

Study Questions to Accompany International Energy Markets

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Chapter 3. Perfect Competition and the Coal Industry

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?

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 Colombia.

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. U.S. DOE data suggests that capital costs for coal are \$1501/kwh while for gas they are only \$419/kwh.)

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

3.4 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.

3.5 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?

$$Q_d = 75 - 2P_c + P_{sb} - 2P_{cm} + 0.1Y$$

3.6a Explain what happens to revenues for a price increase with an elastic demand?

3.6b Explain what happens to revenues for price decrease with inelastic demand,

$(-1 < \epsilon_p < 0)$?

3.7 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?

3.8 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?

3.9 Compute the price elasticities for the following two functions.

3.9a $Q = \alpha + \beta \ln P + \delta \ln Y$

3.9b $\ln Q = \alpha + \beta P + \delta Y$

3.9c $Q = \exp(\alpha + \beta P + \delta Y)$

3.9d $Q = \alpha + \beta P + \delta Y + \gamma P Y$

3.9e Compute the elasticities in 3.9a-3.9d if $P=1$, $Y=100$, $\alpha = 25$, $\beta=2$, $\delta=1$, $\gamma=-0.5$.

3.10 A cross price elasticity measures the percent change in quantity of one good or service resulting from a percentage change in quantity of the price of another good or service.

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.

3.11 Suppose for the electricity market, the price elasticity is -0.3, the cross price elasticity of electricity with respect to price of natural gas is 0.15, the income elasticity is 0.5, $Q = 3,289$ (billion Kilowatthours), $P_E = 6.72$ (cents per Kilowatthour), $P_{Ng} = 273$ (cents per Mcf), and $Y = 215.1$ Bil.\$.

3.11a Create a linear demand equation ($Q = a + bP_E + cY + dP_{Ng}$) using the above information.

3.11b Create a log linear demand for electricity ($\ln Q = \ln \alpha + \beta \ln P_E + \gamma \ln Y + \delta \ln P_{Ng}$ or $Q = \alpha P_E^\beta Y^\gamma P_{Ng}^\delta$).

3.11c Find recent electricity Q and P along with Y and P_{Ng} for your assigned country. Indicate the source of your variables and the units they are measured in. Use your variables and the elasticities given in 3.11a to create a linear demand equation.

3.11d Suppose you have the following economic changes for your assigned country. Income grows 7%, price of electricity grows 3% and the price of natural gas falls 1%. Use your demand equation to forecast new electricity consumption.

3.12 Linear and log linear are the most common functional forms used for energy demand equations, but other forms are possible. Suppose you need a demand equation for oil consumption (Q) as a function of price (P). Let Q = 10 million barrels per day (mb/d), P = 75 and the price elasticity s -0.2. Create demand equations of the following functional forms using the given information.

3.12a $Q = \alpha + \beta \ln P$

3.12b $\ln Q = \alpha + \beta P$

3.13 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.