Problem Set V Solution

T.A. Zhichao Yuan
Office Hours Wednesdays 2:30-4:30pm
Email: zhichao@mit.edu, Office hours are held in 398. Problem set Due April 19.

1. By giving airlines the ability to cut fares, deregulation gave them the incentive to cut costs. The ability to compete freely on any route lead to the introduction of hub and spoke operations, which have much better scale economies than old-fashioned point to point operations.

(a) The Herfindahl index (HHI) has increased for airlines, signifying a reduction in the effective number of airlines. While under some conditions, this would signal a decrease in competition and a possible loss of efficiency, with airlines, it is more likely that scale economies have reduced the minimum effective scale of operations, increasing concentration and increasing efficiency.

(b) After the amendments to the Food, Drug, and Cosmetics Act in 1962, there were much more onerous testing and development requirements for new drugs by the FDA, which lead to greatly increased fixed costs for the drug industry. This introduced large scale economies.

(c) Only large firms do R&D. Thomas (Thomas, RAND 21(4) 1990) finds that small firms more or less stopped innovating after 1962 in the US. Did this by comparing with drug companies in the UK as a control.

(d) The short answer to this is “not much”. The slightly subtler message is that there are no general rules. With regulation, each case must be examined individually, as it could have radically different effects in different markets.

2. Environmental Regulation

Suppose that a fossil fuel fired generating plant discharges sulfur dioxide (SO2) into the atmosphere when it burns coal to generate electricity. SO2 emissions from fossil fuel fired electric utilities are the dominate precursor of acid rain. In addition, high ambient concentrations of SO2 have long been thought to have adverse effects on human health. It would cost the plant $2 million to install a ”scrubber” (a pollution abatement device) to eliminate these SO2 emissions, and doing so would result in $5 million in environmental and health related benefits to residents of the surrounding community.

(a) If the residents are assigned property rights to the air, and if each party has equal bargaining power, what will be the predicted outcome and the dollar transfer between the parties?

If the residents have the rights, then their minimum acceptance for allowing pollution would be $5 million. Since the maximum the company will pay is $2 million, no contract will happen. The company will close down, or install the pollution abatement equipment itself. There will be no transfers.
(b) If the firm is assigned the right to pollute, what will be the predicted outcome and the income transfer between the two parties?

If the firm has the rights to pollute, then their minimum payment to install abatement equipment must be the cost of the equipment, $2 million. The maximum the residents will pay is $5 million. If they have equal bargaining power, the residents pay $2 + (5-2)/2 = 3.5 million.

(c) Suppose we do not know precisely the dollar value of the health benefits from eliminating SO2 pollution from electric utilities. How would you estimate it? Would you err on the side of over-estimation or under-estimation? Why?

Willingness to pay methods in conjunction with scientific studies to decide what benefits, if any, there are from reduced levels of sulfur dioxide. It is unclear if it is better to over or under estimate the benefits. If costs are uncertain and technological advance is uncertain, it may be better to do less today by way of cleanup and wait until there is more certainty (underestimate benefits).

(d) The Clean Air Act forbids the EPA from considering cost considerations when setting air pollution standards. What are some reasons why this is this a reasonable mandate? What are some reasons why this is an unreasonable mandate?

It is an odd rule: as economists we think we’d like to abate until marginal cost equals marginal benefit. If costs aren’t considered then the idea is that we abate until absolutely no one is harmed - that can get pretty costly pretty fast!! The expression sounds nice politically, but economically speaking it is not the kind of standard we think about setting.

3. Tradable Permits

Imagine a world with two electric generating plants each which emits sulfur dioxide emissions. Suppose the environmental goal is to reduce SO2 emissions by two tons from current levels. Plant A can reduce SO2 emissions at the cost of $25 per ton. Plant B can reduce SO2 emissions at the cost of $100 per ton.

(a) One "command and control" approach to achieving the environmental goal of a two ton reduction would be to mandate that each plant reduce emissions by one ton. What is the cost of the "command and control" approach?

The cost of this approach is $25 for Plant A and $100 for Plant B; the total cost is thus $125.

(b) A tradable permits approach to achieving the environmental goal of a two ton reduction is to issue to each plant permits equal to the plant’s current emissions minus one. Suppose the price of a permit is equal to $30. What is the cost of the tradable permits approach? How much does Plant A reduce emissions by? How much does Plant B reduce emissions by?

If Plant A sells an allowance to Plant B for $30 then the cost of this approach is $20 ($25*2 - $30) for Plant A, $30 for Plant B, and the total cost is thus $50. Notice that Plant A is happy to sell Plant B one of its (Plant A’s) allowances (i.e. Plant A must make an additional one ton reduction) since Plant A makes a $5 profit from doing so (cost to reduce for Plant B = $25; revenue from selling
an allowance to Plant B = $30). Notice also that Plant B is happy to purchase an allowance from Plant A for $30 because if Plant B had to reduce one ton itself it would cost Plant B $100. Plant A reduces emissions by 2. Plant B reduces emissions by 0.

(c) Under which approach is total abatement cost lower? Demonstrate which approach Plant A is better off under. Demonstrate which approach Plant B is better off under.

Under the tradable permits program, each Plant is made better off than under the command and control approach (Plant A: $20; $25; Plant B: $30; $100) and total costs are lower under the tradable permits program than under the command and control approach ($50; $125).

4. Environmental Regulation

Suppose a two-stage cool world in which global warming may happen at stage 2 with probability $p$. In a cool world, the value of undeveloped land is 5, and the value of developed land is 10. In a warm world, the value of developed land is still 10, but the value of undeveloped land is 50. The human race may develop land at stage 1 or stage 2, but once developed, land cannot be undeveloped. Development is “all or nothing”, there cannot be development on only part of the land. The total payoff is the sum of the payoff in stage 1 (5 or 10), and the payoff in stage 2 (5, 10, or 100), so there is no discounting. The human race acts (if only) to maximize the expected total payoff.

(a) If there is development, the payoff now is 10. The payoff is also 10 in the future, no matter what happens. The total expected payoff is 20.

(b) With no development now, the payoff is 5. If there is warming, then there is a payoff of 50 with probability $p$, and if there is no warming, then the land will be developed, for a payoff of 10 w.p. $1 - p$. The expected payoff is then $5 + 10(1 - p) + 50p = 15 + 40p$.

(c) Development will occur now if the expected payoff from developing is higher than that from not developing, or if $20 > 15 + 40p$, which happens iff $p < 1/8$.

(d) If not developing means that there can never be development, then the payoff in the cool future is only 5, since land cannot be developed then. The expected payoff is, then $5 + 5(1 - p) + 50p = 10 + 45p$. Development will happen if $p < 2/9$.

(e) The value of the option, $V$, will be the difference in payoff between the case where one has the option to develop later, and the case where one doesn’t. If development would happen anyway, the option has no value, so $V = 0$ if $p < 1/8$. If $1/8 < p < 2/9$, then in the no option case, payoff is 20, but in the case with the option, the payoff is $15 + 40p$. The value of the option is, then $V = 40p - 5$, if $1/8 < p < 2/9$. If $p > 2/9$, then there would be development in either case, and the option value is $V = 15 + 40p - 10 - 45p = 5 - 5p$, for $p > 2/9$. This shouldn’t surprise you too much. If, in both cases, there is no development, the value of the option is an increase of 5 if there is no warming, which happens w.p. $1 - p$. 


(f) It's likely to make conservation more conservative than it would be if one assumed that one could not develop later. See VVH.