The Coal Market

When Markets Fail: Pollution, Taxes and Permits

An experiment from the book

Experiments with Economic Principles

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Student's Manual

II. Exercises

v.1.01, October 2019

https://econclassexperiments.com/experiments/coalmarket

Learning Objectives

In this experiment you will learn that

- when there are negative externalities, competitive trading can lead to inefficient outcomes;
- it is not, in general, efficient to eliminate negative externalities entirely;
- an appropriately chosen sales tax can improve efficiency when there are negative externalities; and
- negative externalities can also be regulated in an efficient way by means of a fixed supply of marketable pollution permits.

Pre-Requisites

To complete the exercises you need to know how to

- draw step supply [HELP] and demand [HELP] curves;
- find competitive equilibrium prices and quantities [HELP];
- compute consumer surplus and seller profits [HELP];
- shift supply and demand curves because of a per unit sales taxes.

Exercises

Your instructor will provide `LabNotes`: a spreadsheet with the relevant information to study and interpret the results of the experiment. Use the data in the `LabNotes` to answer the questions in this section. The spreadsheet will contain the following tables.

- Transactions, prices, and profits in the last round of each session (tables A , B , and C).
- Distribution of types (table D).
- Pollution cost, amount of pollution tax in session 2, and number of pollution permits in session 3 (table E).

Pollution Damages

Exercise 1 Use Table 1 to calculate the total cost of pollution in the last round of each session of the experiment. In the first row enter the pollution cost that each resident of Effluvia suffers from a single unit of coal (table D). In the second row record the number of units of coal traded (tables A - C). In the third row calculate the total pollution cost suffer for each resident. In the fourth row record the total number of participants in the experiment, including any who did not buy or sell (table D). Finally, compute the Total Cost of Pollution.

Table 1: Pollution Damages

Per-Resident Damage by Each Unit of Coal	Session 1	Session 2	Session 3
Units of Coal Burnt			
Total Pollution Cost Per Resident			
Number of Residents			
Total Cost of Pollution			

Experimental Outcomes

Exercise 2 Complete Table 2 for the last round of session 1 in your experiment using Table A and Table 1. Find total profits of all residents of Effluvia net of pollution costs, by subtracting the Total Cost of Pollution from the sum of the Profits of Sellers and Buyers from Transactions.

Table 2: Experimental Results in Session 1

Mean Price	
Units of Coal Sold	
Total Profits of Sellers from Transactions	
Total Profits of Buyers from Transactions	
Total Cost of Pollution	
Total Profits of All Residents Net of Pollution Costs	

Exercise 3 Complete Table 3 for the last round of session 2. Total tax revenue is equal to the units of coal sold time the pollution tax per unit.

Add total after-tax profits of sellers, total profits of buyers, and total tax revenue, and then subtract the total cost of pollution to find total profits and tax revenue of all residents net of pollution costs in Effluvia.

Table 3: Experimental Results in Session 2

Mean Price	
Units of Coal Sold	
Total After-Tax Profits of Sellers from Transactions	
Profits of Buyers from Transactions	
Total Tax Revenue	
Total Cost of Pollution	
Total Profits and Tax Revenue of All Residents Net of Pollution Costs	

Compare total profits of all residents of Effluvia in Session 1 and Session 2. In which of the two sessions is total profits larger?

Exercise 4 Complete Table 4 for the last round of session 3. You can find the total revenue of permit sellers by summing the prices paid for permits as computed in Table C . Add total profits of coal buyers, total profits of coal sellers, and total revenue of permit sellers, and then subtract the total cost of pollution, to get total profits of all residents net of pollution costs.

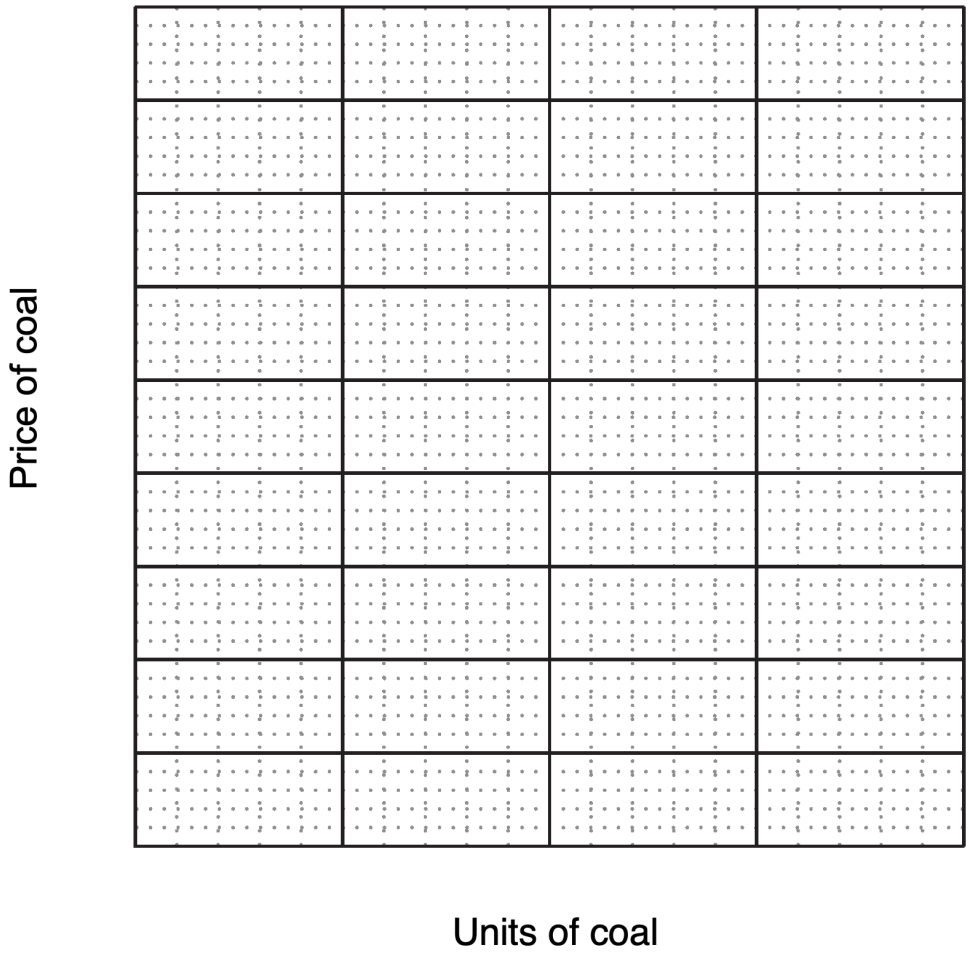
Table 4: Experimental Results in Session 3

Mean Price of a Unit of Coal	
Mean Price of a Permit	
Units of Coal Sold	
Total Profits of Sellers of Coal from Transactions	
Total Profits of Buyers of Coal from Transactions	
Total Revenue of Permit Sellers	
Total Cost of Pollution	
Total Profits of All Residents Net of Pollution Costs	

Competitive Predictions

Exercise 5 Use the information in Table D of your Lab Report to draw demand and supply curves in Figure 1 for the market in Session 1 where there is no governmental intervention. Mark the competitive equilibrium outcome and label it as $CE1$

Figure 1: **Supply and Demand Sessions 1 and 2.**



Exercise 6 From the supply and demand curves that you drew in Figure 1, find the *competitive equilibrium predictions* and record them in Table 5.

Exercise 7 In Session 2, the pollution tax is a sales tax collected from sell-

Table 5: Predictions of the Theory: Session 1

Price	
Units of Coal Sold	
Total Profits of Sellers from Transactions	
Total Profits of Buyers from Transactions	
Total Cost of Pollution	
Total Profits of All Residents Net of Pollution Costs	

ers. On Figure 1, use blue ink to draw the shifted supply curve after the pollution tax is introduced. Mark the competitive equilibrium outcome and label it as $CE2$.

Exercise 8 From the supply and demand curves that you drew in Figure 1, find the *competitive equilibrium predictions* for Session 2 and record them in Table 6.

Table 6: Predictions of the Theory: Session 2

Price	
Units of Coal Sold	
Total Profits of Sellers from Transactions	
Total Profits of Buyers from Transactions	
Total Tax Revenue	
Total Cost of Pollution	
Total Profits and Tax Revenue of All Residents, Net of Pollution Costs	

Pollution Permits

Exercise 9 In Session 3, suppliers must have a permit in order to sell a unit of coal. Therefore, the units of coal supplied in Session 3 can be no larger than the number of permits issues, and the supply curve becomes vertical at that number. In Figure 1, draw a vertical supply curve for the quantity of permits issued. Use the demand curve to find the price at which the quantity demanded equals the number of pollution permits issued. This will be the equilibrium price of a unit of coal. What is the equilibrium prediction for the price of a unit of coal in Session 3?

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Exercise 10 In Table 7 copy the number of suppliers for each type from the data in your Lab Report. In the third column, enter the maximum amount that each type of supplier would be willing to pay for a pollution permit when the price of a unit of coal is the equilibrium price that you found in the previous question. (If there is a range of competitive equilibrium prices, assume that the price is at the midpoint of its range.)

Table 7: Willingness to Pay for Pollution Permits

Seller Cost	Number in Market	Willingness to Pay for a Permit
8		
13		
18		
23		
28		

Exercise 11 In Figure 2, use the information from Table 7 to draw the demand curve for pollution permits. On the same graph, draw a vertical supply curve at the number of permits that were issued in Session 3 of the experiment. The competitive equilibrium price for permits in Session 3 is

Figure 2: Supply and Demand for Pollution Permits