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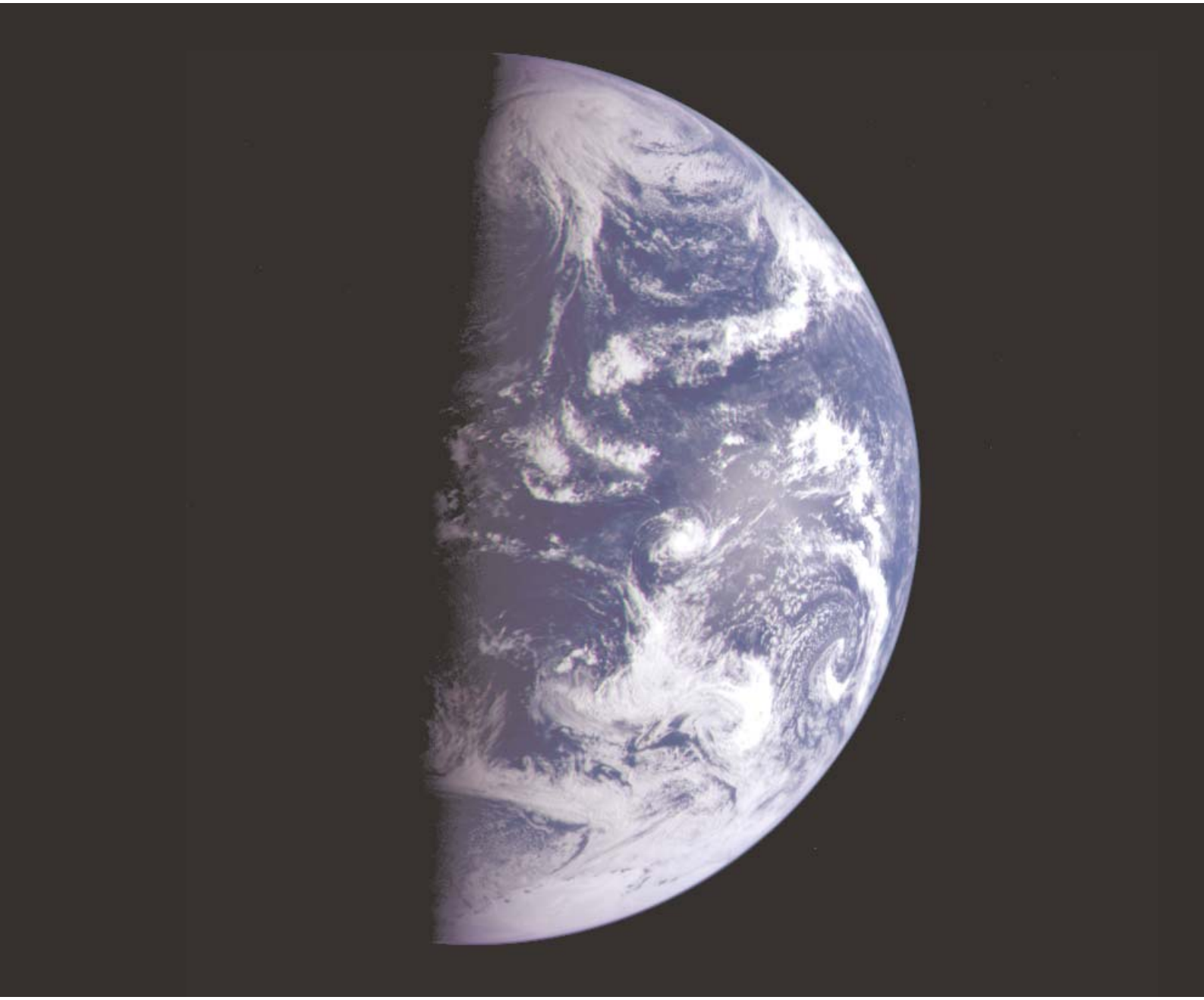
The economics of climate change

By **Simon Kyte**



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Contents

A polarising risk for the climate policy debate? 2
The risks associated with forecasts 2
The assumption of 'technical potential' 2
Mitigation from an investment perspective 3
Is the Stern implied social cost of carbon too high? 5
Health, economic growth and climate effects 6
Mitigation as insurance against risk 6
The developing countries and their role in climate change mitigation 7
London's role 8
Conclusion 8

The Stern Report, published at the end of 2006, whilst widely welcomed, is now facing criticisms both from some members of the climate science academic community and from some economists. This note concentrates on the economic criticisms.

A polarising risk for the climate policy debate?

A number of authors have argued that the forecasts in Stern will not act as a new consensus but will rather exacerbate differences in climate policy debate. In particular, they are likely to continue to attract debate regarding climatic forecasts and economic technicalities thereby losing the report's central messages. According to some of Stern's critics, the damage estimates in themselves are enough to undermine the ability to galvanise a consensus to support near-term intervention.

The risks associated with forecasts

Forecasting is always fraught with difficulties. In the case of Stern, two broad sets of forecasts have been necessary: economic forecasts over a time horizon many times longer than would usually be considered practical and climate change forecasts, which are still in their infancy – also extrapolated over the next two centuries. If both economic growth and temperature change tend towards 'high-end' forecasts in Stern's analysis then the costs of warming will appear very high since the implication is that a lot of economic growth will be lost (relative to a small amount of 'lost' GDP in the earlier part of the period via mitigation expenditure). However a parallel implication of such high rates of average annual economic growth is that people living in two centuries' time are likely to be richer and better able to afford the additional expenditure to adapt to a changed climate. There is also a further consideration: the expected number of people in future generations might distort judgements over sacrifices to be made by today's population for the benefit of future generations.

The assumption of 'technical potential'

The position of the Intergovernmental Panel on Climate Change (IPCC) is that the main barriers to carbon dioxide concentration stabilisation are socio-economic and institutional[1]. In contrast, Hoffert et al.[2] emphasise the fact that stabilisation will require huge amounts of carbon-free energy and that no current technology or combination of technologies is capable of delivering this. Metz et al.[3], on behalf of the IPCC, speak of the 'technical potential' of a renewable technology when this might be better described, as Green et al.[4] have argued, as a 'theoretical potential'. It is generally overlooked that most of the renewable technologies are not only land-intensive (for example, biomass) but are often also water-intensive (for example, hydrogen).

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[1] This is the position outlined in the Working Papers for the Third Assessment Report. A 'Summary for Policymakers' of the Fourth Assessment Report has subsequently been published which states with higher confidence that the globally averaged net effect of human activities since 1750 has been one of warming.
[2] Hoffert et al. – Response. Science 300 (25 Apr 2003)
[3] Metz was co-Chair of IPCC Working Group III on mitigation. See: Climate change 2001: Mitigation, WG III as part of the IPCC Third Assessment Report (2001)
[4] Green et al. – Potential scale-related problems in estimating the costs of CO_2 mitigation policies, Climatic change 44 (2000)

Socolow's 'stabilisation wedges' demonstrate how existing technologies could be used to stabilise CO_2 emissions[5] but that would not be enough to stabilise concentrations. As Pacala & Socolow[6] themselves make clear: *"Stabilisation at any level requires that net emissions do not simply remain constant, but eventually drop to zero"*. They recognise that in order to develop such technologies for such heavy emissions reductions, 'enhanced research and development' is essential.

Consequentially an economic priority must be the facilitation of research and development in scaleable carbon emission-free energy technologies and inducing the deployment of such technologies[7]. Without their development and deployment, no commitment to CO_2 concentration stabilisation will be credible. London is well-positioned to play a key role in such research and development.

Mitigation from an investment perspective

One area of dispute amongst economists is how the high valuation of climate change impacts reported by Stern have been generated. Tol and Yohe[8] argue that these are generated by *"a very low discount rate, risk that is double-counted, and vulnerability that is assumed to be constant over very long periods of time"* i.e. the next 200 years.

Stern generates an overwhelming case for 'mitigation now' on account of an implied benefit to cost ratio of between 5 and 20. However, working with the numbers found elsewhere in the report, a whole range of benefit to costs ratios can be generated ranging from 0.09 to infinity[9]. Past studies have not shared Stern's findings because his report uses an estimate of the damages associated with climate change that are substantially larger than previous studies and his estimates of the costs of emissions reductions are lower.

It is important to distinguish between the 'pure time preference' discount rate and the effective discount rate. 'Pure time preference' is the attachment of greater economic value to a good or service delivered now rather than at some point in the future. This condition can be shown to exist empirically but an ethical question arises as to whether society as a whole should simply reflect the aggregation of individual pure time preferences. The problem here is that deviating from this market-determined course implies that one particular individual's values have to be imposed on other members of that society. Brittan[10] has pointed out that Stern's own technical annexes suggest that using a (still low) pure time discount rate of 1.5% rather than 0.1% that Stern uses in the main report would reduce the loss from a 'Business As Usual' scenario from 5% of GDP to 1.4%.

[5] See for example Where to start – The Economist climate change supplement (9 Sep 2006, pp. 23-24)
[6] Pacala & Socolow – Stabilization wedges: solving the climate problem for the next 50 years with current technologies, Science 305 (13 Aug 2004)
[7] As has been argued by Green, Baksi & Dilmaghani – Challenges to a climate stabilizing energy future, Energy Policy 35 (2007)
[8] Tol & Yohe - A review of the Stern Review, Wold Economics Vol. 7/4 (2006)
[9] Dasgupta – Comments on the Stern's Review's economics of climate change (2006)
[10] Brittan – On climate change and good sense, Financial Times Comment, 9 Feb 2007

Many economists dispute the 1.4% effective discount rate used by Stern as being unrealistically low. Sensitivity testing suggests that this is one of the key drivers of the results obtained by Stern that make it so much more beneficial to invest in climate change mitigation now. The Treasury guidelines to be used in investment decisions are contained in the Green Book on Evaluation and Appraisal. For very long term analysis the Green Book suggests a declining schedule of discount rates starting at 3.5% and reaching 1% after 300 years. From an investment perspective it is not clear why Stern should have departed from this general approach although climate change mitigation is an atypical investment.

Whilst Stern says that the costs of investing in mitigation now are far outweighed by the costs of not investing, Nordhaus[11] – whose work in the field covers three decades – has argued the exact opposite, suggesting that little should be done to reduce carbon emissions in the near future. This has become the basis of the so-called Copenhagen Consensus[12]. The idea behind this is not to dismiss climate change as irrelevant or non-existent but to invest in physical and human capital now so as to build up economies so that resources can be diverted at a later date more effectively, making use of new technologies whose development might have been stalled under slower growth. The risk traditionally associated with acting now is that reduced growth damages investment in research and development and may therefore delay developments in environmental technologies. However, only some countries can be expected to make carbon reductions now so the developing environmental technologies could still flourish in countries such as China. The two largest and fastest-growing developing countries, i.e. China and India, demonstrate no immediate plans to decouple emissions and economic growth. Nordhaus could give more attention to the risk that the necessary technological breakthroughs might not materialise.

Nordhaus' models tend to assume a time discount rate of between 1% and 3% per year. The fact that both Nordhaus and Stern take the elasticity of social weight afforded to a small increase in individual consumption to be unity suggests that the results are strongly driven by the essentially ethical choice of time discount rate. As Lewis[13] has pointed out, Stern has taken the lowest time discount rate ever cited in a comparable study. If the time discount rate is modified, so too is the ultimate finding of Stern about the benefits of mitigation now. However, Brittan[14] suggests that a case for mitigation now still exists even with an effective discount rate of around 3.5% rather than Stern's 1.4%.

Stern has responded to his critics by arguing that welfare comparisons over time must inevitably involve value judgements and therefore ethical issues will necessarily need to be considered in the economics of climate change. These value judgements will be affected by estimates of how affluent future generations are likely to be relative to our own but can never be decisive. Unfortunately, it is not possible to estimate what value

[11] Nordhaus – The Stern Review on the economics of climate change (2006)
[12] The Copenhagen Consensus originated from a small group led by the Director of the Danish Environmental Assessment Institute, Bjørn Lomborg, and is now housed under the auspices of the Copenhagen Business School.
[13] Dan Lewis – How extreme is Stern?, Planning in London Issue 60 (Jan – Mar 2007)
[14] Brittan *ibid*.

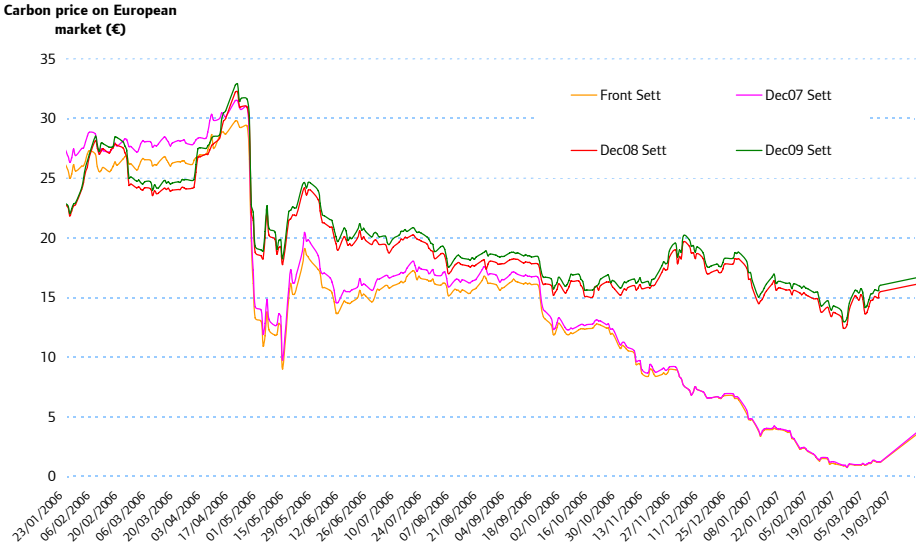
future generations will attach to the environment. From the economic perspective, there is a risk that too high a burden is imposed on people today to compensate people living in two centuries' time who, under Stern's growth assumptions, are likely to have far higher personal disposable incomes than we do today[15].

The assumption in the Stern Report is that there are no other significant drivers of climate change other than anthropogenic carbon emissions and land use change. If there are (for example, the solar warming hypothesis put forward by Cambridge solar physicist, Nigel Weiss[16]) then these will make investment in climate change mitigation less effective.

Is the Stern implied social cost of carbon too high?

One of the main implications of the assumptions behind Stern's modelling is that his resultant social cost of carbon is very high when compared with other studies. However, the gap becomes even greater when the theoretical social cost is compared to actual carbon trading costs on global emissions markets. Stern suggests that the social cost of carbon is $85 per tonne (which equates to around €65) and likely to rise. No mechanism currently in existence to price carbon produces a figure of anything like that magnitude. This is, of course, exactly the point that Stern is making: no current market trading mechanism is reflecting his implied social cost of carbon. The EU market price has not recovered from the steep falls associated with leaks around Easter 2006 (which indicated a surplus of permits – see Figure 1). The Chicago exchange currently also has a similar price – just a small proportion of the estimated social cost per tonne in Stern.

Figure 1: Carbon price (€ per tonne) on European Climate Exchange®
January 2006 – March 2007



Source: European Climate Exchange Data Archive, GLA Economics

[15] The modelling for the Stern Report suggests that, even under a pessimistic scenario, incomes per head will rise by around 1.3% per annum on average.
[16] Weiss is Professor Emeritus at the Department of Applied Mathematics and Theoretical Astrophysics, Cambridge, with a research interest in solar and stellar magnetic fields.

Of course, this could reflect the poor functioning of trading systems such as EU-ETS, driven by over-allocation of permits, vested national interests, poor coverage of installations and weak validation mechanisms. However, it could also be driven by more general problems in the international pricing of carbon. At present, the carbon price is also too low to provide any great incentive for the power generation sector to switch from carbon-intensive coal to cleaner sources.

Health, economic growth and climate effects

Tol and Yohe suggest that the agricultural, health and migration scenarios for the African continent outlined by Stern are exaggerated and note that Africa experiences economic growth under all scenarios in the Stern Report. Both diarrhoea and malaria are diseases that can be eliminated at little expense by countries experiencing rapid economic growth. However, in Africa, malaria epidemiology is focused primarily on countries with limited potential to arrive at middle-income status over the next few decades and where mass public health programmes will be difficult. Therefore, it could be argued that the expenditure on climate change mitigation might be better spent on funding the eradication of malaria in the short term.

Mitigation as insurance against risk

There is, of course, a separate argument for mitigation now or in the near future in terms of risk adversity as recently identified by Wolf[17]. Avoiding the risks of a global catastrophe may well be a more persuasive argument for mitigation now than arguing that the time preference discount rate is as low as 0.1% as Stern does. The uncertainties around: climate change itself; the discount rate to be used; and the extent of potential 'worst case' scenario costs may well make traditional cost-benefit analysis less than ideal. Making a mistake by taking too little action now would not only have global impacts, it could also be irreversible. This suggests that choices may not be best framed as typical project investment decisions. There is a rational case for insuring to reduce the risk of severe climate change in the same way that there is a rational case for insuring a house against fire or taking out travel insurance, even if the purchaser expects to be 'out of pocket' overall. However, the cost of this 'insurance' needs to be considered. Governments must be careful not to impose too high a price on today's citizens to compensate potentially 'richer' citizens of the future.

The difficulty in making a formal economic assessment of climate change 'risks', is that in many cases such risks actually involve 'uncertainties' (the future of the world economy, difficulties with forecasting climate change so far into the future, the particular groups of people who will be most affected by climate change) compounded by technical issues in economic evaluation techniques, such as how to value biodiversity. This makes it very difficult to know exactly how much insurance cover one should purchase – or, in this case, how much mitigation action one should undertake. The risks that one might be insuring against might change substantially at some undetermined threshold value of temperature increase as adaptation becomes

[17] Wolf - In spite of economic sceptics, it is worth reducing climate risk, Financial Times Comment 7 Feb 2007, p16. This approach is sometimes known as the 'precautionary principle'.

increasingly difficult and costly. There is a need to consider that adaptation to climate change will only be possible if temperature changes are limited.

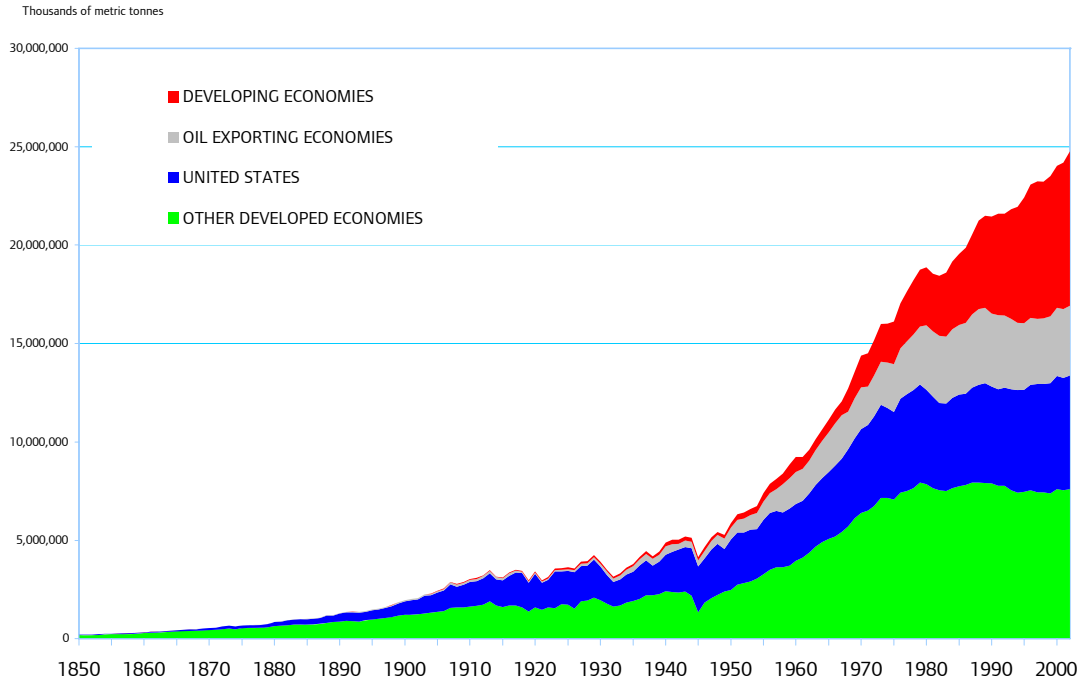
The developing countries and their role in climate change mitigation

The message of Stern is that climate change necessitates an international response with the advanced, Western economies taking action now and the developing countries later. However, an argument often cited outside the academic environment is that future growth in emissions is likely to be concentrated in the developing economies.

"If Britain shut down our emissions entirely, i.e. we closed down the country – not the legacy I want – the growth in China's emissions would make up the difference in just two years."
[Prime Minister, Tony Blair, speaking at Davos World Economic Forum, January 2007]

Overall, emissions from the developed world are already stabilising (especially when the United States is excluded from the analysis – see Figure 2) in contrast to the potential for very rapid expansion of emissions from the developing nations – not just the likes of China (earlier) and India (later) but also countries such as Indonesia and Nigeria.

Figure 2: CO_2 – total emissions (United States, other developed economies, oil-exporting countries and other developing economies)



Source: World Resources Institute, Earth Trends, GLA Economics
Note: 'Oil-exporting economies' defined as OPEC members plus Russia, Mexico and Kazakhstan

The longer term implication is that the developing countries should aim to cut their emissions too[18], but this relies on those countries being motivated enough to join an international emissions trading system and on those systems functioning efficiently. In the shorter term, the more affluent developed economies can both set an example and contribute to actual reductions in CO_2 emissions.

London's role

London can play an influential role by promoting joint research & development projects, encouraging rapidly developing countries to invest in environmental technologies and sharing scientific developments. It is also well placed to engage on the climate change agenda through emissions trading as well as by taking a lead in new technologies and renewable sources of energy itself.

The City is already using its niche in the financial services market to develop products and services such as underwriting weather risks, financing clean energy technology development, new technology insurance, renewable energy funds and climate-related consulting and advisory services.

It is important for London to play its full part in addressing climate change. The development of financial products and services in the capital related to climate change will play a key role in combating climate change and its effects across the world.

Conclusion

Stern's choice of a low discount rate leads to the conclusion that the net benefits of undertaking mitigation now are greater than in previous studies. A higher discount rate would reduce the benefits of undertaking mitigation. However, the insurance principle perhaps provides a more convincing case for mitigation.

Whilst it is important for economists to consider the cost of this insurance, the uncertainties around climate change and the long time horizons involved in economic assessment of its impacts mean that it is currently next to impossible to come to a purely 'economic' decision as to how much mitigation action should be undertaken.

This means that individual projects need to be examined on a 'case by case' basis using a combination of traditional investment analysis and an assessment of their contribution to the big but still 'difficult to quantify' challenge of climate change mitigation.

Beyond traditional paybacks, there is also a need to take into account a 'climate change payback'. This calls for a new way of thinking in economic analysis which places greater focus on estimating the size of the insurance premium we are willing to pay to avoid climate change. Economic analysis can elucidate the scale of benefits and costs but it cannot make the value judgements about what insurance premium is worth paying.

[18] Under the Kyoto Protocol, only 'Annex 1' countries (broadly-speaking the industrialised economy signatories) are formally committed to emissions reductions.

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