Permit Trading Makeup Homework
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.

Follow the instructions below and fill out the trading slip and production report at the end. Make sure that every blank on the trading slip and production report is filled in. You only need to turn in the trading slip and production report. Turn in via Canvas.

2   Basics

- **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. For the makeup, if your last name begins with the letters A through M you are an odd numbered firm. Otherwise, you are an even numbered firm.

- **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.

- For the makeup homework, permits can be bought from the instructor for a price of 36 and sold to your instructor at a price of 26. You cannot buy or sell fractional permits. You cannot sell more than 10 permits.

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

- There can be only one permit trade with the instructor. For that trade, fill out the appended trading slip. The instructor's name can be left blank. The instructor's firm number is 0. Your firm number is 101 if your last name begins with the letters A through M. Otherwise your firm number is 102.

- Choose output Q_i and pollution abatement A_i (both non-negative integers). Then fill out the appended production report.

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- If a firm's emissions exceed its permits, it must pay the "safety valve charge" of 70 per unit of excess emissions.

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 $40Q_1 - Q_2 - (A_2)^2$ 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 bought permits from or sold permits to the instructor

- 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 all homework has been turned in. The benchmark is different for odd-numbered and even-numbered firms.

3   Trading slip

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

4   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)