THE COST IMPLICATIONS (OF POTENTIAL GLOBAL CLIMATE CHANGE) FOR INDUSTRY

Paul Ekins
The Environment Group at the policy Studies Institute, UK

Keywords: Damage, adaptation and mitigation costs; costs for firms, industrial sectors, national economies; structural change; carbon/energy taxes

Contents

Summary

If concerns about climate change continue to intensify, industry will be expected to react, and change its activities, in fundamental ways.

For some firms and industrial sectors, this expectation will be a source of commercial opportunity. Those that develop and adopt technologies that help societies both adapt to climate change and mitigate it will be well placed competitively in a world of enhanced concern about climate change. Some of the new technologies most obviously relevant to adaptation are new crop species with greater tolerance of climatic variation, new flood-defense techniques, and products and processes that increase the efficiency of water use. Mitigation techniques are most clearly exemplified by energy-efficiency and renewable energy technologies. At the firm level, then, climate change presents opportunities as well as challenges. Even firms in sectors which are highly dependent on fossil fuels could do well out of concern over climate change, if they lead the way in their sectors in terms of reducing that dependence through improved energy efficiency, increased use of renewables and diversification away from energy-intensive activities.

Notwithstanding these differences within sectors, some sectors as a whole will clearly face greater potential costs from attempts to mitigate climate change than others. Energy-intensive sectors, in particular, will tend to be adversely affected. Under pressure from regulation and economic instruments, relative price increases in these sectors will mean that, even if they improve their environmental performance, these sectors will tend to become relatively less important as a share of GDP. International differences in the speed and stringency with which this pressure is applied could introduce incentives to relocate production to areas with relatively little pressure. An

important challenge to the international community is not to allow laxity in efforts to reduce emissions to become a source of international competitive advantage. Not only would this act as a discouragement for all countries to intensify their emission-reduction efforts, it would also tend to dissipate the gains from those efforts, as emissions were shifted from one country to another rather than reduced overall.

For economies nationally, different studies give very different results for the cost of emission reduction in terms of reduced output, depending on the assumptions they adopt. This article concludes, on the basis of assumptions which are not unrealistic about such issues as the pace of development of renewable energy sources, and taking into account possible gains in energy efficiency, that the evidence suggests that even deep cuts in carbon emissions in the early decades of this century need not entail heavy costs. It remains to be seen, however, whether opposition to such cuts from those energy-intensive sectors which would be adversely affected will prevent the policy instruments necessary to achieve them from being implemented.

1. Introduction

Industry will be affected by three types of costs as a result of climate change or the threat of it:

- Costs due to damage from climate change
- Costs due to efforts to adapt to climate change
- Costs due to efforts to mitigate climate change

In this article the nature and various estimates of the magnitude of these three types of cost will be surveyed. The focus of the article is on the cost implications of potential global climate change for *industry*. Several points should be borne in mind throughout the article:

- 'Industry' is comprised of many different sectors, which will be very differently affected by climate change and responses to it.
- What is experienced as a cost by one industrial sector, or by society as a whole (for example, storm damage to buildings, or regulations prescribing increased energy efficiency), may be experienced as a profit-making opportunity by a different sector (for example, the construction sector or the manufacturers of energy efficiency equipment).
- There are clear distinctions between the concept of cost as applied to individual firms, to industrial sectors or to national economies as a whole.

2. The Costs to Industry of Damage from and Adaptation to Climate Change

The balance of evidence from studies of impacts from global warming suggests that four statements concerning the impacts of any appreciable global warming and associated climate change may be made with some confidence. First, the impacts will be felt in many different ways. Second, the net impacts will be negative from the human point of view across the world as a whole. Third, the impacts will be different in different regions of the world. In general, the physical impacts will be greater in tropical regions. Given the present global distribution of wealth, this means that, in general, poorer countries will be harder hit physically, and in terms of relative economic costs, than richer ones. Fourth, the size of the impacts and their incidence in either time or place is still subject to great uncertainty.

While there is a clear conceptual distinction between the costs of damage from climate change, and the costs of adapting to it, they will very often be difficult to distinguish in practice. For, example, following inundation due to sea-level rise caused by climate change, as part of the effort to restore the damage, flood defenses may be improved. The resulting costs figure will include elements of both adaptation and damage costs. The difference may be important in respect of who pays the costs (for example, insurance claims would be likely to be valid only for damage costs), but in the various estimates of possible global damages from climate change, damage and adaptation costs are often lumped together, as will be seen.

	Fankhauser[a]	Cline	Eyre et al.	Cline
	(2 x CO_2 warming)			(long term)
Agriculture	8.4	17.5	-31.2	95.0
Forest loss	0.7	3.3		7.0
Species/ecosystem loss	8.4	4.0+[b]	0	16.0+
Sea level rise			3.4	35.0
Coastal defenses	0.2	1.2		
Wetlands loss	6.4	4.1		
Drylands loss	2.4	1.7		
Electricity requirements	-	11.2		64.1
Non-electric heating	-	-1.3		-4.0
Human amenity[c]	7.7	+		+
Human life	11.4	5.8	233.9	33.0
Human morbidity	+	+		+
Migration	0.6	0.5		2.8
Hurricanes	0.2	0.8	9.2[d]	6.4
Tourism	-	1.7		4.0
Water supply	15.6	7.0		56.0
Urban infrastructure	-	0.1		0.6
Air pollution	7.3			
Tropospheric ozone		3.5		19.8
Other		+		+
TOTAL (billion $1990)	69.3	61.6	215.3	335.7
TOTAL (% GNP)	1.3	1.1	1.1	6.0

a In the source the figures given are in $1988. They have been scaled up in the column below by the ratio of 1990 to 1988 GDP.

b + means that the source indicates (further) unquantified costs.

c This entry in Fankhauser corresponds to the previous two rows in Cline. Cline indicates further unquantified costs under this heading as shown.

d Includes hurricanes, winter storms, river floods

Table 1: Estimates of annual damage and adaptation costs from global warming incurred by the US economy and the global economy at 1990 scale

Table 1 reproduces three estimates of damage costs from the 2.5^oC global warming, and the resulting climate change, which is the IPCC best estimate of the effect of a doubling of CO_2-equivalent concentrations of greenhouse gases in the atmosphere, and one estimate of much longer-term warming of 10^{o}C. From these figures the lumping together of the damage and adaptation costs may be clearly discerned: several of the Fankhauser and Cline entries (e.g. construction of dikes, electricity requirements and migration) actually represent the costs of adapting to climate change, rather than of the damages associated with it. It should be noted that the costs of damage and adaptation are not independent. In particular, incurring costs of adaptation may reduce the costs of damage. Indeed it should do so by more than the cost of adaptation, if adaptation is economically rational. Dikes are built to protect land from sea-level rise. Air-conditioning in hot climates may reduce death and morbidity from heat stress (a significant item in Cline's damage costs). With the exception of the figures on sea-level rise, it is not clear in any of the estimates how far it has been possible to take these trade-offs into account.

From Table 1 it can be seen that there is relatively close agreement between the overall totals of damage costs (1.3 and 1.1% of GDP), and these totals also agree quite closely with the other overall levels of damage in the literature, so that the damage costs of 2xCO_2 global warming (the warming caused by the doubling of the concentration of CO_2 equivalents of greenhouse gases in the atmosphere) are quite often quoted as 1-2% of GNP.

However, it can be seen from Table 1 that the agreement between the totals comes about despite entries in individual categories that vary substantially. Many of the entries differ by more than a factor of 2. The differences between Fankhauser and Cline come about for three reasons, illustrating the uncertainties involved in calculating the damage costs of climate change:

1. Use of different scientific predictions of the likely physical impact of climate change (e.g. for forestry Cline uses a source that suggests a loss of 40% of US forests, whereas Fankhauser's source leads him to a figure of 16%).
2. Different interpretations of the same scientific prediction of the likely physical impact of climate change (e.g. Fankhauser derives 6,642 increased deaths per year from heat stress, while Cline's figure using the same source is 9,800).
3. Different valuation of a given impact (e.g. Cline values his loss of life in 2. at $0.6 million per life, while Fankhauser uses a figure of $1.5 million).

The estimates by Eyre et al. are dominated by valuations of the loss of human life and omit a number of the categories covered by Fankhauser and Cline. Agriculture, on these estimates, actually benefits from climate change, as northern latitudes become more productive (because of warmer temperatures and the fertilization effect of higher atmospheric concentrations of CO_2), while the value of species and ecosystem loss is not given.

In addition to the above uncertainties, climate change also entails a risk, as noted above, which is incalculable and may be small but cannot be ruled out, of a major disruption to the biosphere or to human ways of life or both, which could amount to catastrophe.

Table 2 gives an estimate as to how the costs of global warming may be distributed internationally. It can be seen that low-income countries (China, Rest of the World) have substantially higher proportional costs (Fankhauser & Tol [1996, p.665] quote these as up to 9% of GDP for some developing countries).

Region	% GNP (1988)
European Union	1.4
United States	1.3
Other OECD	1.4
Former USSR	0.7
China	4.7
Rest of the world	2.0
OECD	1.3
Non-OECD	1.6
World	1.4

Table 2: Damage due to doubling of atmospheric CO_2 equivalents for different regions (present scale economy)

The figures in Table 1 represent net costs from climate change to society as a whole. As remarked above, the net costs may conceal considerable differences between impacts on different economic sectors. Some sectors will experience global warming as a net benefit. For example the electricity sector will gain if more electricity is used for air-conditioning to offset higher temperatures. Some sectors will gain in some parts of the world, but lose in others. For example, tourism may gain from warming in colder climates, but lose in areas already hot and dry or which become subject to more extreme weather conditions. Agriculture will lose out in some areas (those already hot and relatively dry) but gain in others (those that are cold or in higher latitudes). Table 2 shows that poorer parts of the world, and the industry within them, are likely to fare relatively badly from climate change.

The figures of Table 1 should be regarded as little more than impressions of the possible costs of damage from climate change, so great are the uncertainties associated with them. More certain costs, the recent increase in which may be evidence of the actual onset of climate change due to anthropogenic global warming, are those associated with weather events. In the ten years of the 1980s, economic losses from weather-related natural disasters totaled $54 billion. In the 1990s this was surpassed in one year, 1996, when losses totaled $60 billion. In the eight years up to and including 1997, total losses were $252 billion (Brown, Renner & Flavin 1999, p.80). Clearly these losses are a substantial, and seemingly increasing, cost to society at large. For the construction industry, they undoubtedly represent increased work. For the insurance sector they could either represent great losses (if insurance premia failed to reflect the rise in economic damage), or a commercial opportunity for significant expansion, if appropriate premia for the insurance of these losses can be calculated.

On the one hand, therefore, the potential costs to industry due to damage from or attempts to adapt to climate change are difficult to separate out from losses to society as a whole. On the other, some industrial sectors may stand to make particular gains or losses from climate change. With regard to the costs to industry of attempts to mitigate climate change, there is less uncertainty. These costs form the subject of the next section.

-
-
-

Bibliography

Barker, T. 1995 'Taxing Pollution Instead of Employment: Greenhouse Gas Abatement Through Fiscal Policy in the UK', *Energy and Environment*, Vol.6 No.1, pp.1-28

Böhringer, C. & Rutherford, T.F. 1997 'Carbon Taxes with Exemptions in an Open Economy: A General Equilibrium Analysis of the German Tax Initiative', *Journal of Environmental Economics and Management*, Vol. 32, pp.189-203

Brown, L, Renner, M. & Flavin, C. 1998 *Vital Signs 1998-1999*, Earthscan, London

Bruce, J., Lee, H. & Haites, E. Eds. 1996 *Climate Change 1995: Economic and Social Dimensions of Climate Change*, contribution of Working Group III to the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), Cambridge University Press, Cambridge

Cline, W.R. 1992 *The Economics of Global Warming*, Institute for International Economics, Washington DC

Ekins, P. 1996 'How Large a Carbon Tax is Justified by the Secondary Benefits of CO_2 Abatement?', *Resource & Energy Economics*, Vol. 18 No.2, pp.161-187

Eyre, N., Dowring, T., Hoekstra, R. & Rennings, K. 1997 'Global Warming Damages', Final Report to the European Commission on Contract JO53-CT95-0002, November, European Commission, Brussels

Fankhauser, S. 1995 *Valuing Climate Change: the Economics of the Greenhouse*, Earthscan, London

Fankhauser, S. & Tol, R. 1996 'Climate Change Costs: Recent Advancements in the Economic Assessment', *Energy Policy*, Vol.24, No.7, pp.665-673

OECD (Organization for Economic Cooperation and Development) 1985 *The Macroeconomic Impact of Environmental Expenditure*, OECD, Paris

Oliveira-Martins, J., Burniaux, J.-M. & Martin J.P. 1992 'Trade and Effectiveness of Unilateral CO2-Abatement Policies: Evidence from Green', *OECD Economic Studies*, No.19, Paris

Repetto, R. & Austin, D. 1997 *The Costs of Climate Protection: a Guide for the Perplexed*, World Resources Institute, Washington D.C.

Smart, B. Ed. 1992 *Beyond Compliance: a New Industry View of the Environment*, World Resources Institute, Washington D.C.

Biographical Sketch

Paul Ekins has a Ph.D. in economics from the University of London and is Head of the Environment Group at the Policy Studies Institute, and Professor of Sustainable Development at the University of Westminster. He is also a Member of the UK's Royal Commission on Environmental Pollution.