

*Producing greener,
consuming smarter*



Global Environmental Change
An ESRC Research Programme





Producing greener, consuming smarter

Producing Greener, Consuming Smarter summarises key lessons from social science research in the area of sustainable production and consumption.

It is organised around five questions:

1. Are environmental protection and economic growth incompatible?
2. Is business becoming greener ?
3. Can consumers make a difference?
4. How can environmental policy promote sustainable development?
5. What is the best way of creating economic incentives for environmental protection?

Important contributions of GECP studies to national and international research are highlighted in text boxes.

Key academic references for each project are listed at the end of the document.

This document can be accessed and downloaded from the internet at www.gecko.ac.uk.

The website also offers valuable links to researchers, project descriptions and further web resources.

Re-thinking the questions

Despite some impressive progress over the past 30 years, protecting the natural environment is still one of today's top global issues. Industrial pollution and other headline dangers have been successfully tackled in places. Yet old ills stubbornly persist and new dangers have been recognised.

At the Earth Summit in Rio in 1992, the international community affirmed that current patterns of economic and social development are not sustainable. Since then there have been many constructive responses in government, business and the civil society to meet the challenges that lie ahead. But protecting the environment has been recognised as a broader and more challenging task than it seemed:

- Achieving sustainable development will require significant changes in the way economic activities are organised and lifestyles are secured. Producers as well as consumers have a role in reducing this pressure.
- Environmental policies succeed only if they also promise social benefits such as poverty reduction and work in ways that bolster business competitiveness. Conversely, all policy domains need to incorporate environmental and social aspirations.
- Uncertainty is central to environmental problem-solving. Decisions have to deal with conflicting opinions about environmental problems, the risks they pose to different groups in society, and the need to build trust and engage citizens in solutions.

At the same time, processes of political decision-making are growing more dispersed. The world has become more interdependent. Many decisions have shifted to the international, regional and local level. Politics is increasingly conducted outside traditional institutions. Officialdom has to listen more closely to voices in business and at society's grassroots, and involve them in the outcomes that they seek.

Protecting the environment effectively and fairly in the absence of a clearly defined political centre presents many predicaments. There are great opportunities for more open, legitimate and flexible governance, but there are also dangers that expectations are not met. What is at stake, therefore, is a new form of participatory governance, operating through partnerships, and acting across geographical space and time. This prospect involves fresh ways of visualising futures and assisting people to shape their own destinies.

Decisions have to deal with conflicting opinions about environmental problems, the risks they pose to different groups in society, and the need to build trust and engage citizens in solutions.

Summary: What have we learnt about sustainable production and consumption?

In our economy, natural resources are extracted and harvested, consumed as goods and services and then returned to the environment as waste products. At each stage of the process, impacts to the environment may threaten vital ecological resources. The question, is it feasible to reduce environmental damage without decreasing general economic and social welfare, is not a new one. But research and practical experience have taught a number of new lessons over the last decade:

- Economic development does not always cure the environmental problems it creates. There is no evidence that economic growth is necessarily unsustainable, but the nature of growth will determine its environmental impact.
- A shift from pollution control to more efficient and clean technologies will not be sufficient. We have to re-think goods and services themselves, as well as making changes to life-styles and infrastructures.
- Hopes that green consumerism and corporate environmental management could bring fundamental change have not been met. Their contribution to sustainable development is important, but there is a continuing need for political leadership in setting standards, and in providing incentives for environmental innovation.
- Environmental policy could go much further in applying flexible and incentive-based strategies. These should be based on jointly-agreed environmental objectives, a vigorous policy mix including economic instruments, and a policy process involving co-operation with businesses and other stakeholders.

Sustainable production and consumption

The debate about the effect on the environment of economic growth is polarised: some argue that growth brings prosperity and a shift towards cleaner, service-based sectors, new technology and higher social expectations, that prompt societies to invest in environmental protection. Others say that wealthier economies generate new large-scale environmental impacts such as climate change and the threat to biodiversity. Today, most critics do not argue that there are absolute limits to growth. The concept of sustainability implies that economic development can be reconciled with environmental protection and social justice.

How can this more sustainable growth be achieved? A decade ago, the greatest opportunities seemed to lie in the greening of business through technological and management changes. Many suggested that companies would achieve competitive advantage by becoming greener. Higher resource efficiency, lower waste management costs, more environmentally-friendly products and services would all bring financial benefits. Consumers would demand greener goods. Business sustainability would be driven by better information, social expectations of a clean environment, market forces, and pressure from environmental organisations.

Environmental pressures on businesses from regulation, competitors, consumers and environmental organisations have indeed grown during the 1990s, and many companies have developed new environmental capabilities. The high hopes, however, have not been realised. Few companies regard sustainability as a core strategic issue.

The role of policy is thus crucial. In the past, environmental policy relied heavily on command and control regulation intended to set minimum standards or impose bans. Direct regulation, it is now accepted, tends to be inefficient as it is uniformly applied, freezes standards, and is usually based on an imperfect understanding of the potential for improvement. Market-based policy tools, including environmental taxes and pollution trading, create economic incentives for business and consumers to change their behaviour, promoting innovation and low-cost results.

High hopes for the greening of business have not been realised. The role of policy is thus crucial.

Producing greener, consuming smarter

Yet the practical politics of implementing these measures is often tricky. Research suggests it is better to use a mix of policies, including economic instruments as well as traditional regulation. Overarching policy frameworks including negotiated agreements between industry and government, consensual environmental objectives and sustainability strategies have in some countries provided a useful basis for action.

Over the last decade, it has become widely accepted that it is wrong to assume that environmental problems can be solved by the market alone. We now know more than ever how much needs to be done, but also how much can be done. To achieve the challenge of a sustainable economy, fundamental changes to technology, infrastructure and life-style now seem essential. These need to be linked to the large changes already taking place in society. A new geometry of environmental governance has to include business, policymakers and civil society. In order to encourage these changes, policy needs to emphasise incentives, innovation and learning between actors.

Fundamental changes are needed to technology, infrastructure and lifestyles. However, many of these are possible when linked to the shifts already taking place in society.



Are environmental protection and economic growth incompatible?

Thirty years ago there was growing concern that economic growth would lead to the over-exploitation of natural resources. Scientists projecting current trends into the future warned that there could be a dramatic environmental breakdown because economic development would reach resource limits. Such predictions have been proven wrong, mainly because they underestimated the effects of technological change.

In the 1980s, the notion of ecological modernisation turned the above argument on its head. It suggested that economic development and environmental protection can reinforce each other. Increased wealth would not necessarily lead to more pollution, ran the argument, because efficiency gains can offset the effects of growth, and simultaneously reduce production costs.

The relationship between growth and environment is still hotly debated. Economic and engineering studies have shown that there is great potential for environmental improvement in industry at low or negative cost. New processes and products can significantly reduce pollution, safer substances can substitute for toxic or dangerous materials, transportation can be reduced and information can sometimes replace material goods. Developing countries will be able to reduce or avoid pollution at an earlier stage, rather than following the dirty northern path of industrialisation. Technology transfer and new technologies can lay the path to a cleaner style of development.

Is economic growth always based on the exploitation of nature or can growth resolve environmental problems?

What tensions lie between the economy and the environment and what are the consequences for environmental policy?

Are environmental protection and economic growth incompatible?

Box 1: Innovation for sustainability

Dennis Anderson assessed to what extent innovations in technology and management in different areas of industry can reduce environmental damage. He found, for example, that renewable energy technologies have made impressive progress over the past 25 years, and costs have been considerably reduced. Continued innovation has the potential to decrease costs further as markets expand. Anderson found, however, that the positive effects of innovation are commonly under-estimated or neglected in public policy. Investment in alternative low-polluting technologies is therefore lower than economically and environmentally desirable. Innovation-promoting policies could significantly improve environmental protection and at the same time lower environmental costs. There is a major role for public investment in the search for cleaner development.

Technology has contributed to many environmental improvements, but technical solutions are not always available. Often the benefits from new technologies are offset by economic growth. Faster economic development, stronger trade links and better technology have expanded the scope of human activities and deepened their environmental impact.

Economic and engineering studies have shown that there is great potential for environmental improvement in industry at low or negative cost.

Box 2: Time s up!

Peter Pearson analysed the relationship between environmental quality and levels of economic development in different countries. The Environmental Kuznets Curve hypothesis has attracted considerable attention. It argues that environmental degradation increases at the early stages of economic development, reaches a peak and then falls as Gross Domestic Product rises further. But this idea that economic development automatically cures the ecological illnesses it creates does not stand up to close scrutiny. Pearson's review of recent empirical literature suggests that the links are more complex. Some countries can improve their environmental performance as they develop, but not all can. Moreover, some environmental indicators, such as carbon dioxide emissions and solid waste seem to be positively linked to economic growth.

Barbara Adam formulates a more fundamental critique of the relationship between the industrial way of life and the environment: she observes that industrial time comes into conflict with nature's time scale. Natural life processes are rhythmic, approximate, seasonal and contextual. Industrial time is almost the opposite: standardised, precise, and independent of context. The two are at odds with each other: resources that took millions of years to develop can quickly be depleted. Adam argues that science and policy largely ignore the dimension of time because time is less tangible. She sees GM as the latest example of a technology that cuts across natural time, creating unforeseeable hazards that may take decades to become evident.

We cannot make generalised statements about the relationship between economic growth and the environment. Some key lessons emerge from the research:

- Although there are potentials for cost-effective environmental improvements, economic development does not automatically promote clean production.
- Environmental policy has to look at the opportunities and barriers for greening production and consumption, and identify points for strategic intervention.
- There needs to be a much clearer recognition that strong innovation policy and strong environmental policies can greatly reinforce each other.

2

Is business becoming greener ?

Can we expect business to take the lead in making the economy more sustainable?

What kinds of pressures exist for businesses to become greener ?

What are the opportunities and obstacles for improving business environmental performance?

In the 1980s, new research suggested that environmental measures could often serve the economic interests of companies through cost-savings from more efficient use of resources, new product opportunities and better risk management. Businesses, it was therefore expected, would take a lead in the transformation to a sustainable economy. Over the past decade, there has been considerable change: progressive companies are more pro-active; environmental management systems are wide-spread in industry; environmental reporting is improving and many firms have reduced pollution levels below those required by regulation.

Cost-savings can only partly explain this change. It is also caused by increasing pressures on businesses to take on more responsibilities in society beyond producing and selling goods. Consumers and environmental groups are turning on the pressure to reduce waste production, pollution and noise. Major organisations such as supermarket chains are also beginning to require a higher level of responsibility from suppliers. Financial institutions are increasingly interested in environmental information concerning potential investment undertakings.

However, the greening of industry is not universal and is a much more difficult process than many have expected. Technical potential for environmental innovation is rarely exploited fully and many companies do not comply with regulation. The majority of firms still have a reactive attitude towards the environment. Environmental initiatives, be they national or international, often face strong and sometimes unco-operative opposition from business lobby groups.

Box 3: Getting to green

Do companies become progressively greener? Anja Schaefer and Brian Harvey reviewed models of corporate greening and applied them to four case studies in the UK water and electricity sector. The models assumed that companies have a choice of environmental strategy with a line of progression from no interest in environmental issues to the other extreme where a company is highly responsible. Analysis found that environmental strategy and management in the four case studies fitted poorly with the models. Firstly, the criteria of individual stages are often vague and difficult to put into practice. For example, what constitutes comprehensive environmental risk reduction differs between companies and sectors. Secondly, the model suggested that corporate greening is a linear, straightforward process whereas environmental management and capabilities usually develop unevenly within a company. Moreover, the models of corporate greening may not be relevant to environmental improvement a company may be performing well in relation to the environment even though it has a poorly developed management system.

Research into business attitudes and strategies has pointed up the difficulties inherent in environmental leadership, the most crucial being hard economic fact. There are inadequate economic incentives to allow firms investing in cleaner processes and products to gain commercial advantage over their competitors.

Soft barriers also stand in the way of business greening. These are related to the nature of environmental problems - usually complex, long-term and uncertain. Collecting data about a firm's environmental impact is usually time-consuming and expensive. Interpreting the data and deciding on appropriate measures is difficult because the relative significance of different impacts such as waste disposal, water usage or air emissions is uncertain. Judging between different technologies or management approaches may be difficult, and the risk of investments might seem high in the context of regulatory uncertainty.

There are inadequate economic incentives to allow firms investing in cleaner processes and products to gain commercial advantage.

Box 4: Barriers to change

Much research has been done on the response of large companies to environmental challenges, but very little attention has been paid to small and medium-sized enterprises (SMEs). Judith Petts, examining management and non-management employee attitudes in England and Wales, found that people support environmentally responsible action by companies. A strong mismatch exists, however, between personal belief and perceived corporate performance. Many SMEs comply with the law more by good luck than through conscious action, whilst only a minority take deliberate action. However, employees' concerns about the environment can be translated into business performance if systems to encourage learning and change within organisations are in place.

Life cycle assessment (LCA) measures the environmental impacts of products over their entire life cycle from cradle to grave, and was expected to contribute to the development of cleaner products. Frans Berkhout analysed how large European chemical and automobile firms use LCA. He found that some LCA activities are now going on in all sectors of European industry, driven both by regulation and market competition. However, LCA has not yet significantly contributed to improving the environmental performance of product systems in European industry. This can be explained by a number of barriers to the adoption of LCA, including high cost, methodological differences across firms and sectors, poor access to data, mismatch between the needs of firms and the results of studies, and problems with communication of results.

Findings point to the following general lessons:

- Few businesses go green through a sense of public responsibility alone. Corporate greening is not simple and progressive, but depends on the specific opportunities and costs faced by a company.
- Policies should not only provide economic incentives to change business behaviour, but also promote information exchange and learning.

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3

Can consumers make a difference?

How the economy affects the environment depends on how something is produced and on what people are buying. Consumers have a strong influence on which products and services are offered, and on how they are used. With transport, for example, people's daily choices have a great impact on air pollution and land use.

The level of environmental awareness has grown in many countries and green consumer products were expected to spread rapidly. This has proven to be true in some markets such as organic food which has made its way from health shops to supermarkets. Yet, green consumerism remains marginal: environmental awareness often does not translate into changed buying habits. Decisions on what to buy are usually dominated by other criteria such as personal benefit, price and quality. Consumer-oriented environmental policies have been based mostly on voluntary action but their success has been limited. Priority should instead be given to strategies based on economic incentives such as tax reductions. If consumption behaviour is to be made more environmentally friendly it is crucial that products are both green and economically attractive.

Social science research has identified other explanations of consumer behaviour. Shopping, driving and housekeeping are made up of many small and isolated activities making people feel that, even if they believe they should consume greener, individual decisions make little difference. They are also sceptical about whether government and business will match their rhetoric about sustainability with action. Government attempts to encourage individual behaviour change will suffer from the widespread lack of trust in public and private institutions.

Why is consumption behaviour often unsustainable?

How can behaviour be changed?

Have past policies been successful in raising awareness?

Do we need more information or better incentives for consumers?

Box 5: How green is my trolley?

How do green consumer goods spread into the UK and European markets? Paul Stoneman and Veronica Wong found that regulation of firms and their marketing strategies influence consumer demand for green technologies. In the case of unleaded fuel the greening of consumer attitudes seems to have played a major role only in the early stages. Later on tax differences between leaded and unleaded fuel generated a price difference that helped change the pattern of consumer demand. The researchers found that consumers profess green attitudes, but would not accept higher prices or lower quality. They conclude that improvements in product performance are crucial for the further diffusion of green products.

Lyn Collins looked at whether the European eco-labelling scheme is an effective way of improving environmental performance in the forest products industry. The research, carried out in four major producing countries, revealed a number of weaknesses. Eco-labelling rewards only the top proportion of products, while the rest of industry is not encouraged to improve. Some of the criteria used to select the best products are unscientific and open to manipulation. The Eco-label might also act as a barrier to trade. Further difficulties are caused by the complexity of environmental problems, the time taken in reaching consensus and a lack of information available to consumers. The study concludes that although eco-labelling has potential, the EU scheme appears to have had little or no measurable effect on the environment.

To overcome the public sense of powerlessness, policies should focus on areas where consumer behaviour makes a noticeable difference, such as the use of cars in cities. Consumption policies should be integrated with the broad goal of sustainable development, ensuring that responsibilities are shared within society.

The current debate on sustainable consumption often focuses on the final consumer in the household, and neglects industrial consumption and public procurement. However, government and business-to-business procurement account for a large part of overall consumption. Industrial supply chains are now seen as an important mechanism for environmental improvement within sectors, between sectors and internationally.

Box 6: Greening the supply chain

Barbara Morton and Ken Green studied the mechanisms by which environmentally-friendly products, processes and management practices are diffused through the greening of purchasing and supply. The research draws on case studies in six economic sectors and suggests that green supply could be a more effective driving force than green consumerism for improving the environmental performance of industry. Environmental signals in a firm's purchasing policies can stimulate suppliers to innovate, although this is most effective when a partnership exists with a larger purchasing firm.

There is a range of opportunities for companies to green their supply chains, for example, the certification of products and processes. How they can do this, however, depends on the power relations between firms in a chain. Environmental awareness is growing amongst purchasers, who have traditionally been interested only in the bottom line. Understanding industry from a supply chain perspective should allow legislation and pressure group activity to become more precisely targeted.

Emerging policy lessons on green consumption are:

- Government needs to provide incentives for green consumption, rather than rely on the environmental consciousness of the consumer.
- Policy-makers should focus on areas where consumers can make a difference.
- Measures to encourage greener consumption need to act across the very different domains of industrial, public and private consumption.

Debates on sustainable consumption often focus on the final consumer in the household, and neglect the large proportion of overall consumption accounted for by industry and public procurement.

4

How can environmental policy promote sustainable development?

Can environmental policy encourage the transition to a sustainable economy?

What can we learn from policy failures?

How can policy promote innovative solutions?

Greening producers and consumers is a huge challenge that invites policy-makers to be innovative and forward-looking. Radical changes are needed in technologies, aspirations and life-styles. For example, coal, oil and gas will need to be progressively replaced by renewable energy sources, while sustainable transport can be achieved only with major technical innovation and changes in people's behaviour.

However, there is a large gap between the broadening scope of environmental policy and its past effectiveness. Studies of environmental regulation reveal that there are often big differences between the expected and actual effects of regulation. In reality the process of implementation is not as straightforward as is often presented. Policies failed in the past if they did not anticipate how they would be put into effect.

This finding led researchers and policy-makers to rethink environmental policies. Research concluded that regulation is not a linear process where policy-makers enforce a particular policy with a distinctive and well-defined effect. Policy success depends on many factors and particularly on the co-operation of different groups of society. Environmental policy-making has come to be seen over the last decade as a learning process where the interaction between policy-makers and stakeholders is as important as the rules themselves. The process helps to develop a common understanding of environmental problems and an adaptive process in which technologies and behaviours are changed.

Box 7: The reality of regulation

Stephen Fineman examined the practice of the regulatory process in Britain under the Integrated Pollution Control regime. Interviewing pollution inspectors and companies as well as observing regulatory negotiations between them, he found that the street-level bureaucracy is far from being a standardised, routine and technical process. Rather, environmental legislation is cut down to size and made workable in the process of regulation in and with the industry. Personal style, dramatic skill, emotion and a degree of bluff are used to flesh out the regulatory skeleton. Many inspectors prefer a collaborative style of regulation, which lends itself to mutual capture. Each side becomes committed to finding solutions in a way that doesn't upset their relationship. Fineman concludes that, in this form, regulation is a social construct in which the regulatory official plays a key role. Such processes complicate attempts at organisational change or standardisation of regulatory practice.

The relationship between groups involved in decision-making has proven especially important for regulation that aims to promote innovation. Although innovative clean technologies and products tend to be more cost-efficient, most environmental investment is still in filter-type pollution abatement technology. Companies need to have sufficient regulatory flexibility to develop more environmentally-friendly processes and products. Flexible tools such as negotiated agreements between industry and government need a high level of mutual trust and stability. Confidence of the wider public is also essential. Environmental groups, the media and the public will not support co-operative policies if they see them only as a way to weaken traditional environmental regulation.

Box 8: Mapping values

Simon Guy examined the adoption of property development practices that bring positive environmental outcomes. He observes that the property business has a range of actors each seeking different forms of value. Building practice and design decisions are rarely made by a single person, but result from interaction between individuals and businesses with diverse interests. Policy instruments, therefore, that focus on individual developers have proven to be relatively ineffective. There is a need, Guy suggests, to develop a better framework for understanding and shaping property development processes. Policy-makers need to construct a social map of the changing interests and strategies of, for example, investors, developers, major occupiers and agents. This would identify new opportunities for environmental innovations resulting from changes such as the move to a more demand-orientated market-place in the 1990s.

How can environmental policy promote sustainable development?

Finally, a collaborative decision-making process can lead to better mutual information. To promote technological change, policy-makers need a good understanding of innovation processes, the technological options and uncertainties involved. Current approaches have not been as successful as expected because they failed to consider the specificity of technological and organisational change in firms and sectors.

Box 9: Co-operation comes clean

Jim Skea examined the factors affecting the diffusion of clean technologies in case studies including petrochemicals, pesticides, foundries and the energy sector. He looked at how far changing standards of environmental performance result from ongoing technological changes, or from regulatory pressures. Findings suggested that continuing investment in end-of-pipe technology is often a rational response to environmental regulation. In the energy sector, for example, environmental control had led to perverse results, inhibiting the adoption of cleaner processes and generating weak incentives even to use clean-up technology already installed. As a result, industry must be involved in the development of regulation, so that realistic controls reflecting technological capabilities are developed. Flexibility is also essential to allow for refinements of the regulations as markets and technologies change.

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Key lessons include:

- Regulation is most effective when used as a framework to encourage change, rather than as a system of rigid rules.
- Early signals about new regulation, flexible policy tools and credible long-term objectives can promote the development and adoption of clean technologies.
- Environmental regulation should be based on a co-operative process. The risks of regulatory capture need to be avoided by making these processes transparent and open to participation.

Environmental policy has come to be seen as a learning process where the interaction between policy-makers and stake holders is as important as the rules themselves.

5

What is the best way of creating economic incentives for environmental protection?

Economists argue that the value of environmental services such as clean air, water and soils should be properly reflected in the price of goods we pay. This would encourage producers to use them carefully. Market forces will then come into play in protecting the environment, leading to cost-efficient environmental measures. Rather than applying uniform standards across the board, regulators should impose charges for environmental goods, for example waste water discharges or carbon dioxide emissions. Firms that can reduce their pollution easily would have an incentive to do so, while others could choose to pay the charge.

A similar mechanism underlies the international emissions trading scheme planned under the international convention on climate change. If companies and governments were able to trade with permits giving them a right to pollute, greenhouse gas emissions would be reduced in countries and production plants with the lowest costs. Costs for reducing greenhouse gas emissions are very different across the world: a trading scheme is thus expected to lower the overall cost of preventing climate change.

Environmental charges and emissions trading are the most widely discussed economic instruments. But there are other ways to introduce economic incentives, for example promoting environmental liability of financial institutions. The advantages of market-based policy instruments are widely recognised. They are not appropriate for all areas, however, and their implementation can have negative side effects.

Are economic incentives more efficient than other types of policy instruments?

How should environmental taxes be designed?

What other ways are there to introduce economic incentives?

Box 10: Kicking the carbon habit

Research by Terry Barker and Paul Ekins shows that a number of countries, notably in Northern Europe and Scandinavia, have successfully introduced energy taxes and at the same time addressed competitiveness concerns in key sectors. They observed that in almost all the countries there have been exemptions for sectors exposed to international competition. In some countries, taxes on energy use in households and smaller businesses have been set at high levels promoting changes in behaviour. Eco-taxes also raise revenue, allowing reductions in other taxes. Revenue from energy taxes has been used to support research and development, which should lead to longer term reductions in energy use and greenhouse gas emissions and business opportunities.

Barker and Ekins also modelled the economic costs and benefits of policies aimed at reducing greenhouse gas emissions in the UK. They found that carbon dioxide emissions could be cut by 60% by 2040 without great macroeconomic disruption. The positive side-effects of these policies, mainly the reduction of pollutants other than carbon dioxide, are sufficiently high to alter the cost-benefit profile of abatement measures. They estimate that these secondary benefits are about the same size as the benefits of reducing greenhouse gas emissions. This work was influential in shaping the government policy on a climate change levy on business energy use.

Increased electricity prices, for example, could increase the number of households that cannot afford adequate heating. Traditional regulatory approaches will also continue to play a role where they guarantee a minimum level of protection from pollution. Detailed analysis of how different instruments can contribute to specific environmental objectives has only just begun.

Environmental taxes can bring about large positive side effects, which are often ignored in narrow analyses of costs and benefits.

Box 11: The buck stops there

Environmental regulation usually seeks to hold polluters liable for the cost of the pollution they cause. It has been suggested to extend legal liability to the banks that fund investment by firms. This could, so the argument goes, persuade firms to reduce the risk of environmental damage so as to gain access to favourable credit. Alister Ulph examined the implications of this extended liability. Analysis from the United States shows that liability for environmental damage has a significant negative impact on a bank's willingness to lend to environmentally risky industries. If lenders find it difficult and costly to monitor the environmental risk of certain projects, they may respond by refusing credit to certain classes of risks. Ulph concludes that the extension of liability could be environmentally beneficial but needs to be carefully designed to minimise any such economic side-effects.

Lessons concerning economic incentives include:

- Economic research has been valuable in pointing out that policies ignoring price signals are unlikely to succeed.
- Energy taxes on businesses can lower greenhouse gas emissions efficiently, while simultaneously addressing concerns over competitiveness in key sectors.
- Market-based instruments are not a panacea: they should complement rather than replace traditional regulatory approaches.

Environmental taxes can drive business innovation, leading to greater competitiveness as well as unforeseen ways of reducing pollution.

Unanswered questions

The search for effective, cost-efficient and fair strategies to shift the economy towards sustainability is ongoing. Encouraging change in this direction is tough because production and consumption are determined by many separate but interrelated decisions. A major challenge for public policy will be to develop clearer targets and more integrated policy approaches in the journey towards sustainable development. This is a political undertaking, rather than a purely managerial or scientific task.

Another challenge concerns the interaction between different policy instruments such as taxes, standards and voluntary agreements: how can the policy mix be prevented from degenerating into a policy mess where different instruments impede each other? How can good environmental performance be defined, and how can it be compared within and between sectors? Economic incentive is the most powerful way of changing consumer behaviour, but often has undesirable social implications. How can a more equitable transition to sustainable consumption be attained, based on changes in lifestyles and values?

Finally, what of the role of the citizen consumer? Are we now living in a knowledge economy in which informed citizen consumers are empowered to make more environmentally-friendly choices? Or does the illusion of living in a weightless economy lead to more profligate use of resources?

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