Direct Estimation of Demand Curves

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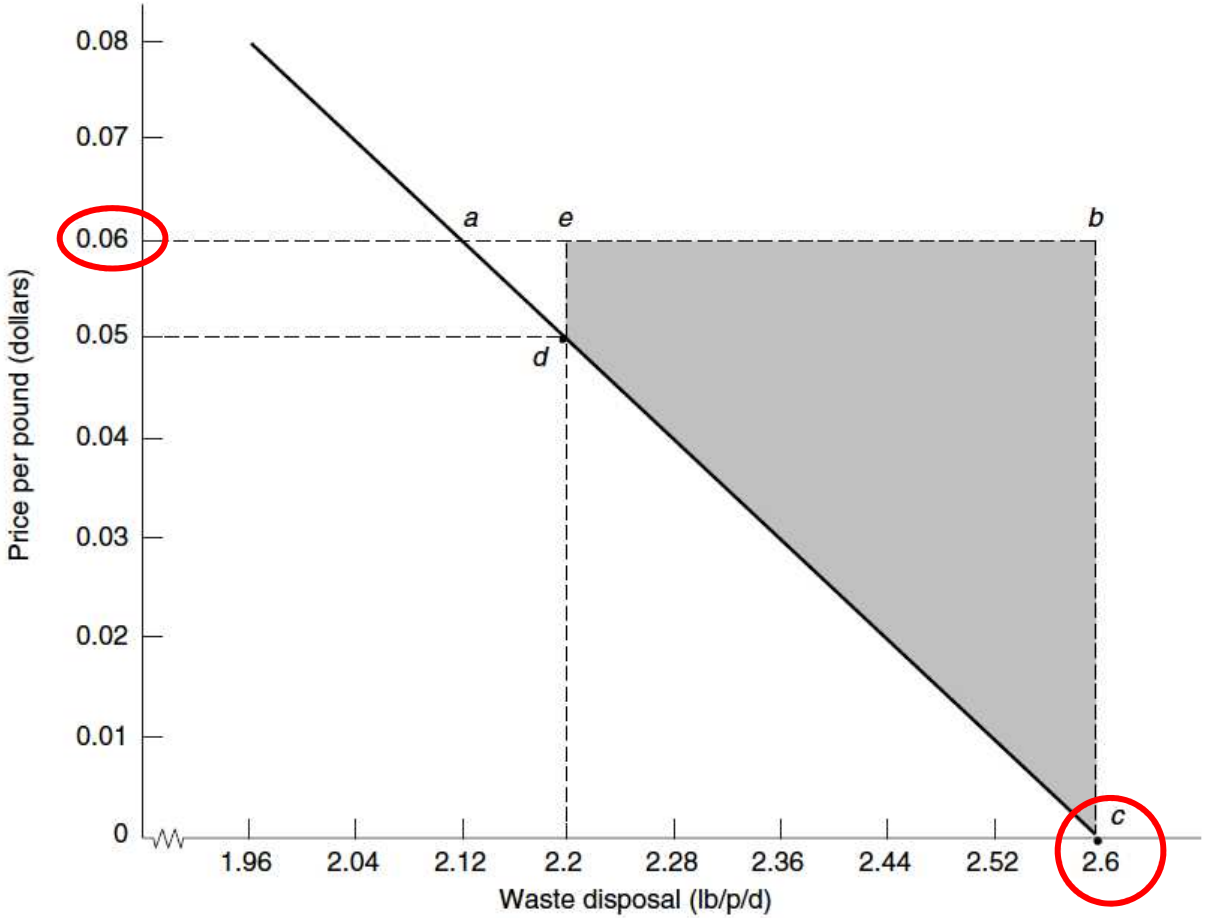
BGVW Chapter 13

Outline

- Calibration of demand curves
  - One point on a demand curve + slope (elasticity)
  - Elasticity
  - Multiple observations
- Econometric estimation
  - Example
  - OLS
  - Problems of OLS

One point on the demand curve + slope (or elasticity)

- Waste disposal
  - 2.60 (lb/p/d) at price = 0
  - MSC: $0.06/lb
- Linear demand curve
  - $q=\alpha_0+\alpha_1 p$
  - Estimate by literature survey
    - $\alpha_1 = -0.4$
    - External validity
- Benefits of pricing refuse collection
  - With: Price = $0.05/lb
  - Without: Price = $0/lb
  - Net benefit = Gray area



Elasticity

- Price elasticity of a linear demand curve

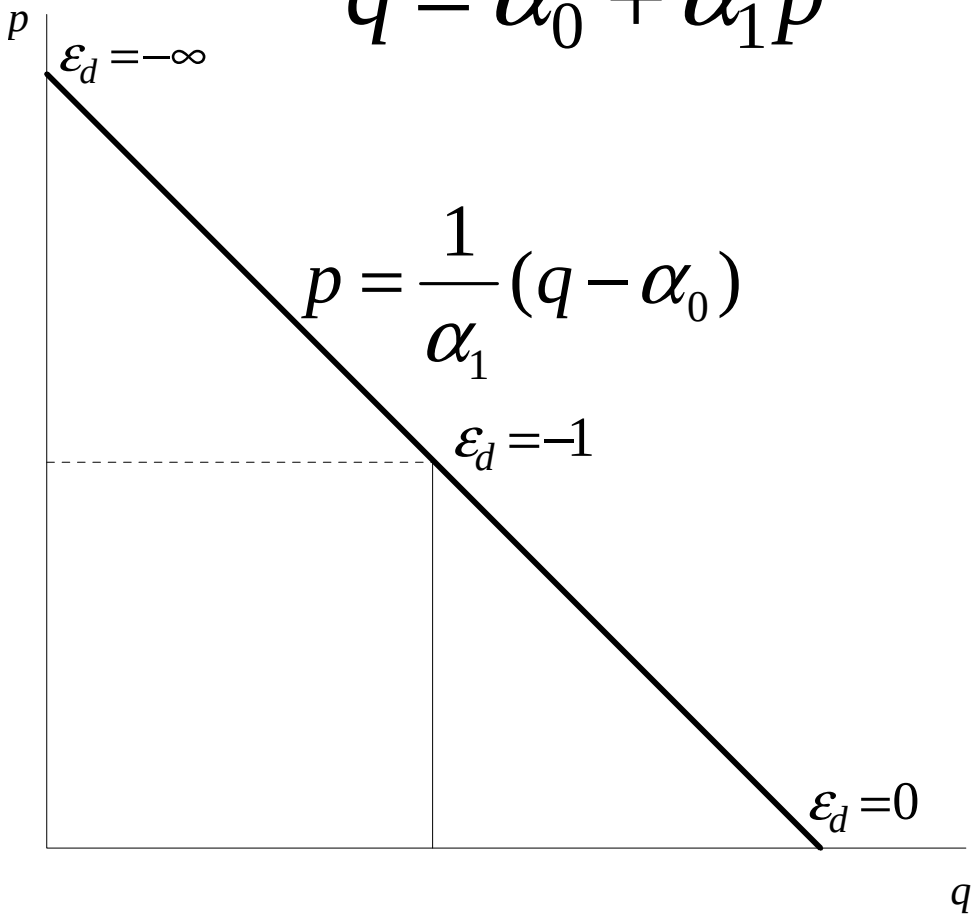
$$E_d = \frac{\Delta q}{\Delta p} \Big/ \frac{q}{p}$$

$$= \alpha_1 p / q$$

- From price elasticity to slope

$$\alpha_1 = E_d q / p$$

$$q = \alpha_0 + \alpha_1 p$$



Constant elasticity demand curves

- Log-linear

$$q = \beta_0 p^{\beta_1}$$

$$\ln q = \ln \beta_0 + \beta_1 \ln p$$

NB: Different from (13.5) in the textbook

- Consumer surplus: With (p_1, q_1), Without (p_0, q_0)

$$\Delta CS = (p_0 q_0 - p_1 q_1)/(1+\beta_1)$$

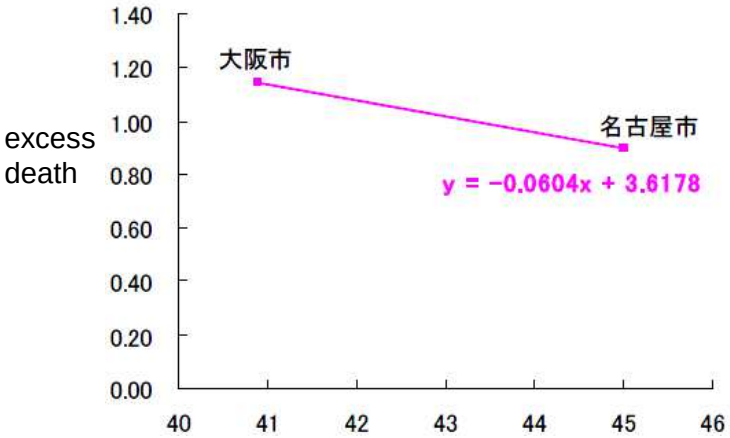
- Gross consumer surplus

$$Area = \left(\frac{1}{\beta_0}\right)^{1/\beta_1} \frac{{q_1}^{\rho} - {q_0}^{\rho}}{\rho} \qquad \rho = \left[1 + \frac{1}{\beta_1}\right]$$

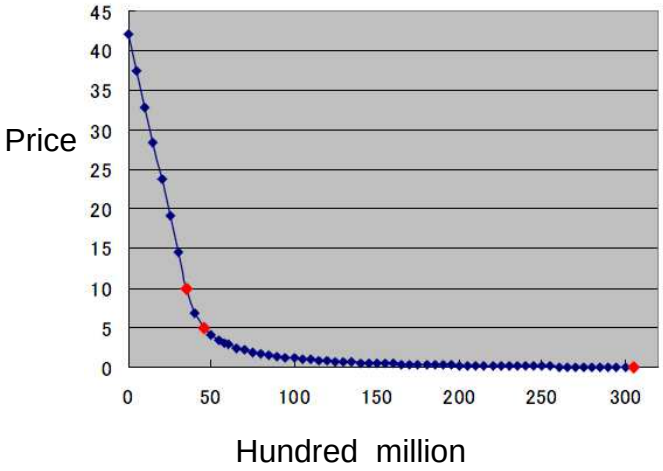
Extrapolating from a few observations

- 2 points + linear demand curve: Dangerous to use
  - The functional form may not be linear
  - Other factors than demand: might be a supply curve rather than a demand curve
- Example

flu vaccination



shopping bag tax



Econometric estimation: Example

- Demand for gasoline: Futamura (2000)

$$\ln q = 8.931 - 0.186 \ln p + 0.707 \ln I - 0.247 \ln E - 0.081 D_1 - 0.101 D_2$$
$$(3.50)\ (-2.74) \qquad (2.52) \qquad (-0.46) \qquad (-2.55) \qquad (-5.03)$$

  - Price p, Income（GDP） I, Average gas mileage E, Dummy for 1988 - 1997 (Bubble) D_1 , Dummy for 1985 - 1988 (High yen exchange rate) D_2
  - Macro time series data

Kanemoto, Hasuike, and Fujiwara Chapter 7, in Japanese

Econometric estimation: OLS

- Formulation of a model
  - $q = f(p, I, T) + u$
    Example: $q = a_0 + a_1 p + a_2 I + a_3 T + u$
- OLS estimates are “good” in the following sense.
  - Explanatory variables are independent from the error term, Expected value of the error term is zero, Explanatory variables are not multicollinear → Unbiased
  - Equal variances of the error terms, No correlation between error terms → Best Linear Unbiased Estimate (minimum variance among unbiased estimates)

Problems with econometric estimates

- Omitted Variable Problem
- Multicollinearity
- Choice of functional form
  - linear, log-linear, translog, Box-Cox, etc.
- Identification
  - In order to estimate the demand function, we need exogenous variables that do not belong to the demand function
  - Cases where identification is easy
    - Government intervention: Different tax rates for regions
    - Government supply
    - Exogenous prices: Expressway tolls

Data types

- The level of aggregation
  - Microdata, regional aggregation (municipality, prefecture, etc.)
- Cross section vs. Time series
  - Long-run and short-run elasticities
    - Cross-sectional data: long-run elasticities
    - Time series data: short-run elasticities
    - Short-run elasticities < long-run elasticities
  - Statistical problems
    - Cross-section: heteroskedasticity (the error terms have different variances)
    - Time-series: autocorrelation (the error terms are correlated over time)
    - Both problems can be tested for and corrected using generalized least squares (GLS) instead of OLS.
- Pooled data, Panel data
  - Pooled cross-sectional and time-series data
    - Rich source of information
    - Requires more complicated econometric methods

QQ #5_1

- 1. What is the most important weakness in the estimation of the gasoline demand curve by Futamura (2000)?
- 2. What would you do to overcome the weakness you pointed out above?