

73-250 - Intermediate Microeconomics

Recitation #5 - March 16, 2001

Exercise #1. A firm produces electricity using capital and coal. The market for electricity is competitive, i.e., the firm takes the output and input prices as given. The production process can be described by the following Cobb-Douglas production function

$$Y = 100K^{\frac{1}{4}}C^{\frac{1}{2}}$$

where C denotes the tons of coal used in production in a given month, K denotes machine-hours of capital per month, and Y denotes megawatts of electricity produced in a month. Let the price of electricity (per megawatt) be denoted by p_e . The price of a ton of coal is p_c , while a machine-hour costs p_k . For simplicity of computation set $p_e = p_c = p_k = \$1$.

- (a) Does the firm's technology display increasing, decreasing or constant returns to scale?
- (b) Find the firm's optimal choice of inputs;
- (c) The Environmental Protection Agency (EPA) imposes a tax on emission of pollutants from burning coal. When the firm uses C tons of coal emission of pollutants (E) is given by

$$E = C,$$

The firm is taxed \$1 per unit of E that is produced (therefore \$1 per ton of coal C used in production). Suppose that in the short-run the amount of capital is fixed at the level you found at point (b), and the firm cannot adjust its capital stock. Compute the optimal choice of coal in the short-run.

(d) After some time the firm is able to vary the capital input at its will (long run). Find the firm's optimal choice of inputs in the long-run. Why does the firm reduce its utilization of coal more in the long than in the short run? Are the firm's profits higher in the short or in the long run?

(e) Now the EPA is thinking about changing the policy of point (c). Instead of taxing emission of pollutants, the EPA now contemplates the possibility of taxing the firm's revenue at the rate t . An economist points out that taxing the firm's revenue is going to reduce (with respect to the result of point (b)) production of electricity, and therefore emission of pollutants, but is *not* going to reduce the ratio of coal used in production per megawatt of electricity produced (a measure of efficiency in the use of coal, from the environmental perspective). This objective is instead achieved by the policy of taxing emissions, in both the short and the long run, the economist argues. Verify (or contradict) both claims: i) taxing the firm's revenue is going to reduce (with respect to the result in (b)) emissions but not the tons of coal used in production per megawatt of electricity produced; ii) taxing emissions reduces (with respect to the result in (b)) the tons of coal used in production per megawatt of electricity produced in the short and in the long run;

(f) Consider now a tax on the profits of the firm, at the rate τ . Is a tax on profits going to modify any of the firm's decisions? Explain the intuition.