Nordhaus Article

Critical of *Stern Review* about the costs of climate change:

if we don't act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, now and forever. If a wider range of risks and impacts is taken into account, the estimates of damage could rise to 20% of GDP or more....

Nordhaus:

One of the major findings in the economics of climate change has been that efficient or "optimal" economic policies to slow climate change involve modest rates of emissions reductions in the near term, followed by sharp reductions in the medium and long term. We might call this the *climate-policy ramp,* in which policies to slow global warming increasingly tighten or ramp up over time.

Nordhaus:

The logic of the climate-policy ramp is straightforward. In a world where capital is productive, the highest-return investments are primarily in tangible, technological, and human capital, including research and development in low-carbon-emissions technologies. As societies become richer in the coming decades, it becomes efficient to shift investments toward policies that intensify the pace of emissions reductions and otherwise slow GHG emissions.

Problem with *Stern Review* assumptions:

But these points are not the nub of the matter. Rather, and this is the final comment, the *Review's* radical revision arises because of an extreme assumption about discounting. Discounting is a factor in climate-change policy – indeed in all investment decisions – which involves the relative weight of future and present payoffs. At first blush, this area would appear a technicality that should properly be left to abstruse treatises and graduate courses in economics. Unfortunately, it cannot be buried in a footnote, for discounting is the central to the radical revision. The *Review* proposes using a social discount rate that is essentially zero.

Problem with *Stern Review* assumptions:

"Behind the *Review's* modeling is the assumption that the world economy is in long-run equilibrium of a Ramsey optimal growth model. In a Ramsey equilibrium with stable population, there are two observables – the rate of return on capital and the rate of growth of consumption; and there are two normative parameters – the social discount rate and the curvature of the utility function.."

Look at this more closely

$$U'_t = (1 + r_t)\beta U'_{t+1}$$

Assume a particular functional form:

$$U(c_t) = \frac{c_t^{1-\alpha}}{1-\alpha}$$

So:

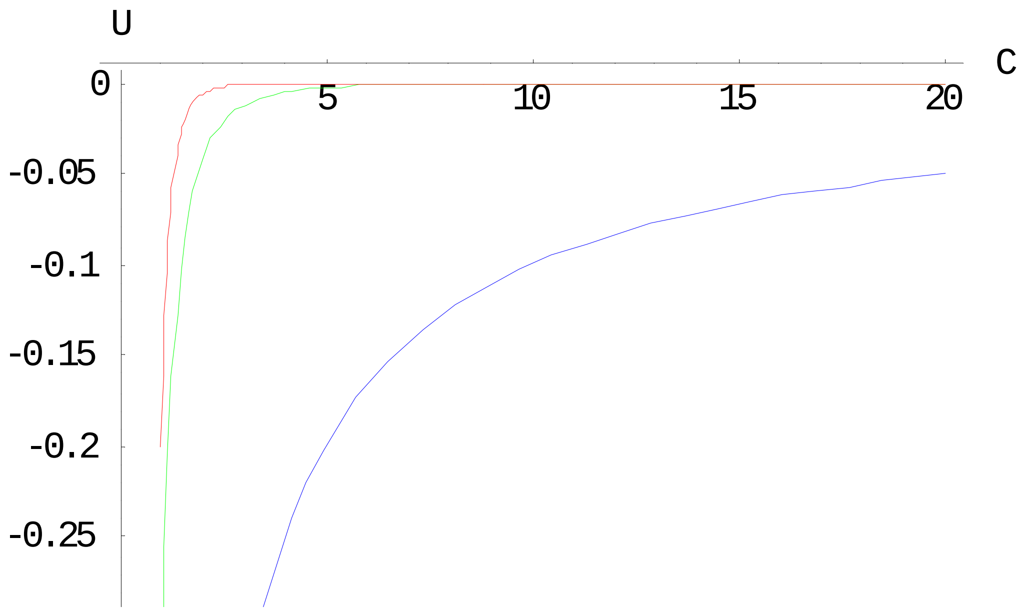
$$U'(c_t) = c_t^{-\alpha}$$

$$c_t^{-\alpha} = (1 + r_t)\beta c_{t+1}^{-\alpha}$$

$$U(c_t) = \frac{c_t^{1-\alpha}}{1-\alpha}$$

Plot of utility: Role of α

Blue: $\alpha = 2$ Green: $\alpha = 4$ Red: $\alpha = 6$



Necessary condition:

$$c_t^{-\alpha} = (1+r_t)\beta c_{t+1}^{-\alpha}$$

$$1 = (1+r_t)\beta(\frac{c_{t+1}}{c_t})^{-\alpha} = (1+r_t)\left(\frac{1}{1+\rho}\right)(1+g)^{-\alpha}$$

Assume constant growth and interest rates:

Take logs:

$$0 = \ln(1+r) + \ln\left(\frac{1}{1+\rho}\right) + \ln((1+g)^{-\alpha})$$

$$0 = r - \rho - \alpha g$$

$$r = \rho + \alpha g$$

In a Ramsey equilibrium with stable population, there are two observables – the rate of return on capital and the rate of growth of consumption; and there are two normative parameters – the social discount rate and the curvature of the utility function..

$$r = \rho + \alpha g$$

Observables:

r = return on capital

g = consumption growth

Normative Parameters:

ρ = social discount rate

α = curvature of the utility function

The *Review* assumes a relatively low curvature parameter (the logarithmic utility function) along with the near-zero social discount rate. However, in calibrating a growth model, the social discount rate and the curvature parameter cannot be chosen independently if the model is designed to match observable variables. A low curvature (such as in the logarithmic utility function) implies a relatively high social discount rate. A high curvature (represented by a high degree of risk aversion or a high aversion to intergenerational inequality) implies a low or even negative social discount rate. It turns out that the calibration of the utility function makes an enormous difference to the results in global-warming models, as I show in the modeling section below.

Conclusion of *Stern Review:*

"…. would probably increase the cost of climate change to the equivalent of a 20% cut in per-capita consumption, now and forever."

DRAMATIC COSTS!!

However, the major point is that these impacts are far into the future, and the calculations depend critically upon the assumption of low discounting. Take as an example the high-climate scenario with catastrophic and non-market impacts. For this case, the mean losses are less than 1 percent of world output in 2050, 2.9 percent in 2100, and 13.8 percent in 2200 (see Figure 6.5d). Yet this somehow turns into a mean annual impact of 14.4 percent shown in Table 6.1, and after a few other gloomy ingredients are stirred in, it becomes the "20% cut in per-capita consumption, now and forever."

How do damages, which average around 5 percent of output over the next two centuries turn into a 14.4 percent reduction in consumption now and forever?

Suppose that scientists discover that that a wrinkle in the climatic system will cause damages equal to 0.01 percent of output starting in 2200 and continuing at that rate thereafter. How large a one-time investment would be justified *today* to remove the wrinkle starting *after two centuries*?

The answer is that a payment of 15 percent of world consumption today(approximately $7 trillion) would pass the *Review's* cost-benefit test.