Problem Set

1. Monopoly and dominant position

1.1. Monopoly

A firm that produces a single good (Q) is the only supplier of such good in certain market. Its demand function has the following form:
\[ Q = 120 - P \]
where “P” is the market price. The firm’s total cost is given by this function:
\[ TC = 30 \cdot Q + 0.25 \cdot Q^2 \]

a) Find the value of “Q” that maximizes the firm’s profit. Find as well the equilibrium price, the profit and the consumers’ surplus (Remember that in this case the marginal revenue is “120 – 2 \cdot Q” and the marginal cost is “30 + 0.5 \cdot Q”).
b) Find the profit margin with respect to the marginal cost [(\(p-C_{mg})/p\)] that this monopolists obtains, and show its relationship with the own-price elasticity of demand.
c) Which would be the quantity, the price the firm’s profit and the consumers’ surplus if the firm behaved as a price-taker?

1.2. Price leadership

In the market of a certain good there are two firms: a leader (EL) and a follower (EF). They both have an average and marginal cost for supplying the product which is equal to $10, but the follower has a maximum installed capacity of 10 units (that uses completely) and the leader, conversely, has an installed capacity that is larger than the market’s total demand. Such a demand is the following:
\[ Q = 100 - P \]
where “P” is the price and “Q” is the total demanded quantity (which has to be equal to the sum of the quantities supplied by EL and EF).

a) Find the equilibrium values for P and Q, knowing that the leader’s demand is equal to “QL = 100 – QF – P” (where “QL” is the leader’s quantity and “QF” is the follower’s quantity), and therefore the leader’s marginal revenue is “MR_L = 100 – QF – 2 \cdot QL”. Also find the leader’s and the follower’s profits (BL, BF).
b) Now assume that the leader acquires the follower, and becomes a monopolist (which implies that his demand is now equal to the market’s total demand, and his marginal revenue becomes “MR_L = 100 – 2 \cdot Q”). Find the new values for P, Q and BL.

2. Competition and oligopoly

2.1. Symmetric oligopoly

The market of certain homogeneous good (Q) is an oligopoly with two identical firms (1 and 2), each of which with a constant average cost of $2. The demand price
function of that good is “\( p = 14 – Q_1 – Q_2 \)”. Assume that each firm has only three
possible production levels: 3, 4 or 6 units of output, and therefore the market prices for
the 9 possible combinations of “\( Q_1 \)” and “\( Q_2 \)” are the following:

<table>
<thead>
<tr>
<th>Price</th>
<th>( Q_2 = 3 )</th>
<th>( Q_2 = 4 )</th>
<th>( Q_2 = 6 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Q_1 = 3 )</td>
<td>8</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>( Q_1 = 4 )</td>
<td>7</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>( Q_1 = 6 )</td>
<td>5</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

a) Analyze the interaction of these two firms as non-cooperative game, and write the
corresponding payoff matrix.
b) Find the best response of each player to each action of the other player, and find the
unique Nash equilibrium (in pure strategies) of the static version of this game.
c) Now assume that firm 1 acts as a quantity leader, and therefore decides its production
level first. Find the subgame perfect Nash equilibrium (Stackelberg equilibrium) of this
new version of the game, and draw the corresponding “tree diagram”.

2.2. Asymmetric oligopoly

The market of a homogeneous good (\( Q \)) is supplied by two different firms. One
is larger and has higher fixed costs but lower variable costs. The other one is smaller
and has lower fixed costs but its variables costs are higher. The demand price (\( p \)) is a
function of total quantity, defined as the sum of the output supplied by the large firm
(\( Q_L \)) and the output supplied by the small firm (\( Q_S \)). The corresponding demand and
total cost functions are the following:

\[ p = 192 – (Q_L + Q_S) \]
\[ CT_L = 1000 + Q_L^2 \]
\[ CT_S = 500 + 2 \cdot Q_S^2 \]

a) Find the equilibrium price and quantities, assuming that each firm maximizes its own
profit taking into account the other firm’s output (Cournot solution). Remember that the
large firm’s marginal revenue is “\( MR_L = 192 – 2 \cdot Q_L – Q_S \)”, that the small firm’s
marginal revenue is “\( MR_S = 192 – 2 \cdot Q_S – Q_L \)”, that the large firm’s marginal cost is
“\( MC_L = 2 \cdot Q_L \)”, and that the small firm’s marginal cost is “\( MC_S = 4 \cdot Q_S \)”.b) How would those equilibrium values change if the large firm behaved as a price
leader and the small firm were a price-taker?

3. Horizontal and vertical agreements

3.1. Collusion and deviation

In a certain market there are two firms (1 and 2). The market’s demand function
and the firms’ total cost function are, respectively:

\[ P = 150 – Q \]
\[ TC_i = 30 \cdot q_i \]

where “\( P \)” is the price, “\( Q \)” is the total traded quantity and “\( q_i \)” is the quantity produced
and sold by each individual firm.
a) Show that if both firms collude to maximize their joint profits, the price that
maximizes those profits is “\( P = 90 \)”. Find the amount of those profits, assuming that
each firm captures half of the total profits, and remembering that in this case the
marginal revenue of each firm is equal to “\( 150 – 2 \cdot (q_1 + q_2) \)”.

2
b) Which would be firm 1’s profit if it lowered the price to “P = 89” and captured the whole market?
c) Now calculate the profits of both firms in a competitive situation in which price is equal to marginal cost.
d) Which would be the minimum weighting factor of future profits (β) for which a price agreement between firms 1 and 2 were sustainable? Assume that such agreement generates permanent profits equal to the ones found in part “a” and deviating from the agreement implies obtaining a present profit equal to the one found in part “b” (but it also implies reverting in the future to a situation like the one described in part “c”).

3.2. Resale price maintenance

The market of good Q is supplied by a single producer (firm A), whose average and marginal cost is constant and equal to $40. That firm sells its product to a single retailer (firm B) at a price of “r” per unit. The retailer, in turn, sells the product to consumers at a price of “p” per unit, and the demand function of consumers is the following:

\[ Q = 100 - p \]

Firm B does not have any other variable costs but the ones that come from buying the product to firm A, and its fixed costs are equal to $75.
a) Analyze the equilibrium of this market as a situation in which firm A decides first the value of “r”, firm B decides afterwards the value of “p” (taking “r” as given), and each of them seeks to maximize its own profit. Find the values of “r”, “p” and “Q”, and both firms’ profits. Remember that the marginal revenue of firm B is “MR_B = 100 – 2.Q”, and the marginal revenue of firm A is “MR_A = 100 – 4.Q”.
b) Now assume that firms A and B merge, and that as a consequence they integrate vertically. Show that when the new integrated firm maximizes profits, “p” becomes smaller and “Q” becomes larger in comparison with the values found in part “a”.
c) Imagine now that both firms remain separate, but that firm A decides both “r” and “p” (resale price maintenance). If “p” were the same value found in part “b”, which value of “r” would leave firm B with the same profit than it had in part “a”?

4. Exclusionary practices

4.1. Entry deterrence

The market for certain good has the following demand function:

\[ Q = 100 - P \]

Currently there exists a single incumbent firm (I) in that market, whose total cost function is:

\[ TC_I = 40 \cdot Q_I \]

Out of the market, there is a potential competitor (C), who would have the following total cost function if he entered the market:

\[ TC_C = 40 \cdot Q_C + 150 \]
a) Find the market equilibrium in the initial moment, in which the incumbent acts as a monopolist. Find the profits of that firm, remembering that its marginal cost is equal to $40 and that its marginal revenue, when acting as a monopolist, is “MR_I = 100 – 2 \cdot Q_I”.

b) Now assume that the potential competitor enters the market, and suppose that the market becomes a Cournot oligopoly. Find the new equilibrium and the profits of both firms, remembering that now the marginal revenue of each firm is “MR_i = 100 – 2 \cdot Q_i – Q_j”, and that they both have a marginal cost equal to $40.

c) Now suppose that the incumbent firm can make an investment aimed at deterring the potential competitor’s entry. Such investment reduces its own profit in $300, but it also lowers the competitor’s profit in $300 (if he decides to enter the market). Represent the situation as a sequential game in which the incumbent first decides whether to invest or not to invest, and the potential competitor then decides whether to enter or not the market. Find the corresponding subgame perfect Nash equilibrium.

d) Now redo the previous part, assuming that the investment reduces the incumbent’s profit in $100 and lowers the potential competitor’s profit in $200.

4.2. Deterrence and collusion

The demand price function of certain good is “P = 80 – Q” and, therefore, the marginal revenue function of a firm that monopolized the market for that good would be equal to “MR = 80 – 2 \cdot Q”. Currently there is a single firm (I) operating in that market, whose total cost function is “TC_I = 100 + 20 \cdot Q_I”. Out of the market there is another firm (C) that is evaluating the possibility of entering the market. If it did that, it would have a total cost function equal to “TC_C = 300 + 20 \cdot Q_C”.

a) Find the equilibrium values of “P” and “Q” when I is the only firm in the market, and the profit that it obtains in such situation (remembering that its marginal cost is equal to $20).

b) Now assume that, if C enters the market, “P” reduces to $30, and both I and C capture a 50% market share each. Would it be profitable for I to make any kind of entry-deterring expenditure?

c) Now suppose that, if C enters the market, “P” remains in the same value that it had in part “a” (perfect collusion solution), and both I and C capture a 50% market share each. Could it now be possible that I found profitable to make an entry-deterring investment? How much should C’s profit diminish so that deterrence was effective? How large should the investment be so that deterrence was profitable for I?

5. Price discrimination

5.1. Third-degree price discrimination

A monopolist supplies two markets (1 and 2), whose demand functions are the following:

\[ Q_1 = 80 - P_1 \quad ; \quad Q_2 = 100 - P_2 \]

Its average and marginal cost is equal to $20. Given that, you should:

a) Find the values for P_1, P_2, Q_1 and Q_2 that maximize this monopolist’s profit, supposing that it can practice third-degree price discrimination (and remembering that its marginal revenue functions are respectively equal to “MR_1 = 80 – 2 \cdot Q_1” and “MR_2 =
b) Now assume that the monopolist cannot discriminate between the two markets and must charge a single price “P”. Which values of P, Q₁ and Q₂ maximize its profits? (Remember that its total demand now becomes “Q₁+Q₂ = Q = 180 – 2⋅P”, and that its marginal revenue becomes “MR = 90 – Q”).

c) How smaller is now the monopolist’s profit because of moving from the solution of part “a” to the solution of part “b”? What happened with total surplus and with the surpluses of each of the groups of consumers?

5.2. Two-part tariffs and voluntary market segmentation

A monopolist supplies two markets (1 and 2). In each of them, consumers are identical and have the following supruses:

\[ CS_1 = 120 \cdot Q_1 - 0.5 \cdot Q_1^2 - T_1 \quad ; \quad CS_2 = 100 \cdot Q_2 - 0.5 \cdot Q_2^2 - T_2 \quad ; \]

where “T₁” and “T₂” are the total amounts of money that consumers pay for buying “Q₁” and “Q₂”. Average and marginal costs of the monopolist are constant an equal to $10.

a) Find the values of “T₁”, “T₂”, “Q₁” and “Q₂” that maximize the monopolist’s profits if it can perfectly discriminate among its customers. Remember that their implicit demand price functions are “p₁ = 120 – Q₁” and “p₂ = 100 – Q₂”.

b) Show that, if they can choose, market 1’s consumers will prefer to pay “T₂” and to consume “Q₂” rather than to pay “T₁” and to consume “Q₁”.

c) Now compare these two alternative schemes:

Scheme 1: “T₁ = 5349”, “Q₁ = 110”, “T₂ = 4950”, “Q₂ = 90”;

Scheme 2: “T₁ = 5749”, “Q₁ = 110”, “T₂ = 4550”, “Q₂ = 70”; and show that in both cases market 1’s consumers prefer “T₁, Q₁” rather than “T₂, Q₂”.

Show that these schemes both imply situations in which the monopolist offers quantity discounts, and find the implicit average prices for “Q₁” y “Q₂”. Which of the two schemes is more profitable for the monopolist?

6. Single-equation regression methods


The following data correspond to the US manufacturing industry during the period 1947-1951.

<table>
<thead>
<tr>
<th>Industry</th>
<th>Profit</th>
<th>C4</th>
<th>Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobiles</td>
<td>23.9</td>
<td>90</td>
<td>High</td>
</tr>
<tr>
<td>Cigarettes</td>
<td>12.6</td>
<td>90</td>
<td>High</td>
</tr>
<tr>
<td>Liquor</td>
<td>18.6</td>
<td>75</td>
<td>High</td>
</tr>
<tr>
<td>Typewriters</td>
<td>18.0</td>
<td>79</td>
<td>High</td>
</tr>
<tr>
<td>Fountain pens</td>
<td>21.8</td>
<td>57</td>
<td>High</td>
</tr>
<tr>
<td>Copper</td>
<td>14.6</td>
<td>92</td>
<td>Moderate</td>
</tr>
<tr>
<td>Steel</td>
<td>11.2</td>
<td>45</td>
<td>Moderate</td>
</tr>
<tr>
<td>Farm machines</td>
<td>13.4</td>
<td>36</td>
<td>Moderate</td>
</tr>
<tr>
<td>Petroleum refining</td>
<td>12.9</td>
<td>37</td>
<td>Moderate</td>
</tr>
<tr>
<td>Soap</td>
<td>15.8</td>
<td>79</td>
<td>Moderate</td>
</tr>
<tr>
<td>Men’s Shoes</td>
<td>13.4</td>
<td>28</td>
<td>Moderate</td>
</tr>
<tr>
<td>Fertilizers</td>
<td>15.4</td>
<td>85</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
The corresponding concepts are: Profit = average profit rate on equity (in percentage); C4 = sum of the market shares of the four largest firms (in percentage); Barriers = importance of entry barriers.

a) Estimate an equation that explains profitability as a function of the available structural variables. First include only C4 and a constant, and then add dummy variables corresponding to high and moderate entry barriers. Finally, try a regression in which there only appear a constant, a dummy variable for high entry barriers, and another dummy variable for the observations with “C4 > 50”.

b) Analyze the results obtained, and make some comments about the relative importance of supply concentration and entry barriers as determinants of firms’ profitability.

6.2. Demand estimations

The following data correspond to the Argentine beer market (2002-2006).

<table>
<thead>
<tr>
<th>Month</th>
<th>Quantity</th>
<th>Price</th>
<th>Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>200201</td>
<td>126.676</td>
<td>1.4551</td>
<td>87.18</td>
</tr>
<tr>
<td>200202</td>
<td>108.092</td>
<td>1.4772</td>
<td>91.29</td>
</tr>
<tr>
<td>200203</td>
<td>113.035</td>
<td>1.5161</td>
<td>106.08</td>
</tr>
<tr>
<td>200204</td>
<td>77.087</td>
<td>1.5554</td>
<td>121.50</td>
</tr>
<tr>
<td>200205</td>
<td>77.262</td>
<td>1.6619</td>
<td>132.21</td>
</tr>
<tr>
<td>200206</td>
<td>56.646</td>
<td>1.7861</td>
<td>129.98</td>
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<tr>
<td>200207</td>
<td>67.006</td>
<td>1.8416</td>
<td>135.07</td>
</tr>
<tr>
<td>200208</td>
<td>82.528</td>
<td>1.8380</td>
<td>133.98</td>
</tr>
<tr>
<td>200209</td>
<td>87.253</td>
<td>1.8604</td>
<td>134.63</td>
</tr>
<tr>
<td>200210</td>
<td>119.530</td>
<td>1.8532</td>
<td>135.49</td>
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<tr>
<td>200211</td>
<td>130.206</td>
<td>1.8625</td>
<td>139.98</td>
</tr>
<tr>
<td>200212</td>
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<td>142.75</td>
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<td>200301</td>
<td>145.427</td>
<td>1.8540</td>
<td>127.48</td>
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<tr>
<td>200302</td>
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<tr>
<td>200303</td>
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<td>147.91</td>
</tr>
<tr>
<td>200304</td>
<td>86.654</td>
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<td>200305</td>
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<td>162.22</td>
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<td>200306</td>
<td>69.572</td>
<td>2.0428</td>
<td>156.10</td>
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<td>200307</td>
<td>79.500</td>
<td>2.0482</td>
<td>158.84</td>
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<td>200308</td>
<td>86.908</td>
<td>2.0643</td>
<td>152.99</td>
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<td>200309</td>
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<td>2.1657</td>
<td>156.17</td>
</tr>
<tr>
<td>200310</td>
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<td>2.2131</td>
<td>158.49</td>
</tr>
<tr>
<td>200311</td>
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<td>2.2256</td>
<td>160.77</td>
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<tr>
<td>200312</td>
<td>177.050</td>
<td>2.2304</td>
<td>165.46</td>
</tr>
<tr>
<td>200401</td>
<td>160.532</td>
<td>2.2279</td>
<td>144.18</td>
</tr>
<tr>
<td>200402</td>
<td>121.221</td>
<td>2.3726</td>
<td>147.88</td>
</tr>
</tbody>
</table>
The corresponding concepts are: Price = Average sale price of beer without taxes (in Arg$ per liter); Quantity = Total quantity sold of beer (in hectoliters); Income = nominal income index of the population (EMAE*IPC/100).

a) Estimate the following logarithmic demand for beer:

\[ \ln(\text{Quantity}) = c(1) + c(2) \cdot Wint + c(3) \cdot \text{Summ} + c(4) \cdot \ln(\text{Price}) + c(5) \cdot \ln(\text{Income}) ; \]

where “Summ” is a dummy variable for the Argentine Summer (1 for December and January; 0 for the rest of the year) and “Wint” is a dummy variable for the Argentine Winter (1 for the months of April, May, June, July, August and September; 0 for the rest of the year).

b) Now estimate this alternative demand function, adding a lagged quantity variable:

\[ \ln(\text{Quantity}) = c(1) + c(2) \cdot Wint + c(3) \cdot \text{Summ} + c(4) \cdot \ln(\text{Price}) + c(5) \cdot \ln(\text{Income}) + c(6) \cdot \ln(\text{Quantity}(t-1)) . \]

c) Now estimate a new logarithmic demand function, adding the lagged quantity but
also imposing a zero-degree homogeneity condition (which in this case simply implies that “c(4) = -c(5)”):

\[\ln(\text{Quantity}) = c(1) + c(2) \cdot \text{Wint} + c(3) \cdot \text{Summ} + c(4) \cdot \ln(\text{Price/Income})\]

\[+ c(6) \cdot \ln(\text{Quantity(t-1)})\]

d) Compare the results obtained under the different specifications, regarding its goodness of fit and significance of the estimated coefficients. Also compare the estimated values for the implicit short-run and long-run elasticities.

7. Systems of equations

7.1. Demand systems for differentiated products

The following data correspond to the Argentine biscuit market (2003-2005).

<table>
<thead>
<tr>
<th>Month</th>
<th>Qcrack</th>
<th>Qsweet</th>
<th>Qsandw</th>
<th>Pcrack</th>
<th>Psweet</th>
<th>Psandw</th>
<th>Income</th>
</tr>
</thead>
</table>

7.1. Demand systems for differentiated products

The following data correspond to the Argentine biscuit market (2003-2005).
The corresponding concepts are: \( Q_{\text{crack}} = \) quantity sold of cracker biscuits (in kg); \( Q_{\text{sweet}} = \) quantity sold of plain sweet biscuits (in kg); \( Q_{\text{sandw}} = \) quantity sold of sandwich sweet biscuits (in kg); \( P_{\text{crack}} = \) average price of cracker biscuits (in Arg$/kg); \( P_{\text{sweet}} = \) average price of plain sweet biscuits (in Arg$/kg); \( P_{\text{sandw}} = \) average price of sandwich sweet biscuits (in Arg$/kg); \( \text{Income} = \) nominal income index of the population (EMAE*IPC/100).

a) Estimate the demand for the different types of biscuits through the following equations:

\[
\ln(Q_{\text{crack}}) = c(1) + c(2) \cdot \ln(P_{\text{crack}}/\text{Income}) + c(3) \cdot \ln(P_{\text{sweet}}/\text{Income}) \\
\quad + c(4) \cdot \ln(P_{\text{sandw}}/\text{Income}) + c(5) \cdot \ln(Q_{\text{crack}}(t-1)) \\
\]

\[
\ln(Q_{\text{sweet}}) = c(11) + c(12) \cdot \ln(P_{\text{sweet}}/\text{Income}) + c(13) \cdot \ln(P_{\text{crack}}/\text{Income}) \\
\quad + c(14) \cdot \ln(P_{\text{sandw}}/\text{Income}) + c(15) \cdot \ln(Q_{\text{sweet}}(t-1)) \\
\]

\[
\ln(Q_{\text{sandw}}) = c(21) + c(22) \cdot \ln(P_{\text{sandw}}/\text{Income}) + c(23) \cdot \ln(P_{\text{crack}}/\text{Income}) \\
\quad + c(24) \cdot \ln(P_{\text{sweet}}/\text{Income}) + c(25) \cdot \ln(Q_{\text{sandw}}(t-1)) \\
\]

b) Observe the results obtained and re-write the equations, eliminating the variables whose signs are not the expected ones (for example, price of substitute goods whose estimated coefficients are negative). Re-estimate the corresponding demand functions.

c) Now estimate a single demand function for biscuits, through the following equation:

\[
\ln(Q_{\text{total}}) = c(1) + c(2) \cdot \ln(P_{\text{total}}/\text{Income}) + c(3) \cdot \ln(Q_{\text{total}}(t-1)) \\
\]

where “\( Q_{\text{total}} \)” is the sum of \( Q_{\text{crack}}, Q_{\text{sweet}} \) and \( Q_{\text{sandw}} \), and “\( P_{\text{total}} \)” it the weighted average price of \( P_{\text{crack}}, P_{\text{sweet}} \) and \( P_{\text{sandw}} \) (that is, “\( (P_{\text{crack}}*Q_{\text{crack}} + P_{\text{sweet}}*Q_{\text{sweet}} + P_{\text{sandw}}*Q_{\text{sandw}})/Q_{\text{total}} \)”).

d) Calculate the implicit short-run and long-run price elasticities corresponding to the estimations made in parts “b” and “c”.

### 7.2. Supply and demand estimations

The following data correspond to the Argentine gasoline market during 1999.

<table>
<thead>
<tr>
<th>Province</th>
<th>Pn</th>
<th>Tax</th>
<th>Qpc</th>
<th>HHI</th>
<th>SYPF</th>
<th>WTI</th>
<th>GDPpc</th>
</tr>
</thead>
<tbody>
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<td>0.4865</td>
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<td>0.2146</td>
<td>0.3256</td>
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<td>0.4865</td>
<td>16,1316</td>
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<td>1752,10</td>
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The corresponding concepts are: $P_n =$ price of premium gasoline without taxes (in Arg$/lt); $Tax =$ Gasoline excise tax (in Arg$/lt); $Q_{pc} =$ quantity of gasoline consumed per capita (in liters per month); $HHI =$ Herfindahl and Hirschman concentration index; $SYPF =$ YPF’s market share; $WTI =$ international crude oil price (in Arg$/lt); $GDP_{pc} =$ gross domestic product per capita (in Arg$ per month).

a) Estimate the gasoline demand function through the following regression:

$$Q_{pc} = c(1) + c(2) \cdot \text{Summ} + c(3) \cdot Wint + c(4) \cdot GDP_{pc} + c(5) \cdot (P_n + Tax)$$

where “Summ” is a dummy variable for the Argentine Summer months (1 for December, January, February and March; 0 for the rest of the year) and “Wint” is a dummy variable for the Argentine Winter months (1 for June, July, August and September; 0 for the rest of the year).

b) Calculate the marginal revenue of a cartel (MRt), the marginal revenue that YPF
would have if it were a price leader and the other firms had a completely inelastic supply (MRI), and the average marginal revenue of the firms if this market was a Cournot oligopoly (MRo), through the following equations:

\[ MR_t = P_n + Q_p/c(5) ; \quad MR_I = P_n + SYPF-Q_p/c(5) ; \quad MR_o = P_n + HHI-Q_p/c(5) ; \]

where “c(5)” is the coefficient estimated in part “a”.

c) Now perform four marginal cost function regressions following this formula:

\[ MC = c(1) + c(2)\cdot C_{ba} + c(3)\cdot M_{za} + c(4)\cdot S_{Cr} + c(5)\cdot WTI ; \]

where “Cba”, “Mza” and “SCr” are dummy variables corresponding to the provinces of Córdoba, Mendoza and Santa Cruz (1 for the observations that belong to those provinces; 0 otherwise). Make “MC” be alternatively equal to “Pn” (perfect competition hypothesis), “MRo” (Cournot hypothesis), “MRI” (price-leadership hypothesis) and “MRt” (collusion hypothesis). Find which of those regressions has a larger coefficient of determination (R\(^2\)).

8. Monopoly regulation

8.1. Regulation and firms’ profits

The demand function of a certain good (Q) and the total cost function of the firm that supplies that good are the following:

\[ Q = 160 - p \quad ; \quad TC = 40\cdot Q + 2000 \]

where “p” is the price paid by consumers.

a) Find the values of “p” and “Q” that an unregulated profit-maximizing monopolist would choose, and the total amount of the profits of such a firm. Remember that, in this case, the monopolist’s marginal revenue function is “MR = 160 - 2\cdot Q”, and its marginal cost is $40.

b) Find the values of “p” and “Q” that a welfare-maximizing regulator would choose, and show that in this case the monopolist’s profit becomes negative (provided that welfare is defined as the sum of consumers’ surplus plus firm’s profit).

c) Show that, if the regulator sets a price “p = 60”, then the monopolist’s profit becomes zero. Find the value of “Q” in that case.

d) Calculate the consumers’ surpluses and the total surpluses generated in the solutions to the three previous parts.

8.2. Regulation and price discrimination

A regulated firm sells its services in two markets (A and B), whose demand price functions are the following:

\[ p_A = 100 - 2q_A \quad ; \quad p_B = 70 - q_B \]

The total cost of this firm is:

\[ TC = 40\cdot(q_A+q_B) + 450 \]

a) Show that, if “p_A = p_B = MC = 40”, then total surplus becomes maximal but the firm obtains negative profits.
b) Show that, if “\( p_A = p_B = AC = 50 \)”, then the firm’s profit is equal to zero. Which are the corresponding values of “\( q_A \)” and “\( q_B \)” in this case? Which is now the value of total surplus?

c) Now show that, setting “\( p_A = 52,80 \)” and “\( p_B = 46,40 \)”, it is possible to increase the value of total surplus while keeping the restriction that the firm’s profit is non-negative. Find the values of “\( q_A \)” and “\( q_B \)” that correspond to this last case, and show that total quantity is larger than the one obtained in part “b”.

11. Merger control

11.1. Horizontal mergers

In the market of a homogeneous product, there are four identical firms (E1, E2, E3 and E4), whose average and marginal cost of supplying the good is equal to $30. The market is a Cournot oligopoly, and total demand is:
\[
Q = 150 - P
\]
a) Find the equilibrium values of “\( P \)” and “\( Q \)”, and the consumers’ surplus.
b) Show that, if E1 merges with E2, E3 merges with E4, and the market goes on behaving as a Cournot oligopoly, then the new equilibrium generates an increase in price and a reduction in consumers’ surplus.
c) Which reduction in the average and marginal cost of the merging firms is necessary to induce an increase in consumers’ surplus?

11.2. Leader/follower merger

In the market of a homogeneous product there are three firms (1, 2 and 3). Firm 1 is the price leader, and firms 2 and 3 are followers. Firm 1 has an installed capacity of production of 40 units, while firms 2 and 3 have an installed capacity of production of 15 units each. The followers’ supply function is completely vertical (inelastic) for the quantity that coincides with their installed capacity. The three firms have constant marginal costs, equal to $8, while total market demand is:
\[
Q = 100 - P
\]
where “\( Q \)” is quantity and “\( P \)” is price. Given all that, you should:
a) Find the residual demand for firm 1, and its corresponding marginal revenue function.
b) Find the equilibrium values for “\( P \)” and “\( Q \)” in the initial market situation.
c) Now suppose that firms 1 and 2 merge, and find the new equilibrium (in which the new firm “1+2” is the price leader, and firm 3 is the follower).
d) What would the equilibrium be if the merger were between firms 2 and 3 (and firm 1 went on being the price leader)?