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Pushing the boundaries of climate economics: critical issues to consider in climate policy analysis

S. Şerban Scrieciu [a,*], Terry Barker [b], Frank Ackerman [c]

[a] Economics for Equity and the Environment (E3) Network, United States & Department of Land Economy, University of Cambridge, UK
[b] Cambridge Centre for Climate Change Mitigation Research (4CMR), University of Cambridge, UK
[c] Stockholm Environment Institute-US Center, Somerville MA, United States

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ABSTRACT

Climate policy choices are influenced by the economics literature which analyses the costs and benefits of alternative strategies for climate action. This literature, in turn, rests on a series of choices about: the values and assumptions underlying the economic analysis; the methodologies for treating dynamics, technological change, risk and uncertainty; and the assumed interactions between economic systems, society and the environment, including institutional constraints on climate policy. We identify and discuss such critical issues, pushing at the boundaries of current climate economics research. New thinking in this area is gathering pace in response to the limitations of traditional economic approaches, and their assumptions on economic behaviour, ecological properties, and socio-technical responses. We place a particular emphasis on the role of induced technological change and institutional setups in shaping cost-effective climate action that also promotes economic development and the alleviation of poverty.

1. Introduction

The debate on whether climate change is happening or not, whether it is manmade or caused by natural factors, and whether it poses or not a long term real threat to human societies and the environment has largely concluded. The scientific climate community has clearly stated that: "most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic greenhouse gas concentrations", and that "warming of the climate system is unequivocal" and due primarily to human interference via fossil fuel use, agriculture and land use change (IPCC, 2007). Though several counter claims continue to be made at different levels (Carter, 2010; Montford, 2010), these, in turn, have met their own systematic counter-argumentation (e.g. Carr et al., 2010; Rennie, 2009). Furthermore, other leading scientists have expressed concerns that IPCC projections are, on the contrary, too conservative, and that human-induced climate change may be occurring at a faster pace than previously thought (Hansen et al., 2008; Rahmstorf, 2007).

All in all, the scientific understanding of the climate change problem has advanced sufficiently to clearly convey the message that nations across the globe need to take prompt action in terms of both mitigation and adaptation. The risks of doing nothing are increasing rapidly as concentrations and emissions keep increasing, despite uncertainties in climate projections and tipping points. In addition, the precautionary principle embedded in the 1992 Rio Declaration on Environment and Development reminds us that uncertainty is not a reason to postpone or avoid action (Costello et al., 2009). The debate has moved on from "do we need to act now" to "how to act now in order to best mitigate and adapt to climate change". The work-load is being passed from climate scientists via politicians to economists, engineers, sociologists, ecologists and others involved in climate policy planning and analysis. Climate science will continue nevertheless to provide valuable input, such as understanding interactions between the carbon cycle and climate change, the impact of the latter on hazards, and refining climate change projections, particularly in terms of down-scaling impacts to national or local level with crucial implications for adaptation policy. Since action on the climate change front touches upon a myriad of inter-related and multi-dimensional aspects of societies, economies and the environment, any climate policy response would require interdisiciplinary analysis. The economic problem needs to be less concerned about choosing the targets themselves and focus instead on how to achieve political climate targets that are based on scientific evidence (Barker, 2008). What we *should* do about climate change is an ethical question involving conflicting interests; economic analysis helps out instead on the question of what we *can* do about climate change (Broome, 2008). This is not to say that economics should be decoupled from ethics and moral arguments. On the contrary, any new developments in climate economics need to acknowledge underpinning values and explicitly state their implications for policy and society.

New economic analysis is needed to provide answers in this respect not only by focusing on cost-effective strategies, but also by ensuring that any climate action is equitable and compatible with

* Corresponding author.
E-mail address: sss38@cam.ac.uk (S.Ş. Scrieciu).

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context-specific development goals and priorities. As such, climate economics research has to break away from its own current disciplinary limitations, whilst developing stronger links with other relevant disciplines. To some extent this is already occurring with mainstream economic thinking on climate change shifting from a single-discipline focus of cost-benefit analysis preferred by traditional economists[1] to a new inter-disciplinary risk analysis approach (Ackerman, 2008; Barker, 2008; Dietz and Stern, 2008; Heal, 2009; Stern, 2007). This paper hopes to contribute along the lines of spurring new thinking in climate economics. It puts forward a series of what we consider critical issues for the economic analysis of climate policies,[2] with an emphasis on induced technological change (with reference to mitigation) and institutional barriers (applied to both mitigation and adaptation). It also recommends future pathways that research might follow towards a more realistic and comprehensive understanding surrounding the economic problem of climate action.

2. Fundamental Requirements for an Adequate Climate Economic Analysis

There is great uncertainty concerning the human, environmental, and economic impacts of climate change, and the arguments for and against potential policy responses. In order to formulate and adopt policies in a timely fashion, we are compelled to gaze deeply into a cloudy crystal ball, to look far into the uncertain future and project what may happen, what it may cost, and what responses could lead to better outcomes. Projections of future climate policy impacts and costs are based on both detailed empirical research, and structures of assumptions that frame the analysis. The "cost" of climate policy is not an observable market price; rather, it is a construct shaped by the modelling apparatus and its explicit and implicit assumptions.

As in any economic modelling, the future macro-level assumptions driving the analysis have important implications for the costs and impacts of climate policy. The anticipated growth of population and per capita production and consumption represent major influences on future emissions in a business-as-usual scenario. Higher baseline growth rates typically imply greater emissions and climate damages, but also greater potential for benefits (i.e. avoided costs) from emissions reduction. Higher oil prices increase the economic benefit of energy conservation measures, thereby inducing more energy saving technology. Major studies of climate impacts and policy costs have differed widely on this point, with climate policy "optimists" often assuming higher oil prices, and hence deducing lower net costs of mitigation, than "pessimists" (Ackerman et al., 2009). Baseline assumptions employed in modelling studies are often arbitrary and inconsistent with each other, particularly when projections are taken off-the-shelf from different sources. A complete model of climate policy costs and impacts should, in theory, make some of these data endogenous: climate damages can affect the rate of (business-as-usual) growth of per capita incomes; climate policies can change the price of oil. This, however, requires the development of a complex global system of energy-environment-economy interactions, with credible, endogenous dynamics of output, emissions, prices, and incomes.

[1] We use the terms "traditional economics" throughout this paper to refer to the current orthodoxy or dominant school of economic thought, i.e. neoclassical economics. The latter may be summarised as "a combination of the emphasis on rationality in the form of utility maximisation; the emphasis on equilibrium or equilibria; and the neglect of strong kinds of uncertainty and particularly of fundamental uncertainty" (Dequech, 2008, pp.300, and similar characterisations in Hodgson, 1999, and Colander et al., 2004). It is also important to make the qualification here that "traditional" and "mainstream" are not interchangeable in this paper, as mainstream thinking may include increasingly accepted and influential non-neoclassical segments of research.

[2] Some preliminary work in this direction has already been initiated at the Energy Branch of UNEP's Division of Technology, Industry, and Economics in Paris under the auspices of the MCA4climate initiative "Multi-criteria analysis for climate change: developing guidance for pro-development climate policy planning" (UNEP, 2011a,b).

Beyond the universal dilemmas of modelling uncertain futures, the economics of climate change poses unique challenges to orthodox styles of economic analysis. There are four fundamental requirements for an adequate economic framework for climate policy (Ackerman, 2008, 2009):

- Judgment about the importance of current versus future generations, with implications for discounting;
- Incorporation of multi-dimensional, often unmonetisable impacts, rendering cost-benefit analysis problematical;
- Recognition of the problems of catastrophic risks and irreducible uncertainty, leading to a precautionary approach to policy;
- Understanding the nature of implementation costs in dynamic and institutional settings grounded in empiricism, with multiple consequences for policy formation. This includes issues of induced technological change and institutional barriers addressed in more detail in the following two sections of this paper.

2.1. Discounting

Discount rates have been the focus of much debate in the literature, particularly with the publication of the Stern Review (Stern, 2007). Because the benefits of climate policy stretch over a longer time horizon than the costs, a lower discount rate makes the benefits relatively larger in present value, while a higher rate does the opposite. Disagreement is longstanding and inescapable.

Some argue for a significantly positive discount rate and criticise the use of a near-zero discount rate for climate policy analysis (e.g. Nordhaus, 2007). Their discounting should not be dismissed lightly. For financial decisions spanning a few years or decades, it is an indispensible tool for inter-temporal comparisons, appropriately weighing commensurable costs and benefits that are experienced by the same individual. If extended to cover the longer-term and multi-dimensional future costs and benefits of any climate policy action, discount rates have an important influence on decision-making. They simplify calculations and theories, follow the logic of financial markets, and prevent arbitrage and paradoxes of preference reversal.

However, others disagree and support the use of a near zero discount rate. The arguments are twofold. First there is the ethical or philosophical argument advocating for a zero utility discount rate (i.e. zero rate of pure time preference in the Ramsey equation) on the grounds that the welfare of all generations is of equal importance (Broome, 1994; Cline, 1992; Stern, 2007). Second, there are many "market" interest rates and for climate mitigation investments it is more appropriate to apply an interest rate for insurance-type investments rather than for ordinary capital investments. This is because climate mitigation efforts are better understood as social insurance against disaster rather than ordinary profit-seeking investments. As is typical for insurance, their returns are uncorrelated or negatively correlated with the broader market. This would argue for discounting at a risk-free rate of return, often averaging 1% or less in real terms (e.g. long-term government bonds issued by developed countries) (Howarth, 2003).

Whenever possible, outcomes that cannot be adequately expressed in monetary terms should not be discounted. This avoids paradoxes such as the devaluation of future lives: if one asserts that saving a human life is worth exactly €1,000,000, or any other fixed monetary amount, does that mean that one life today is worth about 20 lives, or 150 lives, a century from now (as would be implied by a 3% or 5% discount rate, respectively)? Nevertheless, since the practice of discounting is widely accepted, and even expected in climate analyses, choices must be made about the appropriate rates to use, at least for future quantities that lend themselves to monetary valuation. The arguments made by Stern and others for low discount rates, particularly for zero or near-zero rates of pure time preference, should be carefully considered. In addition, the assumption of constant discount rates could be