Durability

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Outline

1. How Long should a Durable Good Last?
   - Competitive Firm's Choice of Durability
   - The Monopoly's Choice of Durability
   - Costly Installation and Maintenance

2. Renting Versus Selling by a Monopoly
   - Resale Market
   - Consumers' Expectations Constrain the Monopoly

Durability

- This part answers two questions about durability:
  1. Does market structure affect the durability of products?
  2. Does it matter whether a monopoly rents or sells its goods?

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How Long should a Durable Good Last?

- When buying a durable good, consumers consider how long it should last and its resale value in future years
  - e.g., manufacturers of high-quality, expensive cars often argue that consumers are better off buying their cars than less expensive, lower-quality ones because the better cars last longer and can be resold for a higher percentage of their initial purchase price in any future year

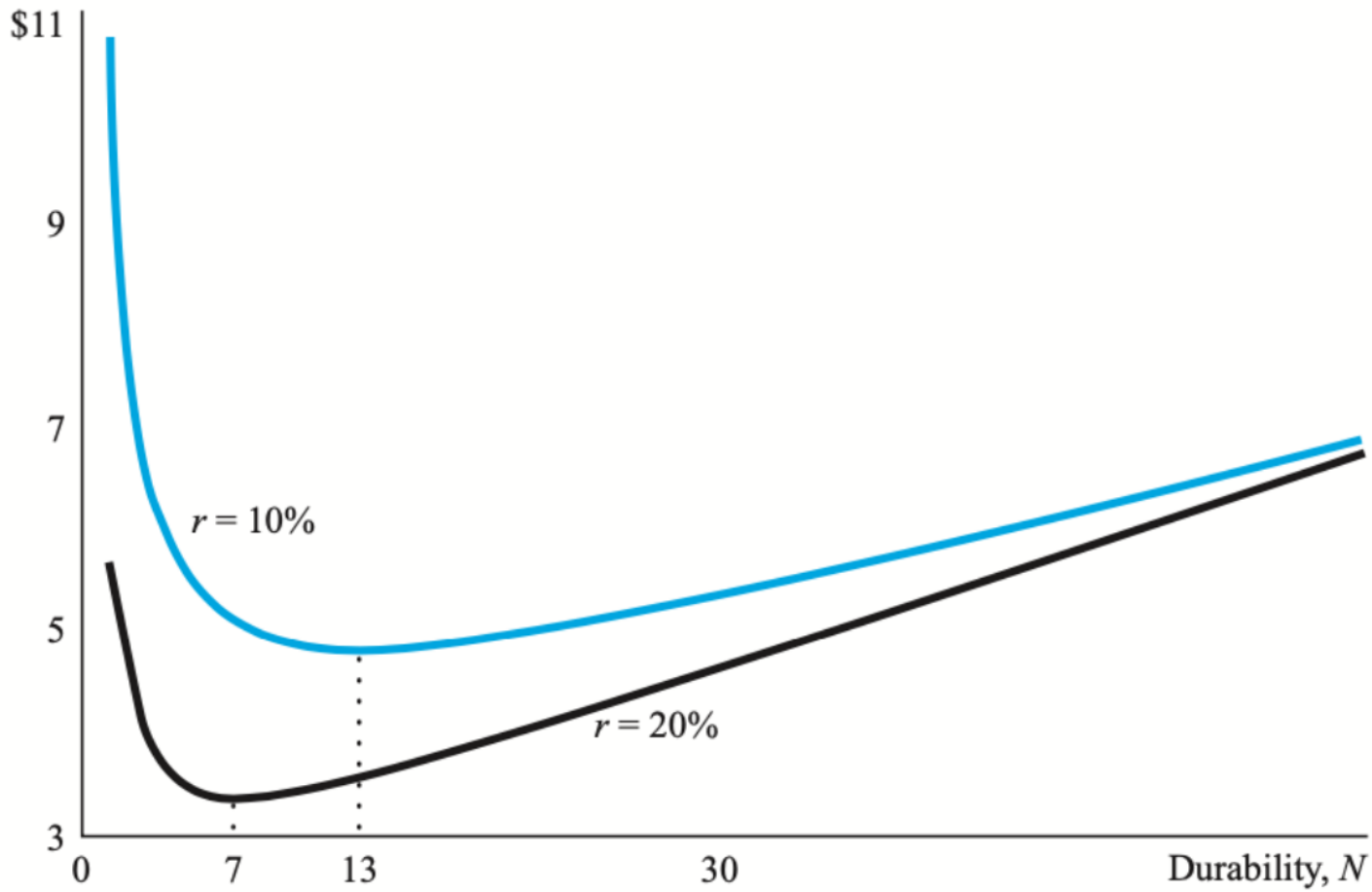
Competitive Firm's Choice of Durability[1]

- Consider a competitive light bulb manufacturer's trade-off between durability and manufacturing cost
  - Suppose that the constant marginal cost of manufacturing a light bulb that lasts N years is C(N)
  - The more durable the light bulb, the higher the cost of manufacture but the less frequently the bulb wears out
- What is the cost of providing the light service from one light bulb forever?
  - In the first period, the bulb costs C(N)
  - No replacement is needed until N periods later
  - Every N periods, the bulb must be replaced at a cost of C(N) dollars
- Costs in the future are less important than costs today
  - If the interest rate is 10 percent, a dollar next period is worth only \$0.91 today
  - The present value of the cost of providing one light bulb's worth of service forever is the cost of producing it today, plus the discounted cost of producing another after N periods, plus the discounted cost of producing another in 2N periods, and so on

Competitive Firm's Choice of Durability[2]

- Figure 15.1 illustrates the effect of interest rates on the cost of providing one light bulb's worth of service forever

FIGURE 15.1 Present Value of Costs of Providing One Unit of Service Forever



Renting

- Suppose only one company can produce light bulbs: its choice of durability may depend on whether it rents or sells the product
- The monopoly chooses a rental price R and a durability N that maximize profits
- Consumers only care about the rental cost of the light service
  - How long the bulb lasts is irrelevant to consumers if the monopoly instantly replaces burned-out bulbs with new ones
- The monopoly should choose the N that minimizes the discounted present value of the cost of producing $Q(R)$ units of service forever
  - Given constant returns to scale, the N that minimizes total cost also minimizes the cost of producing one unit
- Thus, both a competitive firm and a monopoly choose the same N that minimizes the cost of producing a unit of light service forever
- If there are no scale economies and durability does not affect demand for the service, the optimal durability is identical for a monopoly and a competitor
  - With the same durability, the monopoly produces fewer units at a higher price

Costly Installation

- If the costs are the same for each consumer,
  - both the monopoly and the competitive firm choose the same durability that minimizes the full cost of changing the bulb, including the installation
- If the costs of installing light bulbs vary across consumers (i.e. total costs of buying and installing a light bullbs differ)
  - Consumers with relatively high replacement costs prefer relatively expensive, long-lived bulbs
  - Consumers with relatively low costs prefer relatively inexpensive, short-lived bulbs
- Durability
  - affects the demand for the service
  - is an attribute of the product that the monopoly can use to segregate consumer groups

Maintenance

- Suppose that the durability of the product is determined by consumer behavior as well as by the manufacturer
  - e.g., a consumer may be able to use labor to maintain a machine, such as a car, so that it lasts longer
- Many different combinations of machines of a particular durability and labor services can be used to produce a steady flow of machine services
  - If the price of a machine is relatively high, consumers maintain it longer to economize on the number of times the expensive machine must be purchase
- A monopoly provider of a machine does not want its consumers substituting away from the machine and toward labor
  - Firms may try to prevent this substitution by contracts that place vertical restraints on consumers
  - e.g., a firm may tie maintenance to the purchase of the machine
- Market structure will influence the durability choice
  - When the consumer can alter the lifetime of his machine in response to the price of a new machine, there will be a consumer optimization decision that will constrain a monopoly that sells
  - No such consumer optimization decision in the rental case

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Resale Market[1]

- Effect on a durable goods monopoly if consumers can resell the machine
- Consider a monopoly that produces a nondurable good and sells Q^* units at \$10 to those who value the product the most:
  - Even if those Q^* consumers may resell the product, there are no further transactions
    - because those Q^* consumers who valued the product most already own it, and no one else is interested in bidding the product away
  - The ability to resell leaves the optimal pricing unchanged
- Suppose a monopoly sells durable machines with a lifetime of N and that it is profit-maximizing to sell Q^* units every N periods
  - The initial consumers of the machines are those who value it the most, so there are no resales

Resale Market[2]

- Suppose the overall demand curve for the machine services each period does not vary over time, but the consumers who value the machine the most change
  - There are resales from owners who now place less value on the machines to consumers who now value the machines highly but do not own them
  - Because Q^* machines are available each period and aggregate demand is unchanged, the value consumers place on consuming the product is unchanged over time
- Without a resale market, when the consumers who value the good the most change over time, the monopoly cannot obtain as high profits as it would if the same consumers always valued the good the most
  - e.g., suppose you want the use of a refrigerator during this school year only. If you cannot resell it, you are not willing to pay as much for it as you would if you planned to keep it for its entire product life

Resale Market[3]

- Resales help both consumers and the monopoly
  - by effectively lowering the cost of providing each unit of service to consumers, and
  - by allowing the monopoly to capture the value of subsequent resales in the initial purchase price
- The importance of a secondary market was debated in a famous antitrust case involving Alcoa

Second Hand Economics[1]

- In 1945, Judge Learned Hand, writing for a panel of three judges, found the Aluminum Company of America (Alcoa) guilty of monopolizing the domestic aluminum market.
  - The relevant market consisted of domestic aluminum production and net imports of primary ingot.
  - The court held that secondary aluminum, which is obtained by remelting aluminum scrap, was not part of the market even though secondary aluminum is a close substitute for primary aluminum.
  - Judge Hand's reasoning was that Alcoa controlled the secondary production through its domination of primary production.
  - He contended that the existence of secondary aluminum producers did not substantially curtail Alcoa's monopoly profits from the sale of primary aluminum.

Second Hand Economics[2]

- Economists have examined whether Judge Hand was correct.
  - Gaskins (1974) estimated the demand for aluminum and the supply of secondary aluminum and used other data to simulate the long-run effects of having a secondary market.
    - First, the presence of a secondary (recycling) market causes a durable goods monopoly to set a higher price initially.
    - Second, because the demand for aluminum was growing over time, the constraining effect of the secondary market was small.
  - Swan (1980), using different models, conducted other simulations that reached the same conclusion:
    - Alcoa's predicted price was only slightly below the monopoly price without a secondary market and well above the competitive price (based on Alcoa's own cost figures).

Resale Market[5]

- If demand is growing extremely rapidly so that the supply of the resold material does not account for a large fraction of demand, then there is little constraint on the monopoly
- Suppose consumers do not regard new and used goods as perfect substitutes
  - Then control of the used good market can better allow a monopolist who sells to price discriminate
- A renting monopoly automatically can control the ratio of new and used goods, but this is not true for a monopoly that sells
  - Intervention in the used good market can enable the monopoly that sells to reduce the availability of used goods and charge a higher price for new goods
  - Laws or actions by the monopoly may raise the transaction costs of using the resale market, thereby limiting the competition the monopoly faces from secondhand sales

Consumers' Expectations Constrain the Monopoly

- When resales are possible, the price that consumers are willing to pay for a durable good depends on both the value of the durable good during the period the consumer owns it and the resale value at the end of that period
  - e.g., If you buy a house, the amount you are willing to pay depends in part on how much you think you will receive when you sell it years later
- **Coase Conjecture:** constraining effect of consumers' expectations leads to a surprising result
  - A durable goods monopoly that sells its product has less market power
  - In the extreme case, no market power when compared to a monopoly that rents the durable good

When Consumers Do Not Expect Price Cuts[1]

- Consider a case when consumers do not expect price cuts
- Suppose that a monopoly produces a nondurable good that lasts for only one period. There are no costs of production. The demand curve for the services of the good is

$$Q(R) = 20 - R$$

- The optimal policy for the monopoly is charge \$10 and sell 10 units; monopoly's profits are \$100
  - It makes no difference whether the monopoly rents or sells because there are no future periods

When Consumers Do Not Expect Price Cuts[2]

- Suppose this durable good lasts for two periods with the same demand curve for services in each of the two periods
  - The optimal rental policy for the monopoly if consumers do not expect a price cut in the second period:
    - ★ Monopoly rents 10 units of the good in Period 1 for \$10 and 10 units in Period 2 for \$10, producing all 10 units in Period 1
    - ★ With this policy, the monopoly earns \$200 total (assuming the interest rate is zero)
  - The optimal sales policy if consumers do not expect a price cut in the second period and the monopoly can commit to selling nothing in the second period:
    - ★ The monopoly sells 10 units at the beginning of Period 1 for \$20
    - ★ Consumers are willing to pay \$20 per unit to buy because consumers are willing to pay \$10 per period per unit in Periods 1 and 2
    - ★ The monopoly earns \$200 in Period 1 and no revenue in Period 2
  - The optimal sales policy is equivalent to the optimal rental policy

When Consumers Expect Future Price Cuts[1]

- The monopoly has an incentive to produce in the second period, so that the price in Period 2 is less than in Period 1, and rational consumers anticipate this fall in price
  - Because only one period remains at the beginning there is no difference between the sales price and the rental price for a durable product
- The residual demand curve in Period 2:

$$Q_2(R_2) = 20 - R_2 - Q_1$$

When Consumers Expect Future Price Cuts[2]

- Monopoly has an incentive to produce a positive amount in Period 2
  - The optimal sales policy is not credible to consumers anymore as consumers recognize that the monopoly has an incentive to produce a positive amount in Period 2
    - Consumers in Period 1 are only willing to pay $R_1 + R_2$ where R_1 is the implicit rental value they place on the durable good in Period 1 ($10) and R_2 is the rental value in Period 2 ($5)
    - No consumer values the good at $10 in Period 2 if it can be purchased for only $5
    - Profits that the monopoly earns from sales is $\$15(10) + \$5(5) = \$175$, which is less than the $200 (profit if only rent)
  - A monopoly that only rents is unconstrained in setting profit-maximizing rental fees
- When selling, the monopoly cannot credibly commit to producing zero units in Period 2, in contrast to the rental case
  - because consumers know that it is not optimal for the monopoly to produce nothing in the second period, whereas that policy is optimal if the monopoly only rents

The Monopoly's Optimal Sales Policy[1]

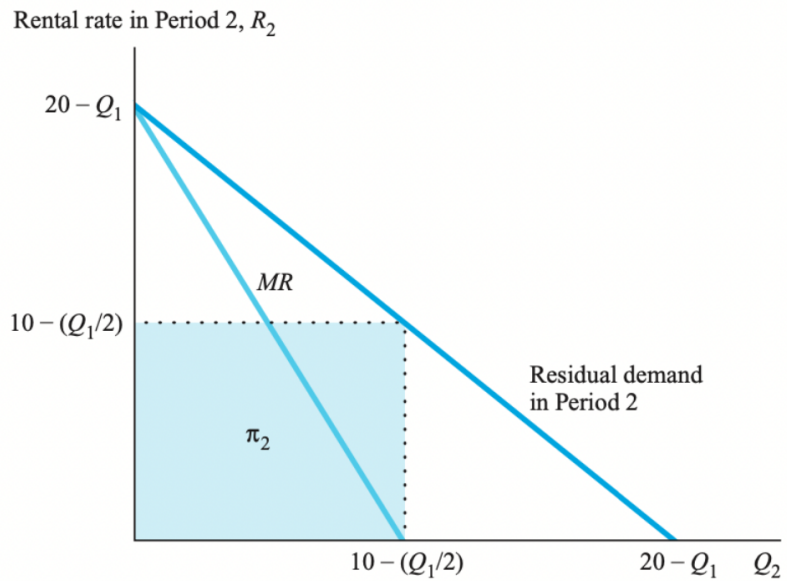
- Suppose the monopoly sells Q1 in Period 1. Then, the residual demand curve facing the monopoly in Period 2 is

$$Q_2(R_2) = 20 - R_2 - Q_1$$

- (Assuming the interest rate is 0) The monopoly wants to maximize the present value of profits (PVP) in the two periods combined:

$$PVP = \pi_1 + \pi_2 = (R_1 + R_2)Q_1 + R_2 Q_2$$

FIGURE 15.2 Profits in the Second Period



The Monopoly's Optimal Sales Policy[2]

TABLE 15.2 Profits in a Two-Period Model

Sales Period 1, Q_1	Rental Rate Period 1, R_1	Sales Period 2, Q_2	Rental Rate Period 2, R_2	Profits Period 1, π_1	Profits Period 2, π_2	Present Value of Profits, $PVP = \pi_1 + \pi_2$
1	19	9.5	9.5	28.5	90.25	118.75
2	18	9	9	54	81	135
3	17	8.5	8.5	76.5	72.25	148.75
4	16	8	8	96	64	160
5	15	7.5	7.5	112.5	56.25	168.75
6	14	7	7	126	49	175
7	13	6.5	6.5	136.5	42.25	178.75
8	**12**	**6**	**6**	**144**	**36**	**180**
9	11	5.5	5.5	148.5	30.25	178.75
10	10	5	5	150	25	175
11	9	4.5	4.5	148.5	20.25	168.75

$\pi_1 = (R_1 + R_2)Q_1$
$\pi_2 = R_2 Q_2$
$Q_2 = 10 - 1/2 Q_1$

- Because R_1 depends on Q_1, PVP can be expressed in terms of only Q_1. Table 15.2 shows how profits vary with Q_1

The Paradox[1]

- When the two-period sales example is extended to cover many periods, the price falls to zero as the number of periods increases
  - A monopoly's behavior can be approximated by a model with a finite number of many short time periods. The price will be driven to zero by this increase in periods.
    - A monopoly that sells a durable good can never receive a price above the competitive price even for a short period of time
- One way to think about this puzzling result is that if the monopoly cannot credibly commit to a policy of no further production, it is as if the monopoly is a different firm in each future period
  - Thus, the monopoly of the future is competing with the monopoly of today
  - Such competition immediately drives the price down to the competitive level

The Paradox[2]

- The results hold for any (constant) positive level of marginal costs
  - The critical assumption is that the output level can be increased costlessly as fast as the monopoly desires
  - If consumers know that the monopoly cannot expand output costlessly, then consumers can credibly believe that output in the future is constrained and therefore the price can remain above the competitive price for some time

How the Monopoly may Solve its Expectations Problem[1]

- A monopoly can only the expectation problem by credibly committing itself not to take advantage of certain profitable opportunities in the future
- There are at least five ways:
  1. The monopoly can **refuse to sell the product and only rent or lease it**
  2. The monopoly may try to **convince consumers that it will limit the number of units it produces**, which will prevent the future price from falling
     - e.g., an artist may commit to producing only a limited number of a particular lithograph (each explicitly numbered) by destroying the plate used to produce it

How the Monopoly may Solve its Expectations Problem[2]

- There are at least five ways (cont'd):
  3. If the firm cannot explicitly contract to control its future production, it may **attempt to acquire a reputation for never lowering price**
     - e.g., De Beers, the South African diamond monopoly, claimed it had a policy of never reducing the nominal price of its diamonds
  4. The monopoly can **produce less durable goods**
  5. The monopoly can use planned obsolescence—purposely making a durable good short-lived—as a way of limiting its ability to lower its price in the future

  The monopoly can **guarantee to buy back products from any consumers at the price they paid for it**
     - This buy-back provision protects the consumer in case the monopoly expands output and thereby lowers price in the future
     - This policy is not feasible where consumer abuse may lower the value of a product

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.