Homework 4

Due Tuesday March 8, 2016

Economics of Sustainability

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You are encouraged to form study groups to work on these problems. However each student must hand in a separate assignment: the group can work together to discuss the papers and comment on drafts, but each study group member must write it up herself/himself. When emailing assignments, please include your name and the assignment number as part of the filename.

1. What are the names of people in your study group?
2. Can you sketch an argument for how you would respond to economic interpretations of sustainability? Do you agree with them? Where do you see problems with the interpretation? *(Don't write a dissertation, a page or so is fine!)*
3. Give an example (like mine of "2 Guys & a Truck") of a simple production with one or two inputs. *(Clever and/or relevant to sustainability would be even better.)* Do you think it shows diminishing marginal returns of each input individually? What do you think are the returns to scale?
4. Consider regulations of an industry with 2 sorts of plants, designated (with a complete failure of imagination) as type 1 and type 2. Costs for both types of plant are $c(y) = 25 + 5y + \frac{1}{2}y^2$. Type 1 plants are dirtier and produce emissions at a rate of $e_1 = y_1 + \frac{1}{2}y_1^2$; type 2 plants just $e_2 = \frac{1}{4}y_2^2$. Each unit of output, y, is sold for a price of 25.
    a. Graph the emissions functions of each firm.
    b. Create a table of costs, revenue, and profit for different levels of output. Assuming that emissions are free, what level of output would each plant type choose?
    c. Add columns to the table for $\frac{\Delta c}{\Delta y}$ and $\frac{\Delta Rev}{\Delta y}$ – either use some calculus to find $\frac{dc}{dy}$ and $\frac{dRev}{dy}$ or just find the differences between integer values of y. What happens around the profit-maximizing level? Graph Costs and Revenues. Separately graph $\frac{\Delta c}{\Delta y}$ and $\frac{\Delta Rev}{\Delta y}$.
    d. Suppose regulations capped plant emissions at 100 – what level of output would the plants choose? Is this efficient – is there a way to produce the same output with fewer emissions? Or could the plants produce more output with the same emissions?
    e. Suppose emissions were taxed at a rate of $1 per unit of emission – what would be the new amounts of output chosen at each plant?
    f. Another way of looking at the emissions cap (each plant's emissions must be 100 of less) is that additional emissions are penalized at a rate of, say, $2 per unit above 100. Does this shift the profit-maximizing choice for each plant?
    g. (*Extra*) With a bit of calculus, find the optimal choices for any given emission tax, some level *T*. What is the marginal amount that a plant would be willing to pay for the last unit of emission?
    h. (*Tricksy*) What if emissions depended on industry output not individual firm choice, so $e_1 = (y_1 + y_2) + \frac{1}{2}(y_1 + y_2)^2$ and $e_2 = \frac{1}{4}(y_1 + y_2)^2$.