Part IV. Pricing strategies and market segmentation

Chapter 9. Menu pricing

Slides
Industrial Organization: Markets and Strategies
Paul Belleflamme and Martin Peitz, 2d Edition

Chapter 9. Learning objectives

- Be able to make a clear difference between menu pricing and group pricing.
- Understand how a monopolist sets menu prices and under which conditions menu pricing leads to higher profits than uniform pricing.
- Assess the welfare effects of menu pricing.
- Analyze quality- and quantity-based menu pricing in oligopolistic settings.

Menu vs. group pricing

- Group (and personalized) pricing
  - Seller can infer consumers' willingness to pay from observable and verifiable characteristic (e.g., age)
- Menu pricing
  - Willingness to pay = private information
  - Seller must bring consumer to reveal this information.
  - How?
    - Identify product dimension valued differently by consumers
    - Design several versions of the product along that dimension
    - Price versions to induce consumers' self-selection

      → **Menu pricing** (a.k.a. versioning, 2nd-degree price discrimination, nonlinear pricing)

      → *Screening problem*: uninformed party brings informed parties to reveal their private information

Case. **Menu pricing in the information economy**

- Versioning based on quality
  - 'Nagware': software distributed freely but displaying ads or screen encouraging users to buy full version
    → annoyance = discriminating device

- Versioning based on time
  - Books: first in hardcover, later in paperback
  - Movies: first in theaters, next on DVD, finally on TV.
    → price decreases as delay increases

- Versioning based on quantity
  - Software site licenses
  - Newspaper subscription
    → quantity discounts

Case. **Geographical pricing by LCCs**

- Low Cost Carriers have abandoned many of the price discrimination tactics of the airline industry
  - 'Point-to-point' tickets, 'no-frills' flights
- But, geographical price discrimination on their website (Bachis and Piga, 2006)
  - Example: London-Madrid flight
    - 1st leg for British traveller, fare offered in £
    - Return leg for Spanish traveller, fare offered in €
  - If booking occurs at same time and no price discrimination, then ratio of prices = exchange rate
  - Yet, difference of at least 7£ for 450 000 observations
  - Despite possibility of arbitrage.

Monopoly menu pricing

- Quality-dependent prices
  - Consumer's indirect utility when buying one unit of quality s at price p: $U(\theta, s) - p$ (utility $= 0$ if not buying)
  - U increases in s and in θ (taste parameter)
  - Suppose 2 types of consumers
    - 'Low type', in proportion $1-\lambda$, with taste parameter θ_1
    - 'High type', in proportion λ, with taste parameter $\theta_2 > \theta_1$
    - High types care more about quality than low types: $U(\theta_2, s) > U(\theta_1, s)$
    - High types value more any *increase* in quality than low types: $U(\theta_2, s_2) - U(\theta_2, s_1) > U(\theta_1, s_2) - U(\theta_1, s_1)$ for $s_2 > s_1$
      $\rightarrow$ *Single-crossing property*
  - Monopolist can produce s_1 and s_2 at constant marginal costs c_1 and c_2.

Monopoly menu pricing (cont'd)

- Quality-dependent prices: a numerical example
  - Monopolist produces software in 2 versions:
    - Basic version and Pro version (higher quality, with advanced computing functionalities); $c_{basic} = c_{pro} = 0$
  - 120 potential consumers
    - types: λ universities (high type) and $120 - \lambda$ businesses (low type)
    - Willingness to pay:

	Universities	Businesses
Pro	**9**	**3**
Basic	**5**	**2**

    - Single-crossing: $U(\theta_2, s_2) - U(\theta_2, s_1) = 4 > U(\theta_1, s_2) - U(\theta_1, s_1) = 1$

Monopoly menu pricing (cont'd)

	Universities λ	Businesses $120 - \lambda$
Pro	**9**	**3**
Basic	**5**	**2**

- A numerical example (cont'd)
  - Optimal uniform pricing
    - Sell Pro version.
    - Either at $p_{pro} = 9 \rightarrow q_{pro} = \lambda$ & $\pi^{uni} = 9\lambda$
    - Or at $p_{pro} = 3 \rightarrow q_{pro} = 120$ & $\pi^{uni} = 360$
    - So, $\pi^{uni} = \max\{9\lambda, 360\}$
  - If seller can tell universities and businesses apart $\rightarrow$ personalized pricing
    - Sell Pro version at $p_{pro} = 9$ to universities and at $p_{pro} = 3$ to businesses $\rightarrow \pi^{pers} = 9\lambda + 3(120 - \lambda) = 360 + 6\lambda$
  - If seller **cannot** tell universities and businesses apart $\rightarrow$ menu pricing
    - Use the 2 versions to induce self-selection: sell Pro version to universities and Basic version to businesses
    - Problem: find incentive compatible prices

Monopoly menu pricing (cont'd)

	Universities λ	Businesses $120 - \lambda$
Pro	**9**	**3**
Basic	**5**	**2**

- A numerical example (cont'd)
  - Let's find menu prices by trial and error
  - 1st trial: charge each group its reservation price
    - $p_{pro} = 9$ and $p_{basic} = 2$
    - Problem: universities prefer Basic version as it yields larger surplus: $9 - 9 < 5 - 2 \rightarrow$ self-selection is not achieved
    - Self-selection (or incentive compatibility) constraint: price difference $\leq$ premium universities are willing to pay for upgrading to the Pro version: $p_{pro} - p_{basic} \leq 9 - 5 = 4$
  - 2nd trial: charge universities their reservation price and compute incentive compatible price of Basic version
    - $p_{pro} = 9$ and $p_{basic} = 9 - 4 = 5$
    - Problem: businesses don't buy!
    - Participation constraint: price of Basic version $\leq$ businesses' reservation price: $p_{basic} \leq 2$

Monopoly menu pricing (cont'd)

	Universities λ	Businesses $120 - \lambda$
Pro	**9**	**3**
Basic	**5**	**2**

- A numerical example (cont'd)
  - Optimum
    - Combining the 2 constraints: $p_{basic} = 2$ and $p_{pro} = 2 + 4 = 6$
    - Profits: $\pi^{menu} = 6\lambda + 2(120 - \lambda) = 240 + 4\lambda$
  - Menu vs. group pricing
    - Lower profits under menu pricing: $\pi^{menu} - \pi^{pers} = -(120 + 2\lambda) < 0$
    - Inducing self-selection induces two types of losses:
      - Businesses are offered a low-quality product instead of a high-quality one $\rightarrow$ loss: $(120 - \lambda)(2 - 3) = -(120 - \lambda)$
      - Universities are sold the high-quality product at a discount; they are left with an 'information rent' $\rightarrow$ loss: $\lambda(6 - 9) = -3\lambda$
      - Total loss: $-(120 - \lambda) - 3\lambda = -(120 + 2\lambda)$

Monopoly menu pricing: summary

- **Lesson**: Consider a monopolist who offers 2 pairs of price and quality to 2 types of consumers. Prices are chosen so as to fully appropriate low-type's consumer surplus. High-type consumers obtain a positive surplus ('information rent') as they can always choose the low-quality instead.

Monopoly menu pricing (cont'd)

	Universities λ	Businesses $120 - \lambda$
Pro	**9**	**3**
Basic	**5**	**2**

- A numerical example (cont'd)
  - Menu vs. uniform pricing
    - Menu pricing *may* improve profits.
    - Scenario 1: $\lambda > 40$ $\rightarrow$ firm only sells to universities under uniform pricing $\rightarrow$ $\pi^{uni} = 9\lambda$
      - Cannibalization: universities now pay less for Pro version $\rightarrow$ *loss* of $\lambda(6-9) = -3\lambda$
      - Market expansion: businesses now buy Basic version $\rightarrow$ *gain* of $(120 - \lambda)2$
      - Net gain if $-3\lambda + (120 - \lambda)2 > 0 \Leftrightarrow \lambda < 48$
      - *If so, menu pricing also increases welfare* (firm and universities strictly better off; businesses as well off)

	Universities λ	Businesses $120 - \lambda$
Pro	**9**	**3**
Basic	**5**	**2**

Monopoly menu pricing (cont'd)

- A numerical example (cont'd)
  - Menu vs. uniform pricing (cont'd)
    - Scenario 2: $\lambda < 40$ $\rightarrow$ firm sells to everyone under uniform pricing $\rightarrow \pi^{uni} = 360$
      - No market expansion in this case, but 2 opposite effects.
      - Businesses buy Basic instead of Pro version $\rightarrow$ *loss* of $(120 - \lambda)(2-3)$
      - Universities pay more for Pro version $\rightarrow$ *gain* of $\lambda(6-3)$
      - Net gain if $-(120 - \lambda) + 3\lambda > 0 \Leftrightarrow \lambda > 30$
      - *If so, menu pricing reduces welfare* (firm better off, but universities worse off; businesses as well off)

Monopoly menu pricing: summary

- **Lesson**: Menu pricing is optimal (i) if proportion of high-type consumers is neither too small nor too large, and (ii) if going from low to high quality increases surplus proportionally more for high-type consumers than for low-type consumers.

- **Lesson**: Menu pricing improves welfare if selling the low quality leads to an expansion of the market; otherwise, menu pricing deteriorates welfare.

Monopoly menu pricing: further results

- If monopolist optimally chooses different qualities to implement menu pricing

$$\max_{s_1,s_2}(1-\lambda)\left[U(\theta_1,s_1)-c(s_1)\right]+\lambda\left[U(\theta_2,s_2)-(U(\theta_2,s_1)-U(\theta_1,s_1))-c(s_2)\right]$$

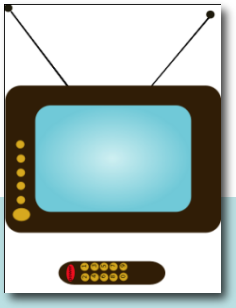
$$\frac{\partial\Pi}{\partial s_1}=0\Leftrightarrow c'(s_1)=\frac{\partial U(\theta_1,s_1)}{\partial s_1}-\frac{\lambda}{1-\lambda}\left(\frac{\partial U(\theta_2,s_1)}{\partial s_1}-\frac{\partial U(\theta_1,s_1)}{\partial s_1}\right)$$

$$\frac{\partial\Pi}{\partial s_2}=0\Leftrightarrow c'(s_2)=\frac{\partial U(\theta_2,s_2)}{\partial s_1}$$

- **Lesson**: High-type consumers are offered the socially optimal quality, while low-type consumers are offered a quality that is distorted downward compared to the first best.

Monopoly menu pricing: further results

- Damaged good strategy may be profitable
  - Firm intentionally damages portion of the goods to price discriminate.



Case. **Damaged goods**

- IBM LaserPrinter E → identical to original printer, but software limited printing to 5 rather than 10 pages/minute
- Sony MiniDisc 60' → curbed 74' disc
- Sharp DVD players → DVE611 and DV740U are almost identical, but DV740U does not allow user to play output encoded in PAL format on NTSC televisions (a critical button is hidden on the remote)

Monopoly menu pricing: further results (cont'd)

- Previous quality model
  - Suppose linear utility: $U(\theta, s) = \theta s$
  - Cost of producing one unit of given quality: $c(s_i)$
- Transposition to time-dependent prices
  - Let $s = e^{-rt}$, where t = date when the good is produced and delivered, and r = interest rate

$$\max_{t_1, t_2} (1-\lambda)\left[\theta_1 e^{-rt_1} - c(e^{-rt_1})\right] + \lambda\left[\theta_2 e^{-rt_2} - (\theta_2 - \theta_1)e^{-rt_1} - c(e^{-rt_2})\right]$$

Monopoly menu pricing: further results (cont'd)

- Transposition to quantity-dependent prices
  - Consumers can buy a certain quantity q_i at price p_i
  - Unit price may depend on quantity purchased (nonlinear pricing). Let $q_i = c(s_i)$
    $\rightarrow s_i = c^{-1}(q_i) = V(q_i)$

$$\max_{q_1, q_2} (1-\lambda)\left[\theta_1 V(q_1) - q_1\right] + \lambda\left[\theta_2 V(q_2) - (\theta_2 - \theta_1) V(q_1) - q_2\right]$$

Menu pricing under imperfect competition

- Monopoly setting gives useful insights.
- But, we want to know how menu pricing is affected by - and affects - competition.
  - E.g.: airline travel
  - Empirical studies suggest that competition tends to reinforce price discrimination
    - Borenstein (1991): number of stations offering leaded gas ↓ → difference between margins on unleaded and leaded gas ↓
- 2 extensions of Hotelling model
  - Quality-based menu pricing
  - Two-part tariffs (quantity-based menu pricing)

Menu pricing under imperfect competition (cont'd)

- Competitive quality-based menu pricing
  - Sketch of the model
    - 2 firms located at the extremes of Hotelling line
    - Each firm can sell high-end & low-end versions of some good
    - Mass 1 of consumers uniformly distributed on the line
      - Heterogeneous in terms of transportation costs
      - Heterogeneous in terms of valuation of quality

Menu pricing under imperfect competition (cont'd)

- Competitive quality-based menu pricing (cont'd)
  - Main results (see details in book)
    - Multiple equilibria → Coexistence of:
      - 'Discriminatory' equilibrium: both firms offer 2 versions, consumers self-select (high types buy high-end version, low types buy low-end version)
      - 'Non-discriminatory' equilibrium: both firms produce only the high-end version

Menu pricing under imperfect competition (cont'd)

- Competitive quality-based menu pricing (cont'd)
  - Comparison with monopoly
    - Here, monopolist would optimally choose uniform pricing $\rightarrow$ introducing a competitor may lead to menu pricing by both firms.
    - In duopoly, firms may prefer to coordinate on the situation where they both price discriminate, while, as a monopolist, each firm would not price discriminate.
    - Incentive compatibility constraints may not be binding in duopoly.

Menu pricing under imperfect competition (cont'd)

- Competitive quantity-based menu pricing
  - Sketch of the model
    - 2 firms located at the extremes of Hotelling line
    - Each firm sets a two-part tariff: $T_i(q) = m_i + p_i q$
      - m_i : fixed fee; p_i : variable fee
      - E.g., telephony: subscription fee + price per minute
    - Mass 1 of consumers uniformly distributed on the line
      - One-stop shoppers, identical variable demand (consumers can consume any quantity from the firm they patronize)

Menu pricing under imperfect competition (cont'd)

- Competitive quantity-based menu pricing (cont'd)
  - Main results (see details in book)
    - Unique symmetric equilibrium: firms offer tariffs $T(q) = \tau + cq$
      - τ : transport cost parameter
      - c : firms' marginal cost
    - Competition with two-part tariffs improves welfare compared to competition with linear tariffs

Review questions

- Suppose a firm can target two groups of consumers by a menu of prices with different qualities but that it can also offer different prices to different consumer groups. What should it do?
- When does menu pricing dominate uniform pricing in monopoly? Discuss the countervailing effects.
- How does competition affect the use of menu pricing? Discuss.
- What are the effects of competition on quantity-based menu pricing?