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Measuring Competition

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How to Measure Competition

- Agenda
  - Structure Conduct Performance (SCP)
  - New Empirical Industrial Organization (NEIO)
    - Structural oligopoly models
    - Entry models (next time)

Structure - Conduct – Performance

Purpose

Purpose

- Question
  - Is market concentration good or bad for welfare?
- Policy relevance
  - eg: Inform merger policy
- Specific purpose
  - Establish empirical relationship between
    - *market structure*
    - *market performance*
  - Valid across industries

Purpose

- Market Structure
  - Concentration
  - Entry barriers
- Firm Conduct
  - eg: Cartel membership (but difficult to observe)
- Market performance
  - Price cost margins
  - Profits

Purpose

- Compare different industries
  - Different levels of concentration
  - Different levels of market power (accounting data)
- Is there a relationship?

S – C – P
Procedure

Procedure

- Estimate equation similar to
  - $L_i = \alpha + \beta_1 CON_i + \gamma_1 EB^1_i + \gamma_2 EB^2_i$
    - L_i = Measure of market power in industry i
    - CON_i = Measure of concentration in industry i
    - EB^j_i = Measure of entry barrier j in industry i

Procedure

- Assume: Structure variables
  - Exogenous
  - Same effect on market power in all markets

Procedure

- Measures of performance
  - Accounting profit
  - Rate of return on investment
    - Preferred since investments vary between industries
    - ror = (Revenues - Other costs - Economic Depreciation) / Book value of assets
  - Learner index
    - Price and marginal cost difficult to observe
    - Approximated by (Revenues - Variable Cost) / Revenues
  - Tobin's q
    - Market value of firm / Replacement value of assets

Procedure

- Measures of concentration
  - **Four firm concentration ratio**
    - Definition: $s_1 + s_2 + s_3 + s_4$ where $s_1 > s_2 > \ldots$
  - **Herfindahl-Hirschman Index (HHI)**
    - Definition: $HHI = \Sigma_i s_i^2$
    - Example: $HHI = 1 / n$ symmetric firms
    - Foundation: $L = \Sigma_i s_i L_i = HHI / \varepsilon$ in Cournot

Procedure

- Measures of entry barriers
  - Economies of scale
    - Measurement: MES / Industry sales
  - Product differentiation & Brand loyalty
    - Measurement: Advertising expenditure, R&D expenditure

Procedure

- Control variables, e.g.
  - Unionization
  - Countervailing Buyer Power

S – C – P

Results

Results

- Hypothesis 1:
  Market power increases with concentration
  - Most studies find positive relation
  - Small effect
    - Increase CR4 by 50% => margins increase 6% (example)
  - Low statistical significance

Results

- Hypothesis 2:
  Market power increases with entry barriers
  - Results are more robust and significant
  - Positive relations
    - Profitability – Scale economies
    - Profitability – Advertising (in consumer goods industries)
    - Profitability – R&D

Results

- Overall conclusion?
  - Concentration doesn't matter for prices?
    - Then theory refuted
    - Then many policies meaningless
  - But, then, why would entry barriers matter?

S – C – P

Critique

Critique

1. Important determinants of profitability not included
   - Example: consumer information
   - Differs between industries
   - Thus, not clear if profits are high due to
     - Entry barriers (as SCP assumes)
     - Lack of information

Critique

2. Effect of concentration different in different industries

- Example, in Cournot market *m* $L_m = \frac{1}{\varepsilon_m} \cdot HHI_m$
- Thus, the effect of concentration on market power depends on how price sensitive the consumers are

Critique

3. Market definition
   - **Correct definition:** Based on cross-elasticity of demand
   - **Data definition:** Standard Industrial Classification (SIC)
     - Airplanes and helicopters on the same product market
     - National markets
     - Plants classified based on primary activity

Critique

4. Measures of profitability

a. How to measure depreciation

- Economic = reduction in value of asset
- Accounting = historic cost + arbitrary rules

b. How to account for intangible assets

- R&D, advertising, training = investments
- Accounting conventions may require them to be treated as cost during the year

c. And so on

Critique

5. Endogeneity problem

- **SCP' goal**
  - Measure: #firms => prices
  - But concentration is not exogenous
  - Key issue: What causes variation in data?
    (i.e. why do markets differ?)

Critique

- **IF: entry cost = main difference between markets**
  - Low entry costs => **many firms => low prices**
  - Causality runs in the right direction
  - Likely finding: negative relation between *n* & *p* (if theory correct)
  - Remaining problem: co-linearity entry barriers and concentration

Critique

- **IF: degree of product differentiation = main difference between markets**
  - Homogenous goods => **low price => few firms**
  - Reverse causality
  - Likely finding: positive relation between *n* & *p*

Critique

- Normally: Markets differ in both dimensions
  - No relation: *n & p*
  - Positive relation entry barriers and p
- This is also what was found
- Thus SCP did not succeed to measure
  #firms => prices

Critique

6. How to interpret results

- **Assume**: Positive correlation Concentration – Profit

- **SCP interpretation**
  - Increased concentration leads to market power
  - Block mergers

- **Alternative interpretation**
  - Some industries economies of scale important
    - Only room for few efficient firms
    - Profits high due to low cost in these industries
  - Don’t block mergers

S-C-P

- Overview of stylized facts from SCP
  - Schmalensee, R. (1989). “Inter-Industry Studies of Structure and Performance.” *Handbook of Industrial Organization*. R. Schmalensee and R. Willig (eds.). Amsterdam: North-Holland.

NEIO

(New Empirical Industrial Organization)

NEIO

- Key ideas
  1. Focus on individual markets
  2. Cannot observe cost
     => cannot observe p – c
     => instead c must be estimated
- Two variants
  - Oligopoly model (today)
  - Entry model (next time)

Estimating Oligopoly Models

Conduct

- How much market power is there?
  - Cartel: $(p - c) / p = 1 / \varepsilon$
  - Cournot: $(p - c) / p = HHI / \varepsilon$
  - Bertrand: $(p - c) / p = 0 / \varepsilon$
- Two determinants
  - Elasticity of demand
  - The way firms compete = conduct
- Define: conduct parameter
  - $(p - c) / p = \theta / \varepsilon$

Conduct

- Expressed differently

$$p = \frac{c}{1 - \left(\frac{\theta}{\varepsilon}\right)}$$

  - Price determined by
    - Production cost
    - Demand elasticity - consumer price sensitivity
    - Firm conduct - the way firms compete

Conduct

- Important to know why price is high
  - Low demand elasticity => Help consumers switch
  - Bad conduct =>
    - Fight cartels
    - Prohibit mergers
    - Prohibit exclusionary practices (eg predation)
    - Regulate price
  - High cost => Price should be high

Conduct

- Q1: Possible to distinguish empirically?
  - $p = c / (1 - \theta/\varepsilon)$
- A1
  - Demand elasticity can be estimated
- Q2: But, how do we distinguish between
  - high cost
  - "bad" conduct
- A2
  - "Rotation method"

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Testing static oligopoly models: conduct and cost in the sugar industry, 1890–1914

David Genesove*

and

Wallace P. Mullin**

We explore the widespread methodology of using demand information to infer market conduct and unobserved cost components under the hypothesis of static oligopoly behavior. Direct measures of marginal cost and conduct, indicating small market power, serve as benchmarks. The more competitive models yield better cost estimates. The best cost estimates occur when conduct is estimated as a free parameter, which in turn only slightly underestimates our direct measure. It also tracks the decline in market power accompanying the industry's structural changes. The methodology is largely validated, although partial cost information can improve its predictive power. Conclusions are robust to the demand function.

1. Introduction

■ Measuring departures from marginal-cost pricing lies at the core of empirical Industrial Organization. Because marginal cost is often difficult to observe directly, the "new empirical industrial organization" (NEIO) infers market conduct and unknown cost parameters through the responsiveness of price to changes in demand elasticities and cost components. In this literature, the equilibrium oligopoly price, P, is characterized by the following generalization of the monopolist's first-order condition:

$$P + \theta QP'(Q) = c, \tag{1}$$

where Q is industry output, θ is the conduct or market power parameter, and c is marginal cost. This equation encompasses much of static oligopoly theory. For perfect

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But why should we be interested in the American sugar industry around 1900?

Why GM interesting 1

- American Sugar Industry Around 1900
  - Import raw sugar from Cuba
  - Transform into sugar
  - Sell in US
    - Households
    - Canning industry

Why GM interesting 1

- Many indications of little market power
  - Homogenous product; no branding
  - MES small
  - No cost differences between firms
  - No entry barriers (R&D or advertising)

Why GM interesting 1

- But
  - One firm has large share of market (80-95%)
- Government forced this firm to dissolve
- Question 1
  - Should we worry about concentration, when
    - Products homogenous
    - Easy entry
    - …

Why GM interesting 1

- Genesove & Mullin
  - Use econometric methods to answer this question
- Result
  - Very little market power despite high concentration

Why GM interesting 2

- Question 2
  - So, should competition authorities use these methods before taking action?
- Answer
  - Depends on how much we believe in these methods
  - How answer that question?

Why GM interesting 2

- Procedure
  1. Estimate demand
  2. Estimate cost and conduct using “rotation”
- Genesove & Mullin
  - Try different functional forms of demand
    => Same result
  - Know cost from independent sources
    => Can test if 2nd step works

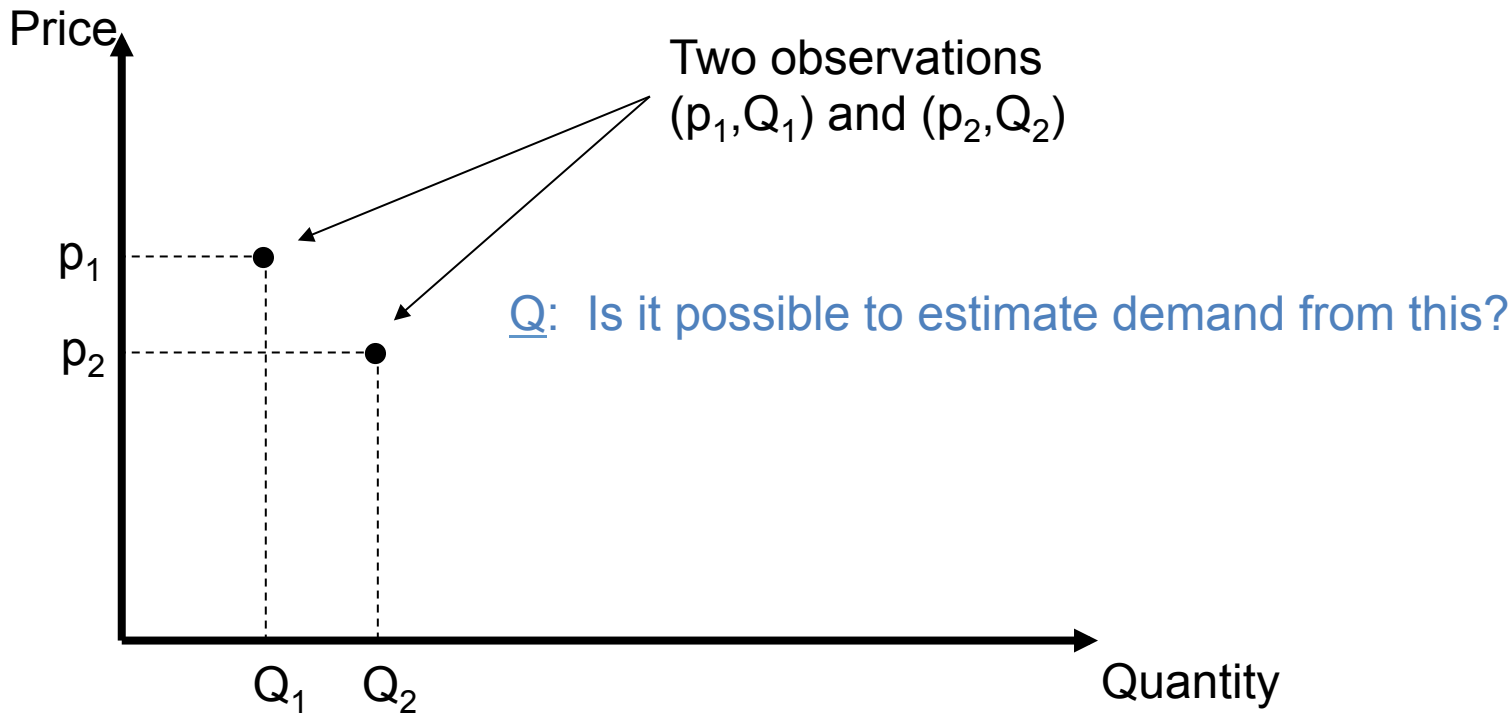
Demand estimation

(instruments, functional form)

Demand

Choice of instrument

G&M observe prices and quantities (quarterly data)



Demand

Choice of instrument

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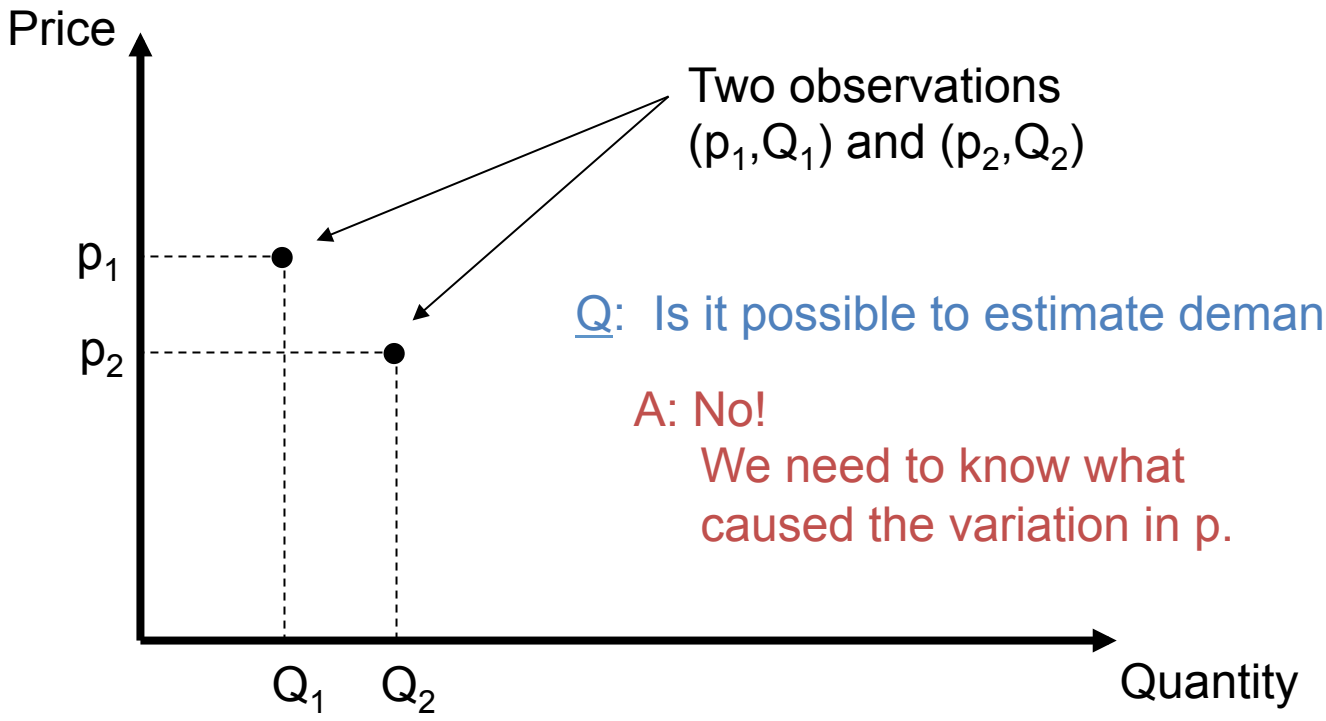


Q: Is it possible to estimate demand from this?

A: No!
We need to know what caused the variation in p.

Demand

Choice of instrument

IF price fell because

- Cost fell between period 1 and 2
- Nothing else changed (in particular: demand constant)

THEN

- We have observed demand

Demand

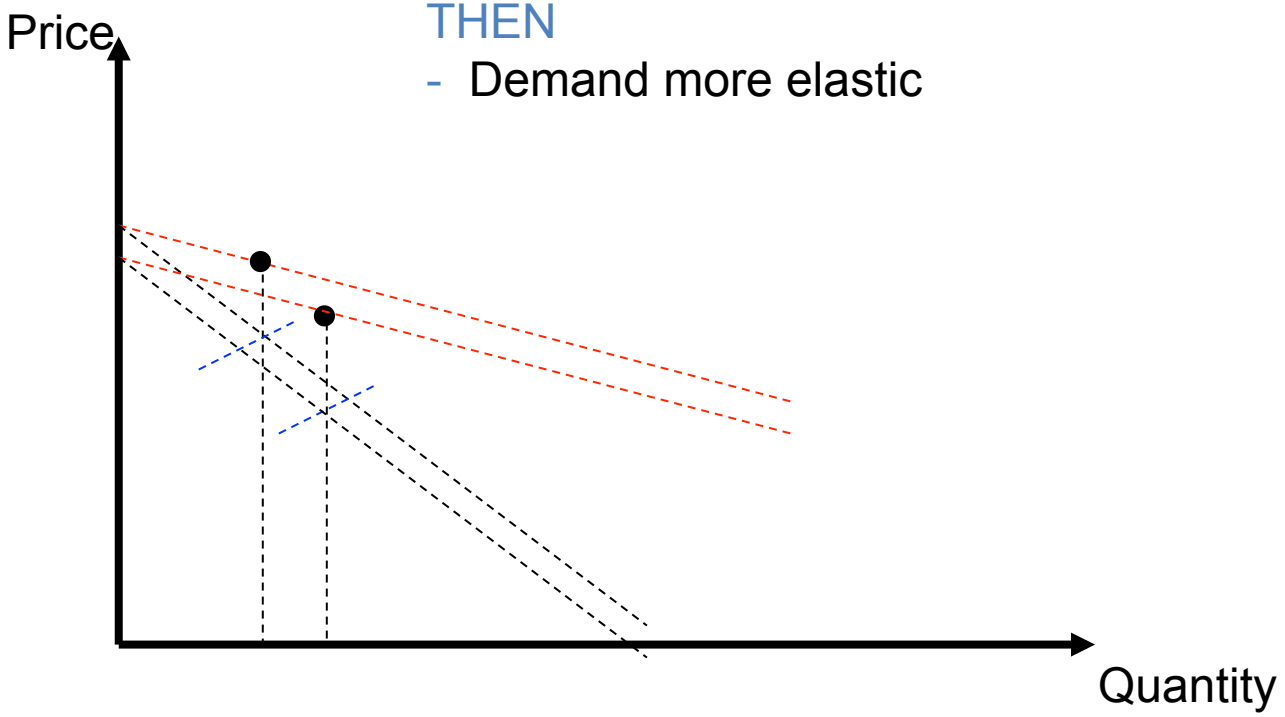
Choice of instrument

IF price fell because

- Cost fell
- Demand fell

THEN

- Demand more elastic



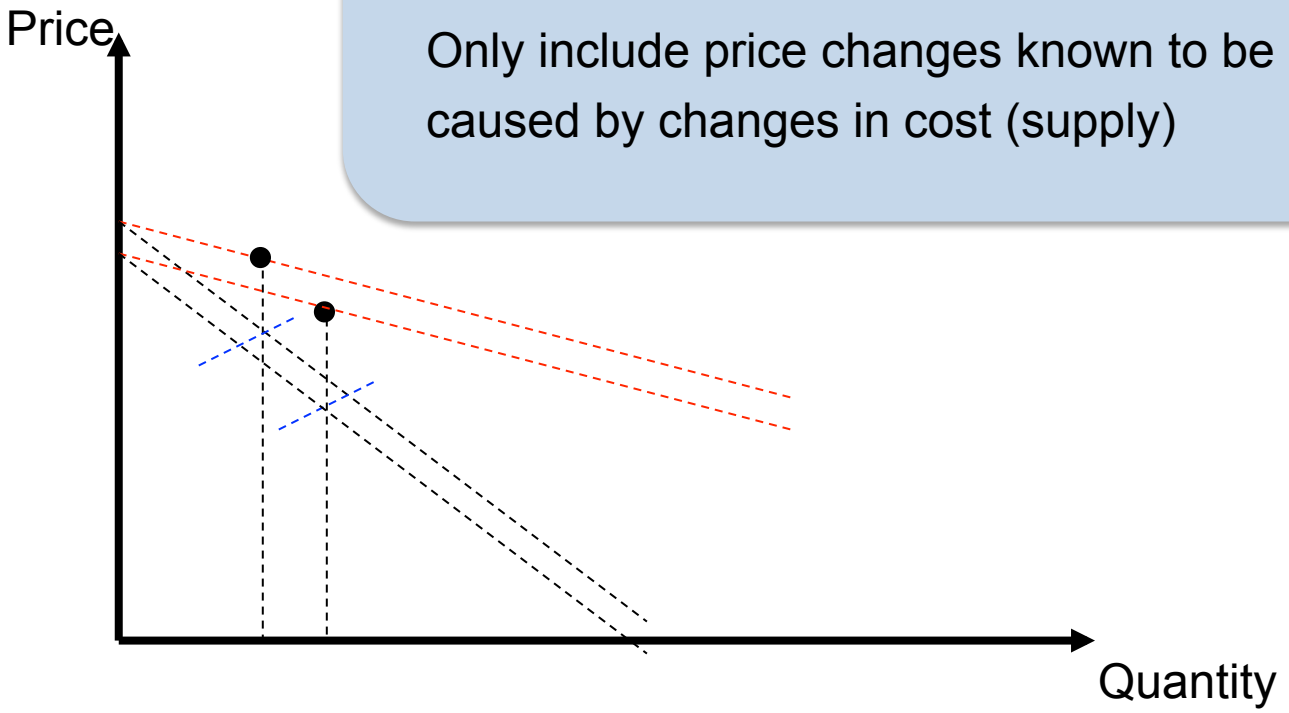
Demand

Choice of instrument

Conclusion:

When estimating demand

Only include price changes known to be caused by changes in cost (supply)



Demand

Choice of instrument

- Solution
  - G&M know the price of raw sugar
    = cost component
  - Step 1: Estimate which changes in price of sugar are caused by changes in price of raw sugar
  - Step 2: Estimate how quantity demanded changes with changes in price of sugar, caused by changes in price of raw sugar

Demand

Choice of instrument

- Problem 2
  - US buys 25% of all raw sugar in the world
  - A reduction in price of raw sugar may be due to a reduction in US demand for sugar
  - Back at square 1

Demand

Choice of instrument

- Solution
  - Use data on Cuban exports of raw sugar to the US
  - Cuban exports determined exogenously
    (weather conditions on Cuba)
  - That is, only consider:
    - variations in price of raw sugar
    - caused by variations in Cuban supply

Demand

Functional form

- Problem 1
  - Estimates of elasticity depend on functional form
- Solution: Try different
  - Quadratic
  - Linear
  - Log-linear
  - Exponential

Demand

Functional form

- Problem 2
  - Seasonal variations
  - During summer and fall demand for sugar is higher due to fruit canning
- Solution
  - Introduce dummy variable for high season
    - Different intercept
    - Different slope

This is important when estimating cost & conduct

Demand

Results

Results: Demand elasticity (at sample mean)

	Quadratic	Linear	Log-linear	Exponential
High	2.18	2.24	2.03	2.13
Low	1.03	1.04	1.10	1.05

- Conclusions
  - Demand is downward sloping
  - High season
    - Higher demand
    - More elastic
  - Little difference between different functional forms

“Rotation”

(How to separate bad conduct from high cost)

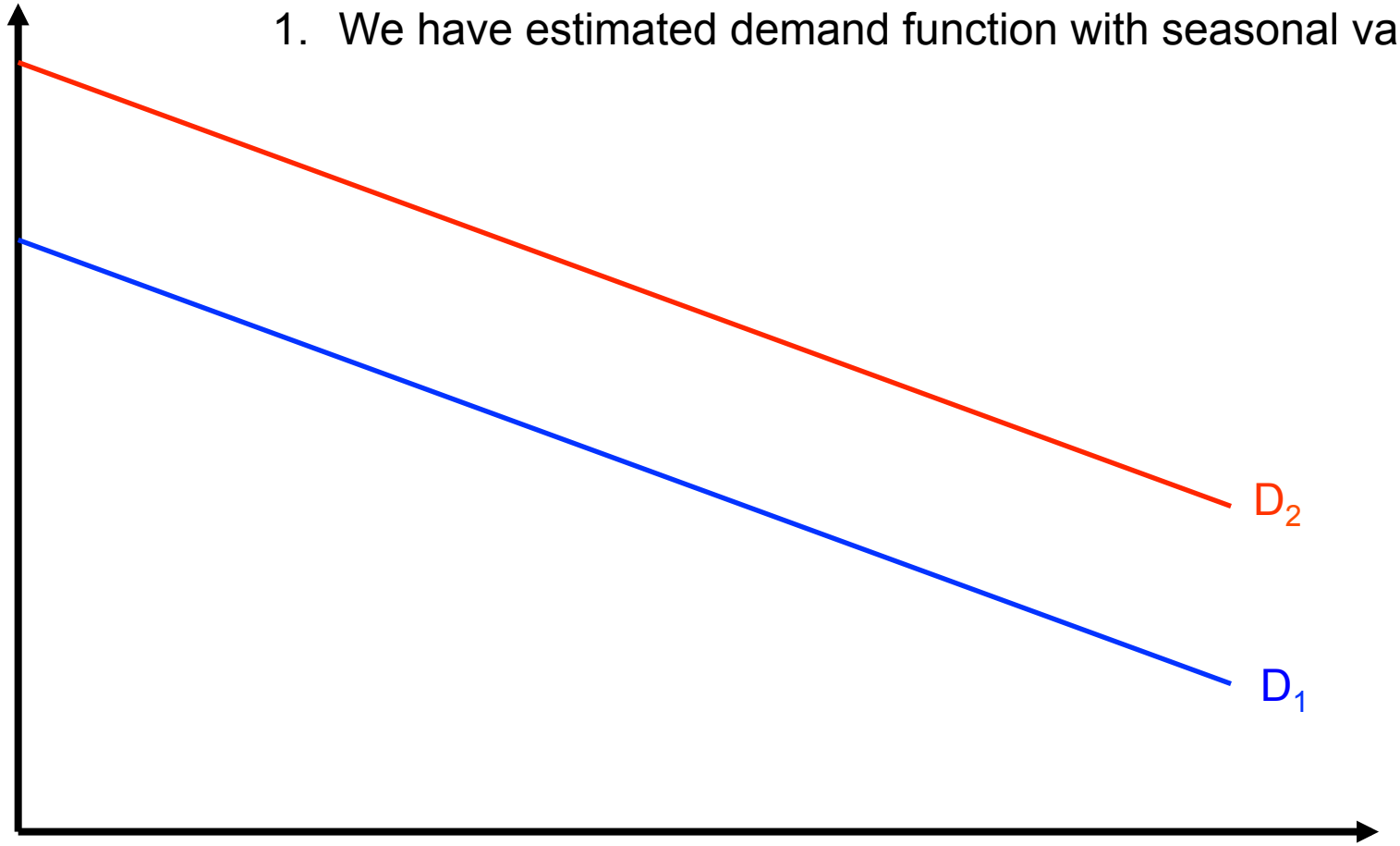
Rotation

- Identification of demand
  - Need to shift supply (cost)
- Identification of supply (= cost & conduct)
  - Need to shift demand
- Problem
  - How do we separate cost and conduct?

Rotation

Assume:

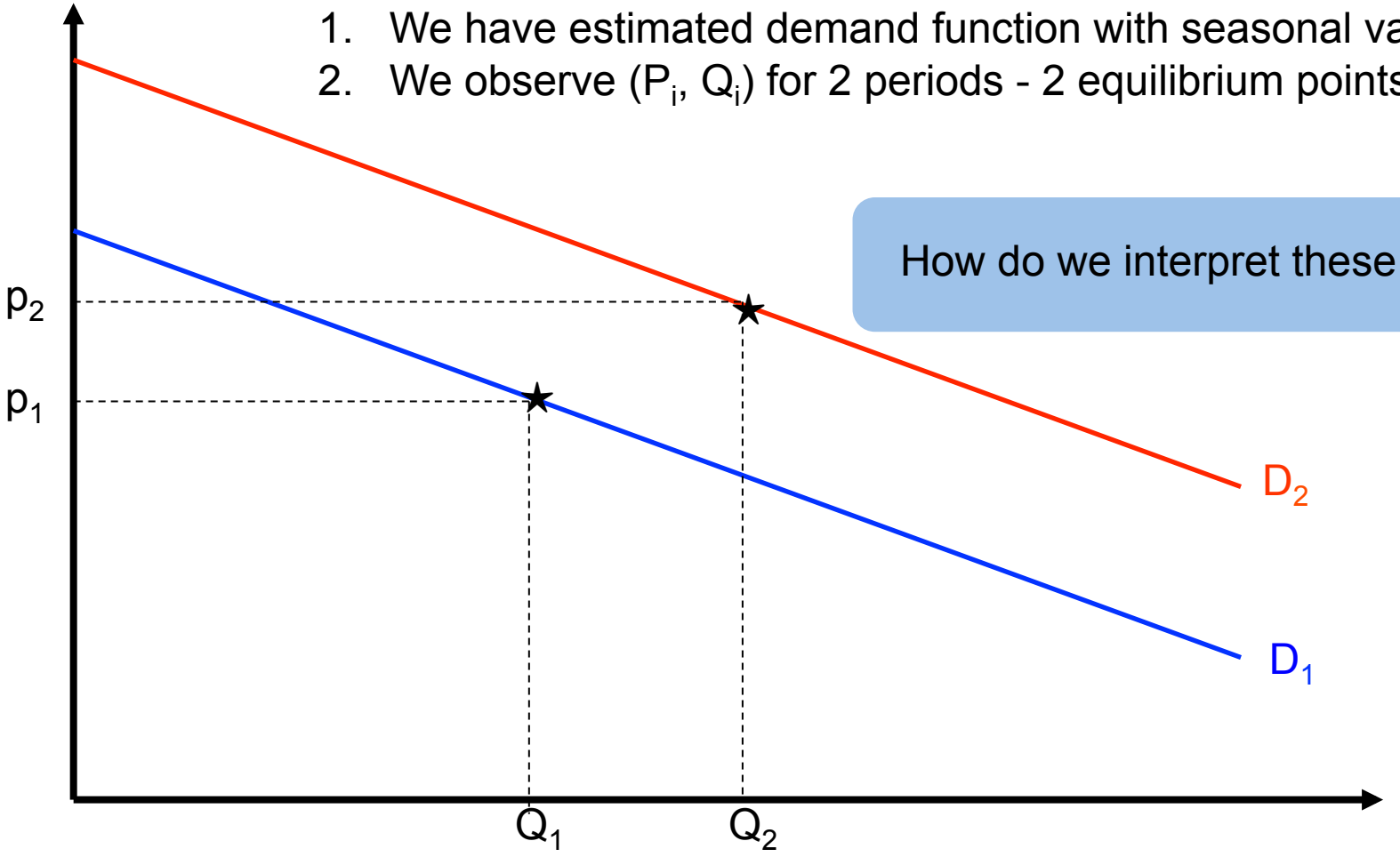
1. We have estimated demand function with seasonal variation



Rotation

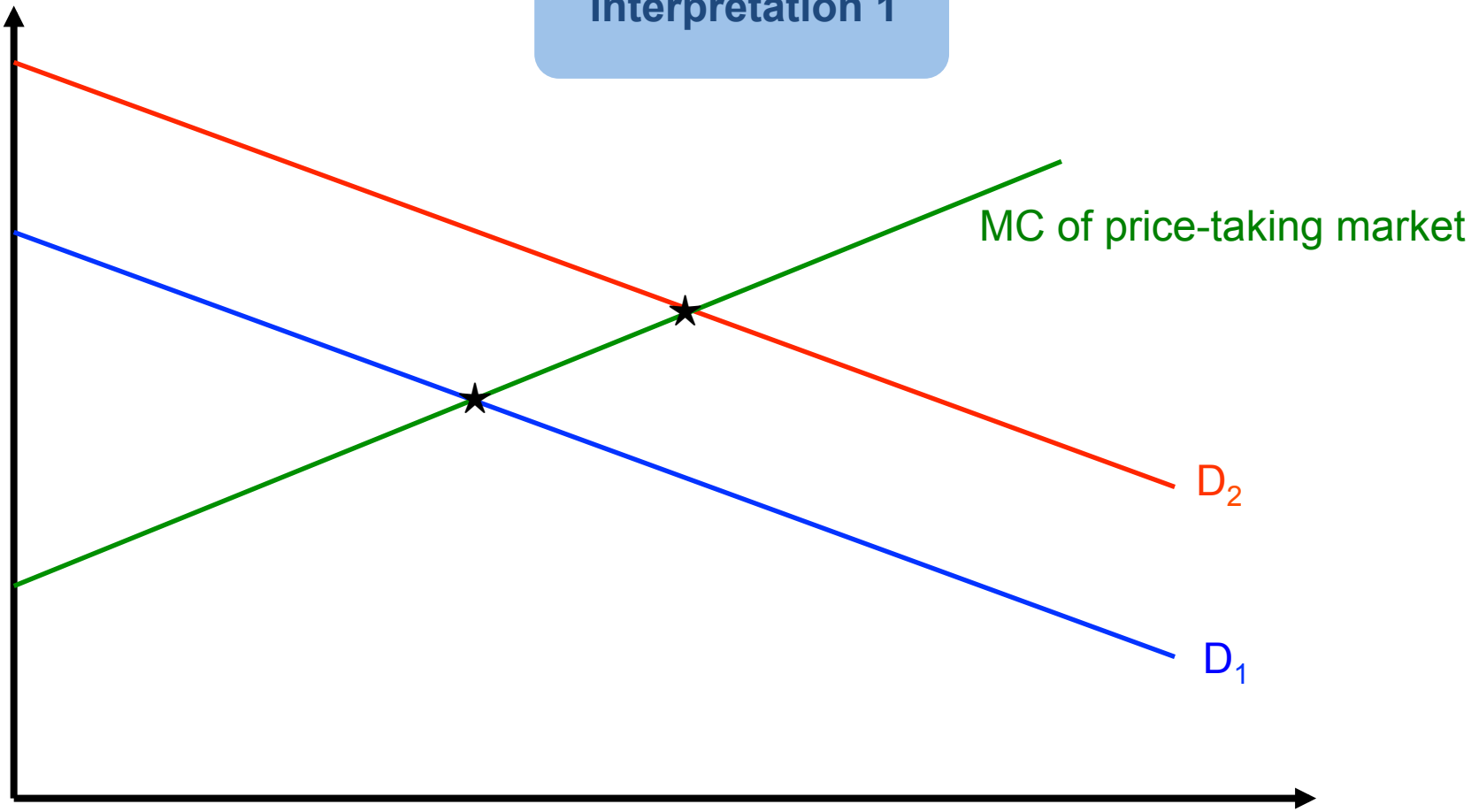
Assume:

1. We have estimated demand function with seasonal variation
2. We observe (P_i, Q_i) for 2 periods - 2 equilibrium points.



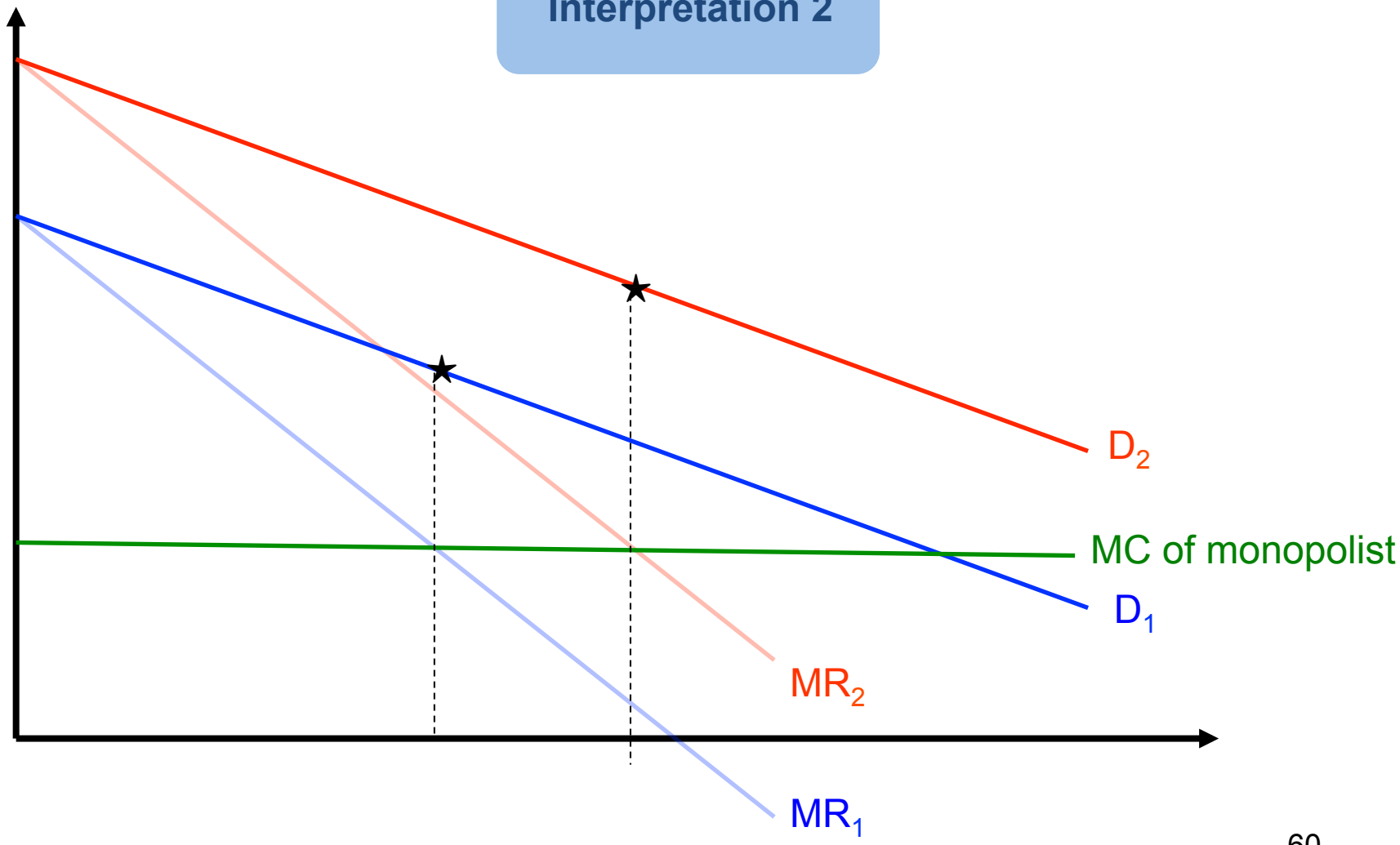
Rotation

Interpretation 1



Rotation

Interpretation 2



Rotation

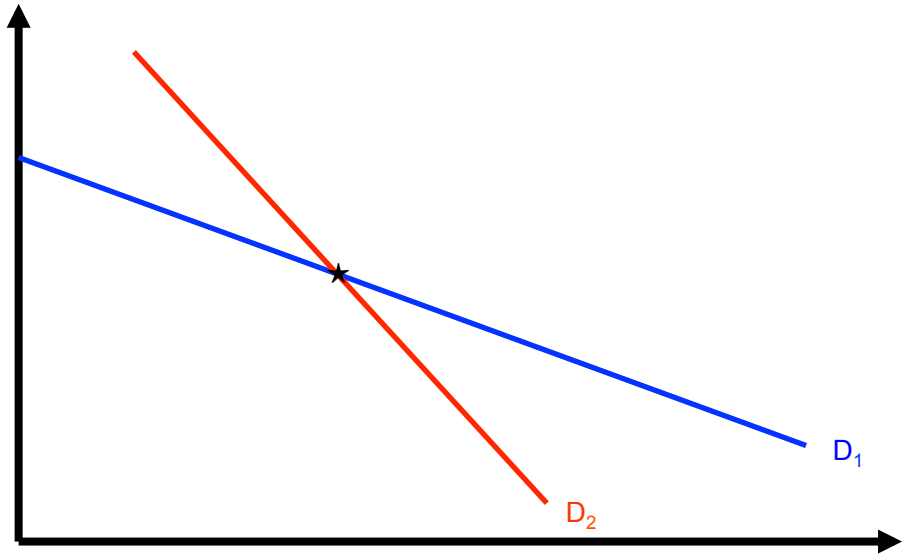
- Several possible interpretations
  - Price taking & steep marginal cost
  - Monopoly power & flat marginal cost
  - Intermediate cases

Rotation

- Several possible interpretations
  - Price taking & steep marginal cost
  - Monopoly power & flat marginal cost
  - Intermediate cases
- Solution
  - Don’t only include shifts in demand
  - Also look at rotations

Rotation

Suppose demand pivots around equilibrium in period 1,
ie elasticity of demand increases



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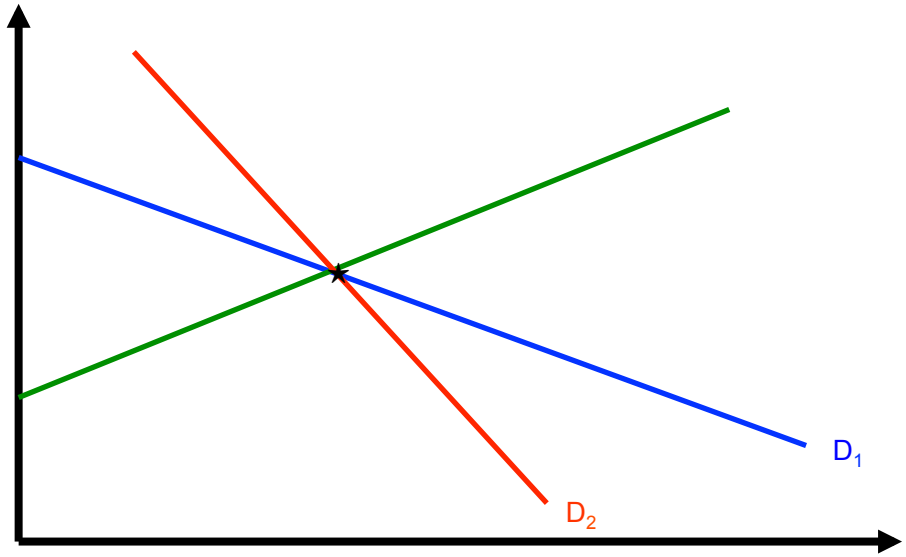

If perfect competition, price unchanged

Rotation

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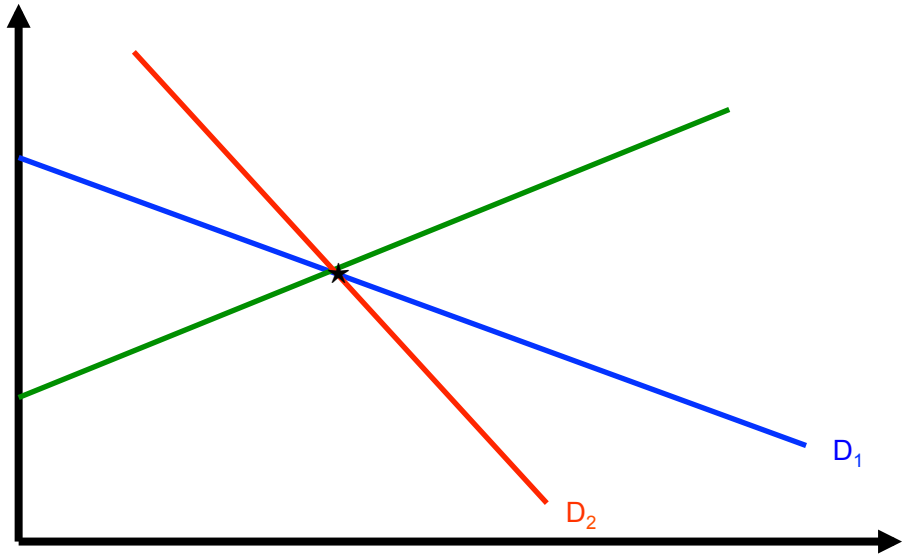

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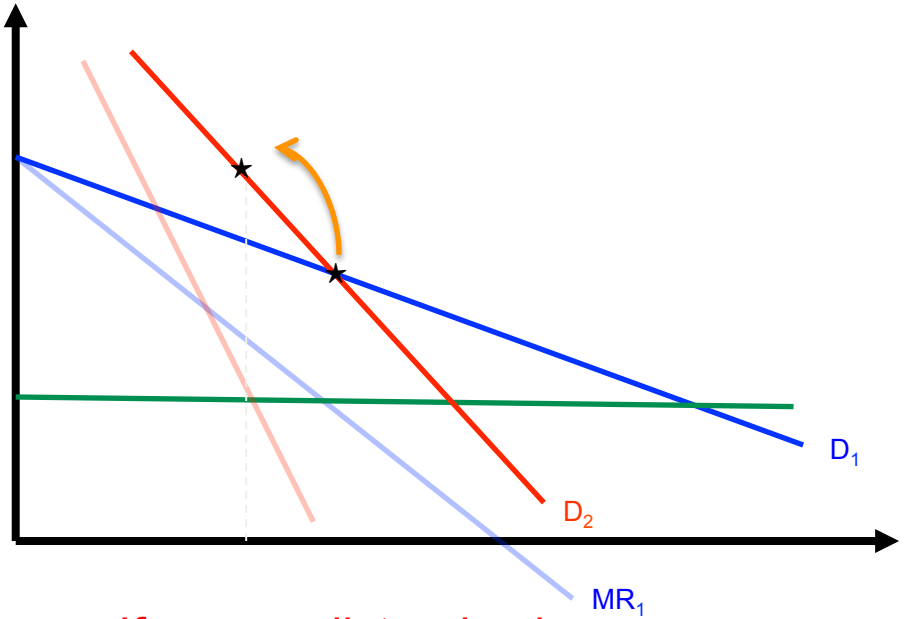

If monopolist, price increases

Rotation

- Key idea
  - We need to observe variations in demand elasticity to estimate conduct and cost
- Sugar industry
  - Difference between high and low season

Rotation

$$\frac{p-c}{p} = \frac{1}{\varepsilon} \cdot \theta$$

- Result
  - Conduct: θ = 0.04
  - Firms have some market power
  - But close to competitive

Rotation

- Reliability
  - Cost known from other sources
  - They underestimate market power somewhat
  - But not big problem

NEIO

New Empirical Industrial Organization

NEIO Method

- Huge differences between industries
  - Only compare “same” markets
    - Car market in different countries
    - Sugar market over time
- Firm’s price-cost margins cannot be observed
  - Marginal cost not found in books
  - Can be inferred from behavior
- Pricing behavior estimated
- Often need firm level data
  - E.g if goods are differentiated

NEIO

Survey of Results

Source: Bresnahan, Handbook, 1989

Industry	*L*	
Food processing	0.50	
Coffee roasting	0.06/0.02	Large vs small firm
Rubber	0.05	
Textile	0.07	
Electrical machinery	0.20	
Tobacco	0.65	
Railroads	0.40	
Retail gasoline	0.10	
Automobiles	0.10/0.34	Standard vs luxury
Aluminium	0.59	
Banks, before entry deregulation	0.88/0.21	Large vs small firm
Banks, after entry deregulation	0.40/0.16	Large vs small firm

NEIO
Results

- Overall Conclusions (Bresnahan)
  - Great deal of market power in some industries
  - A significant cause is conduct
    (as opposed to inelastic demand)
  - Little is known about importance of concentration
    (Most studies in concentrated industries)
- Policy
  - May be reason to intervene, at least if conduct is cartels

Quiz

Q5: Identification of oligopoly

- Find market with seasonal demand fluctuations
  - Is it the level or the elasticity that varies?
  - Are prices fluctuating?
- Intuitive rotation
  - What do price fluctuations say about the firms' market power (or conduct)?