Exercises No. 2: Natural Resources and Development

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Natural Resources and Economic Development

Q1.1.: How do economists define terms of trade (TOT)?

Q1.2. : Which problem can occur if a resource is characterized by open-accessibility? Give an example. What could be a suitable solution?

Q1.3. : In developing economies, government officials often engage in rent-seeking activities. What does 'rent-seeking' mean?

Q2.1.: The following regression is given by

$$Y = \alpha_0 + \alpha_1 \cdot X + \varepsilon$$

a) Which variable denotes the independent variable? Which one denotes the dependent variable?

b) What does α_0 and α_1 stand for?

Q2.2.: Comparative advantage and trade: There are two economies called North and South and each economy has one worker who can work 50h/week. Each worker can spend his time producing either food or clothing. It takes the worker from North 20 hours to produce a unit of food and 5 hours to produce a unit of clothing. It takes the worker from South 40 hours to produce a unit of food and 5 hours to produce a unit of clothing. People in each country consume food and clothing only in fixed proportions, one unit of food per one unit of clothing.

a) Which country has an absolute advantage in the production of food? Which one has a comparative advantage in the production of food?

b) What should both countries do? How many units of the good a country holds a comparative advantage for will each country produce?

Q2.3.: Imagine a resource-based Easter Island economy characterized by open-access renewable resource exploitation. Human population is denoted by L and the island's resource stock is given by S. In equation (1), $G(S)$ equals the biological growth rate, r the intrinsic growth rate and K the carrying capacity of the environment. Here, α is a coefficient and β reflects consumer taste for the output of the harvest good. In equation (2), b equals the proportional birth rate and d equals the proportional death rate. F is the human fertility function $F = \varphi H/L$ with $H = \alpha\beta LS$ and φ is a positive constant.

(1) $\dot{S} = dS/dt = G(S) - H = rS(1 - S/K) - \alpha\beta LS$

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(2) $\dot{L} = dL/dt = L\ (\ b - d + F\ ) = L\ (\ b - d + \varphi\alpha\beta S\ )$

a) Interpret equation (1) and equation (2).

b) Determine the steady-state resource stock level S^* and population L^*, i.e. $\dot{S} = \dot{L} = 0$.

Q2.4.: An economy is endowed with a nonrenewable resource. Here, *s* equals the initial stock of the resource. *N* denotes the natural resource. Thus it is to maximize

$$\max V = \int_0^T [\ p \cdot x - C\ (\ x\ , N\ )\ ] e^{-\delta t} \quad \text{S.T.} \quad \dot{N} = -\ x$$

and $s \geq \int_0^T x dt$;s = N_0.

$C = \frac{w}{N}\left(\ \frac{x+1}{2}\ \right)^2$ with *w* denoting wage.

a) Interpret the following: $s \geq \int_0^T x dt$ and s = N_0.

Information: If an economy is endowed with a nonrenewable resource, then it either exploits the natural resource fully or the value of the natural resource should equal zero in period T. Then the transversality conditions must hold.

$$(\ TC\ 1\ )\ q\ (\ T\ )\ \cdot\ N\ (\ T\ )\ =\ 0$$

TC1 indicates that either the shadow price of the natural resource should equal zero in period *T* or the natural resource given by *N* should equal zero in period *T*. Which case is relevant depends on the costs curve of the natural resource. If the cost function is a function depending on *x* and *N*, then *N(T)* has to be bigger than zero, or else the marginal costs would go to infinity if N(T)→0. Then *q(T)* equals zero and *N(T)>0*. If total costs only depend on *x*, then *N(T)=0* and *q(T)>0*.

$$(\ TC\ 2\ )\ H\ (\ T\ )\ =\ 0$$

or

$$H\ (\ T\ )\ =\ p\ \cdot\ x\ (\ T\ )\ -\ C\ (\ x\ (\ T\ ),\ N\ (\ T\ ))\ -\ q\ (\ T\ )\ x\ (\ T\ )\ =\ 0$$

b) Set up the Hamiltonian *H* and determine (MP) and (TC2).

c) Solve for *x(T)* by using (MP) and (TC2) to show that profit is maximized if the marginal costs (MC)-graph sections the average costs (AC)-graph in its minimum. Draw a figure showing this with *x* denoting the horizontal axis and *p* denoting the vertical axis.

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