Chapter 31
Sensitivity Analysis with Calibration of Natural Resource Variables under Climate Change:
Comparing Computable General Equilibrium (CGE) and Econometric Frameworks

Nilanjan Ghosh
Observer Research Foundation, India & World Wide Fund for Nature, India

Somnath Hazra
Jadavpur University, India

ABSTRACT

This chapter compares two quantitative frameworks, namely, Computable General Equilibrium (CGE) and Econometric models to study the impacts of climate change on human economy. However, as is inferred from this chapter, CGE framework is fraught with unrealistic assumptions, and fails to capture impacts of climate change and extreme events on the ecosystem services. On the other hand, econometric framework can be customised and is not based on the unrealistic assumptions like CGE. The various advantages and disadvantages of the two methods have been discussed critically in the process in this chapter in light of the avowed objective of understanding sustainability science.

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INTRODUCTION

Modelling climate change impacts has been one of the most prevalent exercises in the literature on climate change. Strands of literature exist on those aspects (see Stern 2013 for a detailed survey). Allegations against models are too many. Though scientists describe the scale of the risks from unmanaged climate change as potentially immense, the economic models appear to underestimate those risks due to omission of key variables at the interface of the economy and ecology.

A sensitivity analysis often emerges as a natural fall out of the modelling framework. This analysis determines how the output or the model depends on the input variables (Hamby 1994). More importantly, a sensitivity analysis measures the sensitivity of the output to the input variables. In the context of climate change, models that intend to look at impacts on economic variables often consider the change in the nature-related variables as an input, and eventually, try to obtain their economy-wide impacts. This is no mere challenge!

Though economic modelling of climate change is not a new concept but precise modelling is a major concern. The situation is complicated at both levels: conceptual and methodological. While on the one hand, the mounting global emissions and atmospheric concentrations of greenhouse gases (GHGs) is a matter of concern for the present civilisations, the potentially adverse impacts of future climate change on natural and human systems is no less concerning.

When it comes to economic modelling of climate change, the challenge depends on the research question posed. This can occur at two levels. First, it can occur at the level of understanding the impacts of climate change on the various economic sectors. The second is arriving at the economic costs of climate change considering the nature-society-economy linkages.

The approach to responding to the first question is essentially neoclassical and reductionist. However, it is the second concern that poses a bigger challenge and needs to be addressed in ways that concern itself with variables that are ecological, social, and economic. One needs to understand here that the ways climate change impacts humanity is through various forces that are multi-dimensional.

One needs to appreciate here that quantifying the economic costs of climate impacts is extremely challenging. Impacts exhibit considerable heterogeneity across multiple dimensions: the timing and geographic distribution of changes in climatic variables, the consequent changes in key physical and biogeochemical "endpoints" that might occur over time and space, and the magnitude of the resulting damages that these effects are likely to impose on the range of sectors in the economy. Each of these dimensions is subject to uncertainty, and is the focus of different analytical frameworks that utilize computational simulation models. To undertake integrated assessments of climate impacts these modelling components need to be streamlined and the interfaces between them need to be articulated and coordinated.

To assess the economic impact of climate change, the Integrated Assessment Model (IAM) was initiated in 1991 by Nordhaus but the model has received attention after the Intergovernmental Panel on Climate Change (IPCC) report on socio-economic dimensions of climate change (Weyant, et. al. 1996) came to the forefront. IAM integrates climate science and impact of climate change on economic variables. More than 20 years have gone after the introduction of climate economic model or sensitivity analysis, but there is not much improvement that has happened in the context of economic modelling of climate change.

The intention of this paper is to place a comparative picture of two types of quantitative models to assess the impacts of climate change. The two types of economic modelling are: Computational General Equilibrium Model (CGE) or Macroeconomic Model, and Econometric Modelling Approach (EMA).