Industry Structure and Performance

Jasmine. Hao[1]

[1]University of Hong Kong

ECON 2216: Industrial Organization

Outline

1. Industry Structure and Performance
   - Theories of Price Markups and Profits
   - Structure-Conduct-Performance
   - Modern Structure-Conduct-Performance Analysis
   - Identifying Market Power

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Theories of Price Markups and Profits[1]

TABLE 8.1 **Predictions Based on Market Structure**

	$p - MC$	π_{SR}	π_{LR}
Competition	0	+ or −	0
Monopolistic competition	+	+ or −	0
Monopoly	+	+ or −	+ or 0
Oligopoly	+	+ or −	+ or 0

p = price, MC = marginal cost (short run), π_{SR} = short-run profits, and π_{LR} = long-run profits.

Figure: Table 8.1

Theories of Price Markups and Profits[2]

- Based on the relationships summarized in Table 8.1, two important conclusions can be drawn:
  1. Testing whether long-run profits are positive is a test of free entry, not of (perfect) competition:
     - ⋆ free entry guarantees that long-run zero profits, but not that price equals marginal cost
     - ⋆ firms in a monopolistically competitive industry may earn zero profit even though price is above marginal cost
     - ⋆ to determine whether price exceeds marginal cost, one must examine price data, not profit data
  2. Short-run profits reveal very little about the degree of competition in an industry because, in all market structures, short-run profits can be either positive or negative
- Many more structures are possible
- for any given market structure, industries can differ substantially
  - ▶ Generally, one would expect price-cost margins and profits to vary with the number of rivals and the size of barriers to entry - provides the foundation for the SCP approach

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What is SCP

- In the SCP paradigm
  - An industry's performance (its success in producing benefits for consumers) depends on the conduct or behavior of sellers and buyers, which depends on the structure of the market
  - The structure in turn depends on basic conditions such as technology and the demand for a product
- A typical SCP study has two main stages:
  1. one obtains a **measure of performance** and several **measures of industry structure**
  2. the econometrician uses cross-industry observations to regress the performance measure on various measures of structure so as to explain the difference in market performance across industries

Measures of Market Performance

- Measures of market performance - examine whether market power is exercised in an industry
- Two different measures are commonly used:
  1. **rate of return**
  2. **price-cost margin**

Pitfalls in Calculating Rates of Return

- **Capital is usually not valued appropriately because accounting definitions are used instead of the economic definitions**
  - Accounting definitions: **book value**, based on the historical cost of the capital combined with accounting assumptions about depreciation
  - As historical cost is often very different from the actual replacement cost of the capital, using the book value of capital rather than the economic value can severely bias the measurement of rate of return
- **Depreciation is usually not measured properly**
  - **Straight-line depreciation**: assumes that the asset's value declines in equal annual amounts over some fixed period

Pitfalls in Calculating Rates of Return

- **Valuing problems arise for advertising and research and development (R&D)**
  - Both have lasting impacts on either a firm's demand or its costs
- **Proper adjustment must be made for inflation**
  - The earned rate of return can be calculated as either a real rate or as a nominal rate
  - One should be careful to compare rates that are either all real or all nominal

Pitfalls in Calculating Rates of Return

- **Rates of return may not be properly adjusted for risk**
  - To determine whether a firm is earning an excess rate of return, the proper comparison is between the rate of return actually earned and the competitive **risk-adjusted rate of return**
  - **Risk-adjusted rate of return**: the rate of return earned by competitive firms engaged in projects with the same level of risk as that of the firm under analysis
  - The greater the risk, the higher the expected rate of return

Rates of Return Across Industries[1]

- Comparing Rates of Return
  - Earning positive economic profit and earning excess rates of return (above the competitive or normal level) are equivalent ways of expressing the same idea

TABLE 8.2 **Average Annual Returns, 1948–1976**

Industry	Nominal Rate of Return	Own Rate of Return*	Nominal Rate of Return on Stockholders' Equity
Agriculture	.07	.04	
Crude petroleum	.12	.08	
Food	.10	.07	.10
Tobacco	.14	.11	.13
Textiles	.09	.06	.08
Chemicals	.13	.10	.14
Motor vehicles	.29	.25	.15
All manufacturing - median industry	.11	.08	.11
Railroads	.07	.03	
Telephone and telegraph	.15	.11	
Retail trade	.10	.07	

*The own rate of return subtracts from income the effects of increases in the price of capital for each industry. If the price of capital changes only with inflation, the own rate of return is a real (inflation-adjusted) rate of return.

Sources: Fraumeni and Jorgenson (1980); Federal Trade Commission, *Quarterly Financial Reports*, 1948–1976.

Comparing Rates of Return[2]

- Fraumeni and Jorgenson (1980) calculated the after-tax economic rate of return for a large sample of American industries over the period 1948–1976:
  - Over this period, the median manufacturing industry earned a nominal rate of return of approximately 11 percent
  - Over this same period, the average rate paid on three-month U.S. government Treasury bills was roughly 3.6 percent
  - So the rate of return in manufacturing significantly exceeded the rate of return on Treasury bills, possibly to compensate for the increased risk
- Different methodologies can lead to different rates of return
  - For example, the nominal rate of return in motor vehicles is about 29 percent according to Fraumeni and Jorgenson (1980), but is 15 percent according to the FTC
  - Nonetheless, the relative rates of return between industries follow the same pattern using both methodologies

Price-Cost Margins[1]

- To avoid the problems associated with calculating rates of return, many economists use a different measure of performance, the **Lerner Index** or **price-cost margin**:

$$\frac{p - MC}{p} = -\frac{1}{\epsilon}$$

- A competitive firm sets $p = MC$ because its residual demand price elasticity is negative infinity
- Unfortunately, because a marginal cost measure is rarely available, many researchers use the price-average variable cost margin instead

Price-Cost Margins[2]

- **Price-average variable cost margin** = revenues - payroll - material cost divided by sales
  - It ignores capital, research and development, and advertising costs which may lead to serious biases
  - Marginal Cost is

$$MC = v + (r + \delta)\frac{p_k K}{Q}$$

    - ★ where r is competitive rate of return; d is the depreciation rate, and v is the cost of the labor and materials needed to produce 1 unit of output (Q)

- Using v in place of marginal cost can lead to serious bias as can be seen by substituting MC,

$$\frac{p - v}{p} = -\frac{1}{\epsilon} + (r + \delta)\frac{p_k K}{pQ}$$

  - $\frac{p-v}{p}$ differs from the correct measure $\frac{p-v}{p} = -\frac{1}{\epsilon}$ by $(r + \delta)\frac{p_k K}{pQ}$, which is the rental value of capital divided by the value of output

Measures of Market Structure[1]

- Measures of market structure - examine how performance varies with structure
- Common measures of market structure
  1. Industry Concentration
  - Industry concentration is typically measured as a function of the market shares of some or all of the firms in a market
    - ⋆ **Four-firm concentration ratio (C4)**: the share of industry sales accounted for by the four largest firms
    - ⋆ The U.S. government also has published **eight-firm concentration ratios (C8)**
    - ⋆ **Herfindahl- Hirschman Index (HHI)**: equals the sum of the squared market shares of each firm in the industry
      - Department of Justice and Federal Trade Commission use it to evaluate mergers
      - The government publishes HHI statistics by industry
      - Empirical studies show that HHI is the appropriate index of concentration to explain prices if firms behave according to the Cournot model

Measures of Market Structure[2]

TABLE 8.3 **1997 Concentration Ratios in Selected Manufacturing Industries**

Product Grouping	C4	C8	HHI*
Meat products	35	48	393
Breakfast cereal	83	94	2,446
Distilleries	60	77	1,076
Cigarettes	99	NR	NR
Men's and boy's suits and coats	42	56	846
Sawmills	15	20	87
Folding paperboard boxes	25	38	246
Book printing	32	45	364
Petroleum refining	29	49	422
Tires and inner tubes	68	86	1,518
Blast iron and steel mills	33	53	445
Household refrigerators and freezers	82	97	2,025
Motor vehicles and car bodies	87	94	NR
Computers	40	68	658

*Herfindahl-Hirschman Index for the 50 largest companies. *NR* indicates that the index is not reported.

Source: Census of Manufactures: Concentration Ratios in Manufacturing (2001, Table 2).

Rates of Return and Industry Structure

- Bain (1951):
  - Investigated 42 industries and separated them into two groups: those with an eight-firm concentration ratio in excess of 70 percent and those with an eight-firm concentration ratio below 70 percent
  - Findings: the rate of return (calculated roughly as income divided by the book value of stockholders' equity) for the more concentrated industries was 11.8 percent compared to 7.5 percent for less concentrated industries
- Bain (1956):
  - Classified industries by his subjective estimate as to the extent of barriers to entry
  - Findings: Profits are higher in industries with high concentration and high barriers to entry
- Brozen (1971) criticized Bain's findings for two reasons:
  - The industries that Bain studied could be in disequilibrium
  - Use the profit rates of the leading firms, rather than the profit rate of the industry, which could have skewed results

Rates of Return and Industry Structure[2]

- Mann (1966):
  - Investigated the relationship between profit and his own subjective estimates of barriers to entry
  - Findings: concentrated industries with very high barriers to entry have higher average profit rates than concentrated industries that do not have very high barriers to entry
- Weiss (1974):
  - Findings: concluded that there was a significant relationship between profit, concentration, and barriers to entry
  - However, studies based on more recent data tend to find only a weak relationship or no relationship between the structural variables and rates of return
- Lustgarten and Thomadakis (1980):
  - Findings: good economic news raises the stock market values of companies in concentrated industries much more than those in unconcentrated industries, and bad economic news lowers their values more
- Pasts studies suggests capital-output ratios appear to rise with concentration, though less so recently than in the past. The explanation for the correlation between capital-output ratios and concentration is not known.

Rates of Return and Industry Structure[3]

TABLE 8.6 **Capital-Output Ratios and Concentration**

Four-Firm Concentration Ratio	Average Capital/Output Ratio (Percent) 1963	1997
0–10	26.5	38.8
11–20	26.9	32.8
21–30	32.7	37.1
31–40	34.5	39.9
41–50	37.7	36.8
51–60	37.9	39.4
61–70	44.2	46.6
71–80	49.8	49.0
81–90	51.8	35.6
91–100	57.7	42.5

Source: 1963 series from Collins and Preston (1969, 272); 1997 series is based on authors' calculations using the 1997 *Census of Manufactures, Industry Series* and *Concentration Ratios in Manufacturing*. The numbers in Table 8.6 are based on gross book value of capital and, because of data unavailability, do not exclude depreciation.

Price-Cost Margins and Industry Structure

- Past studies using individual firm data showed that the link between higher concentration and higher price-cost margins is ambiguous:
  - The link, if it exists at all, is very weak
  - The presence of a large second or third firm greatly reduces the price-cost margin that can be earned
- Various studies report significant effects from other explanatory variables:
  - Industry growth has a significant and positive effect on price-average variable cost margins
  - Increased buyer concentration sometimes lowers price-cost margins
  - A higher advertising-sales ratio may raise the price-cost margin
  - Unions lower the price-cost margin

Conceptual Problems with Measure

(1) Whether long-run performance measures are used

- SCP study based on short-run performance measures is not a proper test of the theories
  - The length of time it takes to reach the long run differs by industry
  - Only by analyzing both the level of profits and the rate at which they change can the analyst distinguish between a long-run barrier to entry and the speed with which entry occurs

(2) Whether the structural variables are exogenous

- If concentration is not an exogenous measure, then an estimate of the relationship between profits and concentration leads to what is referred to as a simultaneity bias

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Modern Structure-Conduct-Performance Analysis

- The original structure-conduct-performance literature sought to establish a systematic relationship between price and concentration
  - The most significant criticism is that concentration itself is determined by the economic conditions of the industry and hence is not an industry characteristic that can be used to explain pricing or other conduct
  - Sutton and his coauthors have developed an approach that builds on the structure-conduct-performance idea of looking for systematic patterns of competitive behavior across industries, and that at the same time addresses the endogenous determination of entry (Sutton 1991, 1998)

Theory

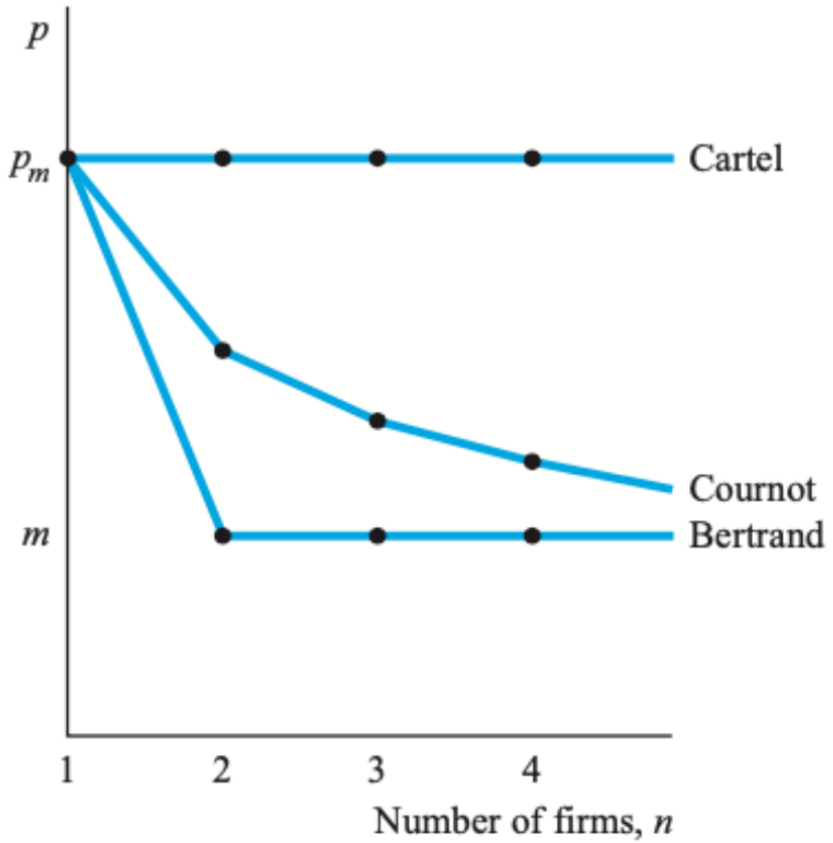
- Sutton's theory can be divided into two cases depending on whether a firm's cost of entry is
  1. an **exogenous sunk cost**: each firm must spend some fixed amount, F, to enter the industry.
  2. an **endogenous sunk cost**: amount a firm must spend to enter the industry is variable and is chosen by the firm

Exogenous Sunk Cost

- Considering a market in which the firms produce a homogeneous product and the only variable firms can compete on is price, not quality
- Each firm incurs a fixed cost F and has a constant marginal cost m
- At low prices, the industry demand curve is $Q = \frac{s}{p}$
  - Q is industry quantity, s is a measure of market size, and p is price
  - For low prices and given s, the market elasticity of demand is -1
  - At some high price p_m, the demand curve is perfectly elastic: a monopoly charge p_m
- The final equilibrium and the change in equilibrium as the market size grows are determined by the form that competition take
- The level of competition: Bertrand $>$ Cournot $>$ Cartel

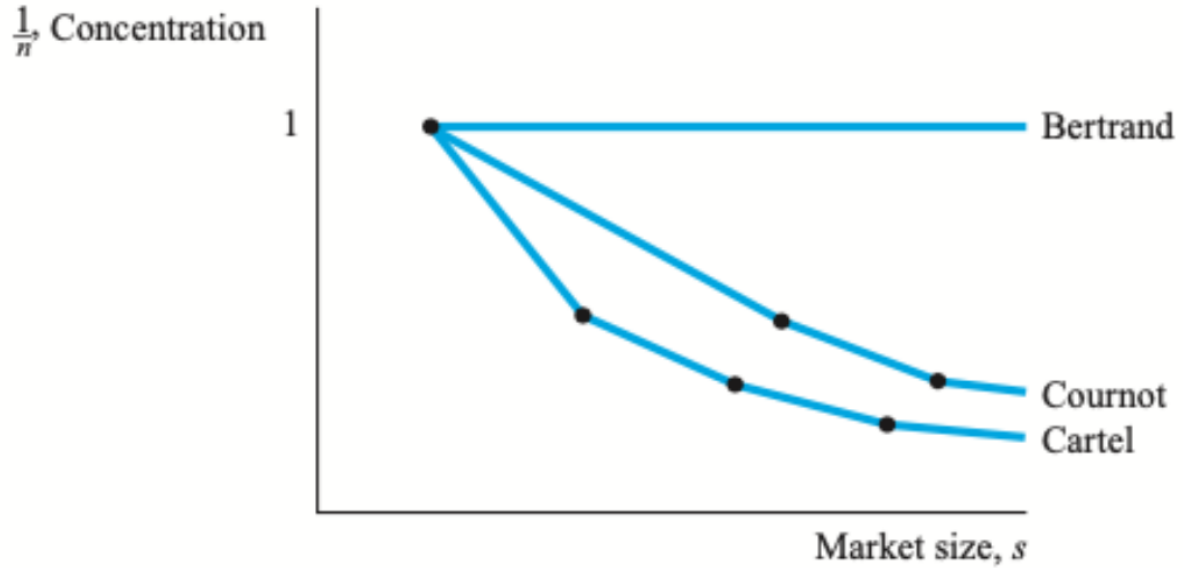
Price and Market Structure

FIGURE 8.1 Relationship Between Prices and Number of Firms Under Three Market Structures



Concentration and Market Size

FIGURE 8.2 Relationship Between Concentration and Market Size Under Three Market Structures



Concentration and Market Size

(1) Concentration falls as market size increases for all but the most competitive game (Bertrand)

- Intuition: larger markets can accommodate more firms

(2) For any given market size, equilibrium market concentration is higher, the tougher the competition

- e.g. concentration is lowest for the cartel model, even though the cartel model has the highest price
  - Intuition: tough competition leads to a low price, which discourages entry
  - Relying on concentration alone to make inferences about price and competitiveness can lead to erroneous conclusions

Heterogeneous Products

- In a model with heterogeneous products, the concentration in the market depends on the nature of the game, e.g.,
  - how many different products one firm may produce
    - whether a firm has an advantage if it can choose its products before other firms choose
  - "toughness" of competition is diminished when one moves from a homogeneous to a heterogeneous product
    - so the equilibrium concentration tends to fall for any given market size s
- The property that equilibrium concentration decreases with market size s depends on the assumption that fixed costs are exogenous and that product quality is given

Endogenous Sunk Costs[1]

- In most markets, firms compete on many product dimensions, such as price, quality, reliability, research and development, and promotional activity
- The key new assumption: a firm may spend money to improve the quality of its product (W)
- **Endogenous sunk costs**: the firm decides how large an investment to make in improving product quality and lowering price, in order to compete for customers
- Paying to improve quality has two important effects:
  (1) Raises the firm's fixed cost and perhaps its marginal cost of production if a higher-quality good costs more to produce
  (2) Attracts customers who were previously buying a lower-quality good

Endogenous Sunk Costs[2]

- As market size s increases, firms have an incentive to compete by improving the quality W of their product
  - To raise quality, a firm must incur larger sunk costs, a circumstance that reduces the incentive for additional firms to enter the industry that otherwise arises from the larger s
  - As a result, as market size increases, concentration no longer necessarily falls
  - For this reasoning to hold, **vertical differentiation** needs to hold:
    - every consumer agrees on a ranking of products by quality
    - all consumers preferring a higher-quality product to a lower-quality product
- As long as the price of a product and the marginal cost of producing a high-quality product do not rise "too fast" as W increases, then the equilibrium has three striking properties:
  - The firms that produce the highest quality available in the market are the largest firms
  - An increase in market size leads to an increase in the quality of the best products in the market
    - with higher-quality products being chosen by consumers at higher prices
    - with some lower-quality products disappearing from the marke
    - and the equilibrium quality rises as the market expand
  - With higher quality and its attendant costs, fewer firms can afford to remain in the industry and concentration will remain high

Empirical Research[1]

- Sutton (1991)
  - Tests his theoretical predictions about the relationship between concentration and market size for several industries in the food and beverage sector
    - ★ Separates the industries into two types:
      - One in which there is little advertising (exogenous sunk cost) and the other in which there is significant advertising (endogenous sunk cost)
      - For each type of industry, Sutton runs a regression of the form

$$C4 = a + b \ln \frac{s}{\sigma}$$

      - where C4 is the four-firm concentration ratio and $\frac{s}{\sigma}$ is the market size divided by the size of an efficient plant

Empirical Research[2]

- There are two important caveats to Sutton's results:
  1. The assumption that the competitive game is the same across countries is not always a particularly good one
     - ⋆ There is little research so far explaining why in some countries competition in a particular industry is more intense than in others
       - Sutton uses the difference across countries in the competitive game for an industry to his advantage
       - Identified industries and countries where competition is unusually intense and found, consistent with his theory, that the industry is more concentrated in those countries
       - Identifies that in countries with lax attitudes toward cartels and againthose, industries tend to have lower concentration levels
  2. Sutton's theory predicts a lower bound to the relationship between market size and concentration
     - ⋆ The reason for the lower bound is that there can be a multiplicity of equilibria, with some having greater concentration levels than the lower bound
       - The theory therefore is unable to help us much in predicting concentration in a particular country when the lower bound is low

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Identifying Market Power[1]

- Suppose that an industry consists of a number of identical firms that produce a homogeneous product. The demand curve is $p(Q; Z)$, where p is the single price in the market Q is output, and Z is another variable that affects demand, such as income or the price of a substitute
- Because industry revenues are $R \equiv p(Q; Z)Q$, the perceived marginal revenue is

$$MR(\lambda) = p + \lambda p_Q Q$$

  - where λ is a parameter to be estimated and $p_Q \equiv \frac{\partial p}{\partial Q}$
  - λ that lies strictly between 0 and 1
    - ⋆ If the industry is monopolized $\lambda = 1$and effective MR(1) is the usual MR measure
    - ⋆ If the firms in the industry are price takers $\lambda = 0$ and effective MR(0) equals price
  - λ is a measure of the gap between price and marginal cost. That is, the Lerner's Index is

$$L \equiv \frac{p - MC}{p} = -\frac{\lambda p_Q Q}{p} = -\frac{\lambda}{\epsilon}$$

Identifying Market Power[2]

- Suppose that the demand curve has the particular linear form $p = \alpha_0 + \alpha_1 Q + \alpha_2 Z + \alpha_3 ZQ + \epsilon_1$ so that the effective marginal revenue is

$$MR(\lambda) = p + \lambda p_Q Q = p + \lambda(\alpha_1 + \alpha_3 Z)Q$$

- A profit-maximizing firm sets its effective marginal revenue equal to its marginal cost. If its marginal cost curve is linear in Q and factor price W,

$$MC = \beta_0 + \beta_1 Q + \beta_2 W + \epsilon_2$$

  - Its optimality equation $MR(\lambda) = MC$, can be written as

$$p = \beta_0 + (\beta_1 - \lambda\alpha_1)Q - \lambda\alpha_3 ZQ + \beta_2 W + \epsilon_2$$

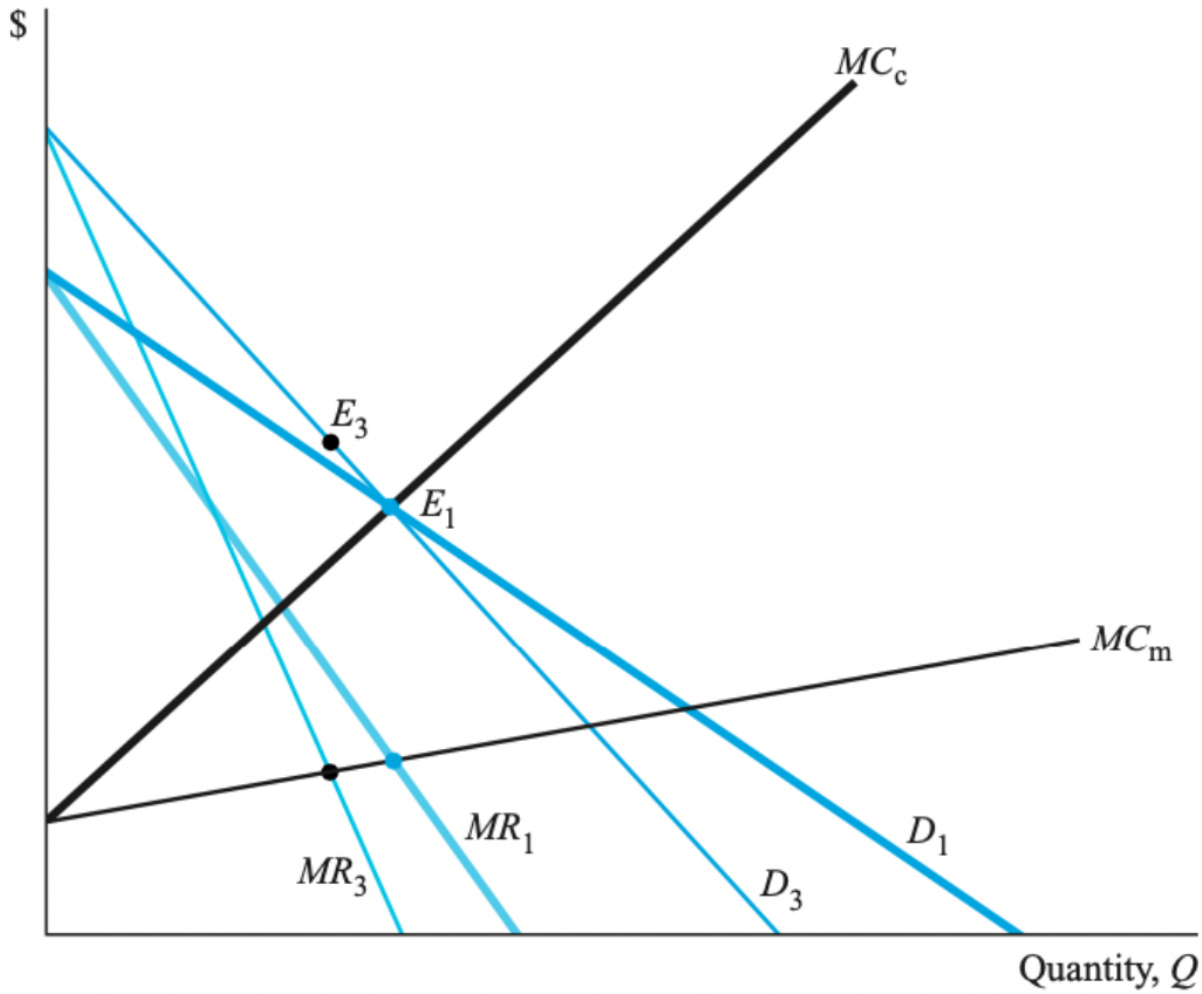
  - Using the appropriate statistical techniques, one can regress p on a constant, Q, ZQ, and W to obtain estimates of the coefficients
  - By dividing the estimate of the coefficient on $-\lambda\alpha_3$ by the estimate of α_3 from the demand equation, an estimate of the market structure parameter λ can be computed

Identifying Market Power[3]

- Alternatively, if MC is known, using the information about price from the demand curve can help to determine λ
  - Rotating the demand curve leaves the level of demand unchanged at the rotation point, but changes the elasticity of demand
  - As the elasticity of demand changes, the price changes, λ can be estimated

Identifying Market Power[4]

FIGURE 8B.2 Identified: Rotation of the Demand Curve



For Further Reading I

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- Belleflamme, Paul., and Martin. Peitz. Industrial Organization : Markets and Strategies. Cambridge, UK ;: Cambridge University Press, 2010. Print.