

# A Perspective Paper on Mitigation as a Response to Climate Change

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## **COPENHAGEN CONSENSUS ON CLIMATE**

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## ABSTRACT

This paper discusses the estimated benefit-cost ratios on mitigation as a solution to climate change. We are in agreement with most of what is written by Richard Tol on the state of the art of economic research into the impacts of climate change and climate change policies, but we highlight a complementary approach that is based on a direct elicitation of (revealed or stated) preferences for climate change. With respect to the reported benefit-cost ratios, this paper argues that they are a bit low because, first, they do not reflect the substantial concerns about equity and uncertainty; and second, because a substantial part of the benefits (after the year 2100) is not accounted for.

## COPENHAGEN CONSENSUS ON CLIMATE

The Copenhagen Consensus Center has commissioned 21 papers to examine the costs and benefits of different solutions to global warming. The project's goal is to answer the question:

*"If the global community wants to spend up to, say \$250 billion per year over the next 10 years to diminish the adverse effects of climate changes, and to do most good for the world, which solutions would yield the greatest net benefits?"*

The series of papers is divided into Assessment Papers and Perspective Papers. Each Assessment Paper outlines the costs and benefits of one way to respond to global warming. Each Perspective Paper reviews the assumptions and analyses made within an Assessment Paper.

It is hoped that, as a body of work, this research will provide a foundation for an informed debate about the best way to respond to this threat.

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## INTRODUCTION

The Assessment Paper on Carbon Dioxide Emission Reduction of Richard Tol includes a survey of assessments of the economic impacts (damages) of climate change, a survey of assessments of the economic impacts (costs) of greenhouse gas emissions mitigation measures,<sup>1</sup> a description of the integrated assessment model FUND, and, finally, a report of benefit-cost estimates of the FUND model of a number of Copenhagen Consensus carbon dioxide (CO<sub>2</sub>) mitigation scenarios.

The survey of impact assessments is divided into three sections: 1) a survey of assessments of the total economic impacts of climate change, 2) a survey of the assessments of marginal economic impacts, and 3) a discussion of the impacts that are missing in the surveyed assessments. The survey and discussion are very clear and competent as may be expected from an author who has such a formidable track record in this area. The purpose of the present paper is merely to add a few observations to this excellent survey.

This paper will also make a few remarks on the estimated benefit-cost ratios that were computed with the FUND model, with a view to highlighting some of the assumptions that lie behind the reported ratios and to help with their interpretation.

## SURVEY ON THE ECONOMIC IMPACTS OF CLIMATE CHANGE

The number of global assessments of the economic impacts of climate change can be counted on the fingers of two or three hands. Given the continued public interest in climate change and climate change policies over a period of two decades and the potentially large social values at stake, this is a remarkable fact. Most of the estimates of the social cost of carbon, including the celebrated estimate of Sir Nicholas Stern in his “Stern Review” are variations on a remarkably small set of original studies. In a recent paper, Tol (2008: 4) poignantly assessed the deplorable situation of current economic research in this area:

“There are a dozen studies. The number of authors is lower, and can be grouped into a UCL group and a Yale one. Most fields are dominated by a few people and fewer schools, but dominance in this field is for want of challengers. The impact of this is unknown, but this insider argues below that the field suffers from tunnel-vision. This situation is worrying. Politicians proclaim that climate change is the greatest challenge of this century. Billions of dollars have been spent on studying the problem and its solutions, and hundreds of billions may be spent on emission reduction (e.g., Weyant et al., 2006). Yet, the economics profession has essentially closed its eyes to the question whether this expenditure is justified.”

This is a serious complaint and should be kept in mind in the discussion that follows. While the Copenhagen Consensus is bravely attempting to address the “closed eyes” part of this complaint, it does of course not have the means to address the “want of challengers” part of it.

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<sup>1</sup> Not yet included in the paper at the time of writing of this perspective paper.

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In his survey of impact assessments, Tol distinguishes between **enumerative** and **statistical** assessment methods. The former method enumerates all physical effects, quantifies them in natural (mostly physical) dimensions and then attaches economic values to the quantified effects. By contrast, the statistical method makes use of observed variations in expenditures and prices of the same activities in different climatic zones to discern the effect of climate on the economy. Both methods have a longer history of application in other areas of environmental concern (e.g. air pollution) and have known strengths and weaknesses. Tol does not mention a third method, which could be called the **subjective** method, that directly examines agents' revealed or stated preferences for the mitigation of climate change. An example of this method can for example be found in Brouwer et al. (2008) who used a survey instrument to elicit the willingness to pay of air travelers for a tax on their air travel to offset their CO<sub>2</sub> emissions. Brouwer et al (2008) found that 75% of the passengers is willing to pay € 25/tCO<sub>2</sub>-eq. on average. There is a small body of research that takes this subjective approach (see e.g., Kuik et al., 2008) and although it hasn't resulted yet in a robust assessment of the social costs of climate change, it represents an interesting addition to the more "objective" statistical and enumerative approaches. In particular, it directly addresses the disutility of (perceived) risk, something that the more objective methods have difficulties of coping with. In the words of Brouwer et al.(2008: 310)

"[...] subjective or perceived risk of climate change is an important additional motivation for tackling climate change. In our survey, people generally dislike being at risk and are willing to pay to reduce their exposure to risks associated with climate change. This reduced disamenity through mitigating climate change is an important economic benefit of action."

Tol writes in the interesting "missing impacts" section that the size of an "uncertainty premium" as a benefit of climate change mitigation would have to be based on a political decision. What I try to argue is that economic research can to some extent help the political process to establish such uncertainty premiums in the context of climate change.

Cost-benefit analysis (CBA) has come a long way from appraising public investment projects such as the construction of a water reservoir to the appraisal of policies to mitigate climate change.

## SCENARIOS

Tol develops five different mitigation scenarios. In the first two scenarios, a carbon tax is implemented for a period of ten years only. In the first scenario the carbon tax is in OECD countries only and in the second scenario a global carbon tax is implemented. Because of the short-term nature of the tax policy the benefits in terms of avoided climate change damage are very small compared to the costs.

The third scenario has a global tax for the entire century, starting at \$250/tC (\$68/tCO<sub>2</sub>) in 2010 and rising with the discount rate (5% per year) to more than \$20,000/tC (\$5,500/tCO<sub>2</sub>) in the year 2100. The FUND model predicts that this tax would drive CO<sub>2</sub> emissions to zero in the second half of this century. But the costs still outweigh the benefits.

The fourth scenario has a global tax for the entire century starting at \$12/tC (\$3/tCO<sub>2</sub>) in 2010 and rising with the discount rate (5% per year) to almost \$1000/tC (\$260/tCO<sub>2</sub>) in 2100. The benefit-cost ratio is 1 to 4.

The fifth scenario has a smaller global tax of 2\$/tC (\$0.5/tCO<sub>2</sub>) in 2010 and rising with the discount rate (5% per year) to \$161/tC (\$44/tCO<sub>2</sub>) in 2100. The benefit-cost ratio is 3 to 2.

These scenarios basically say that 1) climate change is a long-term problem that requires a long-term policy, 2) an optimal mitigation policy is a global policy that starts with a relatively low tax that increases with the discount rate (compare the Hotelling rule for optimal depletion). This is a conventional and reasonable view on optimal CO<sub>2</sub> mitigation policy.

There are some issues with the numbers, however.

One can, of course, always quarrel over specific assumptions like, for example, the height of the discount rate, the marginal utility of income (or equity-weighting), the economic value of impacts on biodiversity, the risk premium for uncertainty, the possible impact of climate change on economic growth, and so forth. These assumptions are ably discussed in Tol's paper, but it should be noted that the treatment of the assumptions in the calculations leads to very conservative benefit-cost ratios: i.e. relatively high discount rate, no equity weighting, zero value for impacts on biodiversity, no risk premium, no effects on economic growth itself.

Further, even for the scenarios that have a policy during the entire century, the cut-off date of the year 2100 has a serious negative effect on the benefit-cost ratios. Due to the relatively long lag times of climate change (represented in the FUND model), the rather high carbon taxes in, say, the last quarter of this century will reduce emissions that will mitigate climate change mainly after the year 2100. Thus, in the benefit-cost ratios as presented in the Assessment Paper, a significant cost is made in the latter part of this century whose benefit is not accounted for. If the mitigation policy would be terminated in, say, 2080, we would save more than 20% of the costs (in NPV) whereas the benefits (in this century!) would likely be little affected.

If the cost-side of the equation is taken for granted, I would argue that the presented benefits of mitigation and the benefit-cost ratios are a bit on the low side. First, as Tol also argues in his paper, because the ratios do not reflect the substantial concerns about equity and uncertainty; and second, a substantial part of the benefits (after the year 2100) is not accounted for.

## BY WAY OF CONCLUSION

At the 2009 Conference of the European Association of Environmental and Resource Economists in Amsterdam, Cameron Hepburn of Oxford University asked himself how far CBA could be stretched before it would break. In contrast to small-scale public investment projects, the climate change problem is:

- inter-national
- inter-generational

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- uncertain and ambiguous
- non-marginal
- (partly) irreversible and non-linear

Cameron Hepburn answered his own question in the affirmative, but there were others in the audience who were more skeptical: if CBA would not break in the appraisal of the mitigation of greenhouse gas emissions, then where *would* it break?

The Copenhagen Consensus project offers an interesting opportunity to further reflect on this question.



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The science is clear. Human-caused global warming is a problem that we must confront.

But which response to global warming will be best for the planet? The Copenhagen Consensus Center believes that it is vital to hold a global discussion on this topic.

The world turned to scientists to tell us about the problem of global warming. Now, we need to ensure that we have a solid scientific foundation when we choose global warming's solution. That is why the Copenhagen Consensus Center has commissioned research papers from specialist climate economists, outlining the costs and benefits of each way to respond to global warming.

It is the Copenhagen Consensus Center's view that the best solution to global warming will be the one that achieves the most 'good' for the lowest cost. To identify this solution and to further advance debate, the Copenhagen Consensus Center has assembled an Expert Panel of five world-class economists – including three recipients of the Nobel Prize – to deliberate on which solution to climate change would be most effective.

It is the Copenhagen Consensus Center's hope that this research will help provide a foundation for an informed debate about the best way to respond to this threat.

## COPENHAGEN CONSENSUS CENTER

The Copenhagen Consensus Center is a global think-tank based in Denmark that publicizes the best ways for governments and philanthropists to spend aid and development money.

The Center commissions and conducts new research and analysis into competing spending priorities. In particular it focuses on the international community's efforts to solve the world's biggest challenges.

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