TSE
Toulouse School of Economics
École d'économie de Toulouse

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Session 1

Semestre 2

Master 1 Economics, Econometrics Statistics

Epreuve : Environmental & Resource Economics

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Non

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Calculator but no devices with storage capacity like smartphones, laptops, etc.

Nombre de pages (y compris page de garde) : 3

Environmental & Resource Economics

Toulouse School of Economics, Master 1

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Exam, Spring 2017, Session 1

Question 1 (5p)

You are asked to use the monetary value for "clean air" from "Area A" (where a value has been estimated) in "Area B" (where no value has been estimated), i.e. you are asked to conduct a benefit transfer (BT). Since you have information about income differences between A and B you will use BT transfer with an income adjustment. You have access to the following info:

- The willingness to pay (WTP) for clean air in area A has been estimated to be 120 €
- The empirical evidence shows that the income elasticity of WTP is 0.5
- The mean income level in area A is 10 000 €
- The mean income level in area B is 40 000 €

Q1.a.: Estimate the BT value for Area B (i.e. the WTP for area B based on the BT approach).

Q1.b: Assume now that a study is conducted in area B that finds that the true WTP in B is 200 €. What is the transfer effort (TE) in percentage (as defined in the course) from using the BT value that you estimated above?

Question 2 (5p)

Estimate the effect on two firm's emissions levels (*x*) from the introduction of a Pigouvian tax (*p*). You have information about the two firms' (A and B) total cost functions:

$$TC_A = 1000 + 150x + 1.5x^2 + px$$

$$TC_B = 1200 + 120x + x^2 + px$$

Q2.a: Assume *p=0*, estimate the firms optimal emission level (*x*).

Q2.b: Assume p=30, estimate the firms optimal emission level (x) and calculate the change in emission from *p=30* for both firms.

Question 3 (5p)

Consider the nonrenewable resource where remaining reserves evolve according to the iterative equation $R_{t+1} = R_t - q_t$, with $R_0 > 0$ given. The net revenue from extraction q_t is given by $\pi_t = pq_t - \left(\frac{c}{2}\right) q_t^2$. The standard discount factor $\rho = \frac{1}{(1+\delta)}$. The current value Lagrangian to this problem can be written as: $\mathcal{L} = \sum_t^{\infty} \rho^t \left\{ pq_t - \left(\frac{c}{2}\right) q_t^2 + \rho\lambda_{t+1}(R_{t+1} - R_t - q_t) \right\}$, where $\rho\lambda_{t+1}$ is the Lagrange multiplier.

Q3.a: Derive the necessary first order conditions and show that $\lambda_t = \lambda_0(1+\delta)^t$.

Q3.b: Suppose that the remaining reserves will be completely exhausted at a given future dates $t = T$, implying $R_T = q_T = 0$ and there is no further exploration. Evaluating the first order conditions at $t = T$ implies $p = \rho\lambda_{T+1} = \lambda_T = \lambda_0(1+\delta)^T \; and \; \lambda_0 = p(1+\delta)^{-T}$. What is the optimal extraction path ? How would you proceed to obtain the optimal date of exhaustion T*? (you don't need to derive T*, however you should show the main assumptions that allow you to solve for the optimal date of exhaustion)

Q3.c : Describe the concept of resource scarcity (in maximum 3 sentences).

Question 4 (5p)

Consider an economy with a representation agent having a constant relative risk aversion $\gamma = 2$, and a constant rate of impatience $\delta = 1\%$. Let c_t denote consumption at date *t*. Suppose that c_t follows a geometric Brownian motion with trend $\mu = 2\%$ and a high volatility of $\sigma = 10\%$.

1. Compute the term structures of risk-free discount rates and risk premia.
2. Evaluate the NPV of the following two projects: All projects have an initial cost ε today.
    - Project A yields a single benefit of 1.1ε in 10 years.
    - Project B yields a single benefit of 30ε in 100 years.
3. Project C yields a sure cost of ε today and an uncertain benefit of $\varepsilon k\left(c_{100} / c_0\right)^2$ in 100 years, where k is a positive constant.
    - Which risk-adjusted discount rate should we use for this project?
    - What is the expected benefit of this project?
    - Estimate the NPV of this project. What is the minimum value of k that makes it desirable?