Demand, Advertising, Price Discrimination

Price Discrimination - market power is necessary but not sufficient
(From ECO 7117 notes):

First Degree - also called perfect; monopoly that can perfectly identify each consumer's value and resale is not possible; not realistic, but good as baseline for potential of price discrimination

Second Degree - individuals have downward sloping demand (allows non-linear pricing); resale infeasible; seller known distribution of demands, but can't identify individual consumers so he can't prevent "personal arbitrage"

Two-Part Tariffs - this is a specific type of non-linear pricing; it's an artificial restriction on seller which isn't optimal, but it's easy to work with; typically set fixed fee equal to consumer surplus and marginal fee equal to marginal cost

Third Degree - signal of group membership; no resale across groups, but there is within groups (i.e., no further discrimination possible)


Bresnahan & Reiss (1985) - look at rent distribution between dealers and automakers; stress importance of multiple product lines for explaining dealer markups

Ayres & Siegelman (1995) - substantial evidence that women and minorities face gender and ethnic discrimination in retail market for new cars; used controlled experiment (same age, education, and appearance and use exact same bargaining strategy)

First Offer - $200 higher for white women, $450 higher for black women, $1100 higher for black men (vs. white men)

Final Offer - $130 higher for white women, $400 higher for black women, $1100 higher for black men (vs. white men)

Len's Critique - day (time of month) & salesperson are key for car prices; didn't say if A&S controlled for it; dealers have sales targets so they're more likely to cut deals toward the end of the month; they also have daily goals; salesmen have different individual strategies (regardless of dealership strategy)... for example, I've met some who are retired lawyers that are loaded and only work at the dealership to meet people; they don't care about commissions; if they like you, you get a good deal (without even asking for it); in general, if a salesman hasn't met his quota, he's more likely to give a good deal

Goldberg - working on the same issue so she emphasizes the different approach: using Consumer Expenditure Survey (CES, 1983-1987); sort of rolling panel data but has 25% turnover each year); argues it's better because it uses "realized purchases" not just offers (people are more motivated to negotiate when it's their money on the line)

Empirical Model - focused on dealer discount from MSRP:

\[ D_{ijt} = \alpha + \beta H_{it} + \gamma Z_{jt} + \delta X_{ij} + \varepsilon_{ijt} \]

where \( D_{ijt} \) = discount for consumer \( i \), when purchasing model \( j \), at time \( t \)

\( H_{it} \) = vector of household characteristics (age, minority, female, minfem [interaction of minority & female], value of assets, income after taxes, dummy for college grad, dummy for white collar job, dummy for population < 300K [*rural*], regional dummies, financed [vs. paid cash], dealer financing, first time buyer, repeat buyer for the brand, traded in old car)
$$Z_{jr} = \text{vector of model-specific characteristics (dummies for foreign, compact, intermediate, standard, luxury, sports, truck, van/utility vehicle; brand dummies)}$$

$$X_{j} = \text{set of time (year or quarter) dummies (several combinations for 1,2,3,4 quarter and previous year, same years and next year models)}$$

**Fixing Data** - pp.626-635 all talk about data being used and what Goldberg had to do to massage it; not complete list here:

- **Model Information** - hard to match up MSRP with options because CES didn’t always have full info (e.g., Honda Accord, but doesn’t say DX, LX, or EX); author used information available (e.g., cylinders, diesel, sunroof, etc. to figure it out when possible; for others used weighted average of list prices of relevant submodels)

- **Trade-In Allowance** - CES reports net purchase price and trade-in allowance received; Goldberg assumes trade-in allowance is equal to the amount a consumer would receive if he sold the car on the wholesale second-hand market to get transaction price

- **Sales Tax** - different in different areas and CES data don't reveal state of residence

- **Financing** - dealer vs. outside

- **Dealer-Specific Fees** - not consumer-specific

- **Race & Gender** - CES reports head of household which is not necessarily the person who negotiated the price

**Data** - 32,000 households interviewed, 9% bought a new car; Goldberg dropped those with inconsistent or missing responses so there are "around 1,300 reliable observations"; CES data supplemented by *Automotive News Market Data Gook* (ANMDB) for information on suggested retail prices and options

**Result** - "variables referring to race and sex have no explanatory power: the hypothesis that whites and blacks, or men and women, receive the same discounts cannot be rejected at any reasonable significance level"; even point estimates are much lower than A&S figures (e.g., $274 higher for black men vs. $1100)

**Significant Variables** - only a handful are:

- **DEALERF** - get $294 bigger discount for dealer financing
- **FISTB** - get $444 bigger discount for first time buyers; large expenditure so they’re more elastic
- **TRANDIN** - get $597 smaller discount when trading in old car
- **Q3P & Q4P** - get $1053 & $1421 bigger discount for last year’s model
- **Q4S** - get $412 lower discount for current year’s model in fourth quarter

**Len’s Comment** - Q4S doesn’t make sense

**Remove Household** - dropping insignificant household variables only drops R2 from 0.180 to 0.177

**Explaining Difference with A&S** - Goldberg felt obligated to defend her results since they seem to contradict A&S; used pp.641-651 to do this... Ai: "It’s not their job because they published before you."

**Distributions** - "the only reason that suppliers’ behavior varies across consumer classes is that consumers differ in some aspects of their demand... supplier’s perception about buyers’ distribution are based on repeated interaction between the two groups"; A&S study only showed one customer from a distribution; firms made offers based on their knowledge of the distribution, not on that particular customer

**Econometrics** - not in paper, but this is what Goldberg used

- **OLS** - based on mean
  \[ y = x'\beta + u \text{ with } E[u | x] = 0 \text{ so } E[y | x] = x'\beta \]

- **Quantile Regression** -
**Median** - suppose \( \text{Median}[u \mid x] = 0 \); that means \( \Pr[u > 0 \mid x] = \Pr[u < 0 \mid x] = 0.5 \)

Introduce **indicator**: \( I(u < 0) = 1 \) if \( u < 0 \) and 0 otherwise

\[
E[1(u < 0) \mid x] = \Pr[u < 0 \mid x]
\]

\( \text{Median}[y \mid x] = x'\hat{\beta}_{\text{median}} \) (or use \( \beta_m \))

Put these together:

\[
E[1(y - x'\beta_m < 0) - 0.5 \mid x] = 0
\]

\[
E[1(y - x'\beta_m > 0) - 0.5 \mid x] = 0
\]

Take difference: \( E[1(y - x'\beta_m < 0) - 1(y - x'\beta_m > 0) \mid x] = 0 \)

What to choose \( \beta_m \) to satisfy this condition

Here’s how: \( E[\{y - x'\beta_m\}] = E[(y - x'\beta_m)1(y - x'\beta_m > 0) - (y - x'\beta_m)1(y - x'\beta_m < 0)] \)

FOC (derivative wrt \( \beta_m \)): \( -x'1(y - x'\beta_m > 0) + x'1(y - x'\beta_m < 0) = 0 \)

Pull out \( -x' \): \( E[-x'1(y - x'\beta_m > 0) - 1(y - x'\beta_m < 0)] = 0 \)

This is basically the same condition we want

**Least Absolute Deviation Estimator**: \( \hat{\beta}_m = \arg\min_{\hat{\beta}_m} \sum_{i=1}^N |y_i - x_i'\hat{\beta}_m| \)

\( \alpha \) **Percentile** - rather than 0.5

\( E[1(u < 0) \mid x] = \alpha \) and \( E[1(u > 0) \mid x] = 1 - \alpha \)

Combine and take difference:

\( (1 - \alpha)E[1(y - x'\beta_\alpha < 0 \mid x] - \alpha E[1(y - x'\beta_\alpha > 0 \mid x] = 0 \)

Objective: \( E\{(1 - \alpha)(y - x'\beta_\alpha)1(y - x'\beta_\alpha < 0) - \alpha(y - x'\beta_\alpha)1(y - x'\beta_\alpha > 0) \mid x\} \)

Estimator:

\( \hat{\beta}_\alpha = \arg\min_{\hat{\beta}_\alpha} \sum_{i=1}^N (1 - \alpha)(y_i - x_i'\hat{\beta}_\alpha)1(y_i - x_i'\hat{\beta}_\alpha < 0) - \alpha(y_i - x_i'\hat{\beta}_\alpha)1(y_i - x_i'\hat{\beta}_\alpha > 0) \)

**Graphically** - choosing parameters to minimize these functions:

**qreg** - Stata command for quantile regression (default is median , \( \alpha = 0.5 \))

**In Paper** - argued that on average, there is no discrimination, but bigger variation in minority allows discrimination at extremes of distribution; used 10% and 90% quartiles to get significant coefficient on MINORITY (*While this parameter estimate is statistically insignificant in both the OLS and median regressions, it is positive and significant in the 90 percent quantile regression and negative and significant in the 10 percent regression... the point estimate for the premium black males face is much closer to the Ayres and Siegelman estimate in the 10 percent quantile regression ($794) than in the OLS regression*)

**Translation** - black males at the top of the distribution pay more than white males at the top of their distribution, but black males at the bottom pay less than white males at the bottom

**Len’s Comment** - this still doesn’t jive with A&S because FEMALE, though not significant, has point estimates showing bigger discount in both 10% and 90%; black females have bigger discount in 10%, but lower in 90% (opposite of black male)

**Bundling** - firms try to get consumers to reveal their type by bundling goods (helps identify those who have more elastic or inelastic demand)

**Trick** - need to "distinguish cost-based differentials from discriminatory differentials, a problem typically compounded by inadequate cost data" (31)

**Solution** - "paper compares the price differential between full-service and self-service gasoline at stations offering both service types (multiproduct stations) with the price differential across stations offering only full-service and stations offering only self-service (single-product stations)." (31)

"If multiproduct stations are price discriminating, the full-service price will be higher at these stations and the self-service price will be lower. Raising the full-service price is less costly to a multiproduct station because customers no longer willing to pay for full-service switch to self service at the same station" (31) rather than leaving the station

**Model** - paper gets into a lot of theoretical detail that it doesn’t really need

**Horizontally Differentiated** - "If price and service quality are held constant, consumers prefer ‘nearby’ stations" (32)

**Vertically Differentiated** - with proximity and price held constant, customers prefer full-service over self-service

**Extremes** - not realistic, but isolate effects of price discrimination

- **Competitive Case** - no horizontal differentiation; equivalent to zero transportation cost
- **Market Power Case** - extreme horizontal differentiation; cost is zero to closest station and infinite to others

Jaskold-Gabszewicz & Thisse (1979) - each consumer buys no more than one unit; utility function is separable in income and gasoline consumption; consumers have identical preferences but different incomes

**Preferences** - \( U = V(g)(t - p_g) \), where \( t \) is customer type (income level), \( g \) is service type (0 for no purchase, \( s \) for self-service, \( f \) for full-service)

\[
V(f) > V(s) > V(0) > 0
\]

**Uniform Types** - \( t \sim U(0,1) \)

**Demands** - consider customer who buys full service

Must have \( V(f)(t - p_f) \geq V(s)(t - p_s) \)

Indifferent consumer has \( V(f)(t - p_f) = V(s)(t - p_s) \) \( \Rightarrow t = \frac{V(f)p_f - V(s)p_s}{V(f) - V(s)} \)

\( \therefore D_f(p_f, p_s) = 1 - t_2 = 1 - \frac{V(f)p_f - V(s)p_s}{V(f) - V(s)} \)

Repeat process for self service:

\( D_s(p_s, p_f) = t_2 - t_1 = \frac{V(f)p_f - V(s)p_s}{V(f) - V(s)} - \frac{V(s)p_s}{V(s) - V(0)} \)

**Problem** - If you do this over for single product stations, you get more demands, but all the demands add to up more than 1

At: "I don't need all these equations"; "We don't need this stuff", author is just giving intuition for how to find the demands, but they’re not used in the empirical model

**Marginal Cost** - \( w = MC \) for self-service; \( w + \alpha = MC \) for full-service
**Profit Maximization** - this is where the demands come in

Single-product, full-service: \( \max_{p_f} \pi^{SP}_{f} = (p_f - w - \alpha)D_f(p_f) \) \hfill (3)

Single-product, self-service: \( \max_{p_s} \pi^{SP}_{s} = (p_s - w)D_s(p_s) \) \hfill (4)

Multiproduct: \( \max_{p_f, p_s} \pi^{MP}_{f} = (p_f - w - \alpha)D_f(p_f, p_s) + (p_s - w)D_s(p_s, p_f) \) \hfill (5)

**Prices** - solve profit maximization problems to get:

\[
p_f^{SP} = \frac{V(f) - V(0)}{2V(f)} + \frac{w + \alpha}{2} \hfill (5)
\]

\[
p_s^{SP} = \frac{V(s) - V(0)}{2V(s)} + \frac{w}{2}
\]

\[
p_f^{MP} = \frac{[V(f) + V(s)][V(s) - V(0)]}{\delta} + \frac{2wV(f)V(s)}{\delta} + \frac{\alpha V(f)[V(s) - V(0)]}{\delta}
\]

\[
p_s^{MP} = \frac{2V(s)[V(f) - V(0)]}{\delta} + \frac{wV(s)[V(f) + V(s)]}{\delta} + \frac{\alpha V(s)[2V(f) - V(0) + V(s)]}{\delta}
\]

where \( \delta = 3V(f)V(s) + V(f)V(0) + V(s)^2 - V(s)V(0) \)

**Differences** - don’t necessarily indicate price discrimination because cost difference between full and self-service, but difference in difference cancels out change in cost between self and full service; if no discrimination \( \Delta = 0 \)

\[
\Delta_{MP} \equiv p_f^{MP} - p_s^{MP} \hfill (8)
\]

\[
\Delta_{SP} \equiv p_f^{SP} - p_s^{SP}
\]

\[
\Delta \equiv \Delta_{MP} - \Delta_{SP} \quad \text{(difference in difference)}
\]

"When the same feasibility constraints are imposed, it is possible to show that the self-service price is not higher and the full-service price is not lower." \hfill (36)

\[
\Delta_f \equiv p_f^{MP} - p_f^{SP} \geq 0
\]

\[
\Delta_s \equiv p_s^{MP} - p_s^{SP} \leq 0 \quad \text{(Note: } \Delta = \Delta_f - \Delta_s)\]

**Peak-Load Pricing** - if demand exceeds supply, firms want to raise price; "a high-price station will sell at capacity only rarely, and a lower-price station will sell at capacity more often. The high-price station is charging a peak-load price. In equilibrium, each station must make zero profit on average or it will be profitable for some firm to add capacity." \hfill (38); "Because this model makes no prediction about which prices will be relatively high, it cannot be tested using price differentials. The theory does, however, make a clear prediction about profit that is distinct from the prediction of the price discrimination model." \hfill (38)

**Summary** - if \( \Delta \geq 0 \) we might suspect price discrimination, but if profits are zero, then the differentials can be explained by peak-load pricing rather than price discrimination

**Data** - 1,527 stations in four-county area in eastern Massachusetts; "treated as a cross section, data collection occurred over a 12-week period in early 1987, during which the wholesale prices of refined petroleum products were rising slowly... retail prices have been indexed using weekly free on board wholesale price data for the Boston area." \hfill (39)

**Empirical Model** -
Possible Sources of Different MC - things to control for in model:
- Geographic area
- Volume discounts
- Newer capital (faster pumps or electronic control equipment might lower MC)
- Economies of scale &/or scope
- Other services (convenience store, repair shop)

"Cost variation could disguise price discrimination but cannot reasonably be expected to mimic it." (43)

Model - first introduces model (11) with \( \gamma_j M_j D_k \) term which gives wrong results; fixed in (11') which is the model Shepard runs

Ai: "JPE makes mistakes; AER is even worse."; "Very smart, just very sloppy."; terrible referee too

\[
p_{kjg} = \beta_0 + \beta_1 D_g + \beta_2 D_k + \beta_3 D_k D_g + \phi X_{kjg} + \mu_{kjg} \quad (11')
\]

Station \( i \), type \( k \) (MP or SP), service \( g \) (f or s), market \( j \)

- \( \beta_0 \) = mean price for self-service gasoline at single-product stations
- \( \beta_1 \) = average increment to \( \beta_0 \) (i.e., \( \bar{\Lambda}_{SP} \))
- \( \beta_2 \) = average increment to \( \beta_0 \) for self-service at multiproduct stations (i.e., \( \bar{\Lambda}_s \))
- \( \beta_3 \) = average difference in differentials (i.e., \( \bar{\Lambda} \))

Note: \( \bar{\Lambda}_f = \beta_2 + \beta_3 \ldots \) this would also include \( \gamma_j M_j \) in the original model so the \( \gamma_j M_j D_k \) term was dropped in (11')

\( X \) contains variables that might be related to cost or demand:
- CSTORE - 1 for convenience store
- REPAIR - 1 for repair shop
- SPF CAP (SPSCAP) - number of full-service fueling places at single product stations (self-service)
- MPCAP - number of full- and self-service places at multiproduct stations
- UNBRANDED - 1 if unbranded stations
- MINI - 1 if mini-service (pump fuel only, but no tires or oil checked)
- NEW - 1 if station remodeled in last 3 years

Result - "The coefficient estimates are consistent with the price discrimination hypothesis and inconsistent with cost-driven differentials" (results in table 2, p.45)

Control for Market - define "near by" as 0.5, 1, 1.5, or 2 mile radius from station; take difference of average prices in those areas to eliminate market effects, but number of firms in markets differ which introduces heteroskedasticity

Result - ran separate regression for full and self-service so \( \bar{\Lambda}_s = \) constant; "The results of table 2 are confirmed" (49)