

EE481: Industrial Economics

Product Differentiation (Chapter 7)

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What we study

- Please read Chapter 7 of “Modern Industrial Organization” by Carlton and Perloff.
- Monopolistic Competition - firms have some market power
- Models of differentiated products (not perfect substitutes)
 - 1 representative consumer model - all firms compete equally for all consumers
 - 2 spatial or location model - each consumers prefers products that are closer to their preferences

** No economics model is perfect in explaining what's happening in the real world. We just use them to help us understand the real world situations in a more systematic way.

Homogenous product

- Homogenous product demand (no differentiation)

$$\begin{aligned}P &= a - bQ \\ &= a - b(q_1 + q_2 + \dots + q_n) \\ &= a - bq_1 - bq_2 - \dots - bq_n\end{aligned}$$

where

q_1 is the quantity produced by firm 1, etc.

Q is the total quantity and $Q = q_1 + q_2 + \dots + q_n$

P is the price of this homogenous product.

- There is one price no matter who produces the product.

Differentiated products

- Differentiated product demand

$$P_1 = a - b_1 q_1 - b_2 q_2 - \dots - b_n q_n$$

where

q_1 is the quantity produced by firm 1, etc.

P_1 is the price of a differentiated product produced by firm 1, etc.

b_1 is the effect of quantity produced by firm 1 on price of product produced by firm 1.

b_2 is the effect of quantity produced by firm 2 on price of product produced by firm 1, etc.

$|b_1| > |b_2|$ and $|b_1| > |b_3|$, etc. because firm 1's output has a greater effect on its price than other firms' outputs.

Demand Curve Faced by “A FIRM”

Graph 1: (Perfectly competitive market) Graph 2: (Differentiated product market)

** Firms in a differentiated product market are called to be in a monopolistic competition. Each firm has some market power.

Representative Consumer Model

- Chamberlin (1933)
- All consumers are identical
- Firms offer differentiated products in the SAME market.
 - Each firm has some market power -> faces a downward sloping demand.
 - Each firm has a total cost $C(q) = VC(q) + F$
 - In the longrun (with free-entry), $P = AC(q)$. No firm makes a positive economic profit.
- Examples:
 - Smartphones: iPhone, Samsung, Nokia, Motorola, Nexus, Huawei, Xiaomi, etc.
 - Juice: Tropicana, Malee, Tipco, Sunkist, etc.

Representative Consumer Model

Suppose $AC(q) = \frac{C(q)}{q} = 0.28 + \frac{F}{q}$, AC decreases as q increases because fixed cost get spread over more units.

Graph: price and quantity in the long-run equilibrium

Representative Consumer Model: Optimal Diversity

- The higher the fixed cost, the less likely another firm would enter the market.
 - High fixed cost could lead to too little variety
- The equilibrium number of firms, product variety, product quantity for each variety, may not be at the socially optimal level

Representative Consumer Model: Summary

- The model imposes some unrealistic assumptions:
 - All consumers are identical
 - Firms are identical on every aspects except for their products are differentiated
 - All products are equally good substitutes for each other
- As a result:
 - Equilibrium outcomes depend on the level of firms' fixed cost (F).
 - This model **cannot** be used when consumers have differentiated preferences; and products are not equally good substitutes.

Location Models

- Consumers have differentiated preferences
- Brands are not equally good substitutes. Some are closer substitutes than others.
- Location models use “location of consumers” to locate their differentiated preferences.
- We will study
 - 1 Hotelling’s Location Model - Hotelling(1929)
 - 2 Salop’s Circle Model - Salop(1979)

Hotelling's Model

Hotelling uses consumers' geographical locations to represent their preference locations

- Hotelling's city is a linear city with 1 road.
- Consumers are identical on every aspect except for their location on the road.
 - Consumers prefer firms that are closer to them.
- Suppose we study the ice-cream industry.
 - Ice-cream shop owners choose their location.

Hotelling's Model

Suppose

- 1 The government regulates the price of ice-cream. So, P is the same in every shop.
- 2 Suppose shop 1 has chosen to locate their shop as below, where should shop 2 locate to get the most profit?

** If firms can costlessly change their price and location, there would be no Nash equilibrium (firms will keep on changing the price and location).

Salop's Circle Model

Salop uses consumers' geographical locations to represent their preference locations. **BUT** Salop's city has no end point (a circle).

- Salop's model allows us to consider the “outside options”.
- Consumers are located on the circumference of a circle. Each consumer chooses one product that is the closest to them.

Salop's Circle Model: The Consumers

- Let us analyze an ice-cream market.
- Consumers maximize their utility which takes the form:

$$U(t, t^*) = u - c|t - t^*|$$

where

Salop's Circle Model: The Consumers

- This model allows consumers to have an outside option.
 - e.g. they can choose not to buy any ice-cream, but choose “cake” instead.
 - Let the “NET utility” from choosing an outside option (buy cake instead) = \underline{u}
- So, a consumer would buy ice-cream if

- Suppose a consumer get to buy their most favorite ice-cream (t^*), the max utility would be obtained

Salop's Circle Model: The Consumers

- meaning that, this consumer will buy ice-cream if “price of ice-cream” is LESS than $u - \underline{u}$.
- Here, the reservation price would be

- or, rearranging equation (2), we get

** Consumers buy a scoop of ice-cream only if the “net surplus” from the most favorite type of ice-cream minus the surplus from cake is positive.

Salop's Circle Model: Firms' Behavior

- Salop assumes that firms (or brands) already locate themselves around the circle.
 - Also assumes that the distances between any of the two brands are equal.
- So, if the circle circumference = 1 and there are n firms in the market,
...

Salop's Circle Model: Deriving x_m

Now, back to

$$\max_i [v - c|t_i - t^*| - p_i] \geq 0$$

suppose a consumer already chosen a flavor of ice-cream that maximizes his/her utility. So,

Salop's Circle Model: Firms' x_m

Graph : Monopoly Region

- If the territories x do not overlap, then each brand has its own “monopoly region”. We can denote x as x_m .





Salop's Circle Model: Firms' x_C

- If the territories x overlap, then each brand would compete in “competitive regions”. We can denote x as x_C .

Salop's Circle Model: Deriving x_c

- A consumer buys ice-cream flavor i (or product brand i) if the net utility from buying flavor i is greater than the net utility from buying flavor j .

Reference and Further Reading

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-  Salop, S., “Monopolistic Competition with Outside Goods.” *Bell
Journal of Economics*. vol.10, 1979.