

Problem Set 1

Econ 420 - Intermediate Macroeconomics
UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

Due: June 28, 2020

For questions 1-6, consider the following demand and supply functions:

$$Q^d = \alpha_0 - \alpha_1 P$$
$$Q^s = \beta_0 + \beta_1 P$$

where Q^d is the quantity demanded, Q^s is the quantity supplied, P is the price, and all parameters $[\alpha_0, \alpha_1, \beta_0, \beta_1]$ are positive constants unless otherwise stated. Denote ∂ as the partial derivative symbol, and Δ as the discretized units of change.

1. Derive the demand curve. What is the slope of the demand curve?

- A. $\frac{1}{\alpha_1}$
- B. α_1
- C. $-\alpha_1$
- D. $-\frac{1}{\alpha_1}$

Solution:

Rewrite the quantity demand in terms of price P as your y variable.

$$P = \frac{\alpha_0}{\alpha_1} - \frac{1}{\alpha_1} Q$$

The slope of this line is $\frac{dP}{dQ} = -\frac{1}{\alpha_1}$

2. What is the intercept of the demand curve (along the vertical axis)?

- A. $\frac{\alpha_1}{\alpha_0}$
- B. α_0
- C. $\frac{\alpha_0}{\alpha_1}$
- D. $-\alpha_0$

Solution:

The intercept of the line is $\frac{\alpha_0}{\alpha_1}$

$$P = \frac{\alpha_0}{\alpha_1} - \frac{1}{\alpha_1}Q$$

The slope of this line is $\frac{dP}{dQ} = -\frac{1}{\alpha_1}$

3. Find the answer to this partial derivative $\frac{\partial Q^d}{\partial P}$:

- A. $-\alpha_1$
- B. α_1
- C. $\frac{\alpha_0}{\alpha_1}$
- D. $-\frac{\alpha_0}{\alpha_1}$

Solution:

Using the given quantity demand formula

$$Q^d = \alpha_0 - \alpha_1 P$$

The slope of this line is $\frac{dQ}{dP} = -\alpha_1$

Note this simply the inverse of the slope from problem 1

This quantity demand formula is Q on the y-axis and P on the x-axis.

4. Suppose α_1 decreases. What is the impact on the demand curve?

- A. Lower intercept; steeper curve
- B. Lower intercept; flatter curve
- C. Higher intercept; flatter curve
- D. Higher intercept; steeper curve

Solution:

From our demand equation we see as α_1 becomes smaller

$$P = \frac{\alpha_0}{\alpha_1} - \frac{1}{\alpha_1} Q$$

The intercept $\frac{\alpha_0}{\alpha_1}$ becomes larger

The slope $-\frac{1}{\alpha_1}$ becomes even more negative making the line steeper.

The demand curve becomes more and more inelastic (a vertical line)

5. Find the equilibrium price and quantity.

A. $P^* = \frac{\alpha_0 - \beta_0}{\alpha_1 + \beta_1}$, $Q^* = \frac{\beta_0 \alpha_1 + \beta_1 \alpha_0}{\alpha_1 + \beta_1}$

B. $P^* = \frac{-\beta_0}{\alpha_1 + \beta_1}$, $Q^* = \frac{\beta_0 \alpha_1 + \beta_1 \alpha_0}{\alpha_1 + \beta_1}$

C. $P^* = \frac{\alpha_0 - \beta_0}{\alpha_1 + \beta_1}$, $Q^* = \frac{\beta_1(\alpha_0 - \beta_0)}{\alpha_1 + \beta_1}$

D. $P^* = \frac{-\beta_0}{\alpha_1 + \beta_1}$, $Q^* = \frac{\beta_1(\alpha_0 - \beta_0)}{\alpha_1 + \beta_1}$

Solution:

Set $Q^d = Q^s$ or $P^d = P^s$. In this case I am going to set $Q^d = Q^s$ and solve for P^*

$$\alpha_0 - \alpha_1 P = \beta_0 + \beta_1 P$$

$$P^* = \frac{\alpha_0 - \beta_0}{\alpha_1 + \beta_1}$$

Plug P^* into either Q^d or Q^s . And do some simplifying algebra to get

$$Q^s = \beta_0 + \beta_1 \left(\frac{\alpha_0 - \beta_0}{\alpha_1 + \beta_1} \right)$$

$$Q^s = \beta_0 \left(\frac{\alpha_1 + \beta_1}{\alpha_1 + \beta_0} \right) + \beta_1 \left(\frac{\alpha_0 - \beta_0}{\alpha_1 + \beta_1} \right)$$

$$Q^s = \frac{\beta_0 \alpha_1 + \beta_1 \alpha_0}{\alpha_1 + \beta_1}$$

6. Suppose β_0 decreases by one unit. What is the impact upon equilibrium price?

A. $\Delta P^* = \frac{\beta_1}{\alpha_1 + \beta_1}$

B. $\Delta P^* = \frac{1}{\alpha_0 + \beta_0}$

C. $\Delta P^* = \frac{1}{\alpha_1 + \beta_1}$

D. $\Delta P^* = \frac{\beta_1}{\alpha_0 + \beta_0}$

Solution:

Take the derivative of the equilibrium price with respect to β_0

$$\frac{\partial P^*}{\partial \beta_0} = -\frac{1}{\alpha_1 + \beta_1}$$

Describe the derivative

$$\Delta P^* = -\frac{1}{\alpha_1 + \beta_1} \Delta \beta_0$$

If $\Delta \beta_0 = -1$

$$\Delta P^* = \frac{1}{\alpha_1 + \beta_1}$$

7) Suppose Ford produced 500 of its popular new car in the first quarter of the year. Ford has two production costs: labor and intermediate goods. Ford pays its workers \$60 per hour, and they employed 10,000 work hours in total. Intermediate goods were bought from Firestone for \$5,000 per car. Firestone's only input was labor, which cost \$180,000 total. In the first quarter, Ford sold 250 cars to consumers at a price of \$8,000.

In the second quarter, Ford produced 900 cars. Labor costs (wage per hour) went up by 10%, and intermediate good costs went up by 10% per car. Ford employed the same number of work hours. Also, Firestone's labor costs were the same as in the previous quarter. Ford sold to consumers all cars produced in the second quarter and the cars left in inventory from the previous quarter. However, Ford was able to raise the price of the car to \$10,000.

Assume that Ford and Firestone are the only companies in the economy.

A. What was National Income in the first quarter?

(National income is all the income households and firms make in an economy. It's another measure of national wealth like GDP. The formula for National Income = Wages + Profits for all firms.)

B. What were Corporate Profits in the second quarter?

(Sum the corporate profits for both companies)

Solution:

Quarter 1

• Ford:

- Ford sold 250 cars at \$8,000. Therefore, total sales were \$2,000,000 in Q1.

- Ford had two production costs:

· Labor Costs: $Wage * Hours = \$60 * 10,000 = \$600,000.$

· Intermediate Goods Costs: $Goods\ costs\ per\ car * Number\ of\ cars\ produced = 5000 * 500 = \$2,500,000.$

Ford's total costs of production were therefore \$3,100,000. This implies a cost per car of $\$3,100,000/500 = \$6,200.$

- Profit per car: $Price - Cost\ per\ car = \$8,000 - 6,200 = \$1,800.$ Therefore, total profits for Ford were: $Profit\ per\ car * Number\ of\ cars\ sold = \$1,800 * 250 = \$450,000.$

- Ford had $500-250=250$ cars left in inventory. Since we value inventories at cost, inventories were: $250 * Costs\ per\ car = 250 * \$6,200 = \$1,550,000.$

• Firestone: - Firestone paid wages of \$180,000. - Firestone had profits of: $Intermediate\ Good\ Sales - Wages = \$2,500,000 - 180,000 = \$2,320,000.$

$$NI_{Q1} = Wages + Profits = Wages_{Ford} + Wages_{Firestone} + Profits_{Ford} + Profits_{Firestone} = 600,000 + 180,000 + 450,000 + 2,320,000 = \$3,550,000$$

Quarter 2:

• Ford:

- Ford sold 1,150 cars (cars produced + cars from inventory) at \$10,000. Therefore, total sales were \$11,500,000 in Q2.

- Ford had two production costs:

· Labor Costs: Wage * Hours = ($\$60 * 1.1$) * 10,000 = $66 * \$10,000 = 660,000$.

· Intermediate Goods Costs: Goods costs per car * Number of cars produced = ($5000 * 1.1$) * 900 = \$4,950,000.

Ford's total costs of production were therefore \$5,610,000. This implies a cost per car of $\$5,610,000/900 = \$6,233$.

- Profit per car: Price - Cost per car = $\$10,000 - 6,233 = \$3,766$. Therefore, total profits for Ford were: (Profit per car taken from inventory * Number of cars sold from inventory) + (Profit per car currently produced * Number of cars sold currently produced) = $\$(10,000 - 16,200) * 250 + \$3,766 * 900 = 950,000 + 3,389,400 = \$4,339,400$.

- Ford had $500 - 250 = 250$ cars left in inventory. Since we take out inventories at their original cost, inventories were: $-250 * \text{Costs per car} = -250 * \$6,200 = \$ - 1,550,000$.

• Firestone:

- Firestone paid wages of $\$324,000 = 180,000/500 * 900$.

- Firestone had profits of: Intermediate Good Sales - Wages = $\$4,950,000 - 324,000 = \$4,626,000$.

$$Profits_{Q2} = Profits_{Ford} + Profits_{Firestone} = 4,339,400 + 4,626,000 = \$8,965,400$$

8) Visit the Bureau of Labor Statistics economic news releases:

<https://www.bls.gov/news.release/cpi.t01.htm>

<https://www.bls.gov/news.release/cpi.t06.htm>

Take a look at the table “Consumer Price Index” where you can view the index summary.

A. What was the inflation rate (for all goods) for 12 months ending in May of 2020?

Solution: Prices barely moved. CPI Index values May 2020: 256.389 and May 2019: 256.092 $\pi = 0.1\%$

B. What was the inflation rate for Apparel goods for 12 months ending in May of 2020?

Solution: Sadly retail industries lost on foot traffic due to the coronavirus. You can see the impact on the price of retail apparel goods. $\pi_{apparel} = -7.9\%$

C. What was the inflation rate Gasoline for 12 months ending in May of 2020?

Solution: Gasoline demand fell off because of lack of driving. 45% of oil usage for transportation. $\pi_{gasoline} = -33.8\%$

D. Which Expenditure category saw the highest inflation?

Solution: Categories in food at home. Meats, poultry, fish, and eggs. People spent their money at grocery stores. Food at grocery stores went up. $\pi_{food} = 10\%$

E. What is the basket weight for coffee, bananas, and prescription drugs?

Solution: 0.174, 0.078, 1.178, respectively