

Chapter 3. Perfect Competition and the Coal Industry

Homework 3.1. In the text, we observed that if price was above equilibrium in a competitive market, excess quantity demanded would put pressure down on price. Or equilibrium was stable from above. Is equilibrium stable from below?

Homework 3.2. Graph what happens in the market for the following events in the coal market. Note what happens to equilibrium price and quantity. Has there been a change in demand or in supply? Has there been a change in quantity demanded or in quantity supplied? Note one is a shift in the curve and the other is a shift along the curve.

3.2a. Exxon develops large coal deposits in Columbia.

3.2b. Combined cycle gas turbines increase natural gas efficiencies for the generation of electricity.

3.2c. A financial crisis causes recession in Asia.

3.2d. The end of apartheid removes trade embargoes on S. Africa.

3.2e. Interest rates increase (note that coal consumption tends to be more capital intensive than the consumption of other fossil fuels and that often such capital is financed by borrowing money at the interest rate. Recent U.S. DOE data suggests that capital costs for coal are \$1501/kwh while for gas they are only \$419/kwh.)

Homework 3.3. What do you predict would happen to price and quantity if both c and d in Homework 3.2 occurred?

Homework 3.4. Suppose you are a government policy maker and you have to determine how much extra employment your policy would generate. Compute this number using average production of coal per coal miner. You may use U.S. statistics if you cannot find them for Germany. Try the National Mining Association for coal production and employment figures. <http://www.nma.org/>. Assume the quantities in the above example are measured in millions of short tons. Note any assumptions you make to arrive at your answers.

Homework 3.5. Take the following model from the text:

$$Q_d = 100 - 2P_c + 3P_{sb} - 4P_{cm} + 0.10Y \quad (3.6)$$

$$Q_s = 6 + P_c - 1P_k - 0.2P_l - 0.8P_{nr} - 1.5P_{sm} \quad (3.7)$$

where

P_c is the price of coal

P_{cm} is a complement to coal consumption such as a boiler, set = 10

P_k is the price of capital, set = 2

P_L is the price of labor, set = 3

P_{nr} is the price of other natural resources used in production of coal, set = 5

P_{sb} is the price of a substitute to coal, such as natural gas, set = 6

P_{sm} is the price of similar products which a coal producer could produce, set = 4

Y is a measure of economic activity, set = 954 Change the ceteris paribus value for the price of a substitute from 6 to 2. Resolve the model for price and quantity.

Homework 3.6. Compute price elasticity of demand at a price of 0, 10, 16.5, 25 and 33 assuming the other right hand side variables are as below. What happens to the elasticity as we move up the linear demand curve?

Homework 3.7. U.S. Gasoline consumption is about 8.8 million barrels per day. If gasoline price goes from \$1 per gallon to 1.50 and the short run elasticity is -0.25, what would new consumption be?

Homework 3.8.

3.8a. Using the same reasoning and Table 3.7 to describe what happens to revenues for a price decrease with an elastic demand.

3.8b. What happens to revenues if price increases with inelastic demand, ($-1 < \epsilon_p < 0$)?

Homework 3.9. Income elasticities can be used in the same way as price elasticities to show how much product consumption will change when income changes. Suppose that in China, the largest coal consumer, income elasticity of coal demand is 0.8, current coal consumption is 1350, and income will grow at 5% per year. What would you forecast next year's coal consumption to be?

Homework 3.10.

3.10a. What does a negative cross price elasticity of demand imply? Give a new energy example of two goods that might have a negative cross price elasticity of demand.

3.10b. What does a positive cross price elasticity of demand imply? Give a new energy example of two goods that might have a positive cross price elasticity

3.10c. What does a negative cross price elasticity of supply imply? Give a new energy example of two goods that might have a negative cross price elasticity of supply.

3.10d. What does a positive cross price elasticity of supply imply? Give a new energy example of two goods that might have a positive cross price elasticity of supply.

Homework 3.11. Compute the price elasticities for the following two functions.

3.11a. $Q = \alpha + \beta \ln P + \delta \ln Y$

3.11b. $\ln Q = \alpha + \beta P + \delta Y$

3.11c. $Q = \exp(\alpha - \beta P + \delta Y)$

3.11d. $Q = \alpha + \beta P + \delta Y = \gamma P Y$

a.
$$\xi_{Q,P} = \frac{\partial Q}{\partial P} \frac{P}{Q} = \beta * \frac{1}{P} * \frac{P}{Q} = \beta * \frac{1}{Q}$$

b.
$$Q = e^{(\alpha + \beta P + \delta Y)}$$

$$\xi_{Q,P} = \frac{\partial Q}{\partial P} \frac{P}{Q} = \beta * e^{(\alpha + \beta P + \delta Y)} \frac{P}{Q} = \beta * P$$

Homework 3.12. Create a log linear demand for household electricity for the U.S.

Suppose that the price elasticity is -0.3, the cross price elasticity of electricity with respect to price of natural gas is 0.15 and the income elasticity is 0.5. Use the price and quantity information from the Annual Energy Review. The income variable could be U.S. gross domestic product. A possible link for income information is the U.S. Statistical Abstract, 1996. You could also use the Economic Report of the President 1997, which is a bit more recent. Be sure to use the same year for all of your variables.

Homework 3.13. For the demand model in Homework 3.5 after the price of the substitute changed, compute the demand elasticity at equilibrium P & Q with respect to (a) price, (b) income, and (c) price of a substitute. (d) Compute price elasticity of demand at a price of 0, 20, 40, 60 and 80. (e) What happens to the elasticity as we move up the linear demand function? Compute the supply elasticity at equilibrium P & Q with respect to (f) price, (g) price of capital, and (h) price of a similar good. (i) Compute price elasticity of supply at a price of 0, 20, 40, 60 and 80. (j) What happens to the elasticity as we move up the linear supply function?

Homework 3.14. South Africa coal consumption is about 140 million metric tonnes. If supply shifts and coal price goes from \$100 a tonne to \$120 per tonne and the short run elasticity is -0.25, what would the percentage change in coal consumption be? What would the change in coal consumption be? What would new coal consumption be?

Homework 3.15. Your task is to forecast carbon dioxide emissions coming from the consumption of coal, oil, and natural gas. You have used historical data and econometric techniques to estimate own price, cross price, and income elasticities for coal, oil, and natural gas demand. Which are as follows:

	PriceO	PriceC	PriceNg	Y
Oil	-0.15	0.20	0.10	0.70
Natural Gas	0.14	-0.25	0.17	0.50
Coal	0.07	0.08	-0.30	0.90

You get 161 lbs of CO2 per million Btus of oil, 205 from coal, and 117 from natural gas. Consumption in million BTU of oil in 2010 is 50, of coal is 25, of natural gas is 25.

Forecast consumption of oil, coal, gas, and CO2 emissions for 100 years, if price of gas increases 1% every year, price of oil increases 1.2% every year and price of coal increases 0.7% every year, and income grows 3% every year. You can play around with inputs in the model to see what kind of pricing policy the government would need to implement to cut CO2 emissions by a targeted amount in 2100.