

ENVIRONMENTAL ECONOMICS (IKT5131)
Assignment #2 (Mar 27, 2021)
Assoc. Prof. Tunç Durmaz

DUE DATE: 23:59, Apr 03, 2021/Friday. **Send** your assignment by email to mailbox@tuncdurmaz.com. The **format** of the file name is “Asg2_StudentID_NameSurname”

1. Pareto Optimality, Competitive Economy, and the Pigouvian tax

Consider a simple modern economy with two individuals: a dirty good, a clean good, and labor as the only factor of production. Define the surplus function for each individual as $U_i(x_i, z_i, E)$ for $i = 1, 2$ where x_i and z_i are consumption levels of the two goods and E is the level of pollution emissions. Production of x is polluting. Let the production function of good x be denoted by $x = f(l_x, E)$ where both labor input l_x and emissions E . While the marginal products of l_x and E are positive, their second order derivatives are negative. The clean good z is produced using only labor according to the production technology $z = g(l_z)$. Labor employed in the economy is constrained by the work time endowment \bar{l} so that $l_x + l_z = \bar{l}$.

Let

$$\begin{aligned}U_i(x_i, z_i, E) &= x^{1/2} z^{1/2} (\bar{E} - E), \\f(l_x, E) &= l_x^{1/2} E^{1/2}, \\g(l_z) &= l_z, \\U_2(x_2, z_2, E) &\geq \bar{U}, \\\bar{E} &= 5 \text{ and } \bar{l} = 12.\end{aligned}$$

- a- Derive and interpret the Pareto optimum conditions for this economy.
- b- Find the consumption levels, factor allocations, and the level of pollution emissions satisfying Pareto optimality.
- c- Using an Edgeworth Box and the solutions satisfying Pareto optimality, depict the contract curve.
- d- Consider a free market, competitive economy in which each person has an income of (or is endowed with) Y_i for $i = 1, 2$. Suppose that there is no market intervention by the environmental authority. Solve for the individuals' utility and firms' profit maximization problems. What is the level of emissions in this case?
- e- Suppose that the environmental authority intervenes in the market. Calculate the Pigouvian tax. Show that the Pigouvian tax leads to the efficient level of pollution emissions. What is the efficient level of abatement?
- f- Show the efficient level of pollution and the Pigouvian tax in a figure. Be careful with the curvatures of the 'value of the marginal product of E' and 'marginal utility loss of additional E' lines.
- g- Draw the same figure with 'abatement' on the horizontal axis this time.