Price Discrimination

Jasmine. Hao[1]

[1]University of Hong Kong

ECON 2216: Industrial Organization

Outline

Outline

1. Price Discrimination
   - Incentive and Conditions for Price Discrimination
   - Types of Price Discrimination
   - Welfare Effects of Price Discrimination
   - Nonlinear Pricing
   - Tie-in Sales
   - Quality Choice
   - Other Methods of Nonlinear Pricing

Outline

Profit Motive for Price Discrimination

- Price discrimination is profitable because consumers who value the good the most pay more than if prices were uniform
- The monopoly sets that price so that its $MR = MC$. Its marginal revenue is the sum of two effects:
  - Increase in revenue from selling one more unit, which is the price p that it receives for the last unit
  - Decrease in revenue on all existing output $Q\Delta p$, where Δp is the fall in price needed to induce the sale of one more unit
- If the monopoly could lower the price on only the one additional unit, it would do so as long as the price exceeded marginal cost. It would then earn its current profit plus an additional amount on the last unit
- All methods of price discrimination can be viewed as attempts to minimize this second effect on marginal revenue from expanding sales

Conditions for Price Discrimination

- Three conditions are needed for successful price discrimination
  1. A firm must have some market power
  2. The firm must know or be able to infer consumers' willingness to pay for each unit, and this willingness to pay must vary across consumers or units
  3. A firm must be able to prevent or limit resales by customers who pay the lower price to those who pay the higher price. Any attempt to charge one group a higher price than another is doomed to fail if resales are easy

Resales[1]

- If a firm charges nonuniform prices, consumers who buy at a relatively low price may resell to those facing a relatively high price and thereby render useless the attempt to charge different prices
- There are at least seven reasons why reselling the good may be difficult or impossible for consumers:
  - **Services**: Most services cannot be resold
    - ⋆ e.g., a dentist may charge Lisa a very high price and Jackie a very low price, but it is impossible for Lisa to gain by hav- ing Jackie purchase the dentist's services for her
  - **Warranties**: A manufacturer can void a warranty if a product is resold, which imposes a cost on a buyer who purchases a product from a previous buyer.
  - **Adulteration**: A manufacturer can adulterate a product to make it unfit for other uses
    - ⋆ e.g., alcohol is used for drinking (alcoholic beverages) and for medicinal purposes (rubbing alcohol)

Resales[2]

- There are at least seven reasons why reselling the good may be difficult or impossible for consumers (cont'd):
  - **Transaction Cost**: If consumers incur any large transaction costs to resell the product, resales are less likely
    - Two important examples of transaction costs are tariffs and transportation costs
    - Laws sometimes allow a company to charge more for its product in one country than in another by preventing others from shipping the good from the low-cost country to the other
  - **Contractual Remedies**: A firm may contractually forbid resale as part of its terms of sale
    - e.g., many universities arrange for students and faculty members to purchase computers at lower than market rates. To buy at this reduced rate, one might have to sign a contract that forbids resale

Resales[3]

- There are at least seven reasons why reselling the good may be difficult or impossible for consumers (cont'd):
  - **Vertical Integration**: A firm that produces at more than one stage of a production process is said to be vertically integrated
    - Suppose a manufacturer wants to sell aluminum ingots to producers of aluminum wire at a lower price than it charges producers of aluminum aircraft parts. If the manufacturer did charge two different prices, the wire producers would resell their ingot to the aircraft producers. The ingot manufacturer may choose to produce aluminum wire
  - **Government Intervention:** The government can enact laws that allow firms in a competitive industry to act collectively to prevent resale
    - e.g., government regulations control how much of an orange grower's crop can be sold as fresh fruit and how much as processed

Outline

Perfect Price Discrimination (First-Degree Price Discrimination)

- **Perfect price discrimination** or **first-degree price discrimination** occurs when a monopoly is able to charge the maximum each consumer is willing to pay for each unit of the product
- Perfect price discrimination requires detailed knowledge about individual buyers
  - it is more likely to occur when one-on-one bargaining occurs
    - ⋆ e.g., a car salesperson may ask potential buyers about their jobs, where they live, and where else they have shopped in an effort to estimate the maximum they are likely to spend
    - ⋆ e.g., doctors may be able to successfully price discriminate if they can identify the wealthy people in their area

Perfect Price Discrimination: Each Consumer Buys One Unit[1]

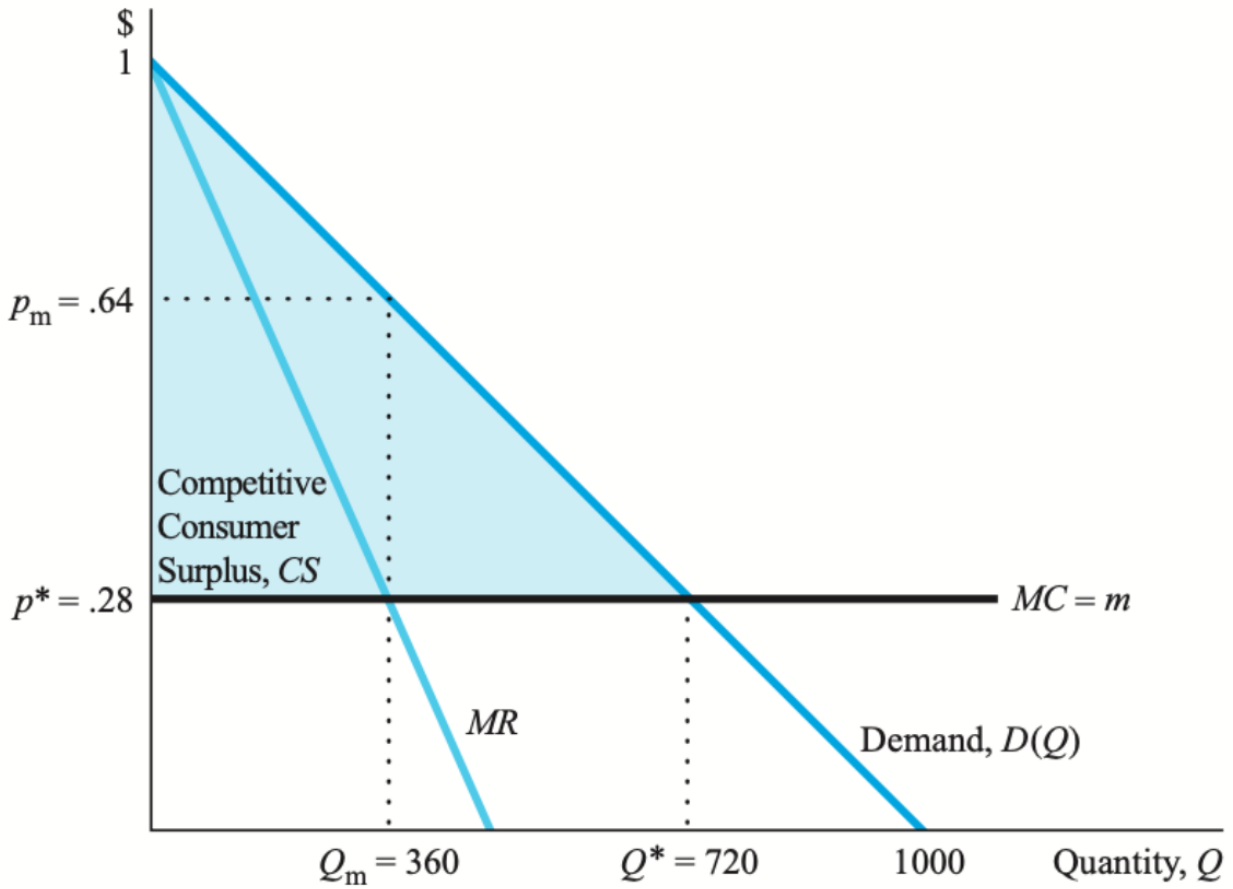
- Suppose that each consumer wants one unit of a product, but consumers are willing to pay a different amount for it, so that the demand curve slopes downward
- Assume that the firm knows the maximum amount that each consumer is willing to pay
  - If it can prevent resales, the firm charges each customer the maximum that person is willing to pay so the customer is left with no consumer surplus
  - The firm sells to any consumer who will pay at least as much as the firm's marginal cost,$MC = m$
  - The perfectly discriminating monopoly sells Q^* units and the marginal consumer pays p^*

Perfect Price Discrimination: Each Consumer Buys One Unit[2]

- A competitive industry would also sell Q* units and charge everyone a single price, p*, which equals the marginal cost. The difference is that:
  - The perfectly discriminating monopoly charges all but the marginal customer more than p* so that there is no consumer surplus
  - Consumer surplus is maximized under competition and captured by a perfectly discriminating monopoly
  - Perfect price discrimination entails no efficiency loss but does affect the distribution of income
- The perfectly discriminating monopoly produces more than the nondiscriminating, single-price monopoly as the perfectly discriminating monopoly makes an incremental profit on each additional sale:
  - By charging each consumer a different price, the perfectly discriminating monopoly avoids the adverse second effect on marginal revenue
  - It lowers price to only the additional customer and so gains that price as an increase in its revenues from selling one more unit

Perfect Price Discrimination: Each Consumer Buys One Unit[3]

FIGURE 9.1 Competitive, Nondiscriminating Monopoly, and Perfectly Discriminating Monopoly



Perfect Price Discrimination: Each Consumer Buys More Than One Unit

- A perfectly discriminating monopoly charges a different price for each unit of the product that is sold and thus extracts all the consumer surplus from each customer
  - The monopoly charges a high price for the first unit consumed, a lower price for the next unit, and so on until it charges m
  - That is, the monopoly sets its (marginal) price schedule equal to each customer's demand curve
- An alternative and equivalent method of perfect price discrimination would be to charge an **optimal two-part tariff**
  - where each customer pays a lump-sum fee for the right to purchase plus a per-unit charge of m for each unit consumed regardless of how many units each consumer purchases
  - If a customer's consumer surplus is CS when price is m (figure 9.1), then the monopoly sets the lump-sum fee equal to CS
  - The consumer is indifferent between buying or not because the monopoly captures all the consumer surplus
  - This pricing method yields the competitive output and generates the same profit for the monopoly as it would earn if it perfectly price discriminated

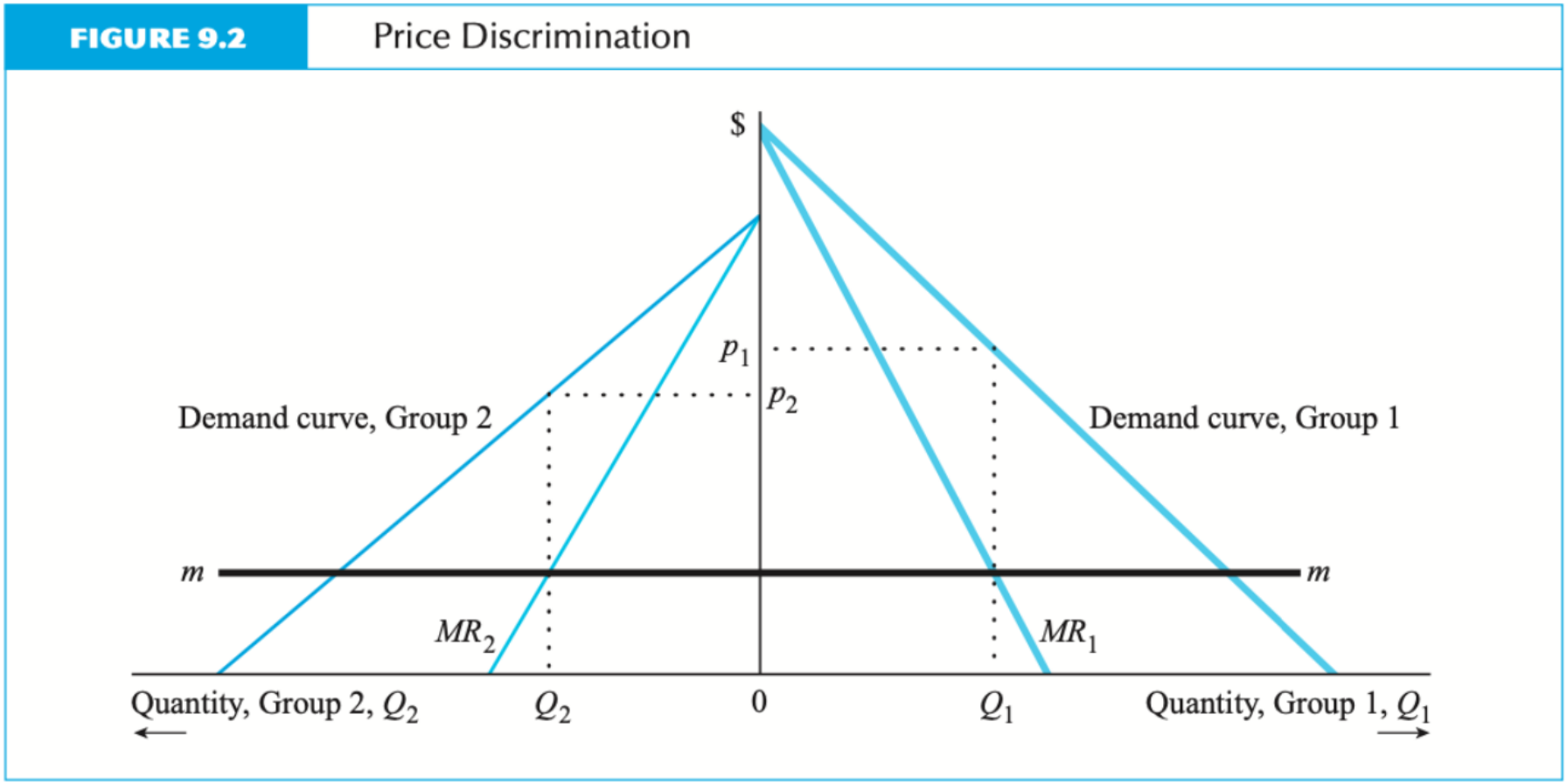
Third-degree price discrimination: Different Prices to Different Groups[1]

- **Third-degree price discrimination**: It charges consumers in different groups different unit prices.
- Suppose a firm can determine whether a particular customer belongs to one group rather than another where the demand elasticities for the aggregate demand curves of the two groups differ, it is profitable to set different prices for the two groups
- If the monopoly has a constant marginal and average cost of m, its profit π is

$$\pi = [p_1(Q_1) - m]\, Q_1 + [p_2(Q_2) - m]\, Q_2$$

  - where $p_1(Q_1)$ and $p_2(Q_2)$ are inverse demand curves

Third-degree price discrimination: Different Prices to Different Groups[2]



Third-degree price discrimination: Different Prices to Different Groups[3]

- The monopoly maximizes its total profit by maximizing its profits from sales to each of the groups separately, that is when $MR_i = m$:

$$MR_1 \equiv p_1 \left(1 + \frac{1}{\epsilon_1}\right) = m$$

$$MR_2 \equiv p_2 \left(1 + \frac{1}{\epsilon_2}\right) = m$$

- Because m is the same in both equations, it follows that the profit-maximizing monopoly equates marginal revenue across the two markets: $MR_1 = MR_2$
- In the optimal solution, if the monopoly sells one less unit in Market 1 and one more unit in Market 2 or vice versa, revenues must be unaffected

Third-degree price discrimination: Different Prices to Different Groups[4]

- Rewriting the two equations above:

$$\frac{p_1 - m}{p_1} = -\frac{1}{\epsilon_1}$$

$$\frac{p_2 - m}{p_2} = -\frac{1}{\epsilon_2}$$

  - percentage markup of each Group i's price over its marginal cost $\left(\frac{[p_i - m]}{p_i}\right)$ is inversely proportional to its elasticity of demand: the higher the group's elasticity of demand, the lower the price and the closer the price is to marginal cost
- Combining the equations to show that the price ratio to the two groups depends on their relative elasticities:

$$\frac{p_1}{p_2} = \frac{1 + \frac{1}{\epsilon_2}}{1 + \frac{1}{\epsilon_1}}$$

  - a profit-maximizing discriminating monopoly provides a discount to the group that has the higher elasticity of demand

Third-degree price discrimination: Other Methods

- One way a firm can charge different prices to consumers is to set a high list price
  - The firm charges the list price unless a customer complains that it exceeds the price of the product at other stores
  - In the event of a complaint, the store matches the lower price
  - This method of pricing causes uninformed consumers to pay higher prices than knowledgeable ones
- Another example of third-degree price discrimination involves exploiting differences in the value customers place on time
  - High-wage, high-income people typically value their time more than low-wage, low-income people
  - One way to price discriminate between these two groups is to make a special offer that requires consumers to spend time to take advantage of the offer
- A related method of price discrimination is to exploit differences in the willingness of consumers to wait to consume a new product
  - e.g., some people insist on being among the first to see a new movie or own the latest electronic gadget
  - e.g., early purchasers pay more than later purchasers if prices fall over time

Outline

Welfare Effects of Price Discrimination[1]

- Perfect price discrimination does not distort efficiency but does affect the distribution of income
  - With first-degree discrimination, consumers wind up with less surplus than under competition
- The welfare effects of third-degree discrimination are more difficult to analyze
  - Third-degree price discrimination prices exceed marginal costs, so they are not as efficient as perfect competition or perfect price discrimination
  - Third-degree price discrimination may be better or worse than nondiscriminating monopoly pricing from an efficiency viewpoint, depending on the shapes of the demand and cost curves
  - The closer imperfect price discrimination is to perfect price discrimination, the more likely it is that the price discrimination leads to a more efficient outcome than nondiscriminating monopoly pricing

Welfare Effects of Price Discrimination[2]

- There are three sources of inefficiency in third-degree discrimination:
  1. Price exceeds marginal cost
     - ★ which results in an output restriction and hence an output inefficiency
  2. Consumption inefficiency
     - ★ because different consumers pay different per-unit prices for a product, each consumer's marginal willingness to pay is not the same, which results in an inefficiency because of unexploited opportunities for further trade
  3. Consumers may have to expend resources that do not benefit the firm to obtain a low price
     - ★ e.g., the consumer may have to wait in line or travel to a distant location to obtain the low price
- Welfare may be higher with third-degree price discrimination than with a nondiscriminating monopoly if output is higher with discrimination
  - e.g., suppose there are two groups of consumers and a nondiscriminating monopoly finds it optimal to set a price so high that one group buys no units
  - Then, because a discriminating monopoly serves both groups, output expands and consumers benefit in aggregate
  - However, which type of monopoly leads to greater welfare is theoretically ambiguous and is an empirical question

Outline

Nonlinear Pricing

- **Nonlinear pricing** occurs when a consumer's total expenditure on an item does not rise linearly with the amount purchased - i.e. price per unit varies with the number of units the customer buys
- Methods of nonlinear pricing are used to practice **second-degree price discrimination**
  - Can prevent resale between individuals charges different consumers different prices
  - But the firm does not know the demands of each individual

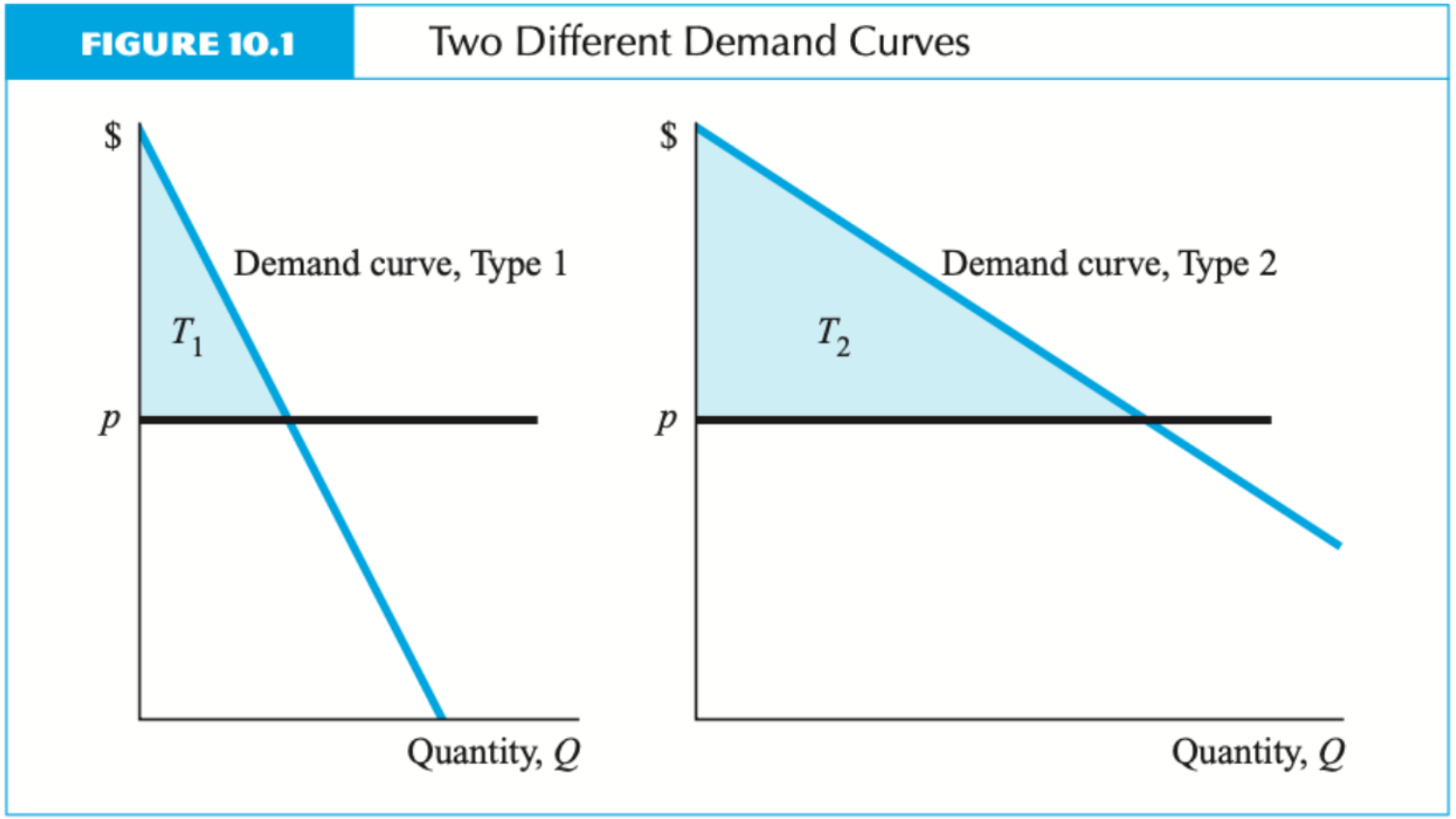
A Single Two-Part Tariff[1]

- A firm that uses a two-part tariff charges consumers a lump-sum fee for the right to purchase goods and a usage charge per unit
  - e.g. a firm sells cameras whose use requires a special type of film (such as Polaroid's instant-picture cameras):
    - Purchase of the camera = the payment of a lump-sum fee
    - The film purchases = the payment of a usage-sensitive fee
  - Resale must be prevented in a two-part tariff
    - Otherwise, it would make sense for one customer to pay one fixed fee and purchase all the goods, and then resell them to everyone else

A Single Two-Part Tariff[2]

- Assume that the firm knows that demands differ within the population but lacks specific knowledge of each individual consumer's demand. Even though the firm knows the general distribution of demand, it may be unable to determine the group to which a particular customer belongs:
  - Suppose that there are only two types of consumers, and they have the demand curves as shown in figure 10.1
    - A Type 2 customer is willing to buy more at price p and enjoys more consumer surplus ($T_2 > T_1$) than does a Type 1 customer
    - If a firm charging a price p per unit could identify each customer's type, it could also charge a Type 1 customer a fee of T_1 and a Type 2 customer a fee of T_2.
  - Suppose the firm must choose a single two-part tariff
    - It chooses a lump-sum fee T and a per-unit charge p so as to maximize profits
    - If $p > AVC$: the firm earns positive net revenues from additional sales
    - If the firm is unable to distinguish consumer types and charges a single two-part tariff involving a per-unit charge of p, the lump-sum fee it charges cannot exceed T_1 if Type 1 consumers are to participate

A Single Two-Part Tariff[3]



A Single Two-Part Tariff[4]

- The firm faces a dilemma:
  - If it charges a low price, it sells more of its product and can charge a higher lump-sum fee
  - On the other hand, its ability to charge a high lump-sum fee to extract the consumer surplus of Type 2 consumers is constrained by the Type 1 consumers' low willingness to pay
  - In many cases, the firm may make higher profits by concentrating on Type 2 consumers, letting Type 1 consumers choose not to purchase the product
  - The less similar Type 1 consumers are to Type 2 consumers, the more difficult it is for the firm to extract consumer surplus from Type 2 consumers with a single two-part tariff
- The optimal two-part tariff
  - generates more profits than a single price, because a single price is a special type of a two-part tariff: a two-part tariff with a zero lump-sum fee
  - generates less profit than first-degree price discrimination, but may or may not generate less profit than third-degree price discrimination
  - unlike with third-degree price discrimination, a firm need not be able to identify which type a consumer is to use a two-part tariff

Two Two-Part Tariffs[1]

- The amount paid can vary with the amount purchased in any prespecified way:
  - The price paid is a function of quantity, and the firm is allowed to choose any function it desires
- Suppose a firm knows the demand curves of two types of consumers (Type 1 and Type 2) and the prevalence of different types of consumers in the population, but it does not know the type of any individual consumer
  - The firm can offer consumers a choice of two different two-part tariff schedules
    - Each consumer chooses the schedule that corresponds to a higher level of utility
  - The two schedules are shown as straight, black lines in Figure 10.2
    - Intercepts on the vertical axis are the fixed, lump-sum fees
    - Slopes of the curves are the constant marginal costs

Two Two-Part Tariffs[2]

- Suppose a firm knows the demand curves of two types of consumers (Type 1 and Type 2) and the prevalence of different types of consumers in the population, but it does not know the type of any individual consumer (cont'd)
  - The consumer can purchase a small number of units for less money by choosing Two-Part Tariff Schedule 1 and a large number of units for less money by choosing Two-Part Tariff Schedule 2
    - Following this reasoning, consumers choose the lower "envelope" of the two curves (a thick blue kinked line)
  - The firm chooses its two two-part tariff schedules to maximize its profits
    - It provides a choice of two two-part tariffs in order to separate consumers into groups, so it can lower the price to one group without having to pass along the same low price to the other group.
    - If the firm knew which consumers belonged to each group and could prevent resale, the firm could design a two-part tariff for each group

Two Two-Part Tariffs[3]

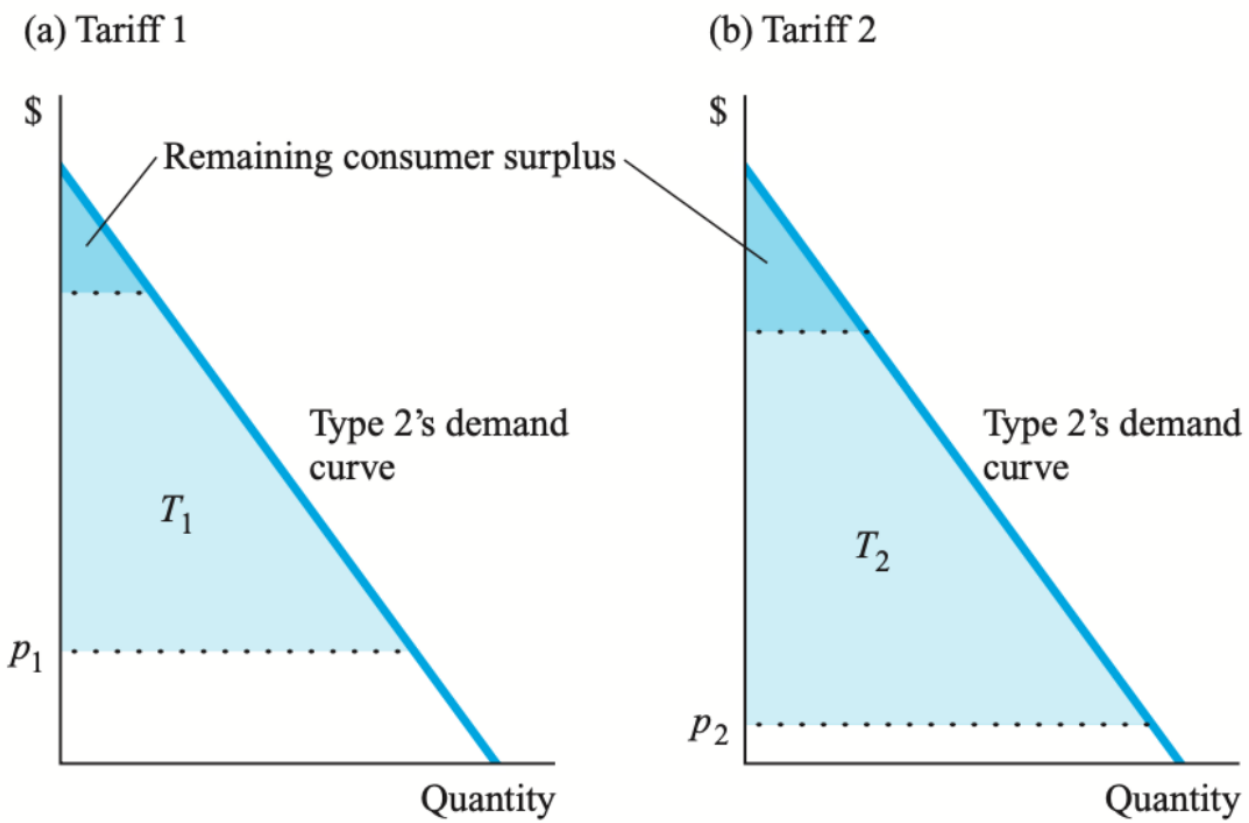
- The firm designs its pricing structure to maximize profits subject to a self-selection constraint: a restriction on a firm's pricing structure such that consumers in any group do not prefer another group's two-part tariff schedule
  - e.g., suppose that Type 2 consumers demand more units than Type 1 consumers at every price
    - ★ The firm's optimal policy is for the Type 2 consumers' fixed fee (T_2) to exceed the fee for Type 1 consumers (T_1); the marginal price facing Type 2 consumers (p_2) to be below that for Type 1 consumers (p_1) and to equal marginal cost
    - ★ By offering a low price to the large demanders, customers derive a large consumer surplus, which the firm captures through T_2. The high T_2 discourages the small-volume buyers (Type 1), who prefer to pay a higher marginal price on the smaller amounts they purchase

Two Two-Part Tariffs[4]

- Figure 10.3 illustrates this example for Type 2 consumers:
  - Even though $T_2 > T_1$, a Type 2 consumer prefers (T_2, p_2) to (T_1, p_1) because the price is lower $(p_2 < p_1)$ so that the remaining consumer surplus is higher under the second tariff
  - Type 1 consumers prefer (T_1, p_1) to (T_2, p_2)
  - Their remaining consumer surplus is higher under the tariff (T_1, p_1) because they can take advantage of the low fixed fee
  - Type 2 consumers benefit from the presence of the Type 1 consumers. Consumer diversity helps consumers who have large demands

Two Two-Part Tariffs[5]

FIGURE 10.3 How a Type 2 Consumer Fares Under the Two-Part Tariffs



Outline

What is Tie-in Sales

- **Tie-in sale** is one in which a consumer can buy one good only by purchasing another good as well
  - e.g. if a supermarket sells you a pound of coffee on the condi- tion that you also buy sugar, that would be a tie-in sale

General Justifications for Tie-in Sales[1]

- Besides price discrimination, tie-in sales may be used to increase efficiency, avoid price regulations, give secret price discounts, and to assure quality
- Efficiency
  - Tie-in sales may be used to increase efficiency
    - e.g., laced shoes are typically sold with laces; everyone who buys laced shoes needs shoe laces
- Evade Regulations
  - Tie-in sales may be used to avoid price regulations
  - Imagine that the government sets price controls on steel. Suppose the controlled price is below the market-clearing price by \$5.00
    - One method of circumventing price controls is to sell steel at the controlled price but only on the condition that the consumer also pay \$5.25 for a pencil that costs 25¢ to produce
    - In this way, the market-clearing price for steel is maintained, and the price controls are still met

General Justifications for Tie-in Sales[2]

- Secret Price Discounts
  - Tie-in sales may be used to offer secret price discount
    - A member of an oligopoly may want to give price discounts without rivals knowing about them
    - It may be able to keep its discounts secret by selling a product at the oligopoly price but tying that sale to another product with a very low price
- Assure Quality
  - A firm may assure quality by forcing customers to buy another of its products or services or to not use substitutes

Tie-in Sales as a Method of Price Discrimination

- There are two common types of tie-in sales:
  1. **bundling** or a **package tie-in sale**: two or more products are sold only in fixed proportions
  2. **requirements tie-in sale**: customers who purchase one product from a firm are required to make all their purchases of another product from that firm
- Tie-in sale is effective only if trades between consumers are prevented

Outline

Quality Choice

- Consumers prefer different levels of quality, a monopoly manipulates the qualities of goods in order to extract consumer surplus
  - e.g., an automobile monopoly may choose to produce only very high-quality and very low-quality cars. By not providing close substitutes for the high-quality cars, the monopoly may be able to extract more profit from selling them
    - The firm can charge a high price for the high-quality car and not worry about consumers substituting to the low-priced, low-quality car because it is not a good substitute

Outline

Minimum Quantities and Quantity Discounts

- Many sellers specify that their product can be bought only in certain minimum amounts
  - Causes pricing to be nonlinear
  - The average price per unit consumed is very high for small quantities and is lower after consumption reaches the minimum purchase level

Selection of Price Schedules

- Sometimes consumers must choose the pricing schedule that will govern their purchases before they know how much they will purchase
  - e.g., some telephone companies require consumers to select a pricing schedule at the beginning of the month
- By requiring customers to specify in advance the pricing schedule they will face, monopolies can discriminate between those who can accurately predict their demands and those who cannot
  - Those who cannot accurately predict may overpay relative to those who can predict accurately

Premium for Priority

- If consumers differ in their desires to obtain a good quickly, a firm can charge more for rapid delivery
  - e.g., a common pricing strategy for new goods is to price high initially and then to lower price over time
- Airlines often charge more for tickets ordered one day in advance than for those ordered several weeks in advance
  - Possible reason: business people, who often travel on short notice, have a less elastic demand than tourists, who do not travel on short notice
- When obtaining a good is uncertain, it may be possible to price discriminate by charging different prices for different probabilities of obtaining the good

Auctions

- Some firms use auctions to sell valuable assets, such as art, antiques, off-shore oil leases, and Treasury bills
  - Purpose of an auction: to obtain the maximum revenue from buyers when the seller does not know which buyers value the goods the most
  - Objective: to design a pricing mechanism that induces the consumers with the greatest willingness to pay to bid high prices
- If buyers maximize expected consumer surplus and have independent valuations of the item in the auction, Dutch and English auctions yield the same expected revenues, and it is optimal to set minimum bids
  - English auction: an auction in which bids start low and rise until there is no one willing to bid any higher
  - Dutch auction: an auction in which the price starts out very high and is slowly lowered until one person agrees to buy at that price

For Further Reading I

- Carlton, Dennis W., and Jeffrey M. Perloff. Modern Industrial Organization. Fourth edition. Harlow, Essex, England: Pearson, 2015. Print.
- Belleflamme, Paul., and Martin. Peitz. Industrial Organization : Markets and Strategies. Cambridge, UK ;: Cambridge University Press, 2010. Print.