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MODELING THE ECONOMIC IMPACTS OF CLIMATE CHANGE: WHAT IS AT STAKE?

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NON-TECHNICAL SUMMARY

The work of the International Panel on Climate Change (IPCC) since 1988 has confirmed the fact of anthropogenic climate change, and the urgency of substantially reducing greenhouse-gas emissions. But the slow pace of international climate negotiations point at the difficulty of selecting appropriate actions and establishing a priority order. This is partly due to the large differences between various assessments of the economic impacts of climate change and of the cost of mitigation policies. These assessments cannot avoid a number of questionable assumptions in energy-economic modeling which impact the results, originating in a value system one should be aware of.

Most of the models merely operate in a "cost-effective" mode to compare climate change mitigation policies. This approach consists in defining an a priori GES emissions reduction target which would allow attaining a GES atmospheric concentration target at a certain time horizon. Then the role of models is to estimate the economic impacts of policies needed to reach these objectives, in order to help decision-makers to choose the most efficient policy, that is to say the least costly. In this paper, we review the existing models, taking as examples the main four models used in France: ENV-LINKAGES (OECD), IMACLIM-R (CIRED), GEMINI-E3 (C-ORDEE and MEEDAD) and POLES (LEPII).

The models are analyzed according to two factors: representation of technical progress and dynamics. As concerns technical progress, Bottom-Up models describe in detail the energy

technologies, but do not model satisfactorily the feedback effects on the rest of the economy; whereas Top-Down models assess the impacts of mitigation policies on GDP and welfare, but do not catch satisfactorily technical progress potentials. As concerns projections, a recursive dynamic framework is used in most of the models, which does not allow to represent expectations satisfactorily; with this type of framework, one can build only exploratory scenarios. The intertemporal optimization models, which include agents' expectations in normative scenarios, necessitate many calculations, if regions, sectors and technologies are represented in detail. Hybridization between models of different families attempts to compensate these shortcomings.

The work of the Quinet Committee on "State-imposed Value of Carbon" is then used to analyze the consequences of theoretical differences between models on a practical case: the assessment of the economic value of carbon by GEMINI-E3, IMACLIM-R and POLES. According to IMACLIM-R, a hybrid model, the abatement cost stabilizes in the long term, due to induced technical progress; the cost continues to grow according to the Top-Down GEMINI-E3 model, due to the constant elasticities of substitution in the production function, and according to the Bottom-Up POLES model, due to a supply constraint in no-carbon energy supplies.

The analysis of energy-environmental models is continued with the Stern Review and its critics. New sources of uncertainty appear when a "cost-benefit" mode is used: incomplete knowledge of future damages, the choice of a rate of discount to compare early policies and their effects, and finally alternative methods of estimating non-market damages. The "cost-benefit" mode reveals the complexity of the links between the economy and the environment. Exogenous extrapolations of income growth and technical progress, induced by the use of traditional growth indicators which do not take into account changes in the environment, could delay the launch of environmental policies indefinitely.

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