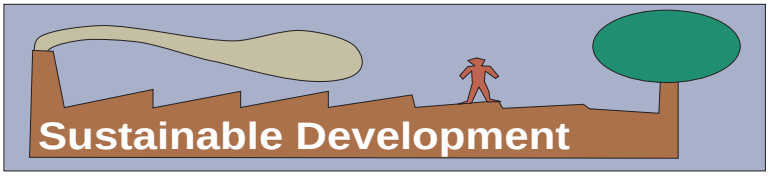

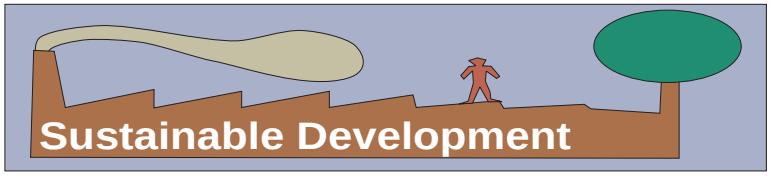

Core lecture 3

Natural resource demand and Solow's mechanisms

Study questions

Resource efficiency.

1. Assume that you are building a general equilibrium model of natural resource demand and supply. Inputs will be augmented labour $A_L L$ and augmented resources $A_R R$.

   (a) You must choose between the following three production functions. Write each of them down, and discuss advantages and disadvantages.

      i. The Cobb–Douglas.
      ii. Leontief.
      iii. CES.

   (b) Assuming Cobb–Douglas, suggest a value for α. And assuming CES, suggest a value for the elasticity of substitution between the inputs.

2. In the trees and houses question, what happens if they find a house design that requires half the number of planks?
3. Explain why it makes sense that research effort is in proportion to factor shares.
4. Explain the role of the knowledge production function. Suggest functions for A_R and A_L based on the idea that 'a rising tide raises all the boats'.
5. Given labour and resource inputs, if we assume independent knowledge stocks we get constant factor shares. What is good about this? What is not so good?

Alternative resource inputs

1. Is scarcity of non-renewable natural resources likely to be a major brake on economic growth within the next 200 years? Energy?
2. Are 20 SEK and 100 SEK notes perfect substitutes?
3. Assume the production function $R = [(A_1 R_1)^\epsilon + (A_2 R_2)^\epsilon]^{1/\epsilon}$. Suggest a value for ϵ.
4. Explain what happens to demand for alternative resources given independent knowledge stocks.
5. What does analysis of long-run price and quantity trends for specific resources teach us? How could we model what is going on?

Structural change

1. Do rich people like energy-intensive stuff?
2. Consider the model of structural change with only substitution effects, and assume R is energy. Assume that we change the production function for y_2 to $y_2 = \gamma_r k_r \min(\beta l, r)$ and parameterize such that the share of R in y_2 is 20 percent.

   (a) How will this model behave?
   (b) What will happen to the energy share in y_2 over time, as the economy grows?
   (c) Do you think the model will be able to explain the data?

3. What happens if we raise energy efficiency in a simple model with pure income effects? Link to rebound. What is the effect of taxing energy use?
4. Assume that you want to reduce damages from CO_2 emissions from air travel in an economically efficient way. However, a tax on emissions (or equivalently a tax on fuel use) is not an option. Discuss the option of subsidising research into engine efficiency. How about a 'per seat' flight tax? What would the social planner do?

Bonus question

1. Assume an island economy with 100 people in 1800. Everything they need to live on is buried deep underground, and to get it out they need motive power and labour. Luckily 100 kg of coal washes up on the beach every day, and they have a Newcomen steam engine. Given this technology, their production function is

$$Y = [(A_L L)^\epsilon + (A_R R)^\epsilon]^{1/\epsilon},$$

where $\epsilon = -1$, $A_L = 1$, and $A_R = 0.1$.

   (a) What is the elasticity of substitution between L and R?
   (b) Find GDP, the prices of labour and coal, and the factor shares of labour and coal.

Now assume that it is the year 2000 and someone designs and builds a modern coal-fired electric turbine.

   (c) Suggest values for A_L and A_R, and find prices and factor shares based on these values.

Go back to 1800 and assume that 11 more people arrive who are researchers by nature. The knowledge production functions are $A_{Lt} = A_{Lt-1} Z_{Lt}/100$ and $A_{Rt} = A_{Rt-1}/10$, where periods are 10 years.

   (d) Assuming that research effort is in proportion to the factor shares, describe what happens. What is the long-run balanced growth path?
   (e) What happens if the flow of coal doubles?