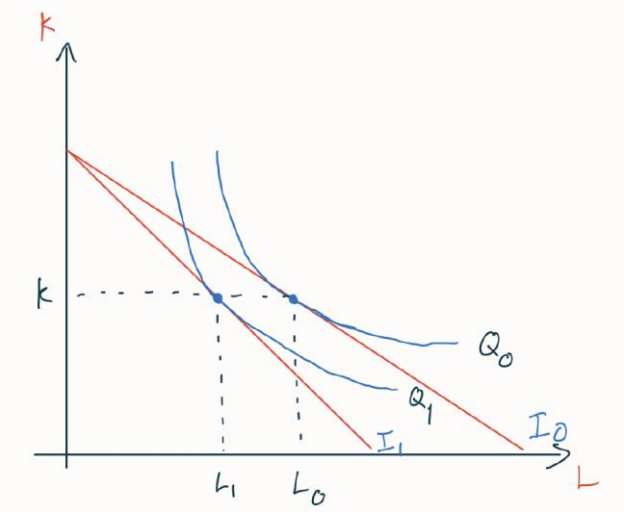
1. Consider a long-run production in which there are only two inputs labor and capital, and the input prices for labor and capital are wage (w) and interest rate (r), respectively. Suppose that at the equilibrium levels of labor and capital (L^*, K^*), the marginal product of labor (MP_L) and marginal product of capital (MP_K) are 6 and 8, respectively.



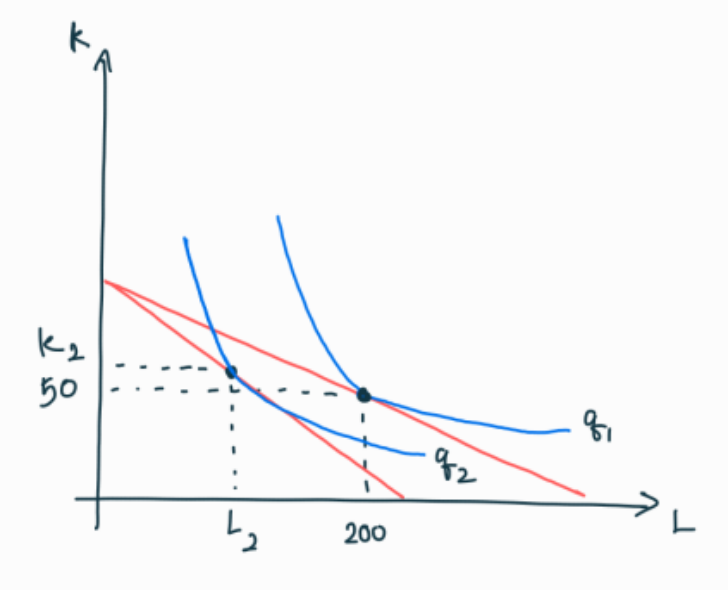
1.a) Calculate the marginal rate of technical substitution (MRTS), and state the cost-minimization conditions of this firm, given that the required output is fixed at Q_0. If the market wage rate (w) is \$3, what is the interest rate at the equilibrium?

At the producer's equilibrium, cost-minimization condition is $\frac{MP_L}{MP_K} = \frac{w}{r}$. Therefore, plugging in all the figures, the interest rate is $\frac{6}{8} = \frac{3}{r}$ or $\boldsymbol{r = 4}$.

1.b) Suppose now that the wage rate (w) increases to \$4, *ceteris paribus*. Draw a diagram to illustrate the changes in the cost-minimizing combination of inputs.

- When wage increases from \$3 to \$4, the isocost tilts inward (clockwise) from I_0 to I_1. Isoquant that is tangent to the new isocost is lower, leading to the lower level of output produced from Q_0 to Q_1. (NOTE: level of K can remain the same, increased or decreased, depend on how much K and L can be substitutable to each other which is not a concern here.)

2. Suppose that in the long-run production of wine, a firm uses two inputs: workers (L) and machines (K). At the required output of 3,000 bottles of wine, the firm's least-cost input combination is 200 units of L and 50 units of K, and the per-unit input prices for L and K are \$10 and \$20, respectively. Suppose further that at this least-cost combination of inputs, the marginal product of the 50th machine (MP_K) is 8 bottles of wine.



2.a) Draw a diagram to illustrate this firm's cost-minimization decision, where L is on the x-axis and K is on the y-axis. Also, explain the firm's cost-minimization conditions.

At the producer's equilibrium, cost-minimization condition is $\frac{MP_L}{MP_K} = \frac{w}{r}$. The equilibrium illustrated is on the level of output q_1.

2.b) At the equilibrium in part a., what is the marginal product (MP_L) of the 200th workers?

- According to the cost-minimization condition is $\frac{MP_L}{MP_K} = \frac{w}{r}$, we can fill in all the information to figure out the marginal product of labor.

- $\frac{MP_L}{8} = \frac{10}{20}$ so the $\boldsymbol{MP_L = 4}$.

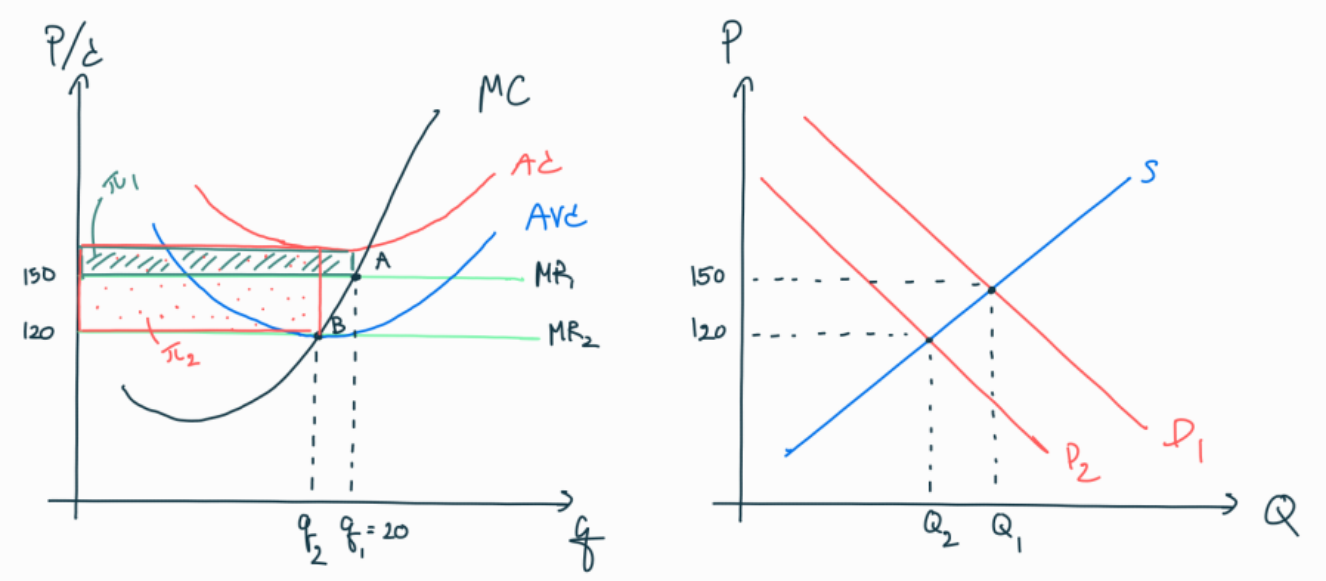
2.c) Suppose that the input price for L increases to \$15 per unit, while the input price for K and the required amount of output are the same. Draw another diagram to illustrate the change in the least-cost input combination.

Increased input price to $15 per unit tilts the isocost inwards (clockwise), the new achievable level of output is now on q_2 where the combination of capital and labor becomes at K_2 and L_2.

2.d) Explain the difference between short-run and long-run production.

In the short-run production, there is at least a factor of production that the firm cannot make an adjustment to its amount or a fixed factor, while in the long-run production, every factor of production is variable.

3. Consider a perfectly competitive market, in which the current equilibrium price is 150 baht per unit.



3.a) Suppose that a firm in this market sells 20 units of its output. State the profit-maximizing condition of this firm, and draw a diagram to illustrate how the equilibrium quantity is determined.

- The illustration above shows that the firm's equilibrium can be found on point A when MC = MR at the price of 150. Optimal quantity for this firm to produce is at q = 20.

3.b) At this equilibrium quantity of 20 units, suppose that the firm's average total cost is 180 baht, and its average fixed cost is 60 baht. Calculate this firm's average variable cost, total revenue, total cost, and profit.

- Since AC = AFC + AVC, then given that AC = 180 and AFC = 60, AVC is **120**.
- TR = P x q = 150 x 20 = **3,000**
- TC = AC x q = 180 x 20 = **3,600**
- π = TR – TC = 3,000 – 3,600 = **-600**

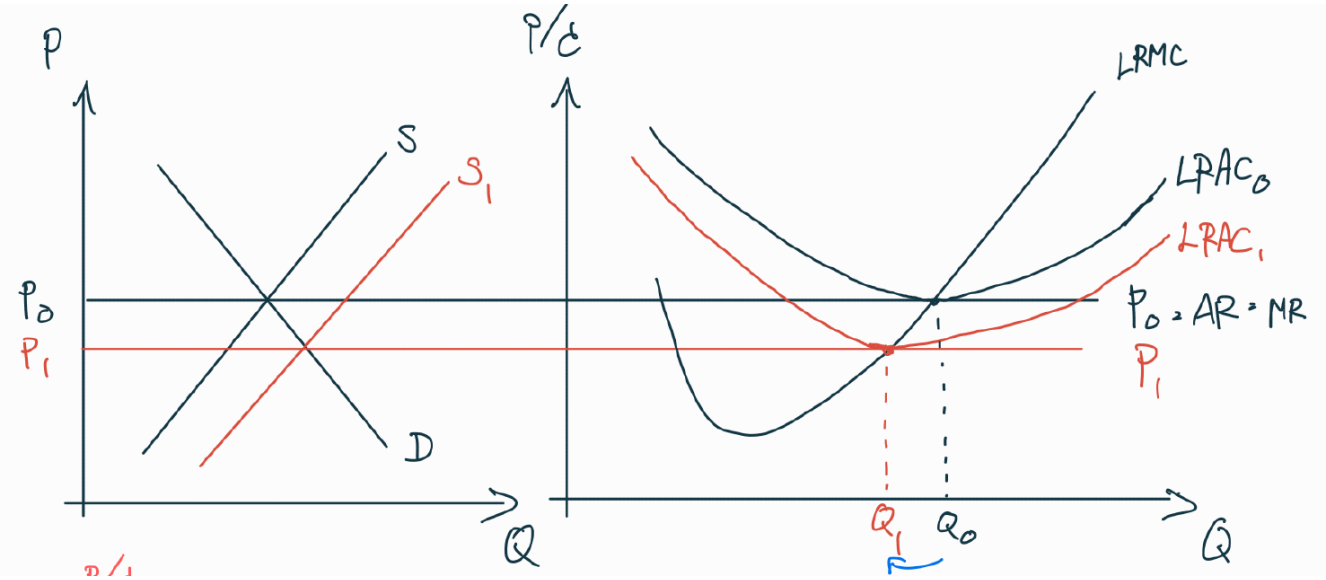
3.c) From part b., should this firm stay in the market in the short run? Justify your answer.

- Yes, the firm stays in the market and keeps producing since the price (150) is still higher than AVC (120). There is an excess gain from producing that can be used to cover fixed cost.
- To elaborate, producing zero unit, this firm has to pay the fixed cost for TFC = AFC x q = 60 x 20 = 1,200. On the other hand, producing 20 units of output leads to this firm's loss for only 600. Hence, keep producing is more sensible.

3.d) Suppose now that the market demand decreases, and the market price decreases to 120 baht per unit. Draw two diagrams to illustrate: (i) the change in the equilibrium price and quantity in the market, (ii) how the change in the market price affects the firm equilibrium quantity and profit. Would your answer from part c. change?

- Supposed that demand decrease causes D_1 to shift to D_2, leading to a lower price at 120.
- MR also drops from 150 to 120 from this firm's perspective.
- This firm chooses new optimal quantity from the new profit maximization condition on point B at q_2, leading to a larger sum of loss from π_1 to π_2.
- The firm can either choose to operate or leave the market since producing nothing or producing at the optimal quantity yield the same result.

4. A Thai rice farmer is in a long run equilibrium in a perfect competition and produces at the quantity Q_0 as shown in the graph below.



4.a) The government grants a lump sum subsidy to every farmer. How will this change the LRAC? Explain why LRMC does not change.

- LRAC will drop downward parallelly to the original curve since the subsidy acts like a reduction to cost per unit.

- LRMC does not change because the cost of every unit produced is reduced equally. We can think about this situation equivalently to reduction of the fixed cost. Meanwhile, the variable cost is not affected and therefore, marginal cost is not affected.

4.b) (10 Points) Will the lump sum subsidy change the quantity the farmer wants to produce to maximize his profit? Show in the graph that the farmer now earns an Excess Profit. Explain.

- No, because the maximization condition is when MR=MC. From 4.a), we conclude that both MR and MC are not affected by the subsidy. Thus, the optimal quantity Q_0 remained unchanged.

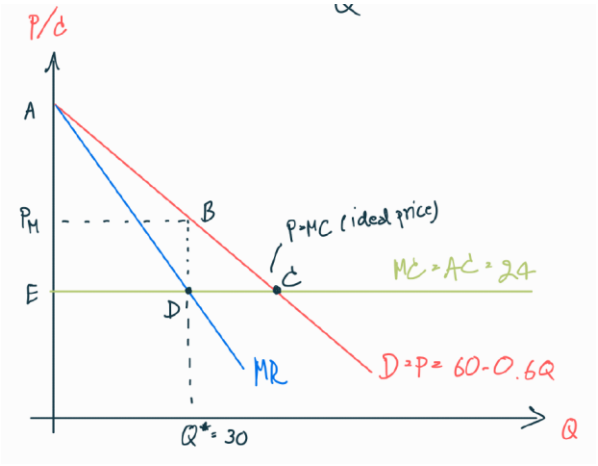
4.c) (10 Points) Demonstrate how this Excess Profit will affect the market price in the Long Run that allows new entry to the market.

- Excess profit will attract new entry to compete in this market, thus, supply increases, shifting from S to S_1. Price will eventually drop to P_1, leading to every firm gaining normal profit.

5. House and Land (HL) is the monopolist in a luxury housing market. It is a very efficient firm in which workers can construct houses with constant marginal cost and average cost. The demand and cost functions for HL are given as follows. (P is in million-baht unit).

P = 60 – 0.6Q

MC = AC = 24



5.a) Derive the marginal revenue function. Draw a diagram to illustrate the demand, marginal revenue, marginal cost, and average cost curves.

- $MR = \frac{dTR}{dQ}$ and $TR = P \cdot Q = 60(Q) - 0.6(Q \cdot Q) = 60Q - 0.6Q^2$.
- $MR = \frac{d(60Q-0.6Q^2)}{dQ} = 60 - 1.2Q$

5.b) State the profit-maximizing condition for HL, and determine the optimal units of houses. Also, indicate the profit in the diagram, and explain how this profit can be derived.

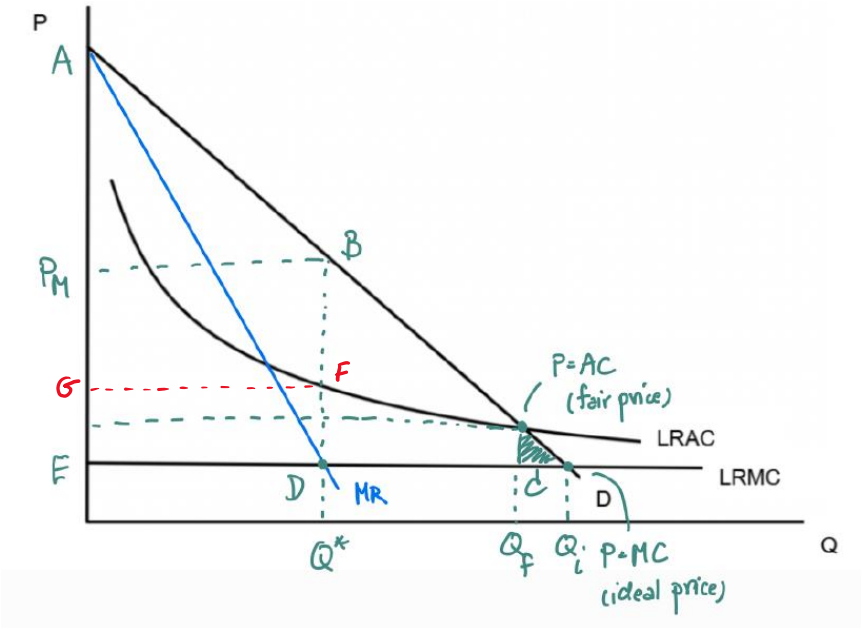
- Profit maximization condition is MR=MC.
- MR is $60 - 1.2Q$ while MC is a constant of 24. Equating them, we get
- $60 - 1.2Q = 24$ then $Q^* = 30$ units.
- Profit is displayed in this graph above in the area P_MBDE.

5.c) The government tries to encourage more people to have access to luxury houses, so they launch a policy forcing HL to sell their houses at the ideal price. Draw another diagram to indicate the ideal price and determine the corresponding quantity at this price. Illustrate the social welfare before and after the intervention in the diagram and discuss.

- The ideal price is on point C. (Sorry, forgot to indicate the quantity there.)

- The social welfare before the intervention is ABP_M triangle, when the seller maximize profit choosing the optimal quantity at Q*.
- After the intervention, social welfare is enlarged to ACE since the price becomes lower and quantity is increased.

6. The producer of the upcoming vaccine for COVID-19 is a monopoly who wants to price their vaccine to maximize profit. The cost of producing the vaccine is mostly fixed cost involving the research so that the Long Run Average Cost (LRAC) keeps declining the more vaccine is produced. The Long Run Marginal Cost (LRMC) is a small constant cost at all production level.



6.a) If the demand of vaccine is downward sloping as usual, show the equilibrium price and quantity that will maximize the profit. State the equilibrium conditions. Identify the profit and the deadweight loss to the society.

- We can find the price that maximizes seller's profit when MR=MC. Therefore, Q* is the optimal quantity and the monopolist sells at P_M.
- The profit is the area P_MBFG.
- The deadweight loss is quite strange for this question. Recall that we define the deadweight loss comparing between perfect competition and monopoly, social welfare if P=MC is ACE while in the monopoly is ABP$_M$. Hence, the difference between these two areas, deducting the monopolist's profit, is BCD.

6.b) Assumed that monopoly price is \$50 per dose, marginal cost \$10, calculate the Lerner's index of monopoly power.

- Lerner index is $L = \frac{P-MC}{P} = \frac{50-10}{50} = 0.8$.

6.c) Determine the Ideal Price? Will the monopoly earn any profit at this Ideal Price? Explain.

- The ideal price is set at P = MC. At this point of production, the monopolist does not profit since the average cost is higher compared to the price.

6.d) Determine the Fair Price? Is there still deadweight loss at this Fair Price? Explain.

- The fair price is set at P = AC. There is still a very small part of deadweight loss highlighted in the illustration. The reason why deadweight loss exists is because the competitive price can be as low as LRMC. At the ideal price, price is lower and quantity is higher.

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