31E11100 - Microeconomics: Pricing

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Lecture 1: Partial equilibrium framework
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Objectives of the course

- Understand different roles of pricing
  - For different types of products
  - In different market situation - although oligopoly analysis is mostly left to the course on Industrial Organization
- Learn how to utilize formal modeling in economic analysis and argumentation
  - Typical lecture introduces one model framework and draws conclusions using that
- See how the tools of modern microeconomic theory are applied
  - Game thery
  - Information economics
- Learn to connect theory to applications (assignment)

Modeling framework for this lecture: partial equilibrium analysis

- This is the standard modeling approach to focus on a single market, and will be utilized throughout the course
- Interactions with other markets assumed away
- Underlying assumption is that the market under consideration is only a small part of the overall economy. Then:
  - Prices of other commodities unaffeted by the price of the commodity under consideration
  - Wealth effects can be ignored (the spending in this market is a negligible part of the consumers' budget)
- This should be seen as an approximation
- Examples: grocery items, books, digital goods, banking services, hairdressing, etc.

Modeling tool for partial equilibrium analysis: quasilinear preferences

- The quantity of the good bought by individual i is denoted by $q_i \geq 0$.
- Utility to i from consuming q_i units: $v_i(q_i)$.
- Outside good y that can be thought of as money or a composite good reflecting all other consumption.
- The good is priced at $p > 0$ per unit of consumption. The composite good is priced at 1, and hence p is also the relative price.
- Initial holdings of m_i units of the composite good or money.
- Quasilinear utility:

$$u_i(y_i, q_i) = v_i(q_i) + y_i.$$

Consumer's problem

- Consumer's problem is to maximize

$$\max_{y_i, q_i \geq 0} v_i(q_i) + y_i$$

subject to

$$y_i + pq_i = m_i.$$

- We will assume that the function v_i is increasing and has decreasing marginal utilities:

$$v_i'(q_i) \geq 0 \text{ and } v_i''(q_i) \leq 0,$$

i.e. $v_i(\cdot)$ is an increasing and concave function.

- For discrete units, this would be

$$v_i(q_i) \geq v_i(q_i - 1),$$

$$v_i(q_i) - v_i(q_i - 1) \geq v_i(q_i + 1) - v_i(q_i).$$

- In the continuous case, the first order condition for maximum is

$$v_i'(q_i) = p$$

- The solution to the consumer's problem is the demand function, denoted by

$$q_i(p).$$

- By differentiating the first-order condition, we get , we get the law of demand:

$$q_i'(p) = \frac{1}{v_i''(q_i)} \leq 0,$$

or in words, the individual demand is downward sloping

- Important simplification by the quasi-linearity: demand is independent of m_i since q_i maximizes $v_i(q_i) + m_i - pq_i$ if and only if it maximizes $v_i(q_i) - pq_i$.We can ignore initial wealth m_i from now on.

Production side

- Firm j supplies q_j^s units of the good.
- The cost function $c_j\left(q_j^s\right)$ measures the cost of delivering q_j^s units on the market in terms of the composite good (or money).
- The produced good is priced at p in the market, and the firm chooses q_j^s to maximizes its final wealth
- Hence, the Firm's problem is:

$$\max_{q_j^s} \; m_j + pq_j^s - c_j\left(q_j^s\right),$$

  where m_j is the initial holdings of money by firm j.
- We can denote the revenue of the firm by $y_j = pq_j^s$.
- The solution to the firm's problem gives the supply function $q_j^s(p)$.

- For the most part, we assume that the cost function is inceasing and convex:

$$c_j'\left(q_j^s\right) > 0 \text{ and } c_j''\left(q_j^s\right) \geq 0.$$

- For discrete units, this would be

$$c_j\left(q_j^s\right) \geq c_j\left(q_j^s - 1\right),$$

and

$$c_j\left(q_j^s\right) - c_j\left(q_j^s - 1\right) \leq c_j\left(q_j^s + 1\right) - c_j\left(q_j^s\right).$$

- First order condition for Firm's problem in the continuous case:

$$c_j'\left(q_j^s\right) = p.$$

- The solution to this equation is called the individual supply of firm j and it is denoted by $q_j^s(p)$.
- By differentiation we get the individual law of supply:

$$q_j^{s\prime}(p) = \frac{1}{c_j''\left(q_j^s\right)} > 0.$$

- In words, more is supplied at higher output prices.

Description of the market place

- In competitive analysis, firms and consumers meet in an anonymous market.
- Anonymity means that the price is the same for all participants and not dependent on the identities i and j.
- Both the buyers and the sellers are price takers: the price is assumed to be given and does not depend on individual demands q_i and supplies q_j^s.
- Price is linear: the cost of buying q_i units is $p \cdot q_i$ rather than a more general function $p(q_i)$.
- All buyers and all sellers know the price.
- We cover here the case with continuous demands and supplies, but the arguments generalize easily to the discrete case too. The market functions as follows

- Aggregate market demand Q is obtained by summing over i all individual demand functions:

$$Q(p) = \sum_{i=1}^{I} q_i(p),$$

where I is the total number of consumers in the market.

- By the individual laws of demand, we get

$$Q'(p) = \sum_{i=1}^{I} q_i'(p) < 0.$$

Market demand curve is thus downward sloping.

- Market supply $Q^s(p)$ is obtained by summing over j all individual supply functions:

$$Q^s(p) = \sum_{j=1}^{J} q_j^s(p),$$

where j is the total number of firms in the market.

- By individual laws of supply, we get

$$Q^{s\prime}(p) = \sum_{j=1}^{J} q_j^{s\prime}(p) > 0,$$

so that market supply curve is upward sloping.

- An equilibrium in the market is a pair (p^*, Q^*) such that markets clear:

$$Q^* = Q(p^*) = Q^s(p^*).$$

- Observe that in equilibrium, each firm j supplies quantity $q_j^s(p^*)$ and each consumer i demands $q_i(p^*)$.
- In other words, every single consumer chooses the optimal consumption level, and every firm chooses the profit-maximizing output, given the market price.
- This shows that in partial equilibrium analysis, aggregating individual consumers and firms is really easy.

Markets, Efficiency, and Welfare

- How to define efficiency?
- As you know, in economics this refers to **Pareto-efficiency**:

Definition

A feasible allocation is Pareto-efficient if there is no other feasible allocation where at least one of the agents is better off and none of the agents is worse off.

- Another way of phrasing this: Starting from a Pareto-efficient allocation, you cannot help anyone without hurting someone else.

- What is an Pareto-efficient allocation in the current context?
- Recall, the welfare of a consumer with quasilinear preferences is

$$u_i(y_i, q_i) = v_i(q_i) + y_i.$$

- Similarly, for firms the relevant welfare measure is their profit in terms of the composite good:

$$\pi_j(y_j, q_j) = y_j - c_j(q_j).$$

- The key insight is the following: in any Pareto-efficient allocation,

$$v_i'(q_i) = v_{i'}'(q_{i'}) = c_j'(q_j) = c_{j'}'(q_{j'}) \text{ for all } i, i', j, j'.$$

- In other words, marginal utilities and costs must be equal across consumers and firms

- To see why this must be true, notice that profitable trade exists between buyers i and i' if $v_i'(q_i) \neq v_{i'}'(q_{i'})$, and between consumer i and producer j if $v_i'(q_i) \neq c_j'(q_j)$.
- Similarly, a profitable reallocation of production exists between j and j' if $c_j'\left(q_j^s\right) \neq c_{j'}'\left(q_{j'}^s\right)$.
- Hence the allocation is Pareto efficient only if $v_i'(q_i) = c_j'(q_j) = p$ for some p.
- Finally, an allocation is feasible only if at least as much is produced as consumed.
- But efficiency requires that total produced should not exceed total amount consumed (no waste). Therefore

$$Q(p) = Q^s(p),$$

and this happens only when $p = p^*$ and $Q(p) = Q^s(p) = Q^*$.

- This is the *First Welfare Theorem* applied in our context: The competitive equilibrium is Pareto efficient.
- Moreover, with quasi-linear preferences, there no are other Pareto-efficient allocations: there is only one allocation that equates marginal utilities and marginal costs across consumers and firms.
- Inverses of aggregate demand and supply have also straight-forward interpretations:
  - Inverse of aggregate supply can be viewed as the industry marginal cost function:
$$C'(\cdot) = (Q^s)^{-1}(\cdot)$$
  - Invese of aggregate demand (inverse demand function), gives the marginal social benefit of good l :
$$P(\cdot) = (Q')^{-1}(\cdot)$$

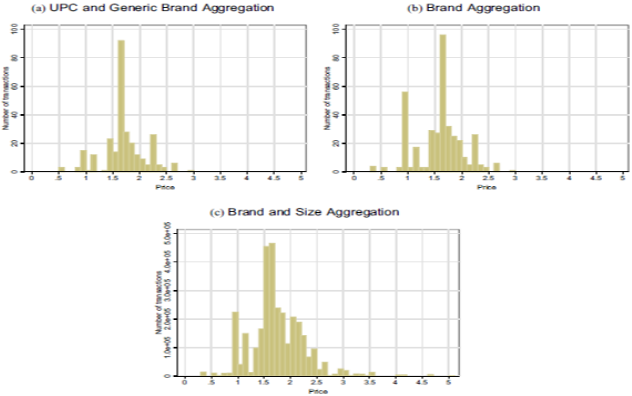
- There is a "normative" representative consumer
- Equilibrium price equates marginal social benefit and marginal social cost of production of l, and in this way ensures that the total welfare is maximized
- The familiar Consumer's and Producer's surpluses measure the shares of welfare going to the consumers and firms, respectively
- Discuss:
  - How do externalities affect the properties of equilibrium?
  - How could prices be corrected to account for externalities?

Learning points from the model

- In competitive anonymous markets:
  - Prices adjust to clear the market
  - A unique price obtains in the market: Law of one price.
  - Competitive equilibrium allocation is efficient, and hence maximizes the sum of producers' and consumers' surplus
  - In other words, price signals simultaneously marginal value and marginal cost of adding output
  - Of course, this hinges on strong assumptions of the model:
    - No market power
    - Perfect information

Law of one price in real markets

- Predictions of basic partial equilibrium analysis seem to work reasonably well in centralized markets such as commodity exchanges
- But fail in many familiar decentralized markets
- A good example: supermarkets
  - Markets do seem to clear reasonable well
  - Law of one price fails.
- This failure has been documented in numerous markets. (see the review article Baye and Morgan, 2005, for extensive discussion on this)
- Does not seem to be too sensitive to the definition of market
- A broad and systematic analysis is presented by Kaplan & Menzio (2014): The Morphology of Prices



NOTES: Figures show distribution of transaction prices for ketchup in Minneapolis in 2007:Q1. Panel (a) shows prices for 36-oz bottles of Heinz brand ketchup, in accordance with the UPC and Generic Brand Aggregation definitions of a good. Panel (b) shows prices for 36-oz bottles of ketchup from all brands, in accordance with the Brand Aggregation definition of a good. Panel (c) shows prices per 36 ounces of ketchup for bottles of ketchup from all brands in all sizes, in accordance with the Brand and Size Aggregation definition of a good. Transactions include those at all stores in Minneapolis, including stores without a unique identifier.

FIGURE 1

DISTRIBUTION OF PRICES FOR A 36-OZ BOTTLE OF HEINZ KETCHUP

How to explain this?

- Maybe the stores are differentiated
  - Some stores higher quality
  - Some stores at more attractive locations
  - But according to Kaplan % Menzio variation by store accounts only for 10% of total price variation
- Maybe supermarkets have different costs
  - Maybe they have different wholesale prices
  - But wholesale price depends on the chain to which the store belongs and the chain explains very little of the price variation.

- Maybe supermarkets are special
  - shoppers get a basket of goods, not a single good
  - But Sorensen (2000) shows similar price dispersion for prescription drugs in pharmacies in a small town.
    - In Sorensen (2000), variation in prices seems to be independent in the sense that some drugs are expensive while others are cheap at a given pharmacy.
- Maybe shoppers are not aware of all the prices in their market
  - Maybe searching for price information is costly
  - How should sellers' respond to consumer search frictions?
  - This is in fact the leading explanation
  - We look at this in more detail in the next lecture

- Later in this course, we will also look at somewhat different reasons that lead to price variation:
    - price discrimination across consumer groups
    - intertemporal price discrimination
    - peak-load pricing

Further readings

- For the partial equilibrium analysis, see any intermediate level microeconomics book
- To move beyond quasilinear utilities to general equilibrium analysis, see more advanced microeconomics textbooks such as Jehle and Reny: Advanced Microeconomic Theory or Mas-Colell, Whinston and Green: Microeconomic Theory
- For empirical analysis of price dispersion, see e.g.
  - Kaplan and Menzio (2015), "The Morphology of Price Dispersion", International Economic Review
  - Sorensen (2000), "Equilibrium Price Dispersion in Retail Markets for Prescription Drugs", Journal of Political Economy
  - Survey article "Information, Search, and Price Dispersion" by Baye and Morgan (available online) contains a lot of other references