

Evolution of modeling of the economics of global warming: changes in the DICE model, 1992-2017

Objective

In the absence of statistical tests, the present study examines the extent and area of revisions of the DICE model from its earliest publication in 1992 to its latest version published in 2017 and 2018. This retrospective gives a flavor for changes in the underlying economic and earth sciences, data revisions, correction of mistakes, and the pure passage of time

Approach

Systematic studies of forecast errors using Monte-Carlo-type techniques were undertaken for the 2008 model and the 2016R2 model. The latter set is more comprehensive but they have the drawback of being retrospective error estimates. Table 3 shows the Berror forecast ratio, which is the ratio of the change in forecasts between 1992 and 2017 relative to the estimated forecast uncertainty (measured as the standard deviation from the Monte-Carlo estimates).

Impact

The projections of most environmental variables (such as emissions, concentrations, and temperature change) have seen relatively small revisions (with the emphasis here on relatively). However, there have been massive changes in the projections of the economic variables, including those that were forecast in 1992 and have now been realized in 2017. The stability of the environmental variables largely reflects the fact that these processes were relatively well-understood by the early 1990s, and, therefore, modeling of these components within IAMs could be based on a solid scientific foundation.

Table 3 Forecast error ratios for different projections

Variables	Ratio: (difference2016-1992)/ estimated error
Major driving variables	
Economic	
Interest rate (% per year)	0.11
Population (billions)	0.54
Savings rate	
Per capita GDP (2010\$)	1.04
Damage parameter (% at 3 °C)	0.77
Consumption per capita (2020\$)	
Geophysical	
Other Forcings (W/m ²)	
CO ₂ /output ratio (tCO ₂ /000 2010\$)	- 0.70
Outcome variables	
2100	
Industrial emissions (GTCO ₂ per year)	- 0.15
Output (trillions 2010\$)	1.03
Atmospheric concentration C (ppm)	0.79
Atmospheric concentrations (GtC)	0.79
Atmospheric temperature (°C)	1.22
Climate damages (% output)	1.02
Total forcings (W/m ²)	