

Study Questions to Accompany International Energy Markets

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Chapter 7. Monopoly, Dominant Firm and OPEC

7.1 Suppose that $MC = 12$ and the demand price elasticity equals -1.2 . The monopoly pricing result is $P = MC/(1-1/|\epsilon_p|)$

7.1a Using the above expression, compute the price the monopolist should charge?

7.1b If MC increases to 14, compute the optimal price? What does this suggest happens to optimal monopoly price when MC increases?

7.1c If the demand becomes twice as elastic, what happens to optimal price? What does this suggest happens to optimal price when demand becomes more elastic.

7.1d If $\epsilon_p = -0.5$, what does the equation suggest is optimal price? Why does this equation imply that the monopolist must be operating in the elastic region of a linear demand curve? (i.e. Where " $\epsilon_p < 1$ or $|\epsilon_p| > 1$.)

7.2 The monopolist's profit function is $P(Q)Q - TC(Q)$. Where $P(Q)$ is the inverse demand equation, Q is the monopolist's production, and $TC(Q)$ is the monopolist's total cost function.

7.2a Use general notation to compute first and second order conditions to maximize the monopolist's profit function

7.2b Give an economic interpretation for the first and second order conditions.

7.3 Suppose a monopolist faces a demand function

$$Q = 200 - 1/4P.$$

Its total cost function is $100 + 40Q + Q^2$.

7.3a Write the monopolist's profit function along with first and second order conditions for a maximum. Solve for the optimal P and Q and monopoly profits.

7.3b Show you get the same result if you solve the equation $MR=MC$.

7.3c Write the after tax profit function for **7.3b**, if a unit tax of 2 is placed on the monopolist. Compute optimal P , Q , monopoly after tax profits, and tax revenues.

7.3d Show you get the same optimal Q , if you tax the supplier or the demander. That is show that you get the same optimal Q , if you solve the equation $MR=MC+t$ or $MR-t=MC$.

7.3e On a diagram, show whether social welfare increases or decreases with the tax.

7.3f If the producing country only sells oil and adds the tax, and the consuming country only buys oil is the producing country better off with or without the tax? (Hint does the producer country get enough tax revenue to more than offset the loss in producer surplus.)

7.3g If the consuming country only buys oil adds the tax only sells oil, and the producing country only buys oil is the consuming country better off with or without the tax? (Hint does the consuming country get enough tax revenue to more than offset the loss in consumer surplus.)

7.4 With an ad valorem tax on consumer price, profits for the monopoly become:

$$\pi = (1 - t_a)P(Q)Q - TC(Q)$$

First order conditions are:

$$\frac{\partial \pi}{\partial Q} = (1 - t_a) \left[P(Q) + \frac{\partial P}{\partial Q} Q \right] - \frac{\partial TC(Q)}{\partial Q} = (1 - t_a)MR - MC = 0$$

7.4a Show the monopolist's optimal price and quantity on a graph.

7.4b For $Q = 200 - (1/4)P$ and $TC(Q) = 100 + 40Q + Q^2$ and an ad valorem tax of 0.1, compute optimal P, Q, monopoly after tax profits, and tax revenues.

7.4c Does this policy get us to the socially optimal Q? Justify your answer with your graph for 7.3a.

7.5 The two other taxes mentioned are a profit tax and a lump sum tax. The after tax profit maximizing condition for these taxes are as follows.

$$\pi = (1 - t_\pi)(PQ - TC)$$

$$\pi = PQ - TC - T$$

7.5a What would be the first order conditions ($d\pi/dQ$) for each of these functions? What are second order conditions?

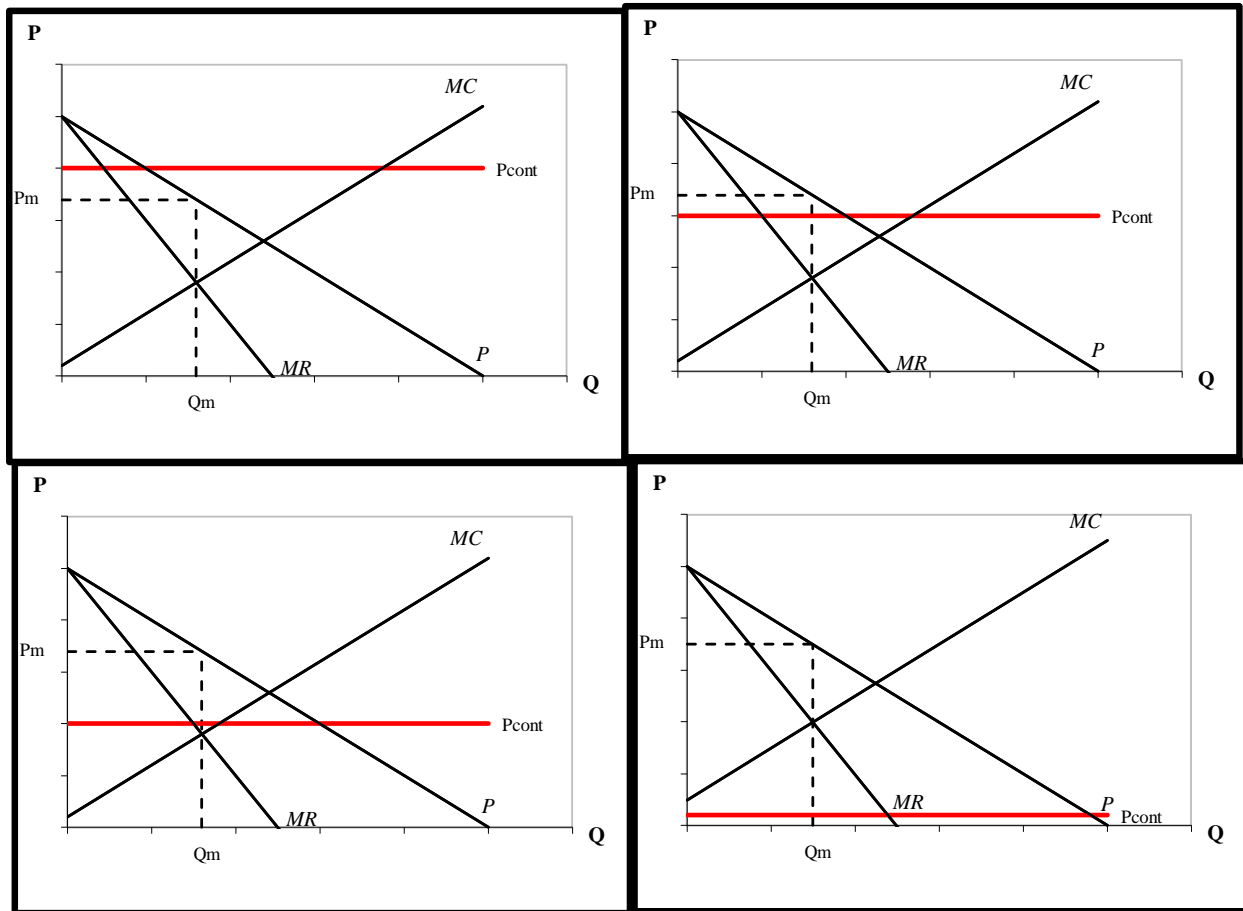
7.5b Explain intuitively why these taxes have no effect on output.

7.5c The implicit function theorem tells us that if $F(Q,t)=0$. Then $\frac{dQ}{dt} = -\frac{\partial F / \partial t}{\partial F / \partial Q}$. Use first

order conditions above and the implicit function theorem to show that neither of the two taxes in **7.5a** have an effect on monopoly output. (i.e. $dQ/dt_\pi = 0$ and $dQ/dT = 0$).

7.6 Under anti-monopoly laws, countries may break up monopolies or prohibit mergers. Alternatively, governments may implement price controls, especially if the industry or a sector within the industry is a natural monopoly as was discussed in chapters 5 & 6.

7.6a Suppose the following diagrams represents a monopoly market with 4 possible maximum price controls. That is, it is not legal to charge price higher than the price control. On each show the monopoly P_{mc} and Q_{mc} after the price control assuming the monopolist obeys the law. Add any extra lines you need to arrive at your answer.



7.6b Now suppose the markets are competitive. Show what happens in each market on the diagrams below for each of the 4 maximum price controls as shown in the figures. Assume no one breaks the law and charges a higher price than the maximum. Discuss what happens in each case.

7.7 Many countries have antimonopoly laws with a few shown in table below. Find information for your assigned country and add to Table below

Country	Laws	Passed	Main Provisions
United States	Sherman Antitrust	1890	Monopoly and restraint of trade are illegal.
Canada	Competition Act	1889	Law is to maintain and encourage competition in Canada, promote efficiency, adaptability, and equitable opportunities for small business.
France			Only state regulated monopolies are allowed, mergers are analyzed for monopoly before being allowed, tobacco distribution monopoly still exists.
Japan	Anti Monopoly Act	1947	Monopolies are regulated by the government, anti-trust may disallow merger or break up monopoly.

7.7a Suppose a market has demand $Q = 100 - 1/4P$ and costs of $40Q + 2Q^2$. Compute the price and quantity for a monopoly market.

7.7b Now compute P and Q in each market for the following maximum prices. $P_1=400$, $P_2=260$, $P_3=220$, $P_4= 100$ and $P_5=30$

7.8 Suppose OPEC is a two country multi-plant monopolist with the countries marginal cost curves as follows.

$$MC_1 = 1 + Q_1$$

$$MC_2 = 1 + 2Q_2$$

7.8a Compute OPEC's marginal cost function? Where is the kink in OPEC's MC curve?

7.8b Compute OPEC's profit maximizing price and quantity, if OPEC inverse demand is $P = 200 - 1/2Q$?

7.8c Compute quantity and profits for each country within OPEC.

7.8d Compute consumer surplus at the monopoly price and quantity.

7.8e Suppose OPEC started squabbling and they broke up into competitive companies. Remember that in a competitive model MC would be the horizontal sum of the MCs that you computed above. Compute what happens to price, quantities, and each country's profits in the oil market? Which country gained the most from monopolizing?

7.8e Compute consumer surplus under the two market structures. Recall that consumer surplus is the area below the demand curve and above the price.

7.9 Suppose OPEC faces the demand and cost information in question 7.7, where OPEC is firm 1 and the fringe is firm 2.

$$MC_1 = 1 + Q_1 \text{ (OPEC)}$$

$$MC_2 = 1 + 2Q_2 \text{ (competitive fringe)}$$

Setting $P=MC$ in the above equation yields fringe supply curve $Q_f = -0.5 + 0.5P$

World demand and inverse demand are $Q_w = 400 - 2P$ and $P_w = 200 - 1/2Q$?

7.9a Compute OPEC's demand and marginal revenue curves. What are P_w and Q_w at the kink? When would you not have a kink in demand?

7.9b Compute OPEC's optimal price and quantity?

7.9c Compute fringe supply, along with OPEC and fringe profits and consumer surplus.

7.10 In a dominant firm model, the demand for the dominant firm is world demand minus supply of the fringe. This typically creates a kinked demand curve. Marginal revenue for each demand curve is taken from each portion of the demand curve. The dominant firm then chooses the quantity where $MR=MC$.

7.10a Suppose OPEC is the dominant firm facing the following world demand and supply of the fringe. Show OPEC's demand and marginal revenue on the diagram. What determines where the kink is?

7.10b Show the dominant firm solution in the following three markets. Add any extra lines you need to determine, P, Q OPEC (Q_o), and Q_{fringe} (Q_f).

7.10c Fill in the following table to compare the above results for the three market structures: multiplant monopoly, competitive, and the dominant firm.

Variable	PC	Monopoly	1 is Dominant Firm
q1			
q2			
$Q=q1+q2$			
P =			
profit 1=			
profit 2=			
Total Profits			
DWL			
CS			

7.9d Did OPEC or the fringe gain more from OPEC acting as a dominant firm?

7.11 Suppose at optimal output $\epsilon_w = -0.8$, $\epsilon_f = 0.3$, $Q_w = 67.5$, $Q_o = 27.5$.

7.11a What is the fringe's production. What is the price elasticity of demand for OPEC's oil?

7.11b Make world demand more elastic by subtracting 0.1 from the world's demand elasticity. Assume production numbers stay the same. Recompute OPEC's elasticity. What happens to the price elasticity of the demand for OPEC's oil as the world's demand gets more price elastic? Why?

7.11c. Now also make the fringe supply elasticity more elastic by adding 0.15 to supply elasticity to the values in 7.10b. Assume production numbers stay the same. Recompute OPEC's elasticity. What happens to the price elasticity of demand for OPEC's oil as the fringe supply gets more price elastic? Why?

7.12 Suppose inverse export demand for OPEC is $P_x = 53 - 4Q_x$, marginal cost is $MC = 5 + (Q_x + Q_d)$ and inverse domestic demand is $P_d = 20 - 10Q_d$. OPEC wants to maximize the benefits its gets from its oil reserves.

7.12a How much will OPEC sell on the domestic and on the export market?

7.12b What price will OPEC charge in the domestic and export markets.

7.13 Now OPEC is a dominant firm facing world demand of $Q_w = 50 - 0.5P_w$ and costs for OPEC are $MC = 5 + 0.8Q_o$

7.13a Let fringe supply be $Q_f = -17.5 + 0.5P$. Solve for Q_o , Q_f , Q_1 , Q_2 , P , π_o , π_f , π_1 , π_2 .

7.13b Let fringe supply be $Q_f = -28 + 0.5P$. Solve for Q_o , Q_f , and P

7.13c. Let fringe supply be $Q_f = -50 + 0.5P$. Solve for Q_o , Q_f , and P

7.14 Given the importance of the global oil market, a number of organizations publish outlooks for the oil market.

International Energy Agency (IEA)

Oil Market Report (OMR) – monthly (short term outlook)

<https://www.iea.org/oilmarketreport/omrpublic/>

Market Report Series: Oil (annual) (5 years into future)

https://www.oecd-ilibrary.org/energy/market-report-series-oil_25202707

World Energy Outlook (annual) contains an oil section with 20-30 year outlook

<https://www.iea.org/weo/>

Organization of Petroleum Exporting Countries (OPEC)

Monthly Oil Market Report (MOMR)

https://www.opec.org/opec_web/en/publications/338.htm

World Oil Outlook (annual) (20-30 year outlook)

https://www.opec.org/opec_web/en/publications/340.htm

U.S. Energy Information Administration (EIA)

This Week in Petroleum (<https://www.eia.gov/petroleum/weekly/>)

Short-Term Energy Outlook (monthly)

<https://www.eia.gov/outlooks/steo/>

Annual Energy Outlook (annual) <https://www.eia.gov/outlooks/aeo/>

International Energy Outlook (annual) <https://www.eia.gov/outlooks/ieo/>

7.15 Daniel Yergin has written a Pulitzer Prize winning book on the history of the oil industry. PBS has a nice eight part series based on the book now on youtube. Watch one episode of The Prize. For your chosen episode make up and answer one question. Your question and answer should be no more than 1/2 single spaced typed page. Your score will be based on the quality of the question and the answer. Questions that require a bit of thought or analysis will receive more points than questions that would require only memorization. (e.g. Questions requiring more thought include ones that compare, contrast. look for themes, give preferences and justify why, relate material in the episode to current events or other material in the course, etc.)

The Prize by Daniel Yergin. Each episode is approximately one hour long.

1: www.youtube.com/watch?v=Qspu35JG59Q

2: www.youtube.com/watch?v=ioazMpe1SHE

3: www.youtube.com/watch?v=y-yaMTYczMM

4: www.youtube.com/watch?v=PvkT3ByU5yg

5: www.youtube.com/watch?v=IIJxBrHcSUo

6: www.youtube.com/watch?v=BOMIY9yAbZw

7: www.youtube.com/watch?v=vgt1ZLDIy1M

8: www.youtube.com/watch?v=u4FdR3KMOZ8

The descriptions of the programs from the VHS tapes are as follows:

The Prize recounts the panoramic history of oil -- and the struggle for wealth power that has always surrounded oil. This struggle has shaken the world economy, dictated the outcome of wars, and transformed the destiny of men and nations. The Prize is as much a history of the twentieth century as of the oil industry itself. The canvas of this history is enormous -- from the drilling of the first well in Pennsylvania through two great world wars to the Iraqi invasion of Kuwait and Operation Desert Storm. The cast extends from wildcatters and rogues to oil tycoons, and from Winston Churchill and Ibn Saud to George Bush and Saddam Hussein.

Eight one hour tapes.

Program 1: Our Plan

Trace the turbulent, rapid rise of the world's biggest business, how a visionary but ruthless John D. Rockefeller controlled it - and how reporter Ida Tarbell took him on in one of the most famous muck racking exposés ever. A fascinating look at Rockefeller's controversial legacy, the rise of modern business, and how Tarbell served as the role model for the modern investigative journalist.

Program 2: Empires of Oil

Witness capitalism on a grand scale: how Shell Oil and Royal Dutch merged, then challenged the supremacy of Rockefeller's Standard Oil. A compelling tale of how oil transformed everyday life in the farthest corners of the globe, mad Russia a great oil power, and helped the Allies win World War I.

Program 3: The Black Giant

It's the Roaring Twenties, and the magic of oil touches everyone, from millions of new car owners to hopeful Texan wildcatters. The American oil industry wrestles with shortage and surplus, as flamboyant entrepreneur Calouste Gulbenkian stakes his claim in Iraq.

Program 4: War and Oil

The untold story of World War II unfolds: how oil dictated strategy to Hitler; how lack of oil slowed Japan's war machine: how oil ultimately determined victory or defeat. Features rare footage on the critical impact of oil on decisively military events.

Program 5: Crude Diplomacy

Post-World War II America awakens to the strategic importance of oil, and witnesses a key moment in history when oil production shifts from the U.S. to the Middle East. An extraordinary cast of characters, including Arabian kings, U.S. presidents, British adventurers, Iranian politicians, and American explorers, paint a global portrait of how oil shaped the world economy and politics.

Program 6: Power to the Producers

It's the heyday of cheap oil, the dawn of the Hydrocarbon Society and the introduction of a prosperous new automobile culture for Americans. Follow the heroes and antiheroes, plots and counterplots, as the producing countries and the independent oil companies challenge the "Seven Sisters" and open a new era in world oil.

Program 7: The Tinderbox

Relive two decades of upheaval that shook the world and changed our lives as power shifted, and nations and companies jockeyed for position amidst embargoes, shortages, and surpluses. A unique view of the rise of the OPEC era, beginning with the British withdrawal from the Persian Gulf and ending with the burning oil wells of Kuwait.

Program 8: The New Order of Oil

The Gulf War marked the beginning of a new era for the Hydrocarbon Society. This program explores the relation of oil and environmental conscience, and the technological race to balance energy, economic, and ecological needs in the Information Age."