ECN 275/375: Sustainability

(EX5-1) The Brundtland commission

The Brundtland commission's definition of sustainable development:

> *... development that meets the **needs of the present** without compromising the ability of future generations to meet their own needs ...*

(a) Propose a definition of needs (of the present generation and for future generations) that you can implement in a model.

(b) One of the aims of economics is to maximize social welfare, which then leads to a utility function formulation. With increasing population numbers a per capita specification of utility may be warranted. Discuss the following objective function for a representative world citizen:

$U(C_t, E(R_t))$

where C_t is **consumption per capita** with partial derivative $U_C(C_t)>0$,

$E(R_t)$ is an externality indicator where R_t is resource use with partial derivative

where $U_E(C_t, E(R_t))<0$ and $E_R(R_t)>0$

Does this utility function capture the essentials for analyzing sustainability, or are some key elements left out? If so, which key elements are left out? Explain briefly.

When structuring a model, it is often easier to formulate it in discrete than continuous time. To see this, consider the following state variable: $S_t=(1+g)S_{t-1}$ where g is the growth rate of the state variable. The equivalent continuous time formulation is $\dot{S}_t=gS_t$, which expressed in discrete time becomes $S_t-S_{t-1}=gS_{t-1}$. Adding S_{t-1} to both sides of this equation yields the discrete time formulation. Something to think about when formulating the various parts of your model. Note that in continuous time, $\lim_{\Delta t\to 0} S_t=S_{t-1}$.

(c) Population growth has been exponential for some time, but it is expected to taper off such that population numbers are expected to stabilize around 2050. How to include population number changes in your model?

(d) How would you formulate the resource constraints?

(e) How would you formulate the pollution constraints?

(f) In lecture 14 the production function in continuous time is $Q(R_t, K_t, E(R_t, A_t))$ where man made capital, K_t, is the only undefined term in this exposition. How would you formulate the change in the stock of production capital?

(g) Given that population growth is assumed to be zero some time around 2050, and climate issues need to be resolved also some time around 2050, consider formulating the objective function with the appropriate choice variables for a finite time horizon T.