Economic Evaluation

Lec 13: Valuing Impacts from Observed Behavior: Direct Estimation of Demand Curves

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AM's reminders

- **Mail policy**
  - **NO content questions by email**
  - Ask during/between classes or just walk over to α 4035B

Reading list

- **BGVW ch.13**

Estimation of demand curves

- **Necessary** to calculate social surplus
  - **Demand** (MBs) and **supply** (MCs) in **primary market**
- **Existing markets**
  - Market failures $\Longrightarrow$ **shadow prices**
  - Next lecture
- **Focus on demand**
  - Δ in producer's surplus easily computed: profits
  - **Often negligible:** focus of intervention is $\approx$ always consumer
  - Eventually, same techniques apply

Lecture plan

1. **Extrapolating from functional form and elasticity**
   - **Requires previous research: ✓**
   - **Assumptions: External validity**
2. **Extrapolating from few observations**
   - **Requires previous research:** X
   - **Assumptions: Structural form, identification**
3. **Estimating from many observations**
   - **Requires previous research:** X
   - **Assumptions: Structural form, identification**

Knowing slope/elasticity of demand

Policy that changes the price of a good

- E.g. **Household refuse collection fee** (free-riding)
  - Marginal collection cost = 40$ per ton
  - Tipping fee = 80$ per ton

$\Longrightarrow$ MSC = 0.06$/lb

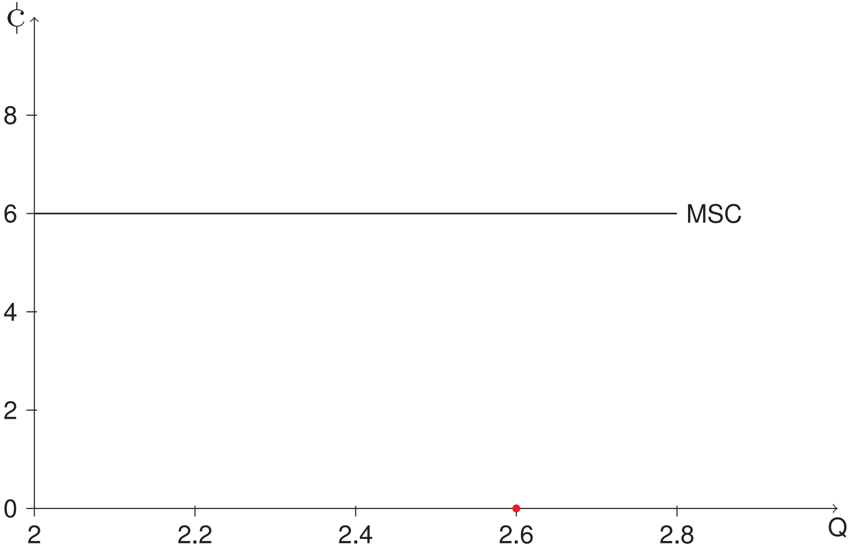
  - Marginal private cost = 0 (fee does not depend on quantity)

Knowing slope/elasticity of demand

Policy that changes the price of a good

- E.g. **Household refuse collection fee** (free-riding)
  - Marginal collection cost = 40\$ per ton
  - Tipping fee = 80\$ per ton
  - $\Longrightarrow$ MSC = 0.06\$/lb
  - Marginal private cost = 0 (fee does not depend on quantity)
- **Fee of 1\$ per container ($\approx$ 20 lb)**
  - $\nearrow$ **of fee per pound of garbage from 0\$ to 0.05\$/lb**
- **Status quo:** provides a point on demand curve
  - Currently: at 0\$/lb, every person produces 2.6 lb

Extrapolating a demand curve



Predict a change in waste disposal usage

Needs assumption on functional form + elasticity

- **Linear demand curve**: constant MB

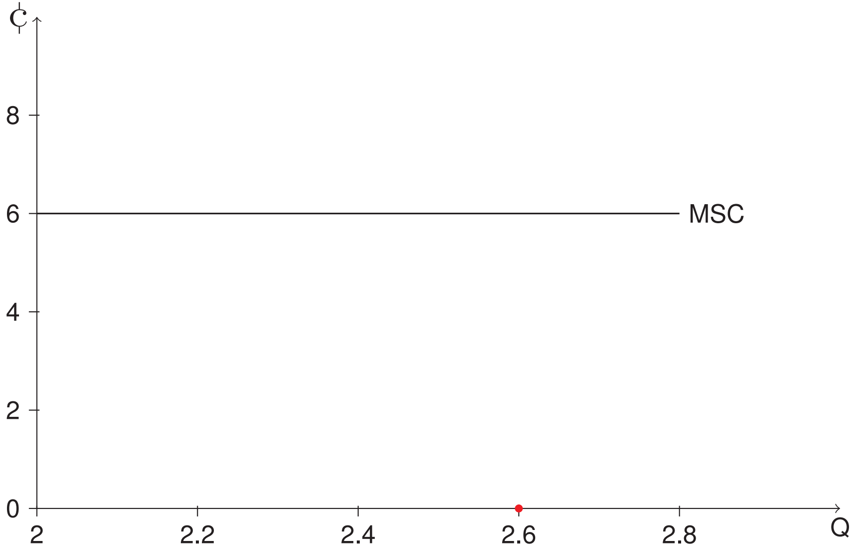
$$q = \alpha_0 + \alpha_1 p$$

- **Jenkins (1993)** - US study
  - 1$ increase in price **per container** $\searrow$ 0.4 lb per day

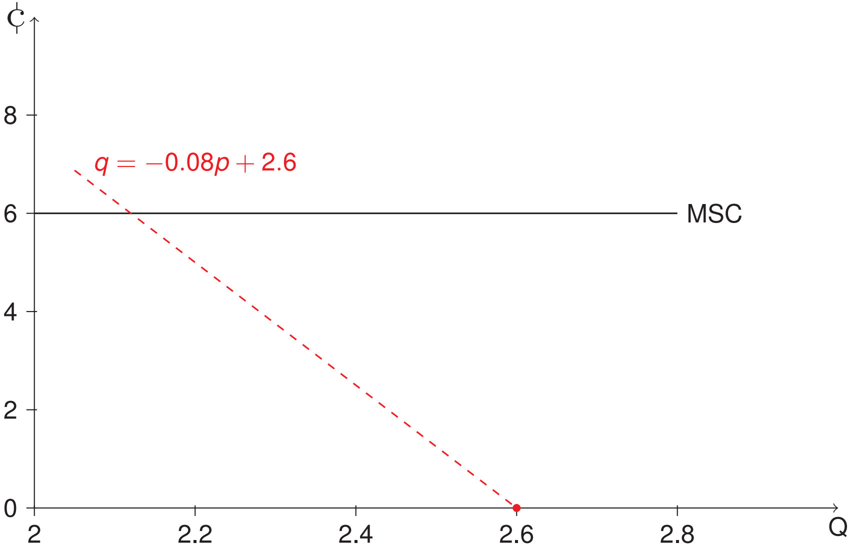
$\Longrightarrow \quad \alpha_1 = -0.4$

  - **Rescale in lb** $\Longrightarrow \quad \alpha_1 = -0.08 \quad$ (price in ¢)

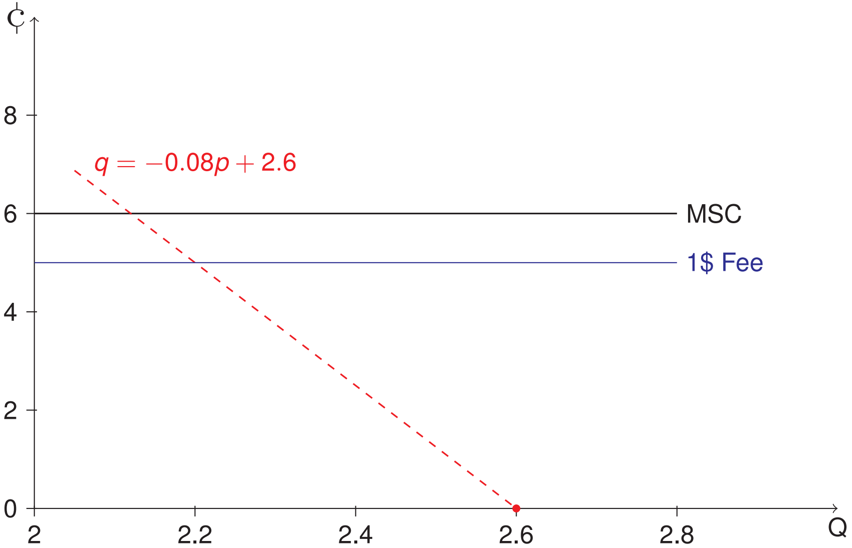
Extrapolating a demand curve



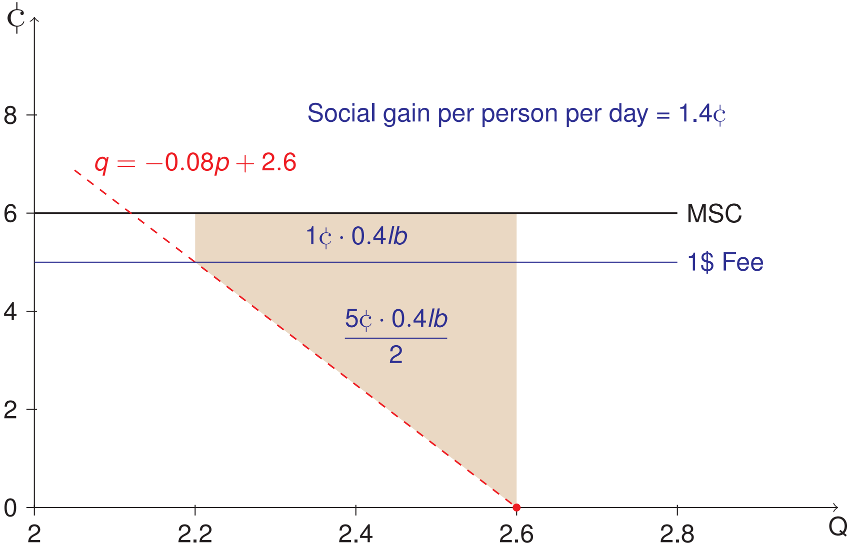
Extrapolating a demand curve



Extrapolating a demand curve



Extrapolating a demand curve



Little more than a basic econ exercise

- **Prediction of benefits if info on the slope**

$$14¢ \cdot 365 \cdot 100000 = 511000\$ \text{ per year}$$

Suppose have price elasticity estimate

- Still assuming **linear functional form**
- **Elasticity:** % change in q for 1% change in price
  - Dependent on point at which it was estimated (typically AVG)

$$\varepsilon_0 = \alpha_1 \frac{p_0}{q_0} \quad \Longrightarrow \quad \alpha_1 = \varepsilon_0 \frac{q_0}{p_0}$$

- **Info:** $\varepsilon_0 = -0.12; \;\; q_0 = -2.62 lb; \;\; p_0 = -0.82\$;$

$\Longrightarrow$ $\alpha_1 \approx -0.4$ (containers per $)

Constant elasticity demand curve

- More often, assumption of **constant elasticity**
  - No need to know at which point estimated: 1% change in p $\Longrightarrow$ x% change in q
  - **Non-linear demand**

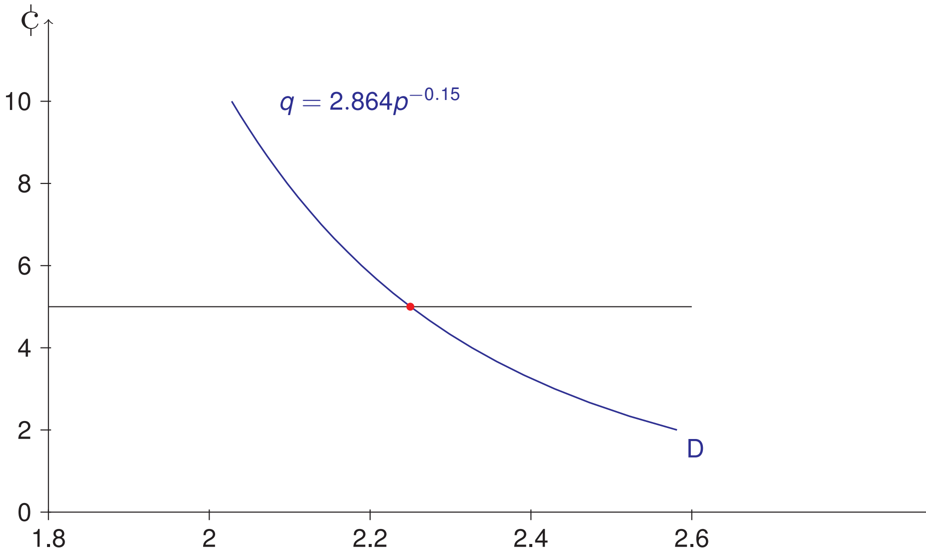
$$q = \beta_0 p^{\beta_1} \quad \Longleftrightarrow \ln q = \ln \beta_0 + \beta_1 \ln p$$

- **Elasticity:** $\beta_1 = \varepsilon$
- **By construction, excludes** $p = 0$
- **Appropriate for most good (loss of consumer surplus):**
  - Status quo: $p_{sq} = 5$¢; $q_{sq} = 2.25$
  - Literature: $\varepsilon = 0.15$

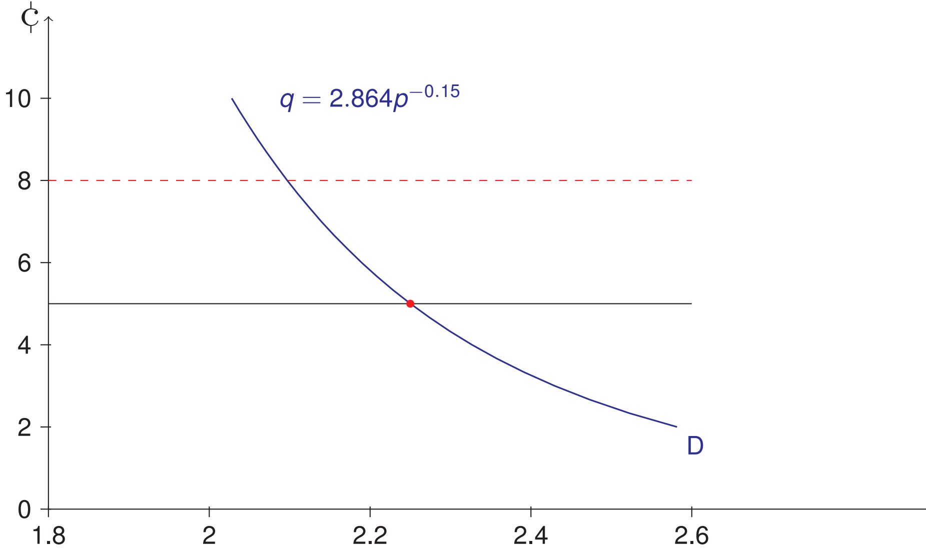
$$\Longrightarrow \quad q = \frac{q_{sq}}{p_{sq}^{\beta_1}} p^{\beta_1} = \frac{2.25}{5¢^{-0.15}} p^{-0.15} \approx 2.864 p^{-0.15}$$

  - Policy change: $p_1 = 8$¢

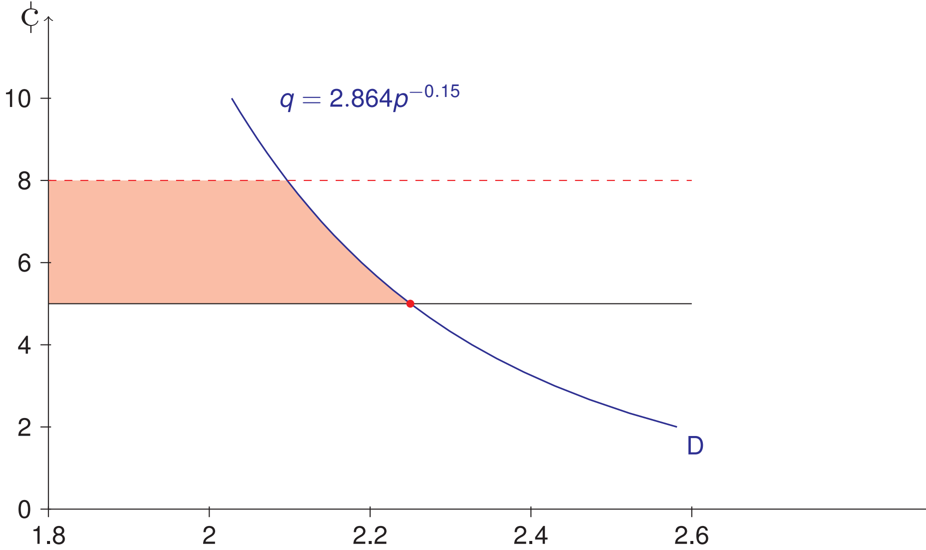
Extrapolating from constant elasticity curve



Extrapolating from constant elasticity curve



Extrapolating from constant elasticity curve



Calculating surplus loss

- **General approximated formula:**

$$\Delta CS \approx \frac{\varepsilon q_0(\Delta p)^2}{2p_0} - q_0(\Delta p) = -\frac{0.15 \cdot 2.25 \cdot 9}{2 \cdot 5} - 2.25 \cdot 3 \approx -6.45$$

$$\text{Total loss} = 0.0645 \cdot 365 \cdot 100000 \approx 2.35M\$$$

- **Exact formula for constant elasticity:**

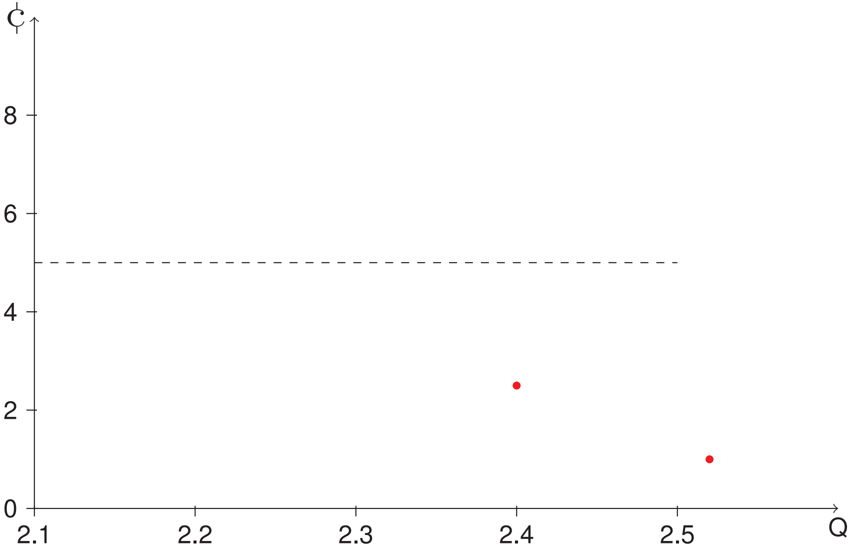
$$\Delta CS = -(p_1 q_1 - p_0 q_0)/(1+\varepsilon) \approx -6.53$$

$$\text{Total loss} = 0.0653 \cdot 365 \cdot 100000 \approx 2.38M\$$$

Extrapolating from few observations

- **No reliable elasticity estimate from literature**
- **Few datapoints from past policy changes**
  - **Validity crucial:** possibly from experiment within the town
- **Assumptions:** informed(?) guess about shape of demand
  - Linear/constant elasticity
- **Example:**
  - $p_1 = 1¢; \;\; q_1 = 2.52 \quad \& \quad p_2 = 2.5¢; \;\; q_2 = 2.4$
  - $p = 5¢ \quad \Longrightarrow \quad ?$

A dangerous extrapolation



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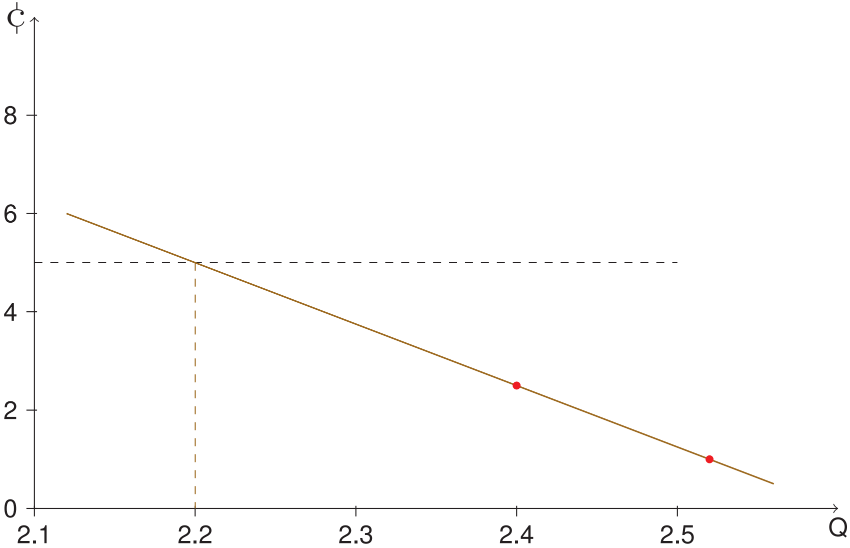
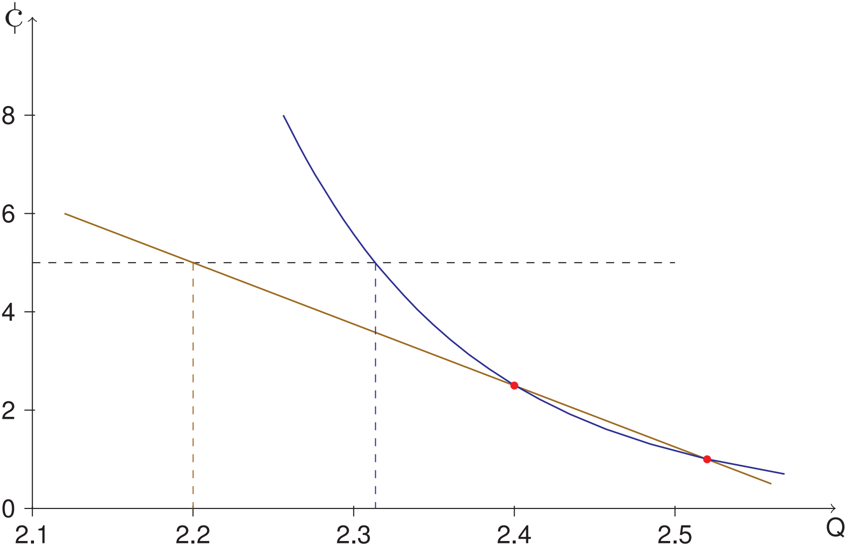


A dangerous extrapolation



Econometric estimation with many observations

- **Strictly dominant strategy wrt simple extrapolation**
- **Estimate elasticity/slope yourself**
  - Relatively new type of policy / not interesting for economists
- **Data gathering costly**
- **Structure & identification**
- **More control**

Ordinary Least Squares - steps

1. **Gather data, standardize measure**
   - Covariates Z : *it* help for **omitted variable bias**
2. **Choose structure**
   - **Linear**

     $$q_{it} = \alpha_1 q_{it} + Z_{it}\alpha + \upsilon_{1,t}$$

   - **Logarithmic**

     $$\ln(q_{it}) = \beta_1 \ln(q_{it}) + Z_{it}\beta + \zeta_{1,t}$$

3. **OLS the hell out of it**

   $$\beta = (X'X)^{-1}X'Y$$

- Only relevant coefficent (α_1/β_1) matters for welfare measures

Issues

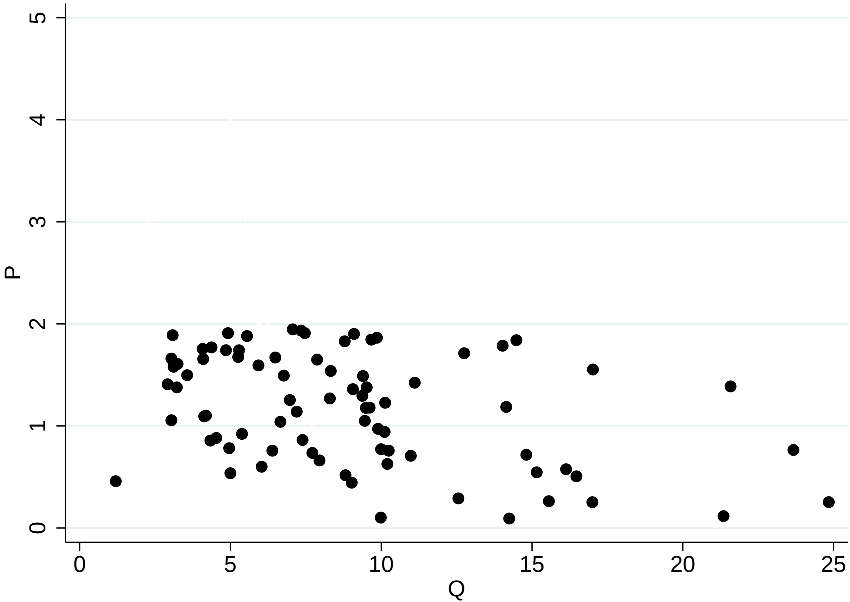
Identification

- **Demand not identifiable in perfect markets!**
  - $\times$ of supply and demand, not enough info to estimate both
- Less of a concern in **reguated markets** (waste): supply fixed
  - Still, **variation needs to be exogenous**
  - If p increases because of $\nearrow$ in waste, no good

Structural form

- **Crucial for prediction**
  - **Linear** admits zeros, **logarithmic** easier to control for inflation, less sensitive to large outliers
- **Manipulation:** *If the data don't behave, hit it with a log. If the data still don't behave, hit it with another log.*

It’s always a dangerous extrapolation



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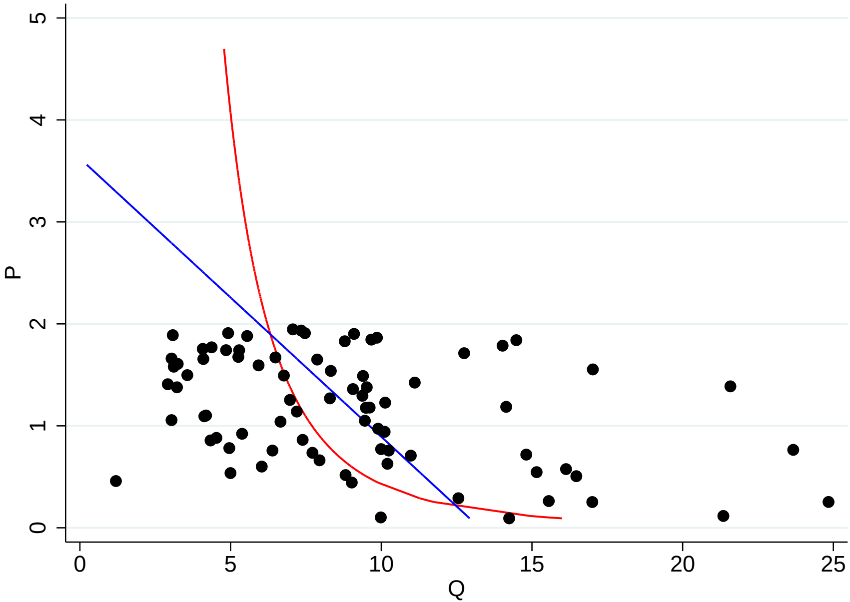

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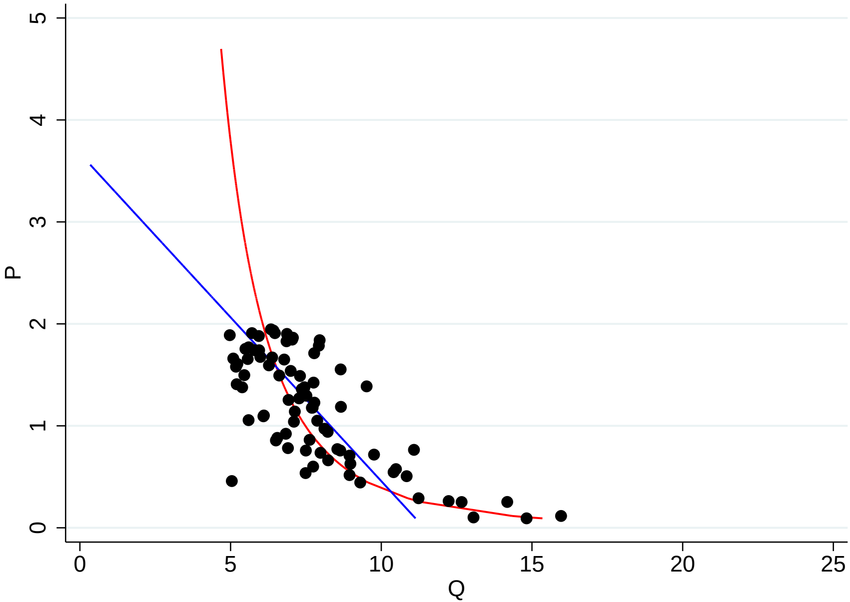

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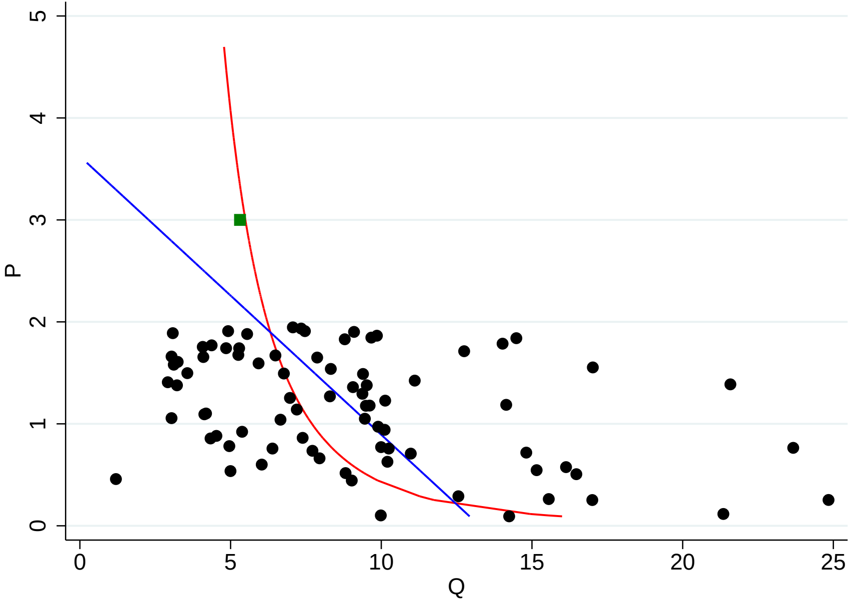

Type of data

Level of aggregation

- Municipality, individual . . .
- **the more informatio, the better, but gains are not linear**
  - **Autocorrelation, clustering**

Structure

- **Cross-section:** Same time, $\neq$ towns
- **Time-series:** Same town, $\neq$ time
- **Panels:** Same towns over time
  - Robust (to misspecification) estimation techniques