

Empirical Workshop 1: Testing static oligopoly models

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The Directorate-General (DG) for Competition at the European Commission is supposed to carry out an investigation of competition in the European coffee market. The project contains an overall assessment of the market as well as national evaluations of each country. You work as a consultant and are responsible for the evaluation of the Dutch coffee market.

To determine the degree of market power in this industry, you have access to monthly data for the Dutch coffee market during the period 1990-1996.

The data contain the following variables: *maand* is year and month of observation; *year* is year of observation, *month* is month of observation; *qu* is per capita consumption of roasted coffee in kg; *cprice* is price of roasted coffee per kg in current guilders; *tprice* is price of per kg tea in current guilders; *oprice* is price index for other goods; *incom* is income per capita in current guilders; *q1* is a dummy variable for season 1; *q2* is a dummy variable for season 2; *q3* is a dummy variable for season 3; *q4* is a dummy variable for season 4; *bprice* is price of coffee beans per kg in current guilders; and *wprice* is price of labor per man hours (work 160 hours per month). Bettendorf and Verboven (1998) provide more details about the data.

The data set *dutch_coffee.csv* (in text format) and *dutch_coffee.dta* (in STATA format) can be downloaded from the course web. You can use any software package you want to solve the exercise.

The answers to the following questions act as a basis for your analysis of competition in the Dutch coffee market:

- 1) Present and discuss summary statistics of the data. Show and describe the following relationships: (a) per capita consumption of roasted coffee and the price of roasted coffee, (b) consumption of roasted coffee and price of tea, (c) price of roasted coffee and price of labor, (d) price of roasted coffee and price of tea. Comment if you observe any clear time trends.
- 2) Regress log of per capita consumption of roasted coffee on the log of price of roasted coffee. Interpret and discuss the coefficient of price. Is it economically meaningful? Is it reliable?
- 3) List and discuss factors that shift demand for coffee. List and discuss factors that shift supply for coffee.
- 4) Use a log-linear model to estimate demand. Add the price of tea and income as additional covariates and re-estimate your model. What do you account for now as compared to the specification you used in 2)?
- 5) There is still at least one major concern that you need to handle in the demand estimation. What is that? Propose a solution. Implement your suggested solution given the data at hand. Exactly what assumptions do you rely on? Interpret your results. What can you tell about the magnitude of the price elasticity of demand?
- 6) As responsible for the Dutch coffee market, you are supposed to provide information about the degree of competition in this market. From theory, we know that if P is the equilibrium oligopoly price, it solves the following equation:

$$P + \lambda \times Q \times \frac{\partial P(Q)}{\partial Q} = c, \quad (1)$$

where Q is the industry output and c is the marginal cost.¹ The parameter λ is called the market power or conduct parameter. The conduct parameter λ can take the following values:

¹The equation (1) comes from the first-order condition of profit maximization for one firm. The profit for firm i is given by $\pi(q_i, q_{-i}) = P(Q) \times q_i - c \times q_i$, where the aggregate quantity can be written as $Q = q_1 + \dots + q_i + \dots + q_n$. The first order condition of profit maximization in the Cournot case (no rival responses) implies

$$\frac{\partial \pi(\cdot)}{\partial q_i} = 0 \Rightarrow P + \frac{q_i}{Q} \times Q \times \frac{\partial P(Q)}{\partial Q} = c.$$

Therefore, we have $\lambda = \frac{q_i}{Q} = \frac{1}{n}$ in case of identical firms.

1. $\lambda = 0$ for perfect competition
2. $0 < \lambda < 1$ for oligopoly
3. $\lambda = 1$ for monopoly or perfect collusion.

For the case where all firms are identical (have the same cost-structure), $\lambda = \frac{1}{n}$ where n is the number of firms. If we have access to information about costs, λ can be expressed in the following way:

$$\lambda = \eta(P) \frac{P - c}{P} \equiv L_\eta, \quad (2)$$

where $\eta(P)$ is the elasticity of demand and L_η is the *adjusted Lerner index*, i.e., Lerner index adjusted for elasticity (Genesove and Mullin, 1998). The coffee market is characterized by a relatively simple production technology and the marginal cost c is constant and can be written as:

$$c = c_0 + h \times P_{\text{coffee beans}}, \quad (3)$$

where c_0 represents all variable costs other than those related to coffee beans, i.e., labor and packaging; and h is a parameter that measures the fixed technology in production. *The International Coffee Organization* estimates that one kg of roasted coffee requires 1.19 kg of beans. The c_0 is estimated to be around 4 guilders. We assume that market demand has a log-linear form. The market price can then be written as a function of the conduct parameter λ , the estimated demand, and cost parameters

$$P(c) = \frac{\eta c}{\eta - \lambda},$$

where η is the estimated demand elasticity.

Use your preferred specification of the estimate of demand and construct the Lerner index and the *adjusted Lerner index*. Do you find any seasonal variation in these indices?

- 7) Estimate the conduct parameter λ for the entire period. How does your result relate to the basic Cournot model? Interpret your findings.

The report needs to be no more than 6 pages. The report must be e-mailed to matilda.orth@hhs.se by 23:59 on **Tuesday April 9, 2019**, at the latest. I will let you know that I have received the report.

References:

1. Genesove, D. and P. Mullin, Testing static oligopoly models: conduct and cost in the sugar industry, 1890-1914, *The RAND Journal of Economics*, Vol. 29, No. 2, pp. 355-377, 1998.
2. Bettendorf, L. and F. Verboven, Competition on the Dutch Coffee Market. Research Memorandum, no.141. Central Planning Bureau, 1998.