Permit Trading In-Class Simulation

Environmental Economics

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1 Purpose

The purpose of this exercise is to allow students to experience how firms make emission-abatement tradeoff decisions in an environment with tradable emission permits and to see how tradable emission permits can function to achieve an efficient outcome.

2 Market Structure

- **Participants:** Each student will be assigned a number. The exercise assumes there is an even number of students. Each student represents a firm. The class is large enough that if there are and odd number of students on the day of the exercise it will not affect the calculations enough to matter.

- **Output market:** The firms operate in the same country. Each firm produces the same product, which is traded on a global scale. Production in the firms' home country is small relative to global production, so the firms take the market price of 40 for their output as given.

- **Production:** Each firm's production cost is $C(Q) = Q$ up to a capacity constraint of 20 all firms have the same capacity constraint. Therefore, marginal cost is $MC(Q) = 1$.

- **Pollution:** Each unit of output produces one unit of pollution.

- **Pollution abatement:** A firm can reduce its emissions by investing in pollution abatement. For odd numbered firms, the cost of reducing pollution by A_1 units is $3(A_1)^2$. For even numbered firms, the cost is $(A_2)^2$. Thus, odd-numbered firms have relatively higher abatement costs than even-numbered firms. Marginal abatement cost is $6A_1$ for odd-numbered firms and $2A_2$ for even-numbered firms.

2.1 Tradable permit exercise

- Consider a cap-and-trade policy whereby the government of the firms' home country issues tradable emission permits to the firms.

- Each firm is issued 10 permits. Each permit allows a firm to emit one unit of pollution.

- There will be a trading period during which firms can buy or sell permits. Prices may be any positive integer although it would obviously be foolish for a firm to pay more than \$39 for a permit. Trading quantities must be a positive integer—you cannot trade a fraction of a permit.

- Selling a permit counts as revenue and buying a permit counts as a cost.

- For each permit trade, firms must fill out a trading slip and bring it to the front. Slips must be dropped off at the front as soon as they are completed. Each trade will, therefore, result in two trading slips being turned in. When a trading slip is turned in, an new one will be issued so that the firm can trade again if it wishes.

- At the end of the trading period, each firm must choose output Q_i and pollution abatement A_i (both non-negative integers). Once these are chosen, fill out the production report and turn it in before you leave the classroom.

- If a firm's emissions exceed its permits, it must pay the "safety valve charge" of \$70 per unit of excess emissions. Therefore it would be foolish to choose "Quantity Produced" that is not equal to "Permits on Hand After Trading" plus "Abatement."

Grading

- Your score in the exercise is based on your profit and a bonus for making at least one trade. To calculate your score, add the following:
  - *Operating profit*: $40Q_1 - Q_1 - 3(A_1)^2$ for odd firms, and $40Q_2 - Q_2 - (A_2)^2$ for even firms.
  - *Trading profit*: revenue from sales of permits minus costs from purchases of permits
  - *Penalties*: minus cost of 70 for each unit of pollution in excess of the permits held at the end of the trading period
  - *Trading bonus*: add 10 points if you made at least one trade
- Your grade is equal to your score divided by a benchmark level of profit times 100. We will discuss the calculation of this benchmark after the exercise. The benchmark is different for odd-numbered and even-numbered firms.

3 Sample trading slip

Record of Permit Trade			
Buyer number:		Buyer's Name:	
Seller number:		Seller's Name:	
Price Per Permit $:		# of Permits:	

4 Sample production report

Firm number	_____	
Name of student	_____	
Quantity produced	_____	
Permits on hand		
at end of trading	_____	(= 10 + number bought - number sold)
Abatement	_____	
Permits bought	_____	
Total paid	_____	
Permits sold	_____	
Total received	_____	
Net revenue	_____	(= total received - total paid)