Commons', *Science* 162, no. 3859 (December 1968), pp. 1243–8, doi:10.1126/science.162.3859.1243.

Chapter 2: Coase, Ostrom and the Economics of Government Action

> What this theory [mid-century neoclassical welfare economics] demonstrated, in a nutshell, was that perfect markets work perfectly, imperfect markets work imperfectly, and perfect government can cause imperfect markets to also function perfectly.[1]
>
> *- Steven Medema*

The theme of Chapter 1 was how features of some goods and markets mean that the sort of positive tendencies that might be assumed in standard markets don't apply in situations described by the related concepts of public goods, spillover effects and commons. In these situations – once thought 'exceptional and unimportant'[2] – the state can intervene, such that the logic of the market is reasserted via policies. In this framework the state is acting to ensure the outcome that the market would did it not have features of public goods or externalities – which could in fact be conceptualised as 'missing markets'.[3]

The building blocks of economic thinking presented in Chapter 1 are the core of a mid-twentieth-century consensus in mainstream economic thinking about markets, external effects and public goods.[4] This theoretical frame relates to the broader view of the need for state action to tame markets and improve outcomes in situations where the invisible hand is defective or at least inadequate (e.g. via tax or regulation).[5] As with Pigouvian taxation, these interventions often derived from abstractions and not a set of pragmatic policy prescriptions (a theme returned to later). A series of theoretical developments and empirical studies in the intervening decades have undermined the claims of this framework.

This chapter introduces these developments and, in some cases, their misinterpretations. More specifically, it folds in related research that undermines one or multiple parts of the older consensus. First, the work of Ronald Coase – though this is complicated because Coase, like Adam Smith or John Maynard Keynes, is read in different and conflicting ways. On the sixtieth anniversary of the publication of 'The Problem of Social Cost', the economist and historian of economic thought Steven Medema considered the many plausible understandings and misunderstandings of the so-called 'Coase Theorem'.[6]

An interesting facet of the Coase paper is its focus on the foundational issues and its emphasis on the institutional context of markets (including law), which is both defined by individuals and channels their interests. While the paper is something of a fountainhead for all sorts of relevant fields (perhaps most importantly law and economics), it also builds an analytic framework with clear relevance for environmental issues ranging from climate change to nutrient runoff. While it deals most explicitly with bilateral trades, its framework applies to broader externalities.

After introducing the basics of Coase's paper the following will consider the evidence for the constructions of the last chapter. The illustrative and quaint examples that show the failure of markets provide evidence of the institutional component of markets and their capacity for contracting and bundling to address problems with externalities and public goods. Finally, the chapter turns to analyse the plausibility of state corrective action. This is not done in a comprehensive way but the point is to underline the fact that the assumption that the state is able simply to correct externality issues can be misleading. The point is not that government cannot solve problems in markets (or that market participants will be capable of solving all problems themselves), but to make the case for the comparative approach that Coase sets out in his paper. Chapter 3 brings these together with the recent history of the environmental movement and practical efforts to improve environmental outcomes via policy, including reforms that not only seek to tinker with existing markets but to create new markets.

One of the themes of this chapter and publication is that the specifics of each environmental problem matter greatly for both the analysis of the problem and the assessment of policy for improving outcomes. Deeper insights flow from the pairing of basic economic theory with political and scientific understanding of the problem. Coase and later thinkers argue that much of the basic economic theory invoked to support action stands on weak foundations and misleads citizens and regulators alike.

2.1 Coase and 'The Problem of Social Cost'

> Much of modern welfare economics is indeed concerned with the problem of market failure, and the analysis of market failure appears to imply the desirability of administrative intervention. *Until recently* everybody agreed that where there are externalities, market allocation is bound to be non-optimal; the only point of controversy concerned the frequency and the severity of the external effects and the urgency of administrative action.[7]
>
> *- Stanislaw Wellisz*

In 1960 Ronald Coase published 'The Problem of Social Cost' in the *Journal of Law & Economics*. It challenged what he depicted as the prevailing Pigouvian analytic paradigm outlined in Chapter 1 and familiar to all students of economics. Rather than analysing externalities as being caused by one side, Coase argued that they are caused by both parties; that is, their interaction. This concept of reciprocity fundamentally changed the mechanics of thinking about externalities and ideal policy responses through taxes and subsidies imposed by government, undermining the principle that with environmental issues, the polluter should pay.

Coase demonstrated that harms arise from incompatible resource uses where both parties contribute to the problem. This reciprocal nature means that preventing harm to one party necessarily imposes costs on another, making the central question not how to eliminate externalities but how to minimise total social costs across all parties. This insight shifts the analytical focus from abstract welfare maximisation towards comparative institutional analysis, where different legal rules and property rights arrangements are evaluated based on their ability to facilitate welfare-enhancing exchanges despite transaction costs. The reciprocity framework thus replaces the presumptive need for corrective taxation with a more nuanced assessment that considers whose rights should be protected, whether exchange can resolve conflicts and when regulatory intervention might improve social outcomes – all while recognising that policy itself entails costs and operates within institutional constraints that may prevent theoretically optimal solutions.

Turning to the specific examples that Coase used makes what might seem an arcane point clearer. First, in an example from English law, *Sturges v Bridgman* (1879), a confectioner operating pestles and mortars in the kitchen of a terraced house backing on to a neighbouring London garden was sued by a doctor whose adjoining consultation room was affected by the noise and vibration of the mortars. The mortars didn't cause harm until the doctor built an extension to his house. This consultation room abutting the confectioner's kitchen rendered the noise audible. Standard analysis would depict the confectioner as the one imposing cost, but Coase argued that the social cost of the action relies on the doctor as much as the confectioner.

In abstract terms Coase set out the implication of introducing reciprocity:

> The question is commonly thought of as one in which A inflicts harm on B and what has to be decided is: how should we restrain A? But this is wrong. We are dealing with a problem of a reciprocal nature. To avoid the harm to B would inflict harm on A. The real question that has to be decided is: should A be allowed to harm B or should B be allowed to harm A? The problem is to avoid the more serious harm.[8]

This distinction sounds pedantic but conceptualising the issue as one of a conflict of uses changes understanding of the problem – and relevant solutions. In this view, issues of 'external costs' become part of a broader topic of property rights and exchange like other topics in economics. As Mark Pennington writes: 'Whether an actor or group of actors is the "victim" or "perpetrator" of an "externality" is fundamentally a question of who has the rights to engage in the activity concerned and if they wish to trade such rights for compensation.'[9] With the focus on reciprocity, Coase argued that the appropriate analytical framework *to start analysis* was not to assume that one party is a polluter who should automatically pay but one in which a lowest-cost solution is found to address a conflict between those who have competing claims.

To facilitate seeing the logic in the question as lying in whether A to B – or B to A – is the best way to limit social cost, Coase considered cattle and crops:

> Another example is afforded by the problem of straying cattle which destroy crops on neighbouring land. If it is inevitable that some cattle will stray, an increase in the supply of meat can only be obtained at the expense of a decrease in the supply of crops. The nature of the choice is clear: meat or crops. What answer should be given is, of course, not clear unless we know the value of what is obtained as well as the value of what is sacrificed to obtain it.[10]

Beyond this is where much confusion about Coase begins.

Coase and the Coase Theorem

> (T)he ultimate result (which maximises the value of production) is independent of the legal position if the pricing system is assumed to work without cost.[11]
>
> *- Ronald Coase*

Coase argued that in a world of zero transaction costs the parties affected would exchange rights such that the initial distribution of rights wouldn't alter the outcome (or the efficiency). The notion of transaction costs was defined only implicitly by Coase in the quote above (and in his 1937 paper 'The Nature of the Firm' in which it originated), although the subject of much debate it can be understood as the cost of defining and enforcing a property right.

To continue with the example, if it is assumed that farmer has the right to be compensated should a rancher's cattle stray (i.e. the property rights are clear), the rancher will consider the expected damage that cattle will cause and take the optimal amount of precautions (e.g. building fences). The rancher will also rear the optimal amount of cattle. While the property rights might lie with the farmer, the rancher could also bargain with the farmer either by contracting or exchanging. Compensation for lost product only occurs after the farmer has taken on the costs of production so were the rancher to buy from the farmer the land most at risk of being trampled (or pay the farmer not to plant there), both could gain by avoiding the damage that might otherwise occur.

Alternatively, Coase showed that if the property right instead rested with the cattle rancher, the farmer would find it in his interest to take steps to mitigate the damage. Similarly, this could be done by removing land from cultivation, building a fence or bargaining with the rancher to reduce harm by rearing fewer cattle. The optimal solution would also be determined by the profitability of both producers. In fact, Coase demonstrated via example that in both property rights regimes the producers would end up with the *same* result in a world without transaction costs: an efficient outcome that would simply rely on the costs not the institutional context.

To go back to the earlier example: if the confectioner has the right to make noise but the doctor values quiet more than the former values that right, they will engage in trade to achieve the efficient result in a world with zero transaction costs. The right lying with either the confectioner or the doctor only affects who is paying whom rather than the efficiency of the outcome.

For many, Coase's insight was some version of the general statement about the efficiency and invariance of outcome: if property rights are well defined and transaction costs are zero, parties will be able to bargain privately to reach an efficient outcome regardless of the initial allocation of rights;[12] that is, the total welfare will not change though the distribution will. This statement – not to mention a formal theorem – doesn't appear in Coase's paper but the notion, further pared down, was dubbed the 'Coase Theorem' by George Stigler.[13] It has had an enormous impact (by some measures it's the most cited work in law reviews and among the most cited in social science), but in many ways Stiger's rendering confuses Coase's insights.

While the examples seem contrived, the insights they give rise to are useful in addressing problems in the real world – Coase's main interest – and serve as a prelude to a framework for understanding how social cost is dealt with. This has clear relevance for thinking about environmental issues. Furthermore, *within economic theory* the Pigouvian framework collapses on its own assumptions, which are the same in Coase and in Pigou rather than some isolated feature of either. As Medema writes, the pitfall for some is to think about the world of the theorem as Coase's world rather than the standard assumption of orthodox economic theory, including the Pigouvian apparatus he was undermining.[14]

2.2 Coase Beyond the Theorem: Institutional Responses to Social Cost

> The recognition that environmental problems are a consequence of positive transaction costs is perhaps the central Coasian insight, yet strangely enough this very idea has often led to the dismissal of Coasian policy ideas.[15]
>
> - Mark Pennington

The first third of 'The Problem of Social Cost' focused on the basic theoretical argument against Pigouvian analysis and forms the basis of the Coase Theorem; the remainder is about application to the real world. It proceeds by tracing out the implications for analysis of the same types of issues in a world with transaction costs. Perhaps the first and most obvious is that if the parties impacting each other can't exchange the property rights without frictions, who has the right – the rancher or the farmer, for example – matters for efficiency.

To this point Coase remarked on the fact that the reasoning for the legal decision between the confectioner and the doctor, and many others – including ones about polluting factories – that emerged through the common law, dealt with not just the reciprocity of cause but the efficiency of the situation.[16] This shows up, for example, in ideas about the 'reasonableness' of precautions. In the ruling on the confectioner, the location and features of the neighbourhood mattered.[17] If the confectioner could be stopped on grounds of nuisance in a residential square, could someone move to an industrial area and stop the operation of externality-generating producers such as tanneries? The judge answered, as Coase quoted: 'whether anything is a nuisance or not is a question to be determined, not merely by an abstract consideration of the thing itself, but in reference to its circumstances; What would be a nuisance in *Belgrave Square* would not necessarily be so in *Bermondsey*.'[18]

More than just being an exercise in abstracted deviations from efficiency, Coase illustrated how the legal system's assignment of property rights and liability rules shaped bargaining around such externalities as pollution. His analysis highlighted the importance of transaction costs in determining whether parties could successfully negotiate mutually beneficial arrangements if the rights were assigned to the party that valued them less than the other. Coase's work thus also drew attention to how alternative legal rules and institutions could minimise transaction costs and facilitate bargaining towards more efficient outcomes.

His insight represents a fundamental reimagining of environmental problem-solving. Contrary to simplistic market-based or government-control narratives, he argued that neither markets nor regulatory approaches are universally applicable solutions. Instead he challenged the existing Pigouvian framework – and the twentieth-century regulatory framework – by demonstrating the complexity of addressing environmental issues:

> A better approach would seem to be to start our analysis with a situation approximating that which actually exists, to examine the effects of a proposed policy change and to attempt to decide whether the new situation would be, in total, better or worse than the original one. In this way, conclusions for policy would have some relevance to the actual situation.[19]

The crux of Coase's contribution lies in his recognition that transaction costs are both ubiquitous and central to understanding environmental problems – without them, externalities would simply be another production cost that markets could handle efficiently. But precisely because transaction costs are so pervasive and significant, the choice of policy instruments becomes crucial. This creates a delicate balance: transaction costs are what make environmental externalities a genuine policy problem, yet these same costs call for special care when designing solutions because poorly chosen interventions can make matters worse.

This highlighted the need to properly align institutions and laws to allow efficient private bargaining and resolution of externalities where possible (e.g. by defining tradeable property rights). A benefit of the property rights solution versus a regulatory solution is that the market process would allow the type of knowledge-generating – and innovation-stimulating – relations characteristic of markets to continue.[20] Some argue that over time, regulatory solutions are hard to displace even when new technologies weaken the claims of their superiority over the market.[21]

More generally, Coase suggested that there are four types of responses to social-cost issues.[22] First, property rights can be specified and exchange can take place. In the presence of transaction costs this may not result in the idealised result but must be compared to the relevant alternatives. Second, the decisions can be brought within a single firm: if the same owner owns both the cattle and the crops, the externality is internalised.[23] Third, the state can regulate a solution. This might result in a better outcome in circumstances where it is implausible to expect that either exchange or the firm solution will work well, but the reality of this option must be considered rather than the idealised comparison (more on this later). Finally, the best option may simply be to do nothing.

While Coase undermined the basic theoretical argument for the necessity of corrective regulations, developments in the economics of regulation and political action further frustrate the simple premise of market failure arguments; that is, that they require some underspecified government intervention. Following Coase, economists have studied historic and contemporary examples of contracting solutions to issues. While the nature of the issue varies in each case, which makes it more difficult for the clear-cut property rights seen in standard exchanges to emerge, a large literature both before and after Coase deals with the institutional ingenuity of market participants in coming up with rules that deal with the difficulty of exclusion and the spillover nature of some goods. While debates about the comparative efficiency of different regimes still rages, the point is that the line of inquiry should be comparative and institutional rather than simply potential market failure leading to government intervention. Both the successes and failures of market participants to improve their own outcomes offer insights for social scientists and policy makers.

2.3 Distilling Policy Implications from Fables?

> Whether or not Keynes was correct in his claim that policy makers are 'distilling their frenzy' from economists, it appears evident that some economists have been distilling their policy implications from fables.[24]
>
> *- Steven Cheung*

> I think we should try to develop generalisations which would give us guidance as to how various activities should best be organised and financed. But such generalisations are not likely to be helpful unless they are derived from studies of how such activities are actually carried out within different institutional frameworks … by showing us the richness of the social alternatives between which we can choose.[25]
>
> *- Ronald Coase*

In an example towards the end of 'The Problem of Social Cost', Coase argued that a famous case Pigou draws on to make the broader argument that government action is needed to deal with externalities is factually erroneous. This is an example of a strand of research that makes a methodological and theoretical point about the need for comparative institutional analysis via empirical study of the very examples that economists use to argue the need for corrective action.

In this instance, the example Pigou used is of sparks thrown off by the friction between train wheels and track, which can cause fires in, say, neighbouring woodland. In Pigou's rendering this damage is an example of the market not functioning adequately for the same reason as any other negative externality, i.e. train companies didn't take this damage into account when making decisions. However, Coase showed that the reason they didn't is because Britain passed an act rendering them not liable for damage resulting from sparks. In this case, then, the externality wasn't straightforwardly produced by a market setting that failed to address it; it was rooted in an institutional context.

Chapter 1 gave two stock examples – lighthouses and bees – of goods with characteristics that make them difficult for markets to provide adequately. In the case of lighthouses the service provided is both non-rival and non-excludable: passing boats can see the beams of light emitted from the Fresnel lens whether or not they pay for the services of the lighthouse keeper; use of the service by one boat doesn't diminish use by another. In the case of the bees the stock example is that of the positive spillover effect from apple orchards providing the nectar bees consume. In reality, neither example is as clear-cut as these simple treatments suggest.

Steven Cheung found that beekeepers and orchard owners had in fact developed sophisticated contractual arrangements to internalise the pollination externality.[26] Apple orchards provide little nectar to bees, so Cheung found that not only can markets deal with the externalities involved but the actual payments go the other way as apiarists pay beekeepers for their pollination services. More generally, there is variation in the contracts for these types of arrangements due to variation in the type of crop grown by farmers and whether the bees provided pollination or whether the crops provide nectar (something that differs with the crop grown). This discovery demonstrated that private markets could often solve externality problems without government intervention, provided transaction costs were low and property rights well defined. Cheung's work reinforced Coase's insights and highlighted the importance of empirical investigation in understanding how markets function in practice.

Additionally, Coase argued that in England, lighthouses were actually successfully built and operated by private individuals or organisations,[27] highlighting the fact that the services of the lighthouse could be tied with the ports in which ships would dock. His analysis demonstrated that the private provision of lighthouses was feasible under certain conditions, suggesting that the boundaries between public and private goods might not be as clear-cut as previously thought.

2.4 Property Rights and Rules of Use: Must the Commons End Tragically?

> Garrett Hardin's (1968) portrayal of the users of a common-pool resource – a pasture open to all – being trapped in an inexorable tragedy of overuse and destruction has been widely accepted since it was consistent with the prediction of no cooperation in a Prisoner's Dilemma or other social dilemma games.[28]

> The classic models have been used to view those who are involved ... as always trapped in the situation without capabilities to change the structure themselves ... Whether or not the individuals who are in a situation have capacities to

> transform the external variables affecting their own situation varies dramatically from one situation to the next. It is an empirical condition that varies from situation to situation rather than a logical universality. Public investigators purposely keep prisoners separated so they cannot communicate. The users of a common-pool resource are not so limited.[29]
>
> *- Elinor Ostrom*

The primary influence of Hardin's famous paper – at least in economics – has simply been the name of the phenomenon and the pastoral example.[30] Hardin presents the tragedy of the commons in a way that doesn't consider how the issue has been solved historically. Rules of use have emerged in many cases and in different ways. He considers property rights solutions but dismisses them for reasons of practicality. Yet there are clever mechanisms for creating property rights solutions, despite the theoretical problems of collective action, public good provision and externalities. By limiting access indirectly, whether by a licensing system or tying things together with goods that are excludable (e.g. tying lighthouses to ports), market actors limit the race to the bottom. Furthermore, Elinor Ostrom showed how collective governance solutions can also emerge in a decentralised way. Despite this, the conventional wisdom surrounding the tragedy of the commons is familiar: either a) privatise the resource in question or b) regulate its use. I describe the pure property rights and command-and-control solutions before adding Ostrom's critique of the private-public dichotomy through her work on self-governance and collective property rights.

The Property Rights Solution

Property rights economists argue that the emergence of rights depends in large part on the transaction costs associated with defining, enforcing and exchanging a resource. In the capitalist world at least, if something was held in common in the mid-twentieth century it was usually because establishing property rights was difficult – it was difficult or too costly to exclude others: 'the reason why some activities are not the subject of contracts is exactly the same as the reason why some contracts are commonly unsatisfactory – it would cost too much to put the matter right.'[31]

While many may dispute just where the extension of property rights with state support is impractical and where necessity dictates more involved regulation, the success of property rights generally is known but always worth repeating. For resources like grazing fields or forests, having an owner who can control access and benefits from the long-term value of the resource often prevents overuse. In England and Wales, for example, riparian fishing rights in rural contexts limit users and lead to legal cases by property owners such as angling clubs against polluters.[32]

As is standard in environmental and resource economics textbooks, Nathaniel Keohane and Sheila Olmstead show how in cases such as timber, where property rights have been established, optimal resource extraction for the owner coincides with the socially optimal outcome of scarce resources being efficiently used. In the past, however, many of these resources would have been open access. This raises the question of how and why property rights emerged, which is relevant to their potential extension as a solution. A foundational paper by Harold Demsetz introduced a simple theory for when property rights emerge,[33] arguing that this occurs when the costs of defining them and enforcing them are lower than the benefit of doing so.

Demsetz offered the example of when animal furs became more valuable to indigenous people in North America. Before the fur trade, the small population of hunters relative to beavers meant there was little to be gained from establishing property rights. After the trade increased the value of beaver pelts, the costly process of establishing rights became worthwhile – an example of a natural resource around which rights emerged because of the cost–benefit relationship, though it is also true of many other examples of natural resources that are relatively excludable.

Gary Libecap argues that the plausibility of property rights being established depends on where along a continuum of transaction costs a particular resource lies.[34] Three main features determine this: the resource value, the physical attributes of the resource in relation to excludability and the attributes of the parties. These features also affect non-property rights methods of preventing the tragedy of the commons.

As the benefit of establishing property rights over environmental goods increases as the goods themselves diminish, or because individuals value them more highly as wealth increases, we should expect more rights to be established.

The cost of establishing property rights is also subject to change. New means of preventing overuse or access, such as surveillance cameras or barbed wire,[35] make it easier to establish rights by making the resource more excludable. While no panacea, the incentives of interested parties are such as to support innovations and take them up once created.

Command-and-Control

A popular response to open-access issues is to have the state set rules. As discussed in Chapter 1 in reference to negative externalities, a command-and-control regulatory approach seeks to address the tragedy of the commons by imposing strict rules and regulations on common-pool resource use. Important for any comparison is analysis of just how governments implement these strategies through laws, permits and enforcement mechanisms. An example is the establishment of fishing quotas to limit the number of fish that can be caught in a particular area, preventing overfishing and ensuring sustainable resource management. While effective in some cases, such command-and-control can be costly to implement and enforce. The specific rules are full of trade-offs. Monitoring the number of fish caught is more difficult than monitoring when fishermen are operating, so regulation sometimes governs the number of operational months or days. This can result in dramatic unintended costs, such as seafood rotting on docks before it can be processed and even the death of workers in accidents caused by exhaustion.[36] Alternative regulatory approaches that more efficiently limited access to commons are discussed in Chapter 3; first it is worth considering empirical examples of emergent common property rights.

Self-Governance and Common Property Rights

> It is crucial to recognize that common property is shared private property … Common property regimes are a way of privatizing the rights to something without dividing it into pieces … Historically, common property regimes have evolved in places where the demand on a resource is too great to tolerate open access, so property rights in resources have to be created, but some other factor makes it impossible or undesirable to parcel the resource itself.[37]
>
> *- Margaret McKean and Elinor Ostrom*

Ostrom's book *Governing the Commons*[38] offered a critique of earlier economic theories that advocated for either individual private property rights as a solution to common resource management or for centralised regulation. Her research demonstrated that communities often develop effective self-governing institutions to manage common-pool resources sustainably, without resorting to private rights or centralised control. It emphasised the importance of local knowledge, communication and context-specific rules in successful resource management.

However, there are difficulties with generalising from the outcomes she surveyed, connected with two main types of variation: the type of resource being managed and the scale and type of group governing the common-pool resource. In cases such as long-standing grazing practices in rural Switzerland, there are features of the resource itself that make it difficult to establish private property rights, and features of the parties that make coordination easier – including a common culture and small scale.

This publication's analysis of regulatory policy has so far focused on whether state action is necessary for dealing with the inadequacies of markets as compared to idealised alternatives. Apart from a short discussion of the weaknesses of command-and-control regulation and the need for comparative institutional analysis instead of knee-jerk 'polluter pays' approaches, it hasn't considered the political process behind state action or the incentives of political actors. The next section considers the motivations and information problems associated with government action.

2.5 Politics Without Romance: Can Governments Do Better?

> Inquiring how far the free play of private self-interest makes for social advantage, we find that it frequently fails to do this, but that there are many different forms and many different degrees in its failure. Inquiring how far Government is fitted to take action against these failures, we find that its fitness to do this varies, not only in different places and different times, but also as between interventions directed against different kinds of failure.[39]
>
> *- Arthur Pigou*

The mid-century developments in thinking on formal market failure bore little relation to detailed policy analysis. Both the practical and political dimensions of policy development were ignored, and instead much on state alternatives was couched in idealised terms, especially where theorists were more distant from real-world policy questions. This is not true of the applied economists thinking about policy directly (as discussed in Chapter 3), but even there the conception of political economy assumed that regulators would act in the public interest.

Beginning in the 1960s, economists began formally to study political processes with the same methodological assumption as that held about individuals in other domains of economic research, namely self-interest. This politics without romance approach would later be termed 'public choice'.[40] Public choice is useful for understanding the real incentives of interested parties in public decision-making processes, and is crucially important for environmental issues because public agencies – from conservation agencies to planning authorities – are intimately involved in many issues. The basic Coasean point is that alternatives must be understood and compared. Despite Pigou's reputation among many public choice economists as simply an avatar of a politically naïve Cambridge don, his work exhibited more realistic – if not formalised – thinking about the constraints of state action than much of what came later. While later thinkers were only interested in the formal models, Pigou makes it clear that the pure theoretical 'blackboard economics' he engaged in was a conceptual basis for pragmatic intervention by experts.[41]

An understanding of the bureaucratic and political processes is clearly relevant for thinking about regulatory outcomes. At a most basic level, a difference between the market process and the political process is that, as Pennington writes: 'Absent the profit-and-loss signals to which individuals and firms have access in markets, decisions by the state to impose taxes, subsidies or regulations are not subject to any obvious feedback mechanism that can weed out erroneous interventions and lead over time to an improved set of decisions.'[42]

As in the example of the rotting fish caused by regulation of fishermen's operational hours, some of the more perverse environmental outcomes occur in settings where state involvement is anything but shallow. Some argue in line with Pennington that: 'In many cases it is the intellectual dominance of the belief that markets *cannot* work that has locked in institutions which *prohibit* the emergence of private, contractual solutions.'[43]

Even ignoring questions about the incentives of legislators and regulators, in the absence of markets and their attendant prices, rational decision-making becomes more complex. Formal cost–benefit analysis emerged in the early twentieth century and has become more central to policy analysis and policymaking since. Firms make decisions based on profit, but cost–benefit analysis seeks to inform rational policymaking and government provision. As the size and scope of state provision increased, new bureaucratic forms and procedures were invented by experts to assess policy alternatives (considered in Chapter 3).

While expert cost–benefit analysis is necessary for contemporary practitioners, the world is rife with examples of public projects that wouldn't stand up to rigorous analysis – while others that would are not pursued. In some cases this has been due to the beliefs of the broader public, as filtered through democratic institutions, which has meant that a project was politically worthwhile regardless of its ability to pass a cost-benefit analysis, while in others it has resulted from special interests. Any discussion of how the government hopes to step in to alter outcomes must be informed by a deeper, more realistic understanding of how and why policies succeed and fail.

Government failure, a concept emphasising potential inefficiencies in public sector interventions,[44] receives comparatively less attention than market failure. While the latter is often thoroughly explored, study of the former – including bureaucratic inefficiencies, rent-seeking behaviour and unintended policy consequences – is much less prominent in economics education and policy discussions.[45]

2.6 Conclusion

> [T]he problem is to devise practical arrangements which will correct defects in one part of the system without causing more serious harm in other parts.[46]
>
> *- Ronald Coase*

The contributions of Coase, Ostrom and public choice theorists provide a more nuanced framework that challenges simplistic assumptions about the necessity and effectiveness of state action. Coase's emphasis on transaction costs and property rights demonstrates that the real question isn't whether government should intervene but which institutional arrangement – market, government or community-based – best addresses specific circumstances. His insight demands comparative institutional analysis rather than theoretical absolutes. Ostrom's groundbreaking research revealed that communities often develop sophisticated self-governance systems for managing common-pool resources, providing viable alternatives to both state control and privatisation. Meanwhile, public choice theory reminds us that government actors respond to incentives and may pursue self-interest rather than public welfare, making government failure a real possibility when addressing market failures. This chapter has critiqued abstract theory but also established a framework for comparative institutional analysis – necessary for evaluating alternatives in environmental governance and determining which approaches will truly serve the public interest. Such applied work is beyond the scope of this publication but provides a fruitful way to have rational public policy debates. Chapter 3 outlines the existing system of American environmental policy alongside applied methods of economic analysis. The second half of the chapter combines the foundational work on the economic nature of environmental problems with applied work to show how environmental policy can be improved.

Notes to Chapter 2

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17 Coase, 'The Problem of Social Cost', p. 21.
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Chapter 3: Environmental Economics and Improving Environmental Policy

> Economics has become less a series of doctrines than ... an engine of analysis in which techniques, ranging from the theory of public goods and externalities, ideas about the role of property rights, negotiation, incentives, and mechanism design, are used together with ideas from other disciplines to work out possible solutions to very difficult problems.[1]
>
> - *Roger Backhouse*

> Economics is the study of the allocation of scarce resources. This central focus, as much as anything else, makes it eminently suited to analyzing environmental problems. Let's take a concrete example. The Columbia and the Snake Rivers drain much of the U.S. Pacific Northwest, providing water for drinking, irrigation, transportation, and electricity generation and supporting endangered salmon populations. All these activities – including salmon preservation – provide economic benefits to the extent that people value them.[2]
>
> - *Nathaniel Keohane and Sheila Olmstead*

While this publication is focused on considering the foundational economic issues connected with environmental protection, achieving a reasonable position requires some understanding of the pragmatic issues. For instance, the two related questions of into *which* issues the state should intervene to alter market outcomes and *how* it should do so depend in part on empirical questions about relevant alternatives. There are myriad existing regulatory mechanisms that attempt to improve outcomes. Do insights from economic analysis of their performance and the theories presented in the Chapters 1 and 2 present ideas about potential improvements?

Contemporary concerns are increasingly focused on climate change. This is because of the risks and costs associated with climate change and because of the success of environmental regulation, private actions and technological improvement in mitigating other environmental harms over the past decades. Despite the understandable focus on climate change, such comparatively mundane issues as air and water quality, habitat and species protection and fisheries management are still vital and register considerable interest.[3] In many cases climate change can be reduced with better management practices on these issues – a topic returned to in the short penultimate section on climate change.

Before getting into some specific environmental issues that show both the potential and limits of markets in assorted policy areas, it is necessary to provide some context for both the development of environmental policy *and* its economic analysis. The two quotes above are representative of the widely held view of economics as a policy science combining notions of efficiency, economic theory and rigorous empirical evaluation. While there is some question about the declining role of economists in policy discussions (such as climate policy in the Biden administration), economics manages to sit astride many topics and provide a framework for thinking about them.

Recent academic literature has attempted to reckon with the shift in policy in the last quarter of the twentieth century towards enabling markets and the rise of economic thinking over a broader period. Most of the work is on the United States and the United Kingdom; the focus in what follows will be on the former context. The term 'neoliberalism' is often but inconsistently used; the basic argument is that markets that were curtailed (or never existed) were freed (or created) by reforms beginning in the 1970s. To some degree these ideas were proposed by economists addressing the contemporary failures of their time, but they were also taken up by policy experts and political figures, on the left as well as the right. Nascent environmental policy is one example of a field where this was rampant, as Elizabeth Popp Berman details in her recent book, *Thinking like an Economist*.[4] This consensus broke down in the 2000s and the 2010s as the right shifted away from the more active policies involved in market-based regulation (while retaining a focus on deregulation), and the left became increasingly focused on distributional issues (what is called 'environmental justice') and green industrial strategy.[5]

Standard accounts rightly focus on the rise of the environmental movement in the middle decades of the twentieth century. It was then that major pieces of legislation were passed to regulate industrial polluters and clean up the environment. As Berman and others note, the language used in them – and the public debate around their passage – was markedly radical.

As one example, the Clean Water Act promised to end all water pollution. To show how far this was from the view of professional economists, Berman recounts:

> Harvard economist Marc Roberts told the *National Journal* in 1972 that he was 'a radical, a Democrat, and an ardent hater of Richard Nixon,' yet continued, 'There isn't a single respectable economist in the country who would back the no-discharge goal adopted by the Senate [in the Clean Water Act]. It will waste billions of dollars for no useful social or environmental purpose.'[6]

These topics are popular both because of interest in the time period and a desire by interested parties to similarly reform policy. Many with environmental concerns hold that radical reform of state policy is needed to limit markets. This includes, at the extreme, those who think the consumption of resources and emissions of harmful substances generated by a wealthy society require degrowth. In her popular book *Not the End of the World*, Hannah Ritchie pushes back against the most pessimistic and doctrinaire claims of this kind with data on the progress made in the last decades.[7] Despite the pressing concerns of climate change, many of these ideas are not new, and earlier policy debates provide interesting context for contemporary ones, as does the performance of more idealistic regulation in the twentieth century.

Relevant for this chapter is how interventions for environmental purposes were conceptualised by both policymakers and economists. The through-line is that at least conceptually, reforms that enable markets to perform better (in efficiency terms) and in more dynamic ways, rather than direct command-and-control interventions, became more central to policy discussions over time (even if never that popular). Legislation passed at the time forbade some economic considerations but was rather based on concerns about health and a framework of creating rights to limit pollution irrespective of cost–benefit analysis. Initial proposals to introduce economic considerations were considered repulsive.

After a few decades the benefits of market reforms were more widely recognised, but for reasons connected to interest-group dynamics and politics generally, this conceptual victory has not led to the degree of reform many economists think desirable.[8] On the most important environmental issues, the last 15 years have witnessed a turn away from the standard economic advice of academic economists and towards a range of mandates, subsidies and other regulations. These are meant to enable an energy transition and combat climate change, while most economists support carbon pricing.

3.1 Potted History: Rise of the Environmental Movement and Economic Analysis of Policy

> The 1960s was a decade of growing awareness of environmental issues, especially concerning air and water pollution and agrochemical toxicity. At the same time, the young field of environmental economics was developing as a specific focus among economists, separate from natural resources economics.[9]
>
> *- Nathalie Berta*

> In 1960, a Gallup poll showed that just 1% of Americans saw 'pollution/ecology' as an important problem. By 1970, 25% did.[10]
>
> *- Alec Stapp and Brian Potter*

While earlier regulation attempted to address environmental harms (and legal judgements enshrined in common law created constraints on action), much of the existing legislation governing environmental harms dates only from the last five or six decades. Although environmental harms are frequently discussed in the language of standard economics, this was rarely the case at the time. Over the nineteenth and early-to-mid-twentieth centuries, environmental concerns were often couched in terms of either resource constraints or public health.

For issues like air or water pollution, their categorisation as either an environmental or a public health problem was unclear. In many cases pollution was the result of situations in which noxious output was paired with weather conditions that caused acute crises, such as London's Great Smog of 1952. While earlier reforms attempted to clean the air, it was this acute crisis that led to the Clean Air Act of 1956, which represented a real political effort to limit pollution. The Great Stink a century earlier had resulted in direct government action to deal with sewage polluting the Thames. In both situations the science of the general health effects was initially contested but the acute public health crisis spurred lasting environmental benefits.

The scale of these issues was new because of the total numbers of people involved and the new forms of polluting technology. The smoke from isolated chimneys may cause little harm but in much of the developing world or in historic centres such as London, wood smoke alone (not to mention new pollutants) can create widespread health issues. Economic growth, population growth and the technological innovations that empowered both may have led to new harms, but the wealth generated by cities also enabled the capacity to pay for improvements.

The Rise of Economics as a Policy Science

In their textbook on environmental economics, Nathaniel Keohane and Sheila Olmstead emphasise the standard contemporary approach to considering policy: cost–benefit analysis. As they write: 'The basic approach is simple enough: Measure the costs and benefits of each possible policy, including a policy of doing nothing at all, and then choose the policy that generates the maximum net benefit to society as a whole (that is, benefits minus costs).'[11] At a minimum, a policy must 'pass' cost–benefit analysis; that is, generate net benefits. Similar statements occur in a number of textbooks. While much of the popular discussion and political efforts are still driven by broader concerns, formal policy analysis focuses on cost–benefit analysis. This is relatively new: when the crises above emerged, there was little role for economic analysis in broader policymaking.

In the United States, legal cases and local ordinances provided some protections even before wider legislation. There was logic in the processes by which these rules were made and adjudicated but prior to the formalisation of cost–benefit analysis, much public debate took place without quantified estimates of the benefits of pollution abatement.

In the nineteenth century the growing ability of the state to raise revenue – and assumption that it should step in – led to increased state action, but again, much of this took place before the widespread emergence of public policy practices attempting to deliver net value. While some major projects, such as turnpikes, canals and railways, were largely private in the United Kingdom (though carried out via private acts of parliament), the rise of public infrastructure projects led to the formalisation of cost–benefit analysis of some kind.

The great nineteenth-century engineers and social reformers such as Jules Depuit in France and Edwin Chadwick in England were forerunners of thinking about economic incentives and processes and a form of cost-benefit analysis even began in eighteenth-century France.[12] Over the nineteenth and twentieth centuries, increasingly formal efforts sought to understand the nature of harms.[13]

As currently practised, however, formal analysis can be traced to the American federal infrastructure projects to control flooding as part of the Flood Control Act of 1936.[14] Over the twentieth century, analysis of this sort became formalised in government decision-making, beginning with flood control efforts and water projects in the American West. From there it developed both within government and think tanks such as RAND and Resources for the Future, and within federal agencies. As one historian writes: 'It is not a story of academic research, but of political pressure and administrative conflict.'[15] By the late twentieth century, executive orders issued by presidents of both parties compelled regulatory agencies to do a form of cost–benefit analysis – regulatory impact analysis – on any rule changes.[16]

Yet within this approach there are key questions about how benefits can be measured – and therefore whether they count – and how to consider future benefits properly. Spencer Banzhaf's recent history of the field shows how the broader accounting for benefits such as recreation and health transformed resource economics into environmental economics.

Environmental Economics and the Difficulty of Accounting for Benefits

> [E]conomists began to measure abstract indices like Gross Domestic Product and inflation as well as the benefits and costs of public investments. When they similarly turned to quantifying natural resources and the environment, economists realized that if they limited themselves to those resources traded in markets, which come with a readily observed market price, they would omit much of what society holds dear.[17]
>
> *- Spencer Banzhaf*

Prior to the rise of the contemporary environmental movement in the 1960s, much of what would now be considered environmental economics was focused on questions of natural resource economics. The questions emphasised were those of how to ensure resources weren't wasted and new resources were developed.[18] Over the course of the twentieth century, new methods allowed quantification of some of 'what society holds dear' and so allowed policy analysis that included relevant benefits of environmental protection.

In his book *Pricing the Priceless*, Banzhaf draws on the standard contrast used to sort environmentalists: conservationists who emphasise the use of resources prudently and preservationists who emphasise the purer protection of nature as a thing set apart from human uses. The earlier twentieth-century economists didn't think about the environment beyond the conservationist approach. This approach also fits historically into a Cold War continuation of the mobilisation of resources for armed conflict and post-war economic growth. The 1952 Paley Commission published a report entitled 'Resources for Freedom', which detailed the potential material risks of the next decades and emphasised ways to ensure material plenty.[19] The goal was to enable economic growth and war-making ability. Out of the commission the influential think tank Resources for the Future was founded. Over the course of the 1960s, attention shifted from the lack of natural resources towards questions of how to respond to the degradation of the environment.

Up to this point the mechanics of economic analysis were geared towards a particular conservationist approach almost by design. In the formalisation of cost–benefit analysis during the mid-twentieth century, projects and policies were evaluated by their productive economic impact, with little room in the analysis for the value consumers might place on environmental preservation. What economists call the 'amenity value' of things that individuals enjoy and might even be willing to pay for – but generally don't directly – can be difficult to estimate in situations far removed from standard markets. Banzhaf argues that part of the revolution in the evaluation of these benefits – like using water to support endangered salmon in the Snake River in the quote at the start of this chapter – is tied to the reorientation of economics away from crude output and towards applied welfare. As economic analysis gets further away from working markets, welfare analysis becomes more difficult. Contemporary environmental economics seeks to find robust ways of estimating the value of environmental benefits. By doing so it can inform policymaking that relies on cost–benefit analysis.

Cost–benefit analysis of environmental harms seeks to reduce their varied and complicated forms to a financial figure. Distilling harms to a figure may be subject to dispute but allows comparisons across areas. It might be clear that it isn't worth devoting resources – whether actively expending money or restricting potential uses – to garner benefits if the net benefits are small, but this can also be true if alternatives have much higher net benefits. While mostly focused on future policy, cost-benefit analysis also allows a look back at some of the regulation passed in the 1960s and 1970s. Pairing economic theory and applied economic thinking about environmental harms, it is possible to see some of the potential for market-based regulatory reforms. The history of cost-benefit analysis reveals the intellectual difficulties of rigorous applied economic thinking apart from the standard notion that politics is the constraint on good policy.

To make this difficulty more apparent, consider the management of a section of national forest in the American West. If the forestry officials are tasked with deciding between allowing the forest to be used by logging companies or continue being used for recreation, it is easy to assess a value for the flow of timber that can be harvested but more difficult – though far from impossible – to impute a value for the walks and picnics that people use the forest for. In part, because of this difference between the legibility of use value, government policy can discourage uses that contemporary environmentalists seek. While amenity values or use values can be estimated with contemporary methods, so-called 'existence values' or 'passive use values' are more difficult to estimate. These are the values that one places on, for example, glaciers in Switzerland or polar bears in the Arctic whether or not one observes (or directly uses) them.

For these, economists have developed 'contingent valuation' methods that allow some estimates for goods such as the preservation of Half Dome in the Yosemite National Park, biodiversity and the damages caused by widespread harms like the Exxon Valdez oil spill. Despite this, they continue to disagree about the estimates and whether they are valuable.[20] The standard view of economists is that survey methods to estimate preferences or willingness to pay are far inferior to market situations where individuals must confront trade-offs directly. The use of surveys to estimate value fails to yield robust results because revealed preferences in markets (i.e. people's preferences as manifested by their behaviour) often vary considerably from self-reported preferences. The methods can be useful in the same way that market analysis is useful to companies prior to launch of a new product – something with notable failures for the same reason.[21]

Apart from the more controversial aspects of economic analysis of environmental degradation, it is worth stressing the related development in estimating the health benefits of reductions in pollution. Many of the public health benefits of improvement in, say, air and water pollution rely on the notion of the value of a 'statistical life' to quantify the value of the lives saved by the marginal reduction in, for instance, particulate matter smaller than 2.5 micrometres in diameter (μm 2.5). These tiny pollutants were not directly targeted by conventional attempts to reduce air pollution (including twentieth-century attempts to reduce things like sulphur dioxide). Contemporary estimates of the cost-benefit ratio of air pollution policies find that many of the benefits come from the health benefits associated with the fall in μm 2.5 pollution. These estimates required measurement of this pollution and the notion of the value of a statistical life to account for the benefits. Like contingent valuation, the value of statistical life is a construct with a long history and the subject of much debate, from both an ethical and applied economic perspective.[22]

Despite these difficulties, contemporary empirical research attempts to create precise estimates of the benefits of removing types of pollution via different mechanisms. This includes research on a wide range of matters, such as how much individuals are willing to pay to escape polluted neighbourhoods and how much air pollution harms health outcomes, to name but two. One standard finding is that the marginal abatement cost of pollution rises; that is, it becomes more costly to lower pollution by additional units.

3.2 The Rigidity of Standard Environmental Policy and the Opportunity to Create Markets

> By the late 1950s, both economists and policymakers had formed quite well developed and deeply entrenched visions of how pollution-control policy should be constructed. Unfortunately, these two visions were worlds apart.[23]
>
> *- Tom Tietenberg*

> The US government sets abatements standards, enforces them, and sometimes even prescribes the technology to be used, without attempting to equate marginal costs across pollution sources or provide incentives for technical progress ... The blame for this lies, in our judgement, partly with the Congress and executive agencies for ignoring economists, and partly with economists for recommending impractical policies and for not offering compromises.[24]
>
> *- Anthony Fisher and Frederick Peterson*

Despite the growth of environmental economics in the 1960s, little of this approach filtered into the contemporary American regulatory framework. This section outlines some of this framework's key features and explains why economists have advanced policy proposals that seek to rationalise the existing environmental protections. These proposals include methods of regulation that seek to reduce pollution in line with the costs and benefits of abatement. Economists argue that better regulation can provide a given level of environmental protection at a lower cost. As Nathalie Berta shows, in making these claims about efficiency, the argument for expert policy slipped from ivory tower notions of an optimal amount of pollution to reducing pollution in a least-cost way.[25] Despite successful intellectual arguments, gaining activist support and some legislative successes, there are still large gains to be made from adopting more market-based mechanisms for environmental protection. The failure of more of these policies to be adopted (and in some cases existing wins were rolled back) is discussed later in this chapter.

One example of an area of environmental policy with the most substantial reforms inspired by economics is the regulation of air pollution in the United States, much of which is via provisions originally passed in the 1970 amendment of the Clean Air Act (CAA). As part of these provisions, the Environmental Protection Agency (EPA) sets emitter National Ambient Air Quality Standards, which are emissions limits for the six targeted pollutants. These standards are set without consideration of abatement costs – though regulatory attempts to achieve these standards do consider costs. The CAA also requires a State Implementation Plan for how states will reach those limits. Areas out of compliance generate additional regulations on existing and new polluters. Additionally, the act sets out that new industrial polluters are to be regulated according to technological standards via New Source Performance Standards issued by the EPA. These vary based on a number of factors, often but not always including cost. The 1970 amendment substantially altered the original 1963 legislation, and two major amendments took place in 1977 and 1990 (discussed below). The legislation also allows the discretion of the executive branch; since the 1980s executive orders have been subject to cost-benefit/regulatory impact analysis.

In the years since the passage of the 1970 CAA, the major pollutants have fallen in response, though causal estimates are difficult to generate. There is a consensus in the literature that the CAA reduced pollution relative to the baseline and passes retrospective cost–benefit analysis.[26] Much of the benefit derives from the health impacts of the reduction of the major pollutants. Despite the scale of the legislation and the active work of researchers, many of the aspects one would need in order to set optimal policy remain unknown. There is *no reason* to think the reductions were achieved at least cost, and there are clear examples of unintended consequences.

One example is from the 1977 amendment to the CAA that prescribed the technical requirements of new coal-based power plants to reduce emissions of noxious sulphur dioxide (SO_2). This technical standard was in the interest of coal producers in the Eastern United States because they sold higher-sulphur coal, something not lost on them or their political allies.[27] Once industrial users met the standard by implementing the technology, they were free to pollute and therefore they were also free to minimise costs by using the cheaper, easier-to-transport eastern coal rather than the cleaner coal from the Western United States. The technical standard had no mechanism to govern the amount of SO_2 generated. The absurdity of the rule is that even were a power plant able to achieve a reduction in the pollutant without the costly technology by using coal with less sulphur, the regulatory standard would rule them out of compliance because they didn't install the technology. Furthermore, the height of the smokestacks increased in response to efforts that sought to improve local air quality. By increasing the height, industrial polluters were able to pollute in a way that generated acid rain miles away – including over international borders – as the pollutants fell back to earth. This is an example of public choice problems – dirty coal producers concentrated in politically important districts – combining with imprecise rules to result not just in a failure to solve existing environmental problems but also the generation of a new one in the form of acid rain. These failures of the conventional regulatory approach and the constrained fiscal space provided the political interest for an experiment in market-based reforms in 1990, explored under 'Creating Markets in Practice' below, preceded by the following discussion of the theoretical framework.

Creating Markets in Theory

By the middle of the 1960s the waning focus on the importance of material resource constraints was being replaced by concern for the ill effects associated with material prosperity.[28] Economists at Resources for the Future and other organisations spearheaded efforts to address environmental degradation via more efficient approaches. Despite the association with Arthur Pigou, contemporary ideas about taxing pollution stem from Allen Kneese. Together with economists thinking about trading mechanisms, it was Kneese who sought least-cost ways to address environmental concerns. Achieving a given target at least cost was both more attainable than the idealised approach of taxing pollution at its marginal social cost and more efficient than heavy-handed regulation.

Kneese's foundational work focused on the governance of water resources.[29] Here, a number of related questions arise about alternative uses and the impact of one use on another. In response to the complicated, interrelated system, Kneese argued – in line with Pigou – that a theoretically optimal solution would be 'a system of spatially differentiated effluent fees, ideally set at the marginal damages of emissions'.[30] However, because this was untenable (at least for the time being), Kneese proposed a system whereby emitters were charged when water quality dropped below a regulatory standard (or emissions went above a certain level). Regulators could adapt prices in response to the observed reduction. But the logic of the tax would mean that emissions were reduced by those who could do so at a cost cheaper than the tax, while those for whom the tax was cheaper would continue polluting. As Banzhaf mentions in his treatment, '[Kneese] stressed the fact that with effluent charges, the market – not a planner – would find the way to reduced pollution.'[31]

Considering the difficulty – and cost – of estimating the benefits of abatement, Kneese showed that taxes could be applied over a *politically determined* level of emissions, with the benefit that the market would choose how to achieve it.[32] This represented the beginning of contemporary attempts to achieve environmental goals at least cost, rather than seeking an impractical optimal policy that achieves the economically ideal *amount* of reduction at least cost. While the level selected by the political process may be too high or too low (as compared to the textbook ideal), the process for achieving the level ensures that it does so in a way that doesn't suffer from the waste of command-and-control regulations. This standard-and-tax approach was further developed by William Baumol and Wallace Oates.[33]

Such an aspect of the appeal of market-based regulations brings up a fundamental question about the nature and role of markets. While recent decades have seen an expanded understanding of what constitutes a marketplace, including domains previously considered outside market frameworks, this broader perspective has introduced important tensions in how we approach environmental challenges. Most advocates of market mechanisms take a moderate position, acknowledging that pure laissez-faire approaches may be insufficient for addressing contemporary environmental problems, particularly the most pressing issues of the twenty-first century.

This moderation reflects a nuanced understanding that while conventional markets may emerge naturally, environmental issues often require some form of intervention to address market failures.

The key insight is that environmental policies, though preferable to no regulation at all, frequently achieve their pollution reduction goals at unnecessarily high costs. This has led to the development of market-based regulations that attempt to mimic the efficiency benefits of market mechanisms while addressing the inherent challenges of environmental management. More committed free-market environmentalists, while potentially sceptical of extensive regulation, often acknowledge that such market-based reforms represent an improvement over traditional command-and-control approaches.

Apart from the standard-and-tax approach, regulators can also generate trading by explicitly creating property rights to emit via a cap-and-trade programme.[34] Here a regulator puts an upper limit ('cap') on something like units of pollution and allows those affected by the cap to buy and sell ('trade') their rights or permits among themselves. Many ascribe the direction of travel in economic thinking about environmental regulation involving tradeable rights to Ronald Coase and set market-based regulations against both idealised Pigouvian taxes and command-and-control approaches. As a historical claim this argument runs into difficulties, but there is much similarity between Coase's thinking and cap-and-trade approaches.

Coase's foundational ideas about market mechanisms for managing spillover effects emerged not from his famous 1960 paper discussed in Chapter 2 but from his earlier work on radio spectrum allocation,[35] which bears closer resemblance to pollution trading markets. In examining the Federal Communications Commission's (FCC) approach to managing broadcast frequencies, Coase challenged the conventional wisdom that government regulation through licensing was the only solution to managing signal interference between broadcasters. The existing system in the United States had evolved into a complex regulatory regime whereby the FCC awarded narrow frequency bands with wide buffer zones, allocating these valuable licences through arbitrary 'beauty contests' that consumed substantial resources from potential broadcasters.

Coase argued that the radio spectrum was not fundamentally different from other resources that markets successfully managed. He proposed replacing the discretionary licensing system with an auction mechanism in which the government would define clear usage rights and sell them to the highest bidders, allowing subsequent free trading of these rights. This proposal faced fierce resistance from both politicians and FCC regulators, but when spectrum auctions were implemented in the 1990s they not only generated significant revenue for the federal government but facilitated the rapid development of mobile phone technology, validating Coase's insight that market mechanisms could efficiently allocate even complex resources with spillover effects (the interference). Taken together, estimates of these efficiency improvements are around $17 billion dollars.[36]

Shortly after Kneese's first developments of his effluence fee scheme (and nearly ten years after Coase's FCC paper), two economists – Thomas Crocker and John Dales – are generally credited with proposed emissions permits schemes whereby regulators would set a cap of total emissions and divide this cap into permits to pollute.[37] Thus, instead of setting (and re-setting) a tax in order to achieve an emissions target (as companies could choose to pay the tax instead of reducing emissions to the level desired), emissions would be reduced by way of a cap-and-trade system. As in Coase's article on tradeable spectrum rights, Dales considers the foundational issues before arguing for a property rights scheme:

> Economists tend to assume implicitly that it is impossible to own water and therefore seek to devise artificial price systems that are identical to what prices 'would be' if ownership were possible. The alternative strategy is to devise an ownership system and then let a price system develop. The purpose of this article is to suggest that there are very considerable advantages to attacking our water problems by means of a system of property rights.[38]

Cap-and-trade combines some of the benefits of the purer taxation approach with the political – if not necessarily welfare-enhancing – benefits of the command-and-control approach. Without examining any issue in detail, it is possible to think about some benefits that – an economist would point out – flow from this system as opposed to more standard command-and-control approaches. For one thing, the system is beneficial when the abatement costs that firms face vary. As shown in Chapter 1, this is one of the benefits of the tax approach as well. In the case of cap-and-trade, firms that engage in production that results in less pollution on the margin will be encouraged to continue producing – and perhaps even expand production – while those that engage in production that results in more pollution on the margin will be encouraged to produce less. It also maintains the incentives for firms to invest in known means of reducing pollution, as well as in research and development into new methods.

For policymakers, a benefit of the cap-and-trade mechanism is that it ensures a certain level of emissions can be achieved. In practice, when for scientific or political reasons achieving the target is of utmost importance, this is a drawback of the tax strategy because policymakers may choose to set the tax at a certain level hoping to achieve a certain result, yet find that the tax is too low to achieve it. This benefit of the cap-and-trade system is even more evident over time, as the permits market adapts to changing circumstances without explicitly changing the rate of tax. In theory, politicians could vary tax rates in pursuit of efficiency, but this runs into obvious political difficulties. The system also spurs innovation as companies look for new ways to reduce emissions when permits become valuable.

While conceptually clear, there are of course specific questions about implementation. The level of geography (whether local, regional, or national) and timespan for permits matter, both in theory and in practice. Additionally, theory suggests that assigning permits via auction is the most efficient outcome, while the political constraints of the situation generally result in their being allocated to existing polluters. Caps can also be designed to become progressively tighter as permits are retired. As the cap tightens over time, permit prices tend to rise, creating stronger incentives for developing – and adopting – cleaner technologies.

In the most important contemporary issue, the distinction between tradeable property rights and taxation is perhaps the least emphasised, instead falling under the combined concept of 'carbon pricing'. This can occur via a cap on emissions and a resulting price being generated via market trading, or via a tax. As discussed below, the benefits of each are still debated,[39] but first, it is worth looking at how this theoretical development was adopted by regulators.

Creating Markets in Practice

The first generation of American environmental regulations did not take advantage of the benefits of market-based mechanisms. Some later reforms have introduced them, in part because of the theoretical argument being won but also as a result of increased political interest in market-based mechanisms. Some of this interest was due to the increasingly fractious politics surrounding tightening environmental reforms in the slower-growth 1970s and the general political environment, but also to the success of incremental reforms at meeting targets that would otherwise not have been politically achievable. This section considers examples from the development of regulations emanating from the CAA,[40] most notably the SO_2 trading scheme.

A consensus around the type of least-cost mechanisms discussed above formed in academic economics, but in some cases the market-based mechanisms were, surprisingly, proposed by political and regulatory figures in the early 1970s. For instance, the Nixon administration had sought to regulate SO_2 with them from the outset. In other cases, as with an early attempt to allow emissions trading in California via state regulators, political pressure shot it down, or the ethical arguments over the right to pollute and the proper role of cost-benefit analysis in environmental/health regulation stymied early efforts. But Charles Halvorsen showed how regulators themselves increasingly turned towards market-based mechanisms.[41] Some of the successful programmes included so-called 'bubbles', which allowed polluters to aggregate their emissions between the plants that they owned, and offsets, which allowed new plants – which would have otherwise been banned – to gain approval by reducing existing emissions at a ratio of more than 1:1. Despite this opening-up to market mechanisms, regulators required approval for each scheme and otherwise limited the extent of adoption.

The development of market-based regulatory environmental mechanisms by the EPA and policymakers in the late twentieth and early twenty-first centuries represented shifts in regulatory strategy. After a few smaller-scale experiments (including removing lead from gasoline), the most notable example is the SO_2 emissions market enabled by the 1990 amendments to the CAA.[42] A key milestone was Project 88, sponsored by Democratic

Senator Timothy Wirth and Republican Senator John Heinz, and directed by the economist Robert Stavins, which proposed using market principles to address environmental challenges.[43] The project report covered a number of environmental issues, including ones that hadn't been directly targeted by regulation. In line with the move from determination of optimality to achieving goals by efficient mechanisms, the report states:

> This study is not about setting environmental goals by the use of economic criteria. It does not recommend the use of benefit-cost analysis, or setting dollar values on environmental amenities or human health. Indeed, for the most part, the report eschews judgement on goals and standards. It does not suggest how much air pollution is acceptable, how many acres of wilderness are needed, or how to balance the need for controlling emissions of toxic chemicals with the costs of such controls. These are important – even crucial – questions. But there is a need to set aside ongoing debates over specific environmental standards, in order to carry out a separate examination of effective mechanisms for environmental protection.[44]

One of its case studies set out a proposal that eventually became the SO_2 emissions trading programme in the 1990 CAA amendments, creating a cap-and-trade system for reducing the emissions that were causing acid rain. Its adoption was influenced by the Environmental Defense Fund (EDF) and renewed interest in environmental outcomes among Republicans after a mainly deregulatory focus at the EPA under President Reagan. This approach, championed by EDF and economists-cum-policy entrepreneurs like Stavins, allowed companies to buy and sell pollution credits, providing financial incentives for more efficient emissions reduction. The programme has been studied by many scholars, and in line with theory, research has found that it achieved reductions at costs between 15% and 90% lower than command-and-control regulations. Furthermore, the incentive to achieve reductions at a lower cost spurred innovation in burning processes and technology.[45] Subsequent market-based mechanisms for carbon dioxide and other pollutants have built on this framework, California's carbon cap-and-trade programme serving as a prominent example in the mid-2000s.

Comparative Analysis and the Political Nature of Market-based Regulation

While market-based regulations, such as those creating trading programmes, offer efficiency gains over standard command-and-control, it should be remembered that political forces impact the nature, timing and existence of market-based regulations, which is relevant both for questions of assessment and for the viability of future schemes. For instance, one point of contention in the SO_2 trading scheme was that EPA administrators – and environmental activists – insisted on classifying the tradeable rights as allowances and not a form of property subject to protections against later changes.[46] This type of insistence and the resulting uncertainty about the permanence of trading schemes has scuppered other markets.

Despite the importance of comparative institutional analysis in determining the relative performance of alternative regimes, Gary Libecap argues that: 'In general, transaction costs are not examined in depth in the environmental economics literature. This is particularly the case for the costs of political bargaining and lobbying that arise from implementing and administering government regulation and tax policies, although these costs have received somewhat more attention with cap-and-trade regimes.'[47] Yet even here it is important to be clear that the caps are the result of a political process. Insofar as the cap is informed by economic analysis, it is often fairly casual. As Stavins writes of the SO_2 cap:

> When the policy was enacted, no credible estimates of economic benefits of alternative target levels were available … Instead, the target was selected based on what was believed to be the 'elbow' of the abatement cost curve – that is, a level of abatement that was possible at relatively low costs, and above which the marginal costs of reducing emissions would climb dramatically.[48]

While economics can inform and improve policy, both electoral and bureaucratic politics shape even market-based policy. Government policy and taxpayer money should be devoted to the environmental protection that is most needed. In some cases, privatisation can generate revenue and improve outcomes by empowering market mechanisms. In many of the most difficult cases, such as air pollution caused by disparate sources, the issues are likely to result in government policy improving outcomes when compared to a laissez-faire approach. Status quo (command-and-control) regulation can benefit from basic economic thinking about the issues, and as seen in the reforms presented in this section the stars can align and improve policy. While this section has focused on air pollution, the logic of other regulatory systems is discussed in the next.

3.3 Additional Policy Examples: Matching Policy Solutions to Environmental Problems

While regulation cannot be analysed in detail here, it is worth offering a few examples of the status quo regulatory attempts to limit environmental harm across different policy areas, along with realistic market-based proposals to improve them. The examples are presented by topic area but underlying this they are broadly organised by order of increasing difficulty. Later proposals move towards increasingly involved regulations to create markets – as has been attempted in efforts to limit air pollution – rather than expecting them to emerge. Environmental problems represent a spectrum of issues that vary in their amenability to market solutions.

When thinking about how to address environmental issues, there are various factors to consider, from the origins of harms to their effects and reach, and how policies relate to each. For the most difficult issues, such as climate-change policy, there are myriad levers and policies that influence both the generation of the environmental harm and the scale of damage caused by it. For some pollutants the threshold for harm is clear – amounts below it cause little harm and marginal harm increases above it. In some cases, such as climate change, the emissions have the same impact on the issue at hand wherever they are released in the world. But even for regulatory schemes targeting climate emissions, the underlying behaviour generating greenhouse gases also generates local emissions. Policies can be adjusted to account for these concerns, including those of environmental justice activists and organisers.[49]

It is perhaps easiest to think about this variation in amenability to market mechanisms in terms of the transaction costs, which are to an extent determined by the nature of the resources involved in the environmental problem at hand. At one end are resources with clearly definable property rights and relatively localised impacts, such as timber production or riparian fishing, where private ownership can effectively align incentives for sustainable management. Moving along the spectrum there are resources with increasing complexity in terms of spillover effects and measurement challenges, such as watershed management and open-water fisheries, where hybrid approaches combining market mechanisms with regulatory oversight have merits. And at the extreme end lie greenhouse gases that threaten climate stability and atmospheric quality, where the global nature of impacts, scientific uncertainty and inability to exclude users make purer market solutions impractical and state involvement all but necessary.

This framework helps policymakers identify where market-based tools might be sufficient on their own, where they need to be supplemented with other approaches and where alternative policy instruments might be more appropriate. The basic point throughout the following examples is that state solutions to environmental problems are often suboptimal and can be improved with economic thinking.

Land

> [T]ransaction costs … tend to be at their lowest in the case of land-based issues … Other stationary resources, such as oyster beds and water-based assets such as rivers and inshore fisheries that are excludable with existing technology also exhibit relatively lower bargaining and enforcement costs. Although in many cases such assets are amenable to private ownership of one form or another, the political/ideological framework often prevents the development of environmental markets even where they have considerable potential to improve resource allocation.[50]
>
> *- Mark Pennington*

Over the past decades, private lands have increasingly been brought into conservation. In the United States these include lands purchased by such trusts as The Nature Conservancy and many smaller organisations. Apart from explicitly charitable organisations, land is being conserved by private owners such as Ted Turner, among others. More complex contracting mechanisms allow landowners and environmentalists to interact in mutually beneficial ways. Perhaps chief among these are conservation easements, which have grown to cover millions of acres.[51] These allow land to be held privately with restrictions that prevent certain environmentally harmful uses, such as, most obviously, building on them but also farming that generates nutrient pollution, or harvesting trees. Parties customise the easements depending on the nature of their goals, but it is difficult to remove easements once they are placed on the property. These efforts show the capacity of private individuals to conserve land with taxpayer support via tax credits introduced by governments.[52]

But for reasons discussed earlier, the public-interest argument for leasing public lands was to encourage their cultivation. There are binding rules either to use the land or forfeit the right to the lease. Conservation activities are not classified as uses of the land so in practice, this has led to a situation in which public lands can't be leased by those wishing to use the land for conservation, while private lands can be. The rules thwart efforts to lease the land directly and to enter into agreements with those who have leased government land for myriad activities ranging from cattle ranching to logging. This is of importance in much of the American West, where a large share of land is held by different federal agencies.

In discussing the recent reforms to the Bureau of Land Management (BLM) rules to allow new leases to be issued for conservation, Shawn Regan writes of the general principle:

> A better, market-based approach would allow competing groups to negotiate with or bid against each other to determine which use has more value to prospective leaseholders – mining, for instance, or restoration. This would streamline the lengthy and contentious battles that often pit extractive industries against conservation interests over certain tracts of land.[53]

The 2024 reforms still make it difficult for conservation groups to bargain with existing leaseholders in extractive industries, and while the BLM manages about a tenth of the land in the United States, the National Forest Service and other agencies still manage large swathes that are unaffected. Reforms and targeted incentives would allow markets to conserve land efficiently.

Water

Some of these same features apply to waterway management, particularly in places like the Western United States where natural rainfall is low. Large populations rely on water collected in major reservoirs, transported long distances and taken from aquifers. This is also true of irrigation for agricultural users. There is a large degree of government involvement both within the legal system of water rights – where there is wide variation – and in public utilities.

Somewhere like the Colorado River basin involves millions of users over numerous jurisdictions. Water is used for recreation, direct consumption, agricultural production and the generation of power, among other things. Chief among these, of course, is the water left within the system for fish to live in, large mammals to drink and natural vegetation to grow. These so-called 'instream' uses have received increased attention in recent years as drought has caused levels to fall.

Two striking features of water governance are, first, how difficult it is to exchange property rights, and second, how little price mechanisms are used to ration water. In parts of the American West, water concerns prevent valuable residential development despite the marginal economic value of the water to the new residents being high enough to compensate existing users who value the marginal unit of water less. (The uses of water they would reduce first if the price were higher would likely include things like reducing the size of the front lawn). The nature of the system of allocation often means existing users have little interest in stewarding the water they use because they face lower – or in some systems zero – marginal cost; in the extreme, use-it-or-lose-it allocations encourage waste. More generally, without metering and charging a cost per unit, there is little reason to reduce use. This is true of many agricultural users but also residential users in water districts with earlier rights to water. For illustration, Sheila Olmstead cites research from 2008 showing that 'farmers in Arizona's Pima County pay $27 per acre-foot, and water customers in the nearby city of Tucson pay $479–$3267 per acre foot.'[54] For some farmers, their most valuable asset may be their water rights. While some trades do take place, the regulatory complexity in sales or leases adds unnecessary complexity, raising transaction costs.

More than just charging different rates to different users, when faced with drought, water authorities routinely engage in public appeals to conserve water and, for example, turn off fountains in parks and museums. In California, citizens are encouraged to report neighbours who let water run off their lawns. Yet as Olmstead cites, these types of rationing rules are costly.[55] Technology standards like low-flow toilets or mandating certain types of appliances are also less efficient than simply raising prices. They also suffer from a rebound effect whereby consumers use more as efficiency improves – which is also true of insulation and heating improvements. Economists find this type of regulation – as opposed to charging higher marginal rates above a certain threshold of use or rebating some basic level of use for low-income users – rather bizarre. Regulation can be warranted in places where the market is expected to face difficulties, but in many cases the regulation is what limits the capacity of markets to do social good.

The differential treatment of agricultural users is not just a feature of the water prices they face. Increasingly stringent regulation on American waterways has meant there are few point sources of pollution left; that is, most pollution results not from drainage pipes from industrial users but from accumulated runoff from fields and roads that drains into watersheds.[56] The Clean Water Act leaves much of this pollution to the states, and while some have made efforts to reduce it, agricultural interests and the difficulty of regulating such disparate pollution have resulted in relatively little progress. Increasingly large sums of money are spent to further reduce some sources of water pollution while little is done to reduce pollution in cheaper ways because the two sources of water pollution are regulated differently. Recent judicial rulings in Europe have resulted in cost-prohibitive restrictions on the nutrient runoff from new polluters such as housing developments.[57] In the United Kingdom, potential exchanges were allowed but faced high transaction costs. Recently proposed reforms seek to allow new polluters to pay into a fund that the government uses to abate pollution in lower-cost ways.[58]

Instream uses of water rights have faced a similar challenge to the example above, of land used for conservation not falling into the standard of use set out by legal rules or regulations. Water-use rights in much of the American West depend on so-called 'use-it-or-lose-it' rules. Absent changes in the law, water rights purchased by conservation groups to leave water in rivers and streams for riparian habitats – rather than remove it for use on fields or human consumption – wouldn't be classified as a use and would therefore risk being lost. This has occurred in some states including notably the Oregon Water Trust (later the Freshwater Trust) which has traded with local users to acquire water rights that allow them to improve and maintain salmon habitats among other things.[59]

Particulate Pollution

Air pollution was discussed above, but a recent experiment in India – the first to apply industrial emissions trading to µm 2.5 particulate matter regulation – is worth mentioning here.[60] As additional research shows, the harms of this type of pollution, and many countries seek to improve air quality with the least economic harm, this experiment may prove influential. The researchers found that the cost of achieving the existing target for pollution via a cap-and-trade mechanism was 11% lower than the pre-existing plant-level controls. As it happened, the targets could be more aggressively set because polluters could achieve reductions at a lower cost. This made it politically viable to maintain lower targets. Compared to the control groups, the treatment group of plants regulated by the cap-and-trade system produced between 20% and 30% less pollution in practice because caps could be tightened. While theoretically targets could be set too low and reduce pollution below an optimal level, in this instance the cost–benefit analysis suggests that the benefits were around 25 times higher than the costs. One important feature of this experiment is that it also reduced the administrative cost of lowering pollution – something particularly valuable in contexts where past efforts to enforce regulation have failed.

Fisheries

Chapter 2 introduced the economic root of the environmental problem with fisheries: the high transaction costs involved in establishing property rights create an incentive to catch more fish than is sustainable. This is a classic collective action problem because any one person who seeks to limit overfishing has no means to stop others from acting in their own interests. Despite government policies to limit overfishing, poorly designed policies mean that resources are wasted as fishing enterprises invest in faster and bigger boats, for example, to maximise the catch during the short fishing seasons mandated by regulators. Ecologically determined seasons don't solve the fundamental economic problem of fisheries management, with the result that seasons become ever shorter while fish stocks continue to be at risk.

While Elinor Ostrom showed that self-governance mechanisms can emerge in some settings, in higher transaction-cost settings, market-based regulations in fisheries have proved successful.[61] These typically operate through systems such as Individual Transferable Quotas, where fishers receive tradeable rights to harvest specific amounts of fish based on the sustainable yield (or the shareholders in a collectively owned fishery can themselves set the allowed catch).

This creates a property rights system that incentivises long-term sustainability, as quota holders have a vested interest in maintaining healthy fish populations to preserve the value of their quotas. The transferability allows more efficient operators to acquire additional quotas, potentially leading to better resource management while reducing overcapacity in fishing fleets. Competition occurs in the marketplace for the property rights rather than in open waters. Despite emerging in the literature in the 1970s, political challenges have slowed take-up of property rights systems in fisheries management, though there has been notable progress.[62]

Fish with widespread migration patterns, such as Atlantic tuna, provide a uniquely challenging fisheries management issue.[63] While domestic fisheries management similarly grapples with monitoring, enforcement and biological sustainability, international management must address these concerns across multiple jurisdictions, political systems and economic contexts. The added layers of international law, varying enforcement capabilities and cross-border transaction costs create a level of complexity that makes even successful domestic fishery management frameworks insufficient. In the late twentieth century the extension of Exclusive Economic Zones sought to reduce the number of international disputes, but for many migratory open-water fish species the issues remain severe.

These challenges foreshadowed many of the difficulties now faced in implementing global climate policies such as cap-and-trade systems. The larger the geographic range of the fish migration and the higher the number of governments involved in the negotiations, the more difficult have governance mechanisms been to negotiate. Like the efforts of climate-change agreements to address global emissions, these suffer from collective-action problems.

3.4 Wicked and Nested Problem: Climate Change

> Most countries, including the United States, do not place an economy-wide tax on carbon, and instead have an array of greenhouse gas mitigation policies that provide subsidies or restrictions typically aimed at specific technologies or sectors ... In the world of a Pigouvian tax, markets sort out the most cost-effective ways to reduce emissions, but in the world we live in, economists need to weigh in on the costs of specific technologies or narrow interventions.[64]
>
> *- Kenneth Gillingham and James Stock*

Climate change is the result of centuries of emissions generated by the very things that allow humans to achieve gains in their standard of living. Both the nature of climate change (multi-causal and wide-ranging) and the nature of the actors (diverse and under myriad legal systems with no worldwide decision-making body) make it not just the 'greatest market failure ever known' but perhaps the most difficult social problem to solve.

Many of the concepts presented throughout this publication apply to climate change. The atmosphere is the extreme example of a common-pool resource hard to protect with property rights that enable exclusion. Climate change stems from the global emissions produced by industrial users and individuals all around the world. While the results of the marginal increase in temperature may harm some regions more than others, whether they come from China or Norway, the pollutants have the same effects. Finally, even the results of the added pollutants today will not be felt for years. Other global environmental externalities, such as those of migratory fish stocks, are difficult to solve, but climate change is the most difficult. All humans benefit from solving the collective-action problem, but that only makes it more difficult because of the coordination needed.

Economists generally see the ideal solution as one of pricing the pollutants, ideally according to their social cost. For greenhouse gases they have created – and debated – the Social Cost of Carbon, which attempts to calculate the negative value of a unit of carbon dioxide (and equivalents).[65] It represents the value of the damage, so within this are the health and environmental costs of carbon, including in the future (which are discounted into a present value). Climate change generates changes in the future that must be accounted for in the present. Analogous to how firms discount their future streams of revenue and expected costs according to standard practices in corporate finance (because revenue in the future is worth less than revenue today), policy analysis uses assumptions about a social discount rate set by government to consider policy with implications in the future.[66]

Unsurprisingly, the Social Cost of Carbon is susceptible to many open debates about the values to be placed on parameters such as discount rates and a 'statistical life', not to mention the myriad scientific relationships relied on to estimate the relationship between emissions and events that cause damage. Given this, estimates vary, but a recent paper finds a value of $185 per ton.[67] This is notably higher than existing pricing schemes.[68]

Beyond the tricky question of what the price should be, of particular importance in relation to climate change is the epistemic function of markets. Pricing leads market participants to act in a new way based on information revealed by the price system. Pricing pollutants leads producers and consumers to mitigate the harm they occasion by more obviously incentivising the reduction of use but also, and perhaps more importantly, by adjusting behaviour on various margins – such as adopting new methods of production or spurring innovation. As many have noted, the considerations that consumers engage in with respect to the effect of their actions on the climate are particularly hard to work out. Are imported vegetables better or worse? Are the fewer resources needed to grow mature tomatoes in Morocco and Spain offset by the transportation miles? Beyond the core economic issues, well-meaning and well-informed consumers may attempt to act responsibly – even more so than some might predict – but the difficulty of knowing the right answer frustrates their efforts. A price on pollution, even if not the optimal price, performs a function that voluntary actions have difficulty achieving. Even if the price of carbon were too low as compared to the optimal price that reflected the social cost of the effects on the atmosphere for present and future generations, any price would lead to producers and consumers economising as relative prices changed. For instance, the price of the climate impact would filter into the decisions made along the tomato supply chain and the market would determine the trade-offs.

The political debates around both taxes and tradeable permits bring to the fore issues about take-up. While prices vary in typical markets, the inherently political nature of carbon markets means that businesses and green entrepreneurs are subject to political change. Governments want flexibility to change policy without legal constraints but market participants – especially in carbon credit schemes) – want the legal protections of real property rights.

Despite the growth of carbon pricing across the world, the United States has not followed suit. As Libecap writes:

> Despite early optimism among some economists that cap and trade would become the template for US greenhouse gas (GHG) emission controls, that too has not been the case. The various federal and state regulatory efforts to address GHGs generally do not follow the national market-based approach in the SO_2 phase-down, for example. Rather, the EPA, Congressional legislation, and Presidential executive orders outline a myriad of non-tradeable standards and restrictions on emissions from oil and gas use, coal and natural gas-fired power plants, industrial facilities, pipelines and other surface transport, along with subsidies and related tariffs for green energy development and electric vehicles.[69]

At least in terms of emissions reductions, climate-change prevention is a global public good: individuals cannot be excluded from the benefits of the reduction in emissions and the benefits that accrue are non-rival. This has led most to focus on binding legal actions between nations and regional groups. Despite this obvious logic, Ostrom has pointed out that many of the externalities are nested; that is, the control of pollution at the local level has benefits that accrue to the wider global populace.[70] This is of relevance for attempts to limit local air pollution.

In the absence of the ideal economic approach of taxing the pollutants themselves, these different features increase the difficulty of dealing with global warming in terms of reducing both the warming that occurs, and its impact, in some globally coordinated way. Much of the focus has understandably been on such agreements as those struck at Kyoto and Paris, but just as the warming outcome is the result of many varied decisions that take place without accounting for their negative effects, the limits to continued warming may result from decisions made at a less than global level (mainly national and subnational) and from technological developments achieved by entrepreneurs (both with and without the help of government policies).

Beyond the different responses to limit climate change, it is also worth considering that many of the mechanisms to limit the *impact* of natural disasters depend on subnational governance decisions and market actors more than national governments or international agreements. This is obvious at the time of the disaster and in the preparation for disasters but is also true of the broader framework of regulation that ensures reasonable decisions by individuals and firms. For instance, state policy should allow insurers to price according to risk, ensuring that both policyholders and insurers make the right investments,[71] yet in many cases insurance markets face politically motivated regulation. There is much room for improvement in management practices in resources where public bodies are in control, be that flood walls, firefighting equipment or controlled-burn policies in forests.[72] The cost of climate change will depend on the amount of warming but also on adaptation and preparation.

The last decade has seen large sums of money invested in the transition to green technology. Some of these investments are simply just market actors adopting new technology where profitable, and little different from the energy sector moving away from coal generation towards cleaner natural gas in the wake of the fracking revolution. Others are the result of state support, both explicitly as subsidy or implicitly as requirements on energy producers. Economists generally predict these acts of industrial strategy to prove poorly targeted and inefficient at reducing emissions; that is, achieving reductions at a greater cost than pricing the pollutants themselves via trading or tax. Research shows these inefficient ways of reducing greenhouse gases to be often more politically popular than relatively efficient alternatives.[73] Even in the United States the rollout of green energy generation has been hampered by environmental regulation in the form of the National Environmental Planning Act (1970) and state and local planning difficulties. If anything it has proved more difficult in the United Kingdom, despite the commitment to net zero.

In a period of increased fiscal strain across developed countries, market-based regulations can improve outcomes at greater efficiency by changing the incentives of regulated industries and disparate individuals. In much of the world, economic progress is still more important to many citizens than limiting environmental harm, especially when those reductions in harm accrue globally. The consequences of climate change are becoming clearer, and improvements must move from mere potential. The high-level approach to multinational agreements has much merit, but this section has emphasised some other elements of policy response that can help solve this difficult and complex problem.

3.5 Conclusion

> The short answer is that command-and-control instruments have predominated because all of the main parties involved had reasons to favor them: affected firms, environmental advocacy groups, organized labor, legislators, and bureaucrats.[74]
>
> *- Robert Stavins*

Despite the theoretical advantages of a market-based approach to environmental problems that stresses property rights and market-based regulation, it often loses out in the political arena. For a time, these solutions seemed ascendant. A simplified version of this triumphant narrative is familiar to students of economics, but even with the rise of the economic framework for understanding and debating policy in the late twentieth century, much of the regulatory apparatus evolved prior to these developments. The continuing existence of much of the pre-existing regulatory framework is not the sole problem; in spite of new market-based regulation, much contemporary environmental policy suffers from the basic problems of command-and-control regulation.

This chapter has built on the work of historians of economics to show how those working in environmental economics in the past responded to theoretical and applied problems to craft market solutions to environmental issues inadequately addressed by regulatory measures. It has also pointed out some of the tendencies within the political sphere that have limited potential market solutions to environmental problems. While the topic is vast, two aspects of the stagnation can be identified.

One is at the intellectual level: despite the consensus for carbon pricing within economics, increased attention has been devoted to more radical transformations of the economy. At the level of more local pollution, political energy has shifted from technocratic reforms towards environmental justice, despite there being potential for many improvements to existing policy.

More generally, the incentives facing politicians and policymakers – shaped in part by the views of citizens and market participants – have limited the take-up of market-based reforms. Policies suggested by the framework are unpopular with politicians, regulators, and diverse interest groups, ranging from environmental activists and regulators to industry groups, as noted by Stavins in the mid-2000s. As with the FCC spectrum auctions mentioned above, market-based environmental policies often weaken policymakers' control by reducing their discretionary authority and opportunities for visible regulatory intervention.

Environmental activists often prefer the perceived certainty of direct regulation, while regulators may resist mechanisms that diminish their bureaucratic role, and industry groups frequently favour targeted subsidies over market-wide pricing mechanisms. However, the continued effort towards limiting carbon emissions via a complex array of subsidies, mandates and bans risks the worst situation of all: spending enormous sums and constraining economic growth without achieving the emissions reductions that more efficient market-based approaches could deliver at lower economic cost.

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Conclusion

In the next decades increasing shares of personal and societal wealth will be spent mitigating environmental harms. These harms are often blamed on the ramifications of the market system. To some extent this is true but the complaints too often ignore the human betterment deriving from the activity that results in environmental degradation. At its core the environmental problem facing humanity is how to govern individual actions with the understanding that this harm is a by-product of human desires. Any rational inquiry into ways of addressing the problems must account for the interests of individuals, including those in political office and regulatory agencies. Despite the centrality of economic analysis to the policy questions involved, much of the discussion about the economic constraints of environmental problems is shallow: the feasibility and desirability of green policy is too often taken as given and the reality of corrective actions ignored.

Economists are sometimes – and sometimes deservedly – accused of being Panglossian, but rather than simply offering support for a laissez-faire approach, market solutions to environmental problems encompass different policy solutions to wide-ranging environmental challenges. They can achieve a given level of reduction more efficiently and in some cases are more politically viable. Environmental problems vary in the institutional scale of the governance needed, while the physical nature of the problem partly shapes the difficulty of establishing property rights and creating markets.

The aim of this publication has been to take these issues from their fundamentals and build up the analysis to include contemporary policy questions. Throughout it has stressed fundamental insights of the Coasean approach: any consideration of governance must be comparative; and all solutions are bound to diverge from naïve ideals. The best answer is contingent and the result of weighing trade-offs. If feasible, market solutions, including market-based regulations, allow the rational use of scarce resources and preserve incentives to innovate in the longer run. The capacity for market solutions to outcompete alternative policies depends not only on the pure economic argument for them, but also on questions of political economy.

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