Review of "The influence of the specification of climate change damages on the social cost of carbon"

Summary and major comments

Estimates of the social cost of carbon (SCC) are subject to a great deal of uncertainty. In much of the literature on the SCC, focus is placed either on climatic uncertainties (e.g. the climate sensitivity) or on what we might call welfare uncertainties (e.g. the pure rate of time preference), while the form and parameterization of the damage function is held constant.

However, increasing focus is being placed on the damage function, and recently several studies have emerged, which consider either variations to the form of the damage function, or, for a given functional form, different parameter values. Their results have generally indicated how important this element of integrated assessment models is to their overall results, which is no surprise, when one considers the meager evidence base on which the damage function is to be calibrated.

This paper performs two useful roles. First, it brings these studies together and synthesizes them. Its literature review is a valuable resource, in particular because it discusses each paper's formulation in detail, with some formalism. Second, it conducts some empirical analysis of the sensitivity of the SCC to changes in damage functional form and parameterization (the latter through Monte Carlo simulation of a given functional form).

However, I have some reservations about how the empirical analysis is presented, which should be addressed before publication.

The main problem stems from the paper anchoring itself in the recent analysis of the SCC for US government regulatory impact assessments. This analysis was fundamentally flawed by applying constant, exogenous discount rates, as if climate change were (in any conceivable state of nature) a small problem, which would not affect consumption growth and were hence amenable to discounted cash flow analysis. This paper does not make that mistake (it uses the Ramsey rule properly), but it sets its pure rate of time preference (rho) and its elasticity of marginal utility (eta) in order to replicate the discount rates set in the US government analysis. As a result, rho and eta co-vary, so that we see, for example, the effect of different damage functional forms and parameterizations on the SCC when eta is zero but rho is 3%, when eta is one and rho is 0.95%, and when eta is 1.4 and rho is 0.14%. One cannot clearly see the effect of risk aversion, if rho co-varies. One could hold rho constant at various values, while looking at variation in eta.

A second comment is that the range of values of eta considered is arguably too narrow. What constitutes an appropriate range is clearly debatable, and the debate is muddied by the fact that eta must simultaneously capture risk aversion and intertemporal consumption smoothing, calibration to which generally suggests different values. However, considering

values of eta up to 2 and beyond to, say, 4 is certainly justifiable, especially in sensitivity analysis, as opposed to picking a central value.

Minor comments

- In thinking about the nature of damages in section 2.5, it is worth citing Fankhauser and Tol (2005), who look at the effect of different models of economic growth on the way in which current climate damages to output propagate into the future via reduced investment. The basic point is that, if growth is somehow endogenous, the consequences of climate damage to current investment for future consumption are larger.
- Since with a CRRA utility function marginal utility tends to infinity as consumption tends to zero, the upper bound on climate damages could matter a lot to the estimate of the SCC in the event that it binds. Since it does bind at times in this paper, it is at least worth discussing uncertainty about where this upper bound could lie.
- Given that the objective of estimating the SCC is to provide a normalized (i.e. monetized) estimate of the change in social welfare resulting from a marginal change in CO2 emissions, I don't see the reason for reporting the unadjusted Sterner-Persson SCC – it is inconsistent with what we are trying to measure.
- How are the standard deviations of damage function Xc, as described on page 15, calibrated?

References

Fankhauser, S. and R. S. J. Tol (2005). "On climate change and economic growth." Resource and Energy Economics **27**(1): 1-17.