EC1340-Fall 2019
Problem Set 7

(Updated 21 August 2019)

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When you write up your answers, your goals should be to (1) be correct, and (2) convince your reader that your answer is correct. It is always helpful if your work is legible and if all steps are presented, possibly with a line of explanation.

In the case of empirical exercises, your goal should be to provide enough information to allow a reader to replicate your answer. This requires a description of data and data sources as well as a description of your analysis of the data.

Answers which do not achieve these goals will not be awarded full credit.

To assist us in complying with the University's privacy policy, the first page of each problem set should be blank except for your name and the problem set number. This will allow us to write your score inside your problem set. Failure to include such a page will be understood as permission to write your score on the front of your problem set where others might accidentally see it.

Problems

1. Suppose that current world income is about 63 trillion dollars. Consider the following three possible growth paths.

   (a) World income grows at 1.5% forever. This path is the mitigation path – we magically solve the problem of warming at time 0 and live happily ever after. The discounted present value of world income on this path is

$$W_1 = \sum_{t=0}^{\infty} \left(\frac{1}{1+r} \right)^t (1.015)^t Y_0$$

   (b) World income grows at 1.5% a year for $t = 1,..,49$ and at 0.5% per year thereafter. This is a stylized description of the path suggested by Dell et al.'s analysis in which warming stops growth in half the world. The discounted present value of world income on this path is

$$W_2 = \sum_{t=0}^{49} \left(\frac{1}{1+r} \right)^t (1.015)^t Y_0 + \left(\frac{1}{1+r} \right)^{50} \sum_{t=0}^{\infty} \left(\frac{1}{1+r} \right)^t (1.005)^t [(1.015)^{50} Y_0]$$

   (c) World income grows at 1.5% a year forever, but in 100 years is subject to a 5% decrease. This corresponds (approximately) to the case Nordhaus analyzes: after it warms up, productivity drops, but growth continues largely unharmed. The discounted present value of world income on this path is

$$W_3 = \sum_{t=0}^{99} \left(\frac{1}{1+r} \right)^t (1.015)^t Y_0 + \left(\frac{1}{1+r} \right)^{100} \sum_{t=0}^{\infty} \left(\frac{1}{1+r} \right)^t (1.015)^t [0.95(1.015)^{100} Y_0]$$

   The value of magical solution to the mitigation problem in W_1 is the difference between W_1 and W_2 or W_3. (Hint: recall that $\delta^t \gamma^t = (\delta\gamma)^t$)

   (a) Evaluate $W_1 - W_2$ for $r = 2\%$ and $r = 5.5\%$.

   (b) Evaluate $W_1 - W_3$ for $r = 2\%$ and $r = 5.5\%$.

(c) What is Nordhaus' estimate of the value of the carbon free energy? To which of the calculations above does this value most closely correspond?

(d) What do the calculations you performed here suggest about the role of the discount rate and the effect of climate on growth in evaluating mitigation policy?