Living Standards and Economic Performance with Ambitious Climate Action

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Abstract
An enormous amount of effort has been invested in modelling the economic impacts of climate change policy options and emissions pathways in order to inform policy decision-making. However, due to the complexity and diversity of many of these models, translating their results into implications for living standards can be difficult. The first part of this paper reviews the common policy findings emerging from a cross section of these models, while the second part examines how a sub-set of well known and widely used models have presented their findings. This second component of the research is interested in drawing attention to the importance of communication in allowing diverse stakeholders to use and understand model results.

Discussion Paper and Summary of the Climate Strategies report prepared by: Sonja Klinsky, Steve Hatfield-Dodds and Emi Mizuno.

Common Policy Findings
Six existing comparative studies of models that have been used to assess the likely costs of climate change mitigation action have been reviewed to generate an overview of common policy findings. Many in-depth comparisons have already been done, and this CS project focused on consolidating some of the most common findings. Direct comparison is very difficult as models are built on different assumptions of how energy and economic systems work, and vary in terms of their focus on particular aspects of these systems.

Importantly, a key difference among models is the extent to which they include climate change impacts in their cost functions, and to which they are truly integrated assessment models in their ability to link the economic, environmental and social components of climate policy. Because many of the common models do not include or fully represent climate impacts, these costs have largely been omitted from the cost estimates which are reported and this brief focuses on the costs of climate change mitigation only. With these caveats in mind, several common policy findings were observed:

• The degree and cost of mitigation strongly depends on the choice of baseline assumptions, making these baselines crucial for understanding cost predictions.

• Low-carbon scenarios such as stabilizing atmospheric CO2 concentrations at 450ppmv are theoretically feasible but challenging.

• Most models focused on forgone GDP or ‘GDP losses’ to describe the cost of mitigation and, as mentioned, did not always include any climate impacts or damages that are avoided through this mitigation, which may make the resulting figures confusing to users.

• In general, the annual cost of mitigation in low carbon scenarios is routinely estimated to be less than 2% of GDP in 2050, and mostly below 1.4%, relative to reference cases (ignoring any direct climate benefits from mitigation). This must be interpreted against substantial model uncertainty.

• Uncertainties are typically represented through the use of alternate scenarios and may not be immediately apparent to the user of the results who may be unfamiliar with this strategy for communicating uncertainty.

• Technology investments and energy system changes appear central for the reduction of mitigation costs by long-term stabilization scenarios.

• Early mitigation actions may reduce total mitigation costs over the long-term, and increase the opportunities to achieve lower atmospheric CO2 stabilizations.

• While some large developed countries have their own region in many models, this is not the case for the majority of developing countries which makes any analysis of potential impacts on these countries difficult to assess.
Communication of Model Results

This project also examined how the results of studies assessing the costs of climate actions have been represented. Observations were made about how results were presented based on original data obtained from several modeling groups through a survey and through data previously publicly released by modeling groups. Reanalysis of these available data was conducted in order to present results against historical data baselines instead of predicted business as usual future baselines. Key findings:

• Most data remains at a global level, with some regional and sectoral divisions. A narrow range of indicators focused on the real value of economic activity (primarily GDP, GWP and GNP), dominate reporting. In some cases, costs are also expressed as marginal abatement costs. Only one of the models studied in this project provided insights into employment.

• Results are typically reported in relation to future predicted baselines instead of historical or current levels. Only one modelling group\(^1\) systematically presented results both in relation to the future reference case and relative to current levels.

• All models predicted significant economic growth, even with ambitious climate action. Even when aiming for 450ppmv stabilization, the global economy in 2050 is projected to be 2.5 to 2.9 times larger than 2010 levels, while GDP per person is projected to be around double current levels. The associated predicted opportunity costs of climate action are typically -0.4% to -1.0% deviations from the per capita incomes predicted by future BAU baselines.

• There are large variations in the rates of projected economic growth rates across regions and models. Certain developing regions are predicted to experience particularly strong economic growth. For example, it is regularly estimated that BRIC\(^2\) economies could grow by 400-750% by 2100 even under a 450ppmv stabilization target.

Revisiting the Communication of Model Results

The graphs below demonstrate two ways of representing the same modelling results. The first graph is the strategy typically used by modeling groups and focuses on the opportunity costs of mitigation action represented as percentage deviations from BAU per capita GDP. As can be seen, under the most ambitious mitigation action aimed at long term 445 ppm CO\(_2\)e stabilization with overshoot, the opportunity costs range from less than 2% to almost 12% of per capita GDP by 2050.

Figure 1: Impact of 450ppm emissions trajectory, Difference in World GDP per capita relative to reference case, different modeling groups

Source: Model Data collated in Mizuno, E. and Klinsky, S. (2011)

1. not included in the modeling comparison projects reviewed in this project
2. a grouping acronym that refers to the countries of Brazil, Russia, India and China
A second approach to representing model results is demonstrated in the following pairs of graphs. This approach explicitly represents changes in per capita GDP relative to current (or recent historical) levels and takes account of the opportunity costs of mitigation but does not focus on these costs. In each pair the first graph shows per capita GDP projections arising from the assumptions in the reference cases used in these modeling exercises. The second graph illustrates the implications of mitigation action in specific scenarios by showing the growth of per capita GDP projected to 2050. As is demonstrated through these graphs, even with dramatic climate policy action per capita GDP rises significantly and is expected to be 50-200% higher than observed historical levels.

The significance of using historical data as the baseline is further demonstrated when the predicted results for mitigation action are presented regionally. This is illustrated by modeling results from IIASA, which explored uncertainties around the impacts of mitigation action across regions by using several reference scenarios. The IIASA results provide a variety of predicted costs across regions due to the diversity of these reference scenarios. The first pair of graphs below shows the IIASA predictions for economic growth in the “Ar2” scenario characterized by high emissions, high population, high urbanization and low resource efficiency. The second pair presents the IIASA predictions under an intermediary scenario,”B2”, in which emissions, population, urbanization, and resource use are all assumed to be in a mid range. The global emissions projections and implied abatement for these scenarios are shown in the annex Figure 4.
Two policy findings emerge clearly from this representation of these results.

1. All regions are expected to experience substantial growth, although there are marked regional variations in the rate and extent of growth.

2. Existing economic conditions and the outlook for economic growth embodied in the reference case assumptions are fundamental to projected emissions and average incomes (per capita GDP) with and without policy action. Data collected by this project suggests these key findings are typical across all or most modeling of this kind.

Reporting model results in terms of projections of growth compared to a historical baseline, rather than deviations of GDP from BAU predicted baselines, has three benefits.

1. It places predicted costs in a broader context of expected growth instead of focusing on costs in isolation. This shift in focus may facilitate wider considerations of opportunity costs and trade-offs in the costs and benefits of engagement in mitigation action.

2. It makes it easier for the user of the model results to understand the reference case, as they have already experienced the historical baseline.

3. The importance of BAU baselines in shaping model results is visually apparent, possibly making it easier to communicate the significance of model assumptions.
Conclusions

The issues summarized in this discussion paper give rise to several conclusions.

1. The indicators most commonly focused on in the communication of model results may not be those of most relevance and interest to policymakers or public stakeholders. Alternative issues of interest may concern income distribution, real wages, employment or other aspects of living standards. Further reflection on the range of indicators that could be explored through modelling would be valuable in maximizing the value of these efforts for different audiences and user groups.

2. The vast majority of model results are communicated in a way that presents policy impacts relative to some future reference case, but provide little information on projected incomes (or other variables) relative to current levels. This implicitly requires audiences interested in other issues to have deep understanding of the assumptions and implications of baselines in order to interpret the implications of the modeling results, which can make it more difficult for them to understand and integrate these insights into immediate policy decision-making.

3. Comparing mitigation costs to historic data instead of to future predicted baselines shifts the focus of attention. Specifically, the costs or forgone gains in income over the next few decades due to mitigation are shown to small or modest relative projected to economic growth over the next 50 years. In addition, regional disparities in projected income levels become particularly evident when examined from this light. Representing data in relation to historic data may allow policymakers to more easily compare the costs of mitigation to other types of costs, and to place this within the context of expected economic growth.

Overall this project highlights the major findings about the implications of ambitious climate policy that emerge from of a sub-set of internationally recognized models designed to provide insight about the costs of climate action, and critically examines the ways in which these results are presented. Our analysis suggests that the communication and representation of results is an area that should be carefully considered in the development and use of models. Modelling results and insights will be most useful and influential when different audiences are easily able to understand them and see their relevance to policy assessments and decision-making.

This project highlights the need for a more plural approach to communicating modeling results to ensure effective and relevant communication to policymakers and civil society, in a manner that provides clarity and empowers sound decisions. None of these considerations suggest that it is inappropriate to analyse and report on the opportunity cost of greenhouse gas mitigation results in net global or regional benefits. We consider, however, that it would be useful to accompany information on opportunity cost with information on projected information on per capita income relative to current levels, in order to help modelling results be better understood and to avoid misunderstanding.

Annex

Figure 4: Projected emissions in reference case and 450-480ppm scenarios, and implied abatement, 2000-2100 (IIASA)

Source: Model Data collated in Mizuno, E. and Klinsky, S. (2011)
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