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)

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

where
q_1 is the quantity produced by firm 1, etc.
Q is the total quantity and $Q = q_1 + q_2 + ... + q_n$
P is the price of this homogenous product.

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

Differentiated products

- Differentiated product demand

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

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).

Hotelling's Model (other applications)

- Politics

- Marketing

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 closet 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

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

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.

Salop's Circle Model : units sold (q)

Suppose there are "L" consumers located along the circle:

- Monopoly region case:

- Competitive region case:

Strategic Use of Product Differentiation

- Brand Proliferation
- Brand Preemption

Reference and Further Reading


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Hotelling, H., "Stability in Competition.", *Economic Journal*. vol.39, 1929


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