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Case Study

Chapter 2
Thinking like an economist

Global Warming

This article looks at the issue of global warming or climate change. Acceptance of climate change as a direct result of human activity is almost seen as being the conventional wisdom. Suggestions that countries need to act to stave off impending disaster are regularly put forward as an imperative. As with any such issue, economists have a role to play in looking at the evidence put forward in relation to climate change and the assumptions and models used to justify decision-making. This resource is designed to highlight some ways in which economists approach problems to show what it means to 'think like an economist'.

The Issue

It is difficult to imagine anyone being unaware of the issue of global warming or climate change (the two phrases are often used interchangeably but are not the same thing). The conventional wisdom is that economic growth (powered by human activity) has led to the creation of negative externalities that have resulted in average temperatures around the globe rising. This global warming, in turn, will lead to a change in climate and have numerous disastrous consequences. Man-made carbon dioxide emissions have been cited as the main reason for the changes predicted.

The consequence of this analysis is that governments around the world must take the lead on finding ways to cut carbon emissions. It is argued that only drastic and lasting cuts in carbon emissions can forestall the impending disaster which millions of people will experience.

Looking beyond the rhetoric

On the face of it the argument sounds very convincing and an issue that any right minded person ought to agree with. The book does make it clear that the value of economics is that it helps provide a '*new and useful way of thinking about the world in which you live*' and that '*Economists try to address their subject with a scientist's objectivity*'. This means that economists rarely simply take any pronouncement, whoever makes it, as the 'truth' without first addressing the topic with a healthy dose of scepticism and a desire to look behind claims and pronouncements. Global warming/climate change is no different.

It might be difficult for the undergraduate student new to economics to offer any arguments against climate change and global warming given the volumes that have been written about it. The point is, however, that part of the training in economics necessitates asking questions of those who propose new ideas and theories, to force theorists to justify their ideas and the evidence put forward in support so that we can arrive at better judgements. We also need to have some understanding of what we

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mean by 'better judgements'; this may mean that decisions are made where the benefits are clearly greater than the costs involved.

One example of this is the economics of climate change. Climate change does not just include economists but geographers, climatologists, geologists and a host of other scientists each keen to make their mark in the field. One major contribution to the economics of climate change was the book of the same name published as a result of the Stern Review on Climate Change[1]. Looking at the CV of the author and the impressive array of comments on the book in the first few pages might lead one to think that there is little an undergraduate student new to economics can add to the debate. That may indeed be the case but that is not a reason to just sit back and cease to think like an economist. This case study is designed to try and encourage you to do just that.

What are the arguments?

The Stern Review draws a number of conclusions which we need to highlight and understand at the outset of any consideration of the issues.

1. The evidence to support climate change is "now overwhelming."
2. "The benefits of strong and early action far outweigh the economic costs of not action."
3. "Hundreds of millions of people could suffer."
4. The "overall costs and risks of climate change will be equivalent to losing at least 5 per cent of GDP each year now and forever."
5. If a wider range of risks and impacts is taken into account the damage could rise to 20 per cent of GDP and more."
6. The cost of action "can be limited to 1 per cent of global GDP each year".
7. If no action is taken, greenhouse gases in the atmosphere "could reach double its pre-industrial level as early as 2035."
8. This will lead to global average temperatures rising by between 2 and 5 degrees centigrade
9. Stabilisation of carbon dioxide at current levels requires emissions to be cut by 25 per cent by 2050 – "and perhaps much more."
10. "Emissions can be cut through increased energy efficiency, changes in demand and through adoption of clean power, heat and transport technologies."
11. Climate change "is the greatest market failure the world has ever seen."

The Stern Review notes a number of other points:

"If the Greenland and West Antarctic ice sheets begin to melt irreversibly, the world would be committed to substantial increases in sea level in the range 5 – 12 m over a timescale of centuries to millennia. The immediate effect would be a potential doubling of the rate of sea level rise 1 – 3mm per year from Greenland and as high as 5mm per year from the West Antarctic Ice Sheet (WAIS). For illustration, if these higher rates were reached by the end of this century, the upper range of global sea-level rise projections would exceed 1m by 2100. Both of these ice sheets are already

[1] Stern, N. 2007. *'The Economics of Climate Change. The Stern Review'*. Cambridge, Cambridge University Press.

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showing signs of vulnerability with ice sheet discharge accelerating over large areas, but the thresholds at which large scale changes are triggered remain uncertain" (p21)

Questions to Ask:

If we assume that the science on climate change is 'certain' then the next question to ask is what are the costs of not doing anything? What are the costs of doing something now compared to the benefits that will be gained and crucially how do we measure the value of these costs and benefits and when do we measure them?

Cost benefit analysis is discussed in Chapter 11. It is an important part of the way economists think about the world and about problems. If we are able to place a value on the costs of a particular decision in relation to the benefits then we have the basis for an informed decision. For example, if the costs of climate change were estimated at 5 per cent of global GDP every year for the next 1000 years then we have some base information on which to make a decision. If, as a result of immediate action now those costs could be reduced to 1 per cent of global GDP then this would be regarded as a *'good'* thing – we have some way of identifying the benefits derived from immediate action. In this example, the value of the benefits could be simplified as being 4 per cent of global GDP.

However, the economist would be asking what the costs of achieving those benefits are. If the value of the costs of achieving the benefits is *much* less than the value of the benefits (let us assume that the cost of achieving the benefits is 0.0025 per cent of global GDP) then there may be a clear mandate for introducing the immediate changes. But what if the costs are 3.75 per cent of global GDP? Would the mandate be as convincing? What if the cost were 3.95 per cent of global GDP?

Clearly if the cost of achieving the benefit were higher than 4 per cent of global GDP it would be logical to suggest that the costs outweighed the benefits and as a result we might think again about taking immediate action. Chapter 11 points to the difficulties of measuring costs and benefits and these difficulties are increased the more we look into the future because there are so many uncertainties and variables which could affect the valuation.

Valuing Costs and Benefits

The Stern Review presents an argument for dealing with climate change based, in part, on 'intertemporal equity'. This basically looks at how we might value the benefits or costs experienced by people now compared to the costs and benefits affecting people at some future point in time. In economics, such a consideration is one factor in decision-making.

In carrying out such an analysis we have to take into account the value of the welfare of people today compared to the value of the welfare of future generations. In Chapter 27 of the book, an introduction to measuring the time value of money is given using present value – a means of discounting the fact that a sum money in the future is not worth as much as that same sum today. In simple terms PV is given by:

$$PV = x/(1+r)^n$$

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where r = the discount rate, x = the amount to be received in n years and n = number of years.

Stern spends some time outlining the assumptions made in their analysis. The discount value applied to the analysis is, therefore an important factor in the validity and reliability of the argument presented.

Reliability in scientific studies refers to whether the results of any 'experiment' or study could be replicated and found to reproduce the same or similar results.
Validity refers to the extent to which the results of any experiment/modelling can be generalised to other contexts.

If a business person, for example, was presenting a case for investing in new plant the decision about whether to invest might depend on the discount rate applied to the investment. The rate of discount applied to the project would be part of the reasoning for making the decision whether to go ahead. If a high rate of discount is applied, then the present value is higher. For example, the amount a firm needs to invest today to earn €1000 in one year's time at a discount rate of 10 per cent would be 1000/(1+1.10) = €909. If the discount rate applied was 5 per cent then the present value would be 1000/(1+1.05) = €952 and if the discount rate applied was 2 per cent then the present value would be 1000/(1+1.02) = €980. In other words, the lower the discount rate applied the greater the present value – the more the firm would need to invest now to generate €1000 in the future.

The discount rate applied by the Stern Review is an important factor in its argument relating to the welfare of future generations and thus the sacrifice that the current generation needs to make in order to generate those future benefits. A low discount rate implies that the sacrifice made today needs to be greater to generate the required benefits in the future. Stern states:

"The argument in the chapter and in the appendix and that of many other economists and philosophers who have examined these long-run ethical issues, is that 'pure time discounting' is relevant only to account for the exogenous possibility of extinction. From this perspective it should be small."

Clearly an assumption of a low discount rate leads to a conclusion that the sacrifices necessary to be made today to ensure the welfare of future generation is relatively high. If a different discount rate were used then a different conclusion might be drawn.

The above is one example of the analysis conducted by Stern and how assumptions of variables might affect the argument being put forward. There are numerous references used in the text used to support points being made. As an economist we might expect such evidence will be used to support claims and assertions. However, economists would also ask what evidence was **not used** which might add a different slant to the argument. For that we have to rely on other researchers who provide comment on research like the Stern Review or who offer counter arguments.

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Alternative Views?

Page 23 notes that "…all models are built with assumptions." A model is only as strong as the accuracy and reliability of the assumptions made in them, therefore. An economist ought to question assumptions that are made in any model and indeed, much of the disagreement between economists is not always about the nature of cause and effect but the extent to which the two are related; the size of the effect may be dependent on the assumptions made.

We have mentioned that the assumptions made by Stern are crucial to the argument being put forward in assessing the value of the costs and benefits associated with taking action on climate change. Cambridge professor Sir Partha Dasgupta is one of a number of economists who have reviewed Stern[2] and raise some questions about the assumptions made in the Review. Professor Mankiw, through his blog, notes: "Partha Dasgupta reads the Stern Review of climate change and, like Bill Nordhaus, does not like what he finds:" William Nordhaus, Professor of Economics at Yale, has been researching global warming and climate change for many years. One of the main sources of concern of Dasgupta and Nordhaus are the assumptions of values associated with measuring the future costs and benefits compared to those of the present. Dasgupta states:

"The Review assumes that delta *[the discount rate]* ought to be set equal to 0.1 per cent per year, which is a very low figure if we are to compare it with the values advocated by other climate Economists… Nordhaus in recent years has used a starting value of 3 per cent a year for delta, declining to about 1 per cent a year in 300 years' time."

Dasgupta also raises an issue about another important assumption made by Stern. Principle 3 of the *Ten Principles of Economics* states that rational people think at the margin. In Chapter 20 of the book, we encountered the principle of utility – a measure of happiness or satisfaction. The concept of marginal utility is, thus, important in comparing satisfaction from consumption today and that of consumption by people in the future. One way to measure this is to take a measure of the addition to total utility (marginal utility) and provide an estimate of how this changes with respect to consumption over time. Some estimate can be made of this variable now and at some point in the future. Dasgupta refers to this variable as '*eta*'. A focus of this variable is the extent to which people in the future are better off than people today. People just 50 years ago, for example, would never have been able to imagine the increases in technology and consumption habits that we enjoy today.

"To assume that eta equals 1 is to say that the distribution of well-being among people doesn't matter much, that we should spend huge amounts for later generations even if, adjusting for risk, they were expected to be much better off than us. To give you an example of what I mean, suppose, following the Review, we set delta *the discount*

[2] Dasgupta, P. 2006. *Comments on the Stern Review's Economics of Climate Change.* http://www.econ.cam.ac.uk/faculty/dasgupta/STERN.pdf accessed 28th May 2010

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rate] equal to 0.1% per year and eta *[the elasticity of marginal utility with respect to consumption]* equal to 1 in a constant-population, deterministic economy that experiences no technological change. Suppose the social rate of return on investment there is 4% a year. *It is an easy calculation to show that the current generation in that model economy ought to save a full 97.5% of its aggregate output for the future*! You should know that the aggregate savings ratio in the UK is currently about 15% of GDP. A 97.5% saving rate is so patently absurd that we must reject it out of hand. To accept it would be to claim that the current generation in the model economy ought literally to starve itself so that future generations are able to enjoy ever increasing consumption levels."

Other concerns expressed by economists are on the values that Stern puts on the costs of externalities. Assuming that carbon is a negative externality (some point to the fact every living cell depends on carbon and so to see it as a pollutant is not entirely accurate) then there has to be some way of putting a value on the cost of this negative externality. Again, working with the concept of the margin, what would the social cost of a marginal unit of carbon be? Different studies come up with different values for this social cost. Dasgupta and Nordhaus both point out that the conclusions that can be drawn from any analysis clearly depend on the value used. Dasgupta comments:

"[Nordhaus] reports that the first-period social price of carbon (which is a measure of the social damage a marginal unit of carbon emitted today inflicts on humanity) is about $13 per ton, whereas the figure reached in the Review's central case is about $310 per ton. But if the Review's figure for delta *[the discount rate]* is put to work on [Nordhause's model of climate and the economy], the first-period social price of carbon becomes about $150 per ton. This is about half the figure offered by the Review, but it's enough to suggest that the drivers behind the Review's findings are the very low values of the two ethical parameters, delta and eta. Indeed, modifying [the Nordhaus model] slightly, so as to take a more alarming view for the worst case scenario under business as usual raises the figure for the social price of carbon to $400 per ton, in excess of the figure recommended in the Review. A recent working paper by Frank Ackerman and Ian J. Finlayson ("The Economics of Inaction on Climate Change: A Sensitivity Analysis", 2006) reports a similar set of calculations."

Professor Mankiw notes that "The Review's apocalyptic conclusions are, according to Nordhaus, severely overstated because of its assumption of a near-zero discount rate (0.1 percent per year) and log utility (so marginal utility does not decline much as technological progress causes consumption to rise)." Professor Mankiw cites this quote from Nordhaus:

"The Review proposes using a social discount rate that is essentially zero. Combined with other assumptions, this magnifies enormously impacts in the distant future and rationalizes deep cuts in emissions, and indeed in all consumption, today. If we were to substitute more conventional discount rates used in other global-warming analyses, by governments, by consumers, or by businesses, the Review's dramatic results would disappear...

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Suppose that scientists discover that a wrinkle in the climatic system will cause damages equal to 0.01 percent of output starting in 2200 and continuing at that rate thereafter. How large a one-time investment would be justified today to remove the wrinkle starting after two centuries? The answer is that a payment of 15 percent of world consumption today (approximately $7 trillion) would pass the Review's cost-benefit test. This seems completely absurd. The bizarre result arises because the value of the future consumption stream is so high with near-zero discounting that we would trade off a large fraction of today's income to increase a far-future income stream by a very tiny fraction."

Dasgupta concludes:
"To be critical of the Review isn't to understate the harm humanity is inflicting on itself by degrading the natural environment - not only in regard to the stock of carbon in the atmosphere, but also in regard to so many other environmental matters besides. But the cause isn't served when parameter values are so chosen that they yield desired answers."

Economists are no the only ones who have raised questions about the assumptions that The Stern Review has used in arriving at its conclusions and recommendations. Geologist Ian Plimer[3] has pointed out that the Review and the Intergovernmental Panel on Climate Change (IPCC) both seem to ignore evidence in the public domain that suggests the view of climate change in terms of a sharp rise in average global temperatures in the 20th Century (attributable to the increase in carbon emissions as a result of humans) – the so-called 'hockey stick' – is inaccurate. The 'hockey stick' (imagine an ice hockey stick lying on its edge with the end pointing up to the sky) is the shape depicted by average global temperatures from 1000AD to 2000AD – average temperatures are essentially flat up until the industrial revolution and then turn upwards from that point.

Plimer highlights an alternative picture which includes a period of medieval warming around the years 1000AD to towards the end of the 16th century followed by the 'Little Ice Age' which characterised much of the 16th, 17th, 18th and 19th centuries and a late 20th Century warming. Plimer notes that "Climate has always changed. It always has and always will…Calculations on supercomputers, as powerful as they may be, are a far cry from the complexity of the planet Earth, where the atmosphere is influenced by processes that occur deep within the Earth, in the oceans, in the atmosphere, in the Sun and in the cosmos. To reduce modern climate change to one variable ($C0_2$), or more correctly, a small proportion of one variable (i.e. human-produced $C0_2$) is not science…"

Plimer is critical of the suggestions that a number of climate scientists who propose models of climate change are reluctant to give up their data for scrutiny, points to the problems some authors who wish to propose alternative views on the issue have in getting their papers published, that of the 2500 people who were suggested as being scientific experts involved in a 1996 IPCC report, 1190 individuals associated with the 'science' in the report were not scientists at all but were political and environmental activists.

[3] Plimer, I. 2009. *Heaven and Earth. Global Warming: the missing science.* London, Quartet.

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Plimer argues that if, as suggested by Stern in the opening to the Review, the science on climate change is 'settled' then: "This means that there is nothing more to learn about Nature. If the science of human-induced global warming is settled then there is no need for climate research funding, climate institutes and government bureaucracies." His book presents a view that the climate is so complex that humans are not able to reduce it to a simplistic correlation with carbon emissions. It should be noted at this stage that Plimer's book has also received scathing criticism from a number of sources as lacking scientific credibility and for judiciously choosing 'facts' to 'prove' points he wants to make.

The Future?

How much better off will those in the future be if we tackled climate change compared to if we did nothing? Nigel Lawson[4], former UK Chancellor of the Exchequer (who freely admits he is no scientist) has come up with the following analysis on this issue.

'According to IPCC figures, and using the upside of these figures (i.e. the gloomiest of the predictions) living standards, as measured by GDP per capita, would rise by 1 per cent a year in the developing world and by around 2.3 per cent a year in the developing world if global warming/climate change could be controlled'. In Chapter 25, we noted that in the UK, average income as measured by real GDP per person has grown by about 1.3 per cent a year. At this rate of growth we noted that average income doubles about every 50 years. Bearing this in mind, Lawson goes on to say:

'Assuming a cost of global warming of 3 per cent of GDP in the developed world and 10 per cent in the developing world, the conclusion is that people in the developed world will only be 2.6 times better off than today compared to 2.7 times better off in 100 years time if carbon emissions can be stabilised at current levels and therefore further global warming can be abated. For those in the developing world they will only be 8.5 times as well off in 100 years time compared to 9.5 times as well off without global warming'.

'If the figures are changed to be more optimistic and assume developed world growth of 1.6 per cent a year and developing world growth of 4 per cent a year along with a warming of 4 degrees C, in 100 years time those in the developed world will only be 4.7 times as well off rather than just over 4.8 times as well off. For those in the developed world instead of being 50 times as well off they will only be 45 times as well off'.

In thinking like an economist, therefore, we are looking to question the basis of policy decisions, the assumptions made in models used to highlight the effects of climate change and whether the cost of dealing with carbon emissions is outweighed by the benefits both in the short and long-term.

[4] Lawson, N. 2009. *An Appeal to Reason: A Cool Look at Global Warming*. London, Duckworth Overlook. Pp36 – 37.

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Questions:

1. Is it possible to measure the costs and benefits to people at some point in the future? If so, how long in the future should such a measurement attempt to go?

2. Why is thinking about costs and benefits one of the ways which characterise 'thinking like an economist'?

3. What issues would an economist need to consider in using the concept of 'time value of money'

4. Economists develop models to help them think about the world and make decisions. In the light of the context of climate change, discuss some of the benefits and limitations of economic modelling.

5. Should we be concerned that people in 100 years time will be marginally worse off if we did nothing about carbon emissions compared to if action is taken now?

6. Some analysts have pointed out that average temperatures in particular regions of the world and within those regions vary tremendously yet humans are able to adapt and survive. Does this suggest that we should not be concerned about climate change?

7. In the 1800s Malthus predicted disaster befalling human kind. His immediate predictions were wrong. Are there lessons we can learn from Malthus and the subsequent events of history that can be applied to the issue of climate change?

8. Former UK Prime Minister Gordon Brown was quoted before the Copenhagen summit in 2009 as saying: "With only days to go before Copenhagen we mustn't be distracted by the behind-the-times, anti-science, flat-earth climate sceptics…We know the science". As a budding economist, how do you react to this quote?

9. Economists use science as a means of analysing events and issues. To what extent do you think that economics ought to be regarded as a 'pure science'? Explain your reasoning.

10. Do the analyses from Dasgupta, Nordhaus and others suggest that climate change is not something humans should be concerned about.

11. 'The risk of human catastrophe as a result of climate change is dwarfed by other more pressing problems including global terrorism, the potential for nuclear conflict and biological warfare/terrorism amongst others.' To what extent do you agree with this view? Explain your reasoning.

12. "The difficulty is that reducing emissions is an extreme "global public good," meaning that no single nation can capture for itself a substantial part of the

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benefits from its own emission reductions."[5] To what extent do you think this characterisation of reducing emissions is the reason for the failure to arrive at a global agreement on carbon emissions?

13. One way to cut carbon emissions is to introduce a 'cap and trade' system. Explain what this means and suggest what should happen to carbon prices in the next ten years. Justify your answer.

14. Chapter 16 of the book introduces game theory. What relevance has game theory to the problem facing governments in reaching agreement on measures to tackle climate change?

[5] Nordhaus, W. 2010. *Economic aspects of global warming in a post-Copenhagen environment.* http://nordhaus.econ.yale.edu/documents/Copen_051010.pdf Accessed: June 2nd 2010.

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