

## **6. COMPETITION, CONCENTRATION AND MARKET POWER IN TRANSPORT**





## 6.1. Theory

# Introduction

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- ▶ What determines the level at which a transport firm actually does produce?
- ▶ The lecture has three objectives:
  1. to combine supply and demand, in order to characterize market equilibrium price and quantity in perfectly competitive markets;
  2. to move away from the perfectly competitive model and consider alternative market structures;
  3. to illustrate the underlying concepts empirically.



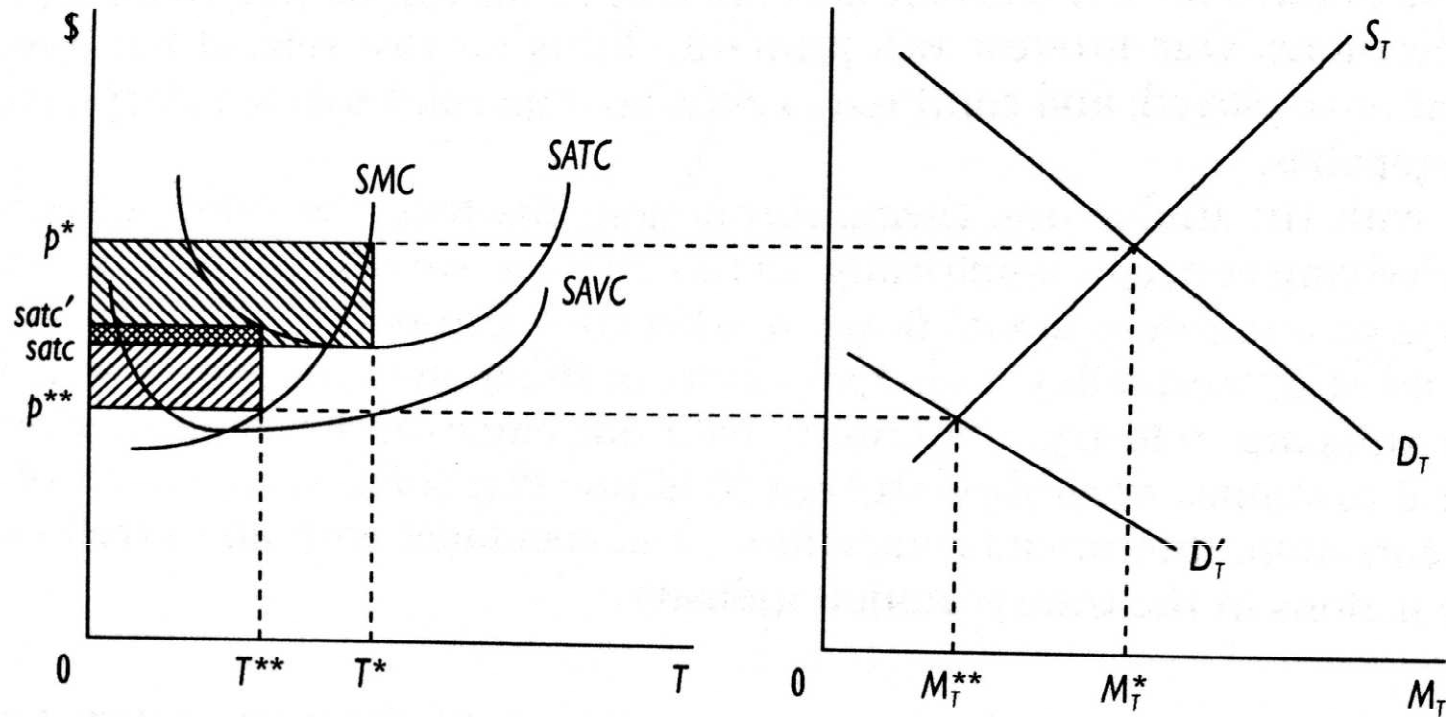
# Perfectly competitive market structure



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- ▶ Under perfect competition there are assumed to be:
  - ❑ Large number of firms
  - ❑ Producing virtually identical or homogenous products
  - ❑ Resources are perfectly mobile
  - ❑ Relevant information for consumption and production decisions is readily available
  - ❑ There is freedom of entry and exit
  - ❑ No interdependencies in consumption and production



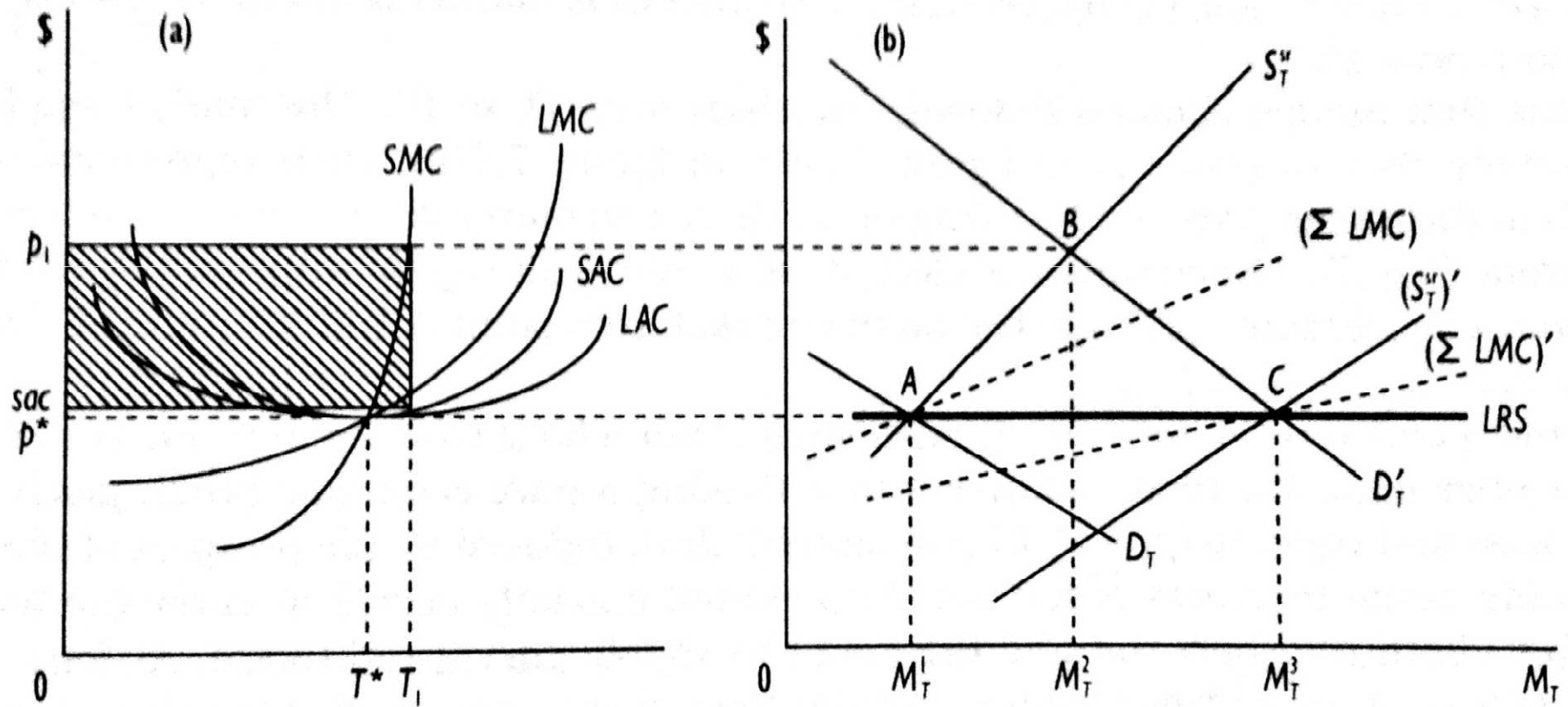
# Short run market equilibrium



-  Short-run economic profit with price  $p^*$
-  Short-run economic loss with price  $p^{**}$
- $T^*$  Equilibrium firm output at price  $p^*$
- $T^{**}$  Equilibrium firm output at price  $p^{**}$
- $M_T^*$  Equilibrium industry output at price  $p^*$
- $M_T^{**}$  Equilibrium industry output at price  $p^{**}$

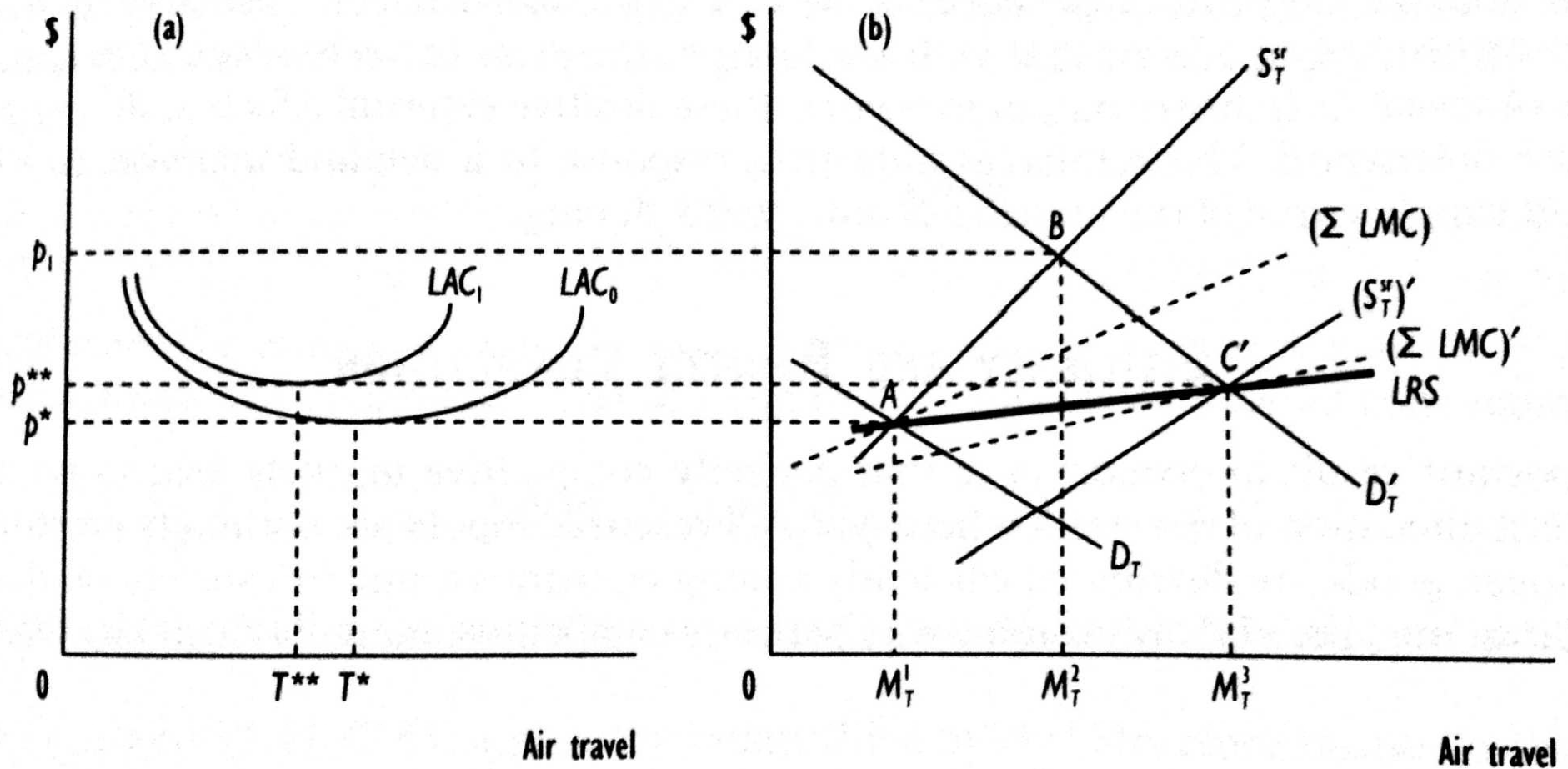
**Figure 7.1** Short-run firm and market equilibria.

# Long run market equilibrium



**Figure 7.2** Firm costs with a constant industry long-run supply curve. (a) Representative firm; (b) market demand and supply.

# Long run supply and external effects of scale



**Figure 7.3** Firm costs with a rising long-run industry supply curve.

# Efficiency and perfect competition

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- ▶ The perfectly competitive markets lead to an optimal or efficient allocation of resources whereby:
  1. All resource inputs are optimally employed
  2. All produced goods are distributed efficiently among consumers
  3. Society produces the right output mix





# Transport flows as interregional trade

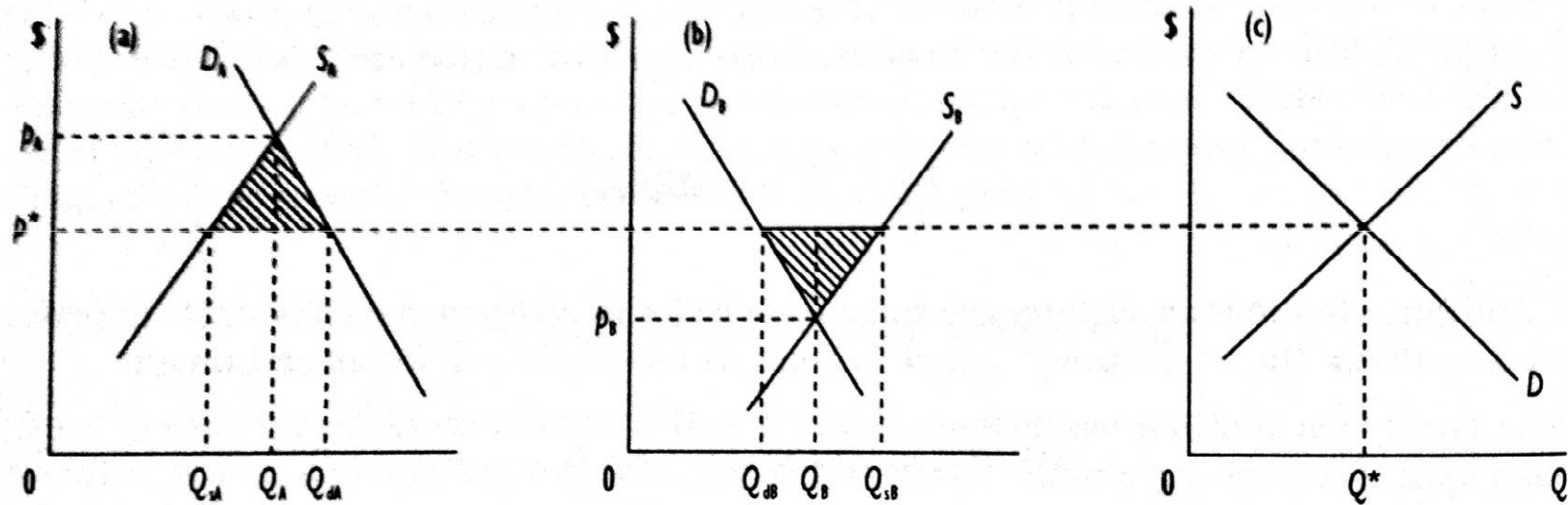


Figure 7.4 Interregional trade flows with zero transportation costs. (a) Region A; (b) region B; (c) total market.

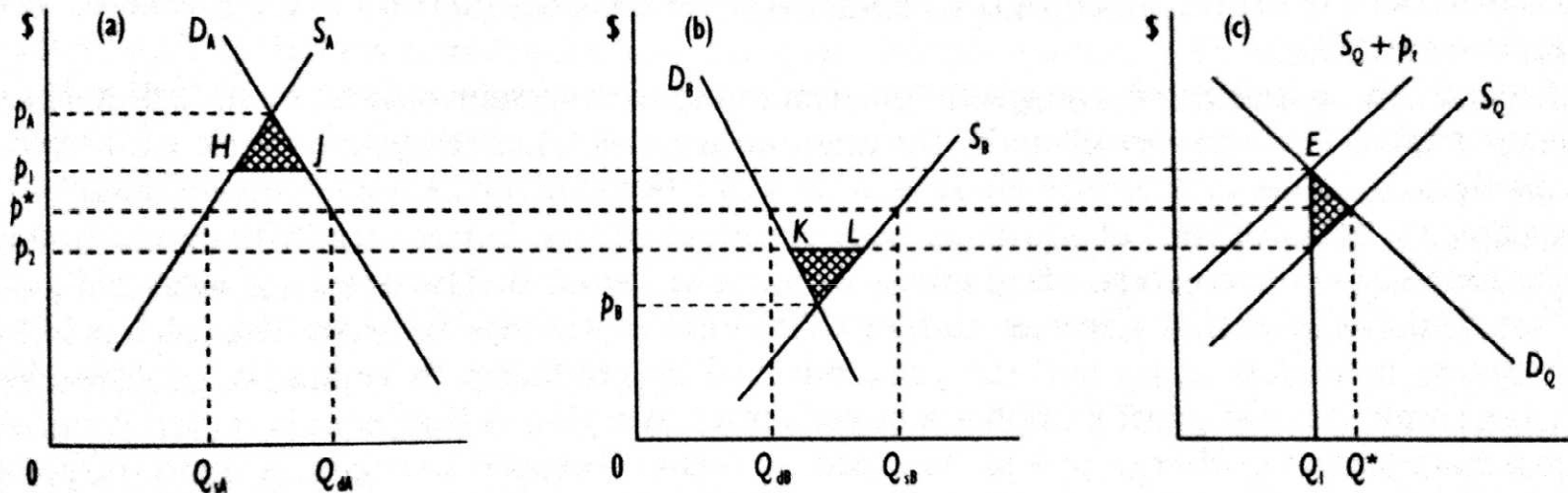


Figure 7.5 Interregional trade flows with positive transportation costs. (a) Region A; (b) region B; (c) total market.

# Case study – an empirical model of interregional freight flows

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- ▶ In an analysis of interregional trade flows for manufactured goods, Friedlaender and Spady (1981) hypothesized the following general relationship between commodity flows and economic variables:



# Variables

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$$Q_{0D}^{OD} = f(Q_{0D}^{OD}, \tilde{Q}_{0D}^{OD}, I^D, Z_{0D})$$

where  $Q_{0D}^{OD}$  is the quantity of commodity  $K$

produced in region  $O$  and shipped to region  $D$ ;

$\tilde{Q}_{0D}^{OD}$  is region  $D$ 's *delivered* price (production cost plus transport charge) of commodity  $K$  produced in  $O$ ;

$Q_{0D}^{OD}$  is region  $D$ 's delivered price of commodity  $K$  if purchased from any region *other than*  $O$ ;

$I^D$  is region  $D$ 's income;

and  $Z_{0D}$  ( $Z_{0D} = 1, \dots, Z_{0D}$ ) represents a series of dummy variables that reflect unmeasured characteristics

of the production or consumption areas.

# Results

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Dependent variable -  $Q_K^{OD}$ , flow (millions of tons) of good K from origin O to destination D

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Explanatory Variable <sup>a</sup>	Industry		
	Food and Kindred	Lumber and Wood	Chemicals and Allied
Constant term	-	-49.29 (-0.56)	-
Delivered Price	-0.3289 (-5.4)	-0.35 (-437.5)	-0.1367 (-3.7)
Destination Region 2 Income	0.092 (7.7)	0.0187 (2.1)	0.0292 (2.9)
Destination Region 3 Income	0.0224 (1.9)	0.019 (2.4)	0.0332 (3.4)
Destination Region 4 Income	0.0388 (3.7)	0.018 (3.0)	-
Intraregional Flow Dummy Variable	350.0 (12.7)	-	247.6 (10.0)

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# Results

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Region 5 Origin Dummy Variable	-	-	-102.35 (4.1)
Region 1 Destination Dummy Variable	43.43 (1.6)	-	-
Flow Within Region 5 Dummy Variable	-	310.5 (11.0)	-
$R^2$	0.82	0.79	0.77

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\* The regions are defined as follows: Region 1, Official Region; Region 2, Southern Region; Region 3, South-Western Region; Region 4, Western Trunk Line Region; Region 5, Mountain-Pacific Region. t-statistics are in parentheses. The general form of the estimating equation was

$$Q_K^{OD} = \alpha_0 + \alpha_1 P_K^{OD} + \alpha_2 \tilde{P}_K^{OD} + \alpha_3 I^D + \sum_m \alpha_m D_m + \varepsilon$$

where the variables are defined in the text and  $\varepsilon$  is an error term.

*Source:* Friedlaender and Spady (1981), table D.1, p. 298

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# Elasticities

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Industry	Elasticity with Respect to		
	Price	Income	Freight Rates
Food and Kindred	-1.5	1.66	-0.051
Lumber and Wood	-0.72	1.96	-0.022
Furniture and Fixtures	-0.34	1.13	-0.002
Pulp, Paper, and Allied	-0.26	1.88	-0.065
Chemicals and Allied	-0.75	1.21	-0.038
Clay, Concrete, Glass and Stone	-0.74	1.60	-0.075
Primary Metal	-	3.61	-
Fabricated Metal	-0.44	2.32	-0.006
Machinery	-0.49	1.04	-0.003

*Source:* Friedlaender and Spady (1981), table D.3, p. 299

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# Equilibrium output for monopolist

$$MR = \frac{\Delta(pT)}{\Delta T} = p + T \frac{\Delta p}{\Delta T} =$$
$$= p \left( 1 + \frac{1}{E_{T,p}} \right)$$

$$MR = p \left( 1 + \frac{1}{E_{T,p}} \right) < p$$

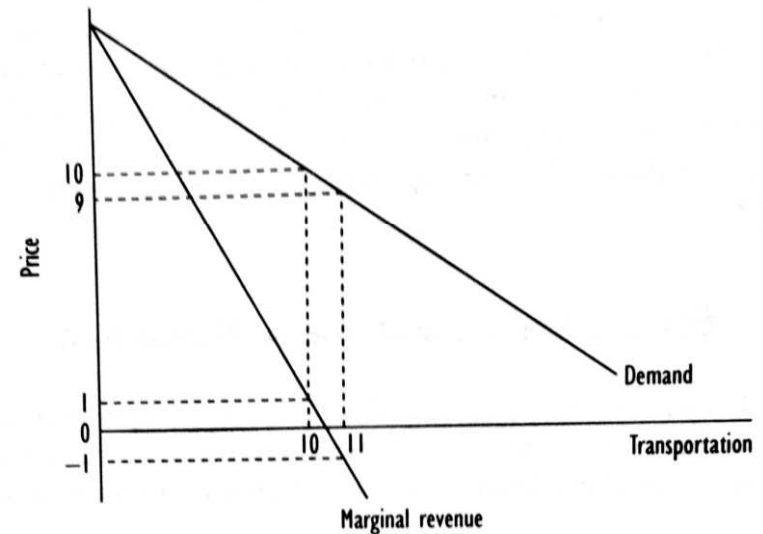


Figure 7.7 Monopolist demand and marginal revenue curves.

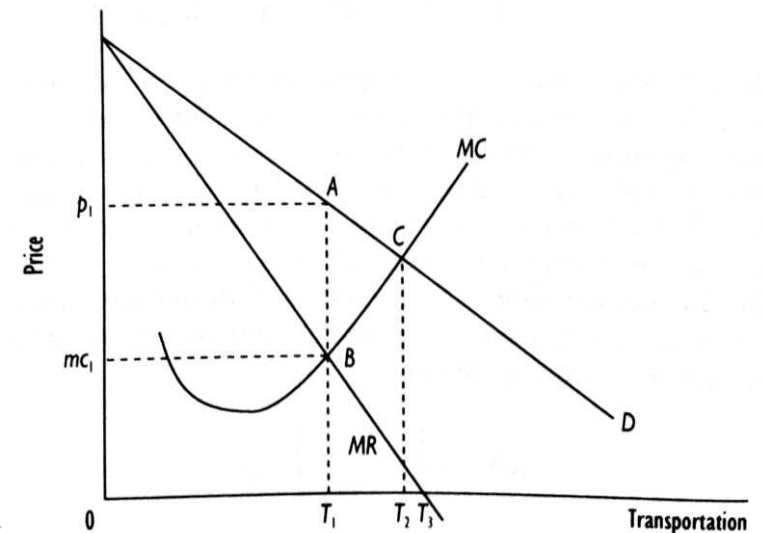


Figure 7.8 Monopolist profit-maximizing behavior.

# Price elasticity of demand and total revenue

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$$\frac{\Delta(pT)}{\Delta T} = T + p \frac{\Delta T}{\Delta p} = T(1 + E_{T,p})$$





# Market power

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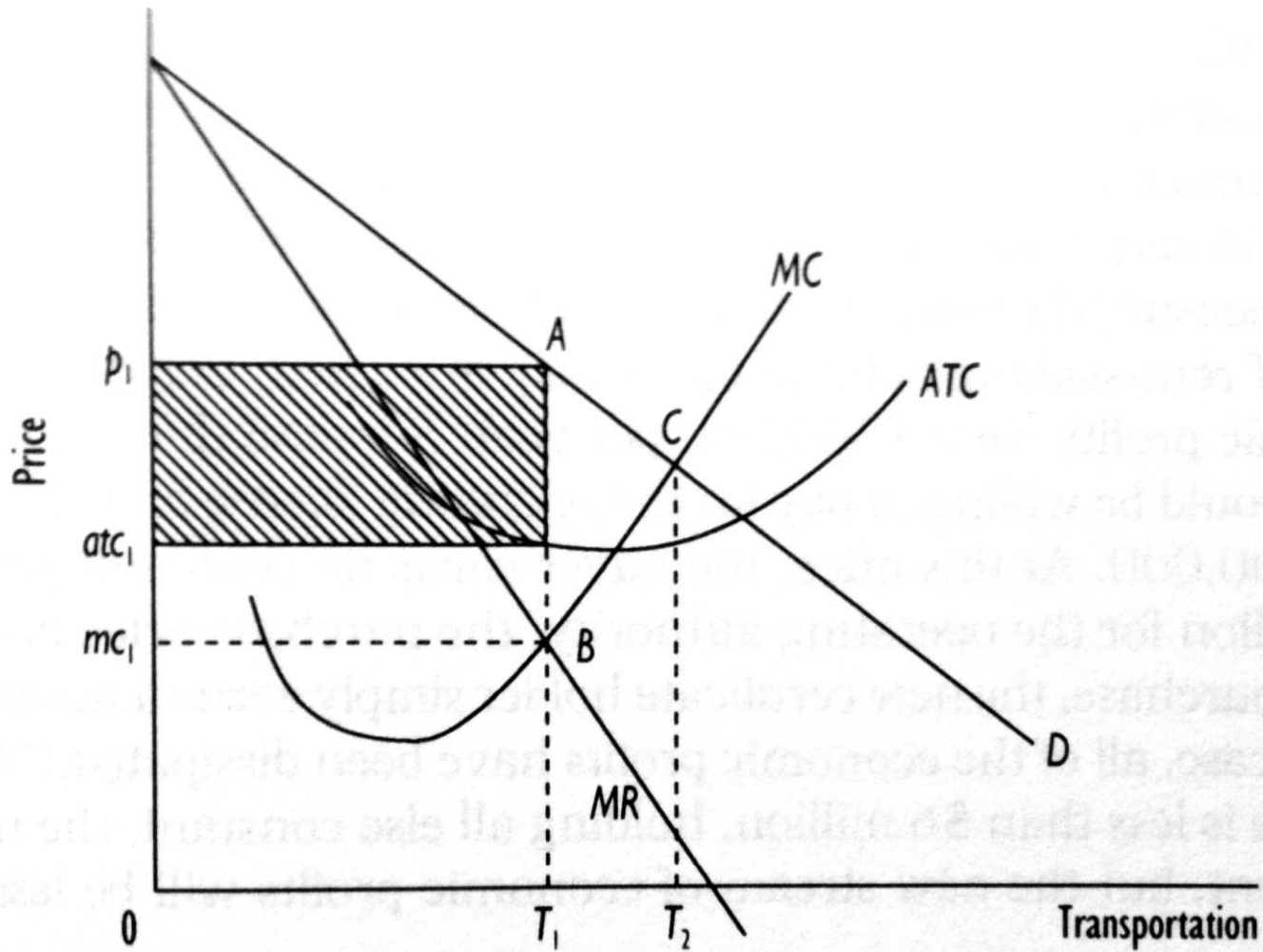
$$\left(1 + \frac{1}{E_{T,p}}\right) = \frac{\Delta STVC(T; w, r, \gamma, \bar{K})}{\Delta T}$$

$$\Rightarrow p + \frac{p}{E_{T,p}} = MC(T; w, r, \gamma, \bar{K})$$

$$\Rightarrow \frac{p - MC(T; w, r, \gamma, \bar{K})}{p} = -\frac{1}{E_{T,p}}$$



# Monopoly rents



**Figure 7.9** Monopoly rents.

# Monopoly rents and price discriminations

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$$MR_b = p_b \left( 1 + \frac{1}{E_{T,p}^b} \right), \quad MR_v = p_v \left( 1 + \frac{1}{E_{T,p}^v} \right)$$

$$p_b \left( 1 + \frac{1}{E_{T,p}^b} \right) = p_v \left( 1 + \frac{1}{E_{T,p}^v} \right)$$

$$\left( 1 + \frac{1}{E_{T,p}^b} \right) < \left( 1 + \frac{1}{E_{T,p}^v} \right)$$

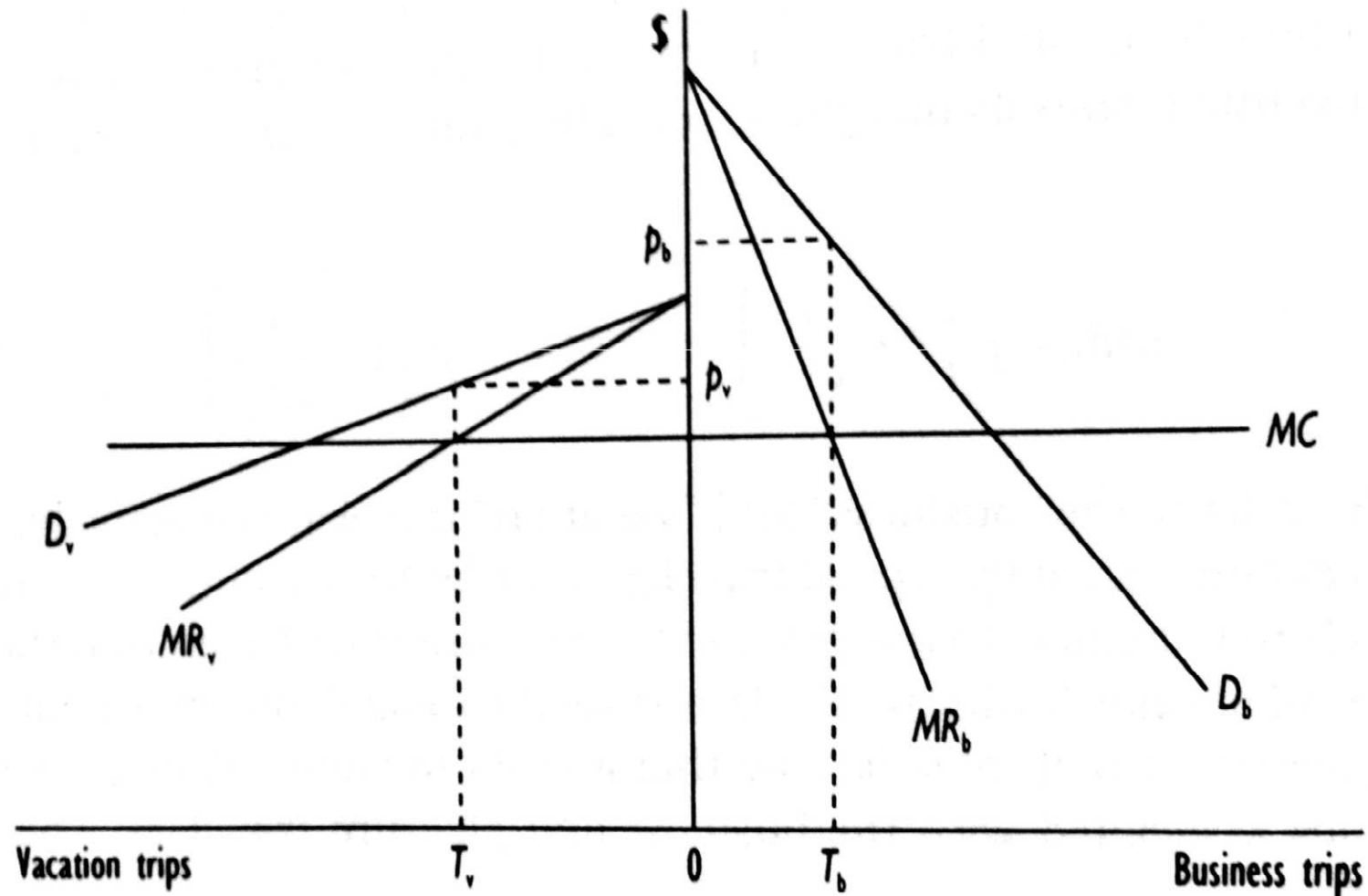
$$\Rightarrow \left( \frac{1}{E_{T,p}^b} \right) < \left( \frac{1}{E_{T,p}^v} \right)$$

$$\Rightarrow E_{T,p}^b > E_{T,p}^v$$

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# Monopoly rents and price discriminations



**Figure 7.10** Price discrimination with uniform marginal cost.

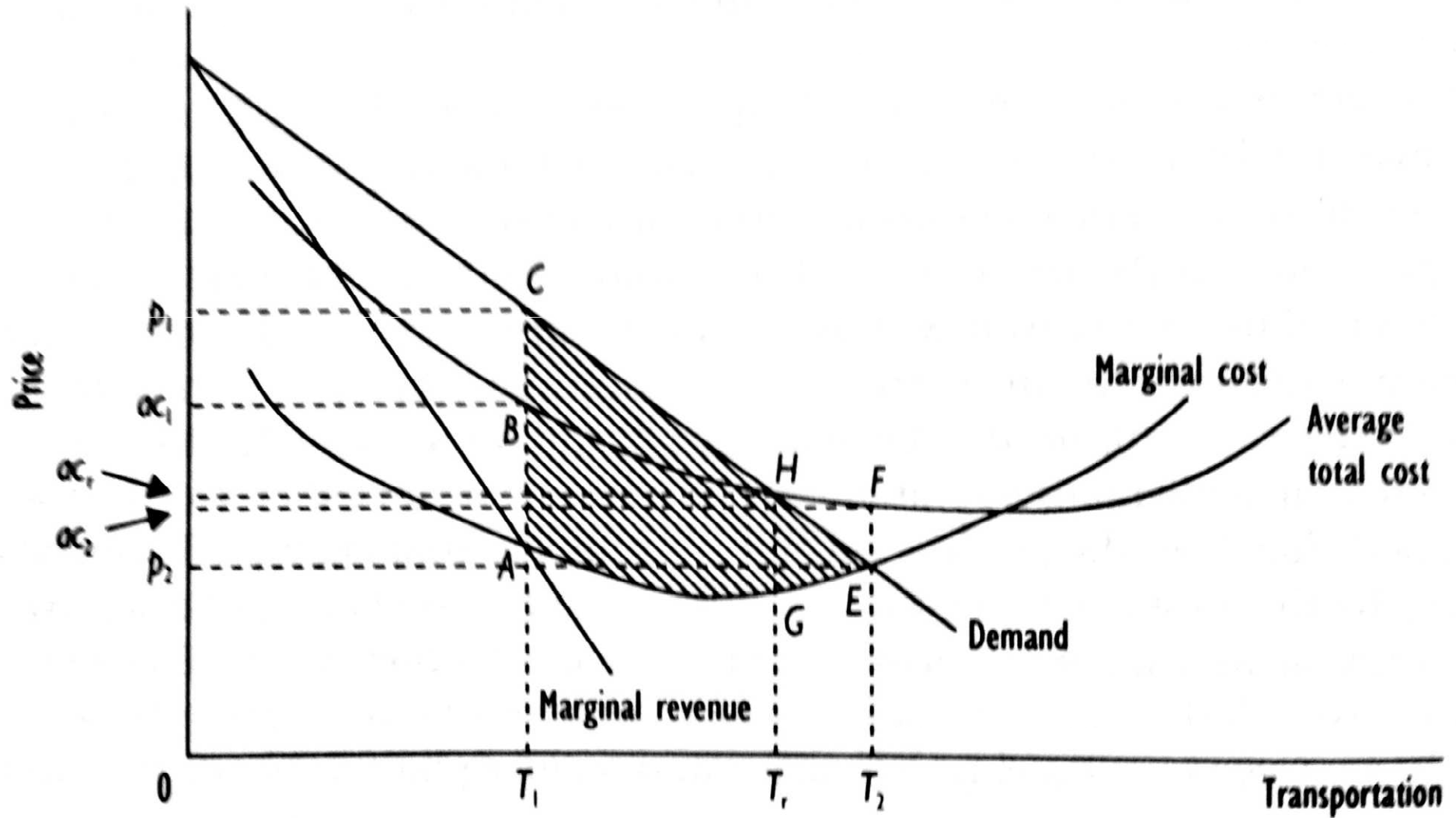
# Monopoly rents and barriers to entry

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- ▶ Government policy
- ▶ Control over critical inputs
- ▶ Scale economies



# Natural monopoly



**Figure 7.11** The efficiency loss of a monopoly pricing natural monopolist.

# Government responses to monopoly behaviour

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- ▶ Marginal cost pricing with subsidy
- ▶ Rate of return regulation
- ▶ Government operation





## 6.2. Measuring market concentration





# Measuring market concentration

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$$CR_4 = \sum_{i=1}^4 (MS_i \times 100)$$

$$HHI = \sum_{i=1}^n (MS_i \times 100)^2$$



# Case study: Concentration in the LTL motor carrier sector


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Table: Concentration ratios in the LTL motor carrier industry, 1990

Revenue Measure	Four-Firm Ratio (%)	Eight-Firm Ratio (%)	<i>HHI</i>
Intercity LTL Freight Revenue	52	66	842.7
Total Operating Revenues	49	63	759.8

*Source:* The US motor carrier industry long after deregulation. Report, Office of Economics, ICC. Interstate Commerce Commission 1992: Data are based on 107 Class I common carrier firms that derive at least 75% of their revenue from intercity transport of general freight

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# Case study: Concentration in the US airline industry

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Table: Concentration ratios in the domestic passenger airline industry, 1977-90

Year	Four-Firm Ratio (%)	Eight-Firm Ratio (%)	<i>HHI</i>
1977	56.2	81.1	1,060
1982	54.2	80.4	930
1987	64.8	86.5	1,230
1990	61.5	90.5	1,210

*Source:* Adapted from Borenstein (1992), table 1, p. 47

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# Case: Concentration in the US airline industry

Table: Average city-pair Hirschman-Herfindahl indices in the domestic passenger airline industry, 1984-90.

Year	Market Distance (miles)					<i>All</i>
	0-200	201-500	<i>501-1,000</i>	<i>1,000-1,500</i>	<i>&gt;1,500</i>	
<i>Direct flights only</i>						
1984	601	598	601	581	536	590
1987	691	648	612	587	532	620
1990	612	641	672	625	536	632
<i>All flights</i>						
1984	600	588	537	479	415	531
1987	689	616	498	444	363	512
1990	618	614	518	424	357	506

Source: Adapted from Borenstein (1992), table 2, p. 49





## 6.3. Contestable market theory



# Theory

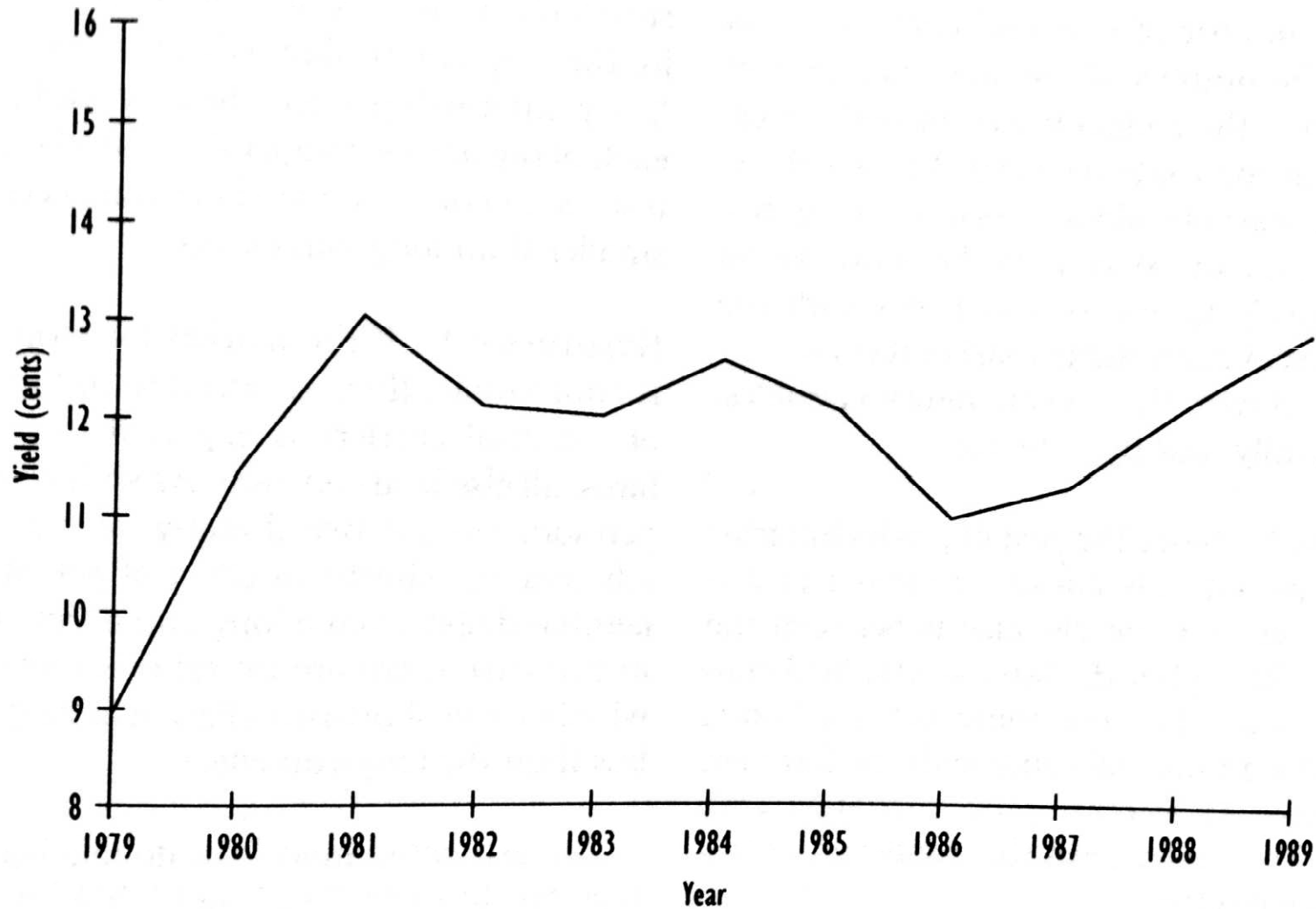
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- ▶ Contestable markets are primarily concerned with competition for the market, not with competition among incumbent producers.
- ▶ It is the markets that are contested and, as a result, potential competitors rather than actual competitors play prominent roles in disciplining the behaviour of incumbent firm
- ▶ Assumption: there are no barriers to entry or exit from the market, there must be a pool of potential entrants .



# Case: Competition and contestability in the US airline industry

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**Figure 7.12** Nominal airline revenues, 1979–89.

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# Case: Competition and contestability in the US airline industry

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- ▶ The rise in air fares in the latter part of the 1980s prompted governmental concern, among other issues, over whether hubbing had contributed to the nominal price rise.
- ▶ This raises a basic question of the roles that actual and potential competition play in price behaviour over time.
- ▶ From a sample of 18573 routes between 1978 and 1988, Morrison and Winston (1990) investigated the importance of actual competitors versus potential competitors in determining nominal airline prices.





# Variables

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- ▶ In their analysis, Morrison and Winston assume, that airline fares depend upon five basic determinants:
  - the distance (in miles) between the airports on a route
  - the number of effective competitors on routes at fixed-slot airports
  - the number of effective competitors on routes at nonfixed-slot airports
  - the minimum number of effective competition at route's endpoints
  - the number of potential carriers



# Hypotheses

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1. The coefficient of Distance is expected to be positive
2. An increase in actual competition will reduce fares → coefficients of number of competitors are expected to be negative
3. It is expected that the effects of actual competition will be greater in the long run than in the short run.
4. If the market for airline routes is contestable, then an increase in the number of potential carriers is expected to reduce air fares.



# Results

Dependent variable – ln (Airfare, cents per passenger mile)

Explanatory Variables	Coefficient Estimate (t-statistic)
ln (Distance, in miles)	0.501 (167.0)
ln (Number of effective competitors on routes at fixed slot airports)	
1978 – 81	-0.037 (-3.70)
1982 – 8	-0.119 (-19.8)
ln (Number of effective competitors on routes at non-fixed slot airports)	
1978 – 81	0.006 (0.46)
1982 – 8	-0.035 (-4.38)
ln (Minimum number of effective competitors at a route's endpoints)	
1978 – 81	-0.015 (-1.67)
1982 – 8	-0.201 (-40.2)
ln (Potential carriers)	
1978 – 81	-0.0055 (-9.12)
1982 – 8	-0.0014 (-3.50)
$R^2 = 0.99$	

► *Source:* Morrison and Winston (1990), table 1, p. 390. The estimated model also included time dummy variables for each year but were not reported

# Interpretation

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- ▶ Are the results consistent with contestable markets? Yes and no.
- ▶ The finding that actual competition induces price reduction implies that airline routes are not perfectly contestable.
- ▶ But the results do indicate that these markets are imperfectly contestable.
- ▶ The increase in the number of potential carriers leads to price reductions, however this effect is relatively small.





## 6.4. Monopoly rents in the motor carrier industry



# Introduction

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- ▶ Monopoly power leads to monopoly rents.
- ▶ In motor carrier industry, government policy conferred monopoly power.
- ▶ We want to quantify the extent to which economic regulation (after 1935) created monopoly rents, as well as examining what factors most contributed to these rents.



# Case

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- ▶ Moore (1978) considered the question of how restriction market entry conferred monopoly rents on firms that possessed operating certificates.
- ▶ Regulation has led to a situation, that by 1974, existing firms in the industry did possess market power and would be expected to have earned some monopoly rents.
- ▶ Can we empirically quantify these economic rents? Yes.
- ▶ For the years 1975 and 1976, Moore obtained 23 cases where only operating rights were purchased.



# Results

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$$\text{Purchase Price} = \hat{\alpha}_0 + 0.152(\text{Annual Revenues}),$$

(9.5)

$$R^2 = 0.91$$

$$\text{Before-Tax Profits} = \hat{\alpha}_0 + 0.568(\text{Purchase Price}),$$

(7.1)

$$R^2 = 0.70$$





# Extension

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- ▶ Frew (1981) extended this study and found out that:
  - Population and retail sales (a measure of disposable income) had significant positive effect upon the certificate value.
  - Annual revenue (as proxy for route network) increased a certificate's value.



# Case study monopoly rent sharing in the motor carrier industry

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- ▶ Rose (1987) examined the extent to which labor shared in motor carrier monopoly rents
- ▶ The drivers are heavily unionized and the union leadership negotiates wage contracts with transport carriers.
- ▶ This gives the union some market power that it can use to extract a portion of economic rents earned by the carriers.



# Specification

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$\ln(\text{Driver Wage})$

$$\begin{aligned} &= \beta_0 + \beta_{1a} \text{Union-Reg} + \beta_{1b} \text{Union-Dereg} + \beta_2 \text{Education} \\ &\quad + \beta_3 \text{Experience} + \beta_4 (\text{Experience})^2 + \beta_5 \text{Nonwhite} \\ &\quad + \beta_6 \text{Single} + \beta_7 \text{Northeast} + \beta_8 \text{South} + \beta_9 \text{West} \\ &\quad + \text{error term} \end{aligned}$$

$$\text{Percentage Wage Premium} = \frac{\text{Driver Wage(Union Driver)} - \text{Driver Wage(Nonunion Driver)}}{\text{Driver Wage(Union Driver)}}$$

$$= \frac{\exp(\beta_0 + \beta_{1a} + \text{all other terms}) - (\beta_0 + \text{all other terms})}{\exp(\beta_0 + \text{all other terms})}$$

$$= e^{\beta_{1a}} - 1$$

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# Hypotheses

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1. Membership in union increases wage level  $\rightarrow \beta_{1a}$  and  $\beta_{1b}$  are each expected to be positive.
2. Less restrictive market entry requirements reduce union wages and union premia  $\rightarrow \beta_{1a} > \beta_{1b}$ .
3. Education and experience are expected to increase one's earning power.



# Results

Dependent variable – natural logarithm of hourly wage rates for drivers

Explanatory Variables	Coefficient Estimate (t-statistic)
Intercept*	1.78 (-)
Union-Reg	0.404 (21.3)
Union-Dereg	0.235 (7.813)
Education	0.018 (4.50)
Experience	0.006 (6.00)
Experience Squared	-0.0003 (-3.00)
Single	-0.023 (-1.04)
Nonwhite	-0.117 (-4.33)
Northeast	-0.061 (-2.77)
South	-0.068 (-3.40)
West	0.060 (2.73)
$R^2 = 0.43$	

\* Rose included time dummies for each of the years. The intercept reported here is the mean of the estimated time effects. Rose did not report the coefficient estimates for the separate time dummy variables.

▶ *Source:* Reprinted from Rose (1987), table 3 p. 1165, with the permission of The University of Chicago Press.

# Comments

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- ▶ Rose estimated that labor captured between 65% and 75% of total monopoly rents in the industry.
- ▶ Because of data limitations, Rose could not include information on firm characteristics that may tend to overstate the union wage premium.
- ▶ Rose's analysis focus upon money wages and does not include benefits.





## 6.5. Market power, shipping cartels and the Shipping Act of 1984



# Background

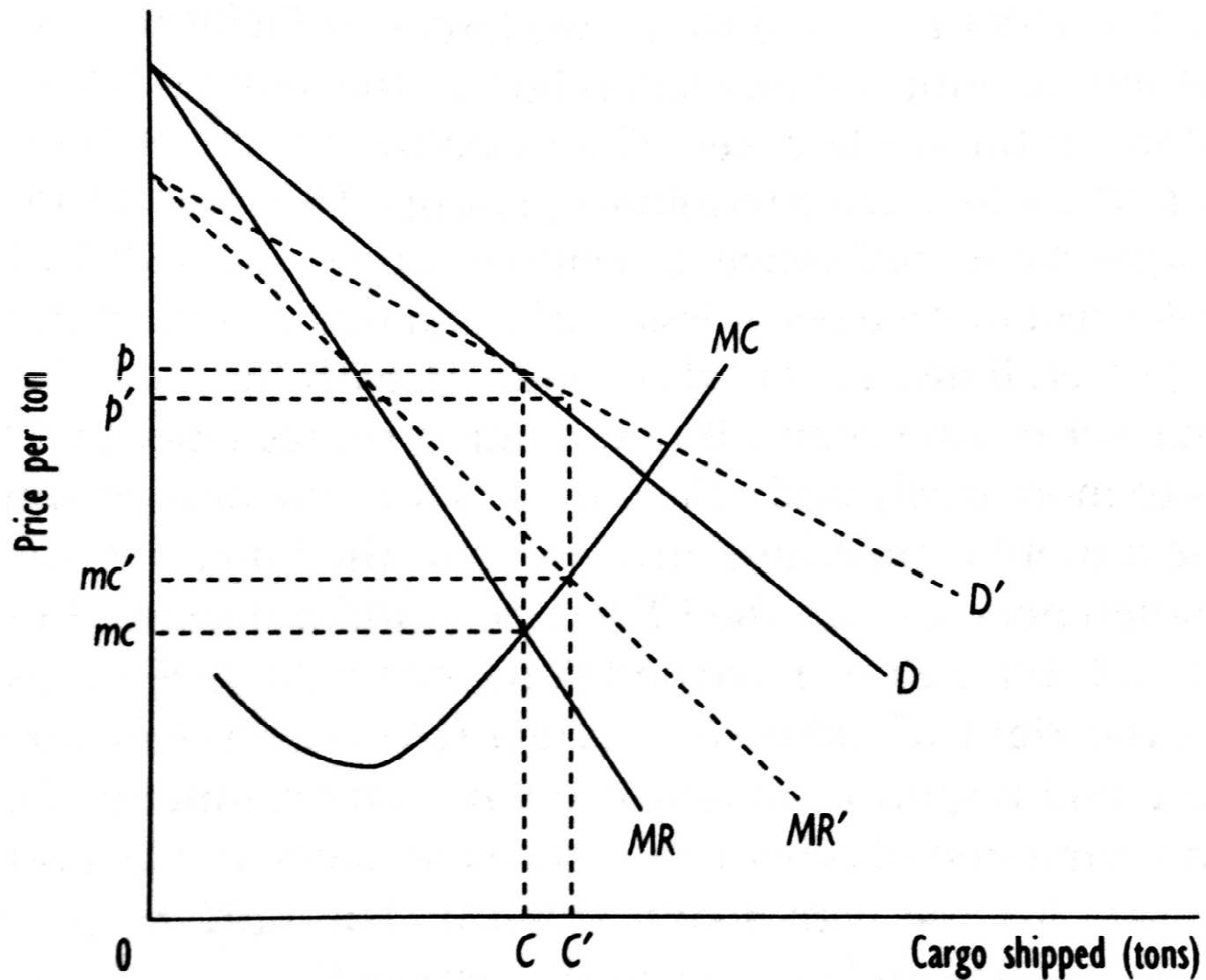
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- ▶ The 1984 legislation increased the potential for market power while simultaneously increasing the support for a competitive environment.





# Case study: The economic effect of the Shipping Act of 1984



**Figure 7.13** The economic effect of the Shipping Act of 1984.

# Profit maximization for the cartel

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$$MR = MC$$

$$\Rightarrow p + T - \frac{\Delta p}{\Delta T}(p, p^S, I^D, \theta) = MC(r, w, \gamma; \bar{K})$$

$$p^* = p^*(p^S, I^D, \theta, r, w, \gamma, \bar{K})$$



# Study

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- ▶ Wilson and Casavant (1991) examined the economic impact of 1984 Shipping Act on market equilibrium prices for westbound traffic from the West Coast of the United States to the Pacific Rim.
- ▶ Based on time series data 1978-1987, Wilson and Casavant analyzed shipments from West Coast to Jpan for four groups of commodities: fries, hay, onions and lumber.



# Specification

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$$\begin{aligned}\ln(\text{Price}) = & \alpha_0 + \beta_1 \ln(\text{Exchange Rate}) \\ & + \beta_2 \ln(\text{Fuel Price}) \\ & + \beta_3 \ln(\text{Capacity}) \\ & + \beta_4 \ln(\text{1984 Shipping Act}) \\ & + \varepsilon\end{aligned}$$



# Hypotheses

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1.  $\beta_1 < 0$
2. Fuel price and Capacity affect the opportunity costs faced by carriers. Thus we expect  $\beta_2 > 0$  and  $\beta_3 < 0$
3.  $\beta_4 < 0$



# Results

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Dependent variable – ln (Price)

Independent Variable	Commodity*			
	Fries	Hay	Onions	Lumber
Constant	11.81 (8.09)	15.90 (3.70)	28.05 (13.56)	7.47 (9.83)
ln (Exchange Rate)	-1.18 (-5.51)	-1.64 (-3.58)	-2.56 (-10.47)	-0.58 (-7.22)
ln (Fuel Price)	0.08 (0.69)	0.68 (3.19)	0.99 (4.43)	0.012 (0.22)
ln (Capacity)	-0.46 (-2.84)	-1.01 (-2.48)	-2.06 (-7.75)	-0.32 (-3.18)
Shipping Act of 1984	-0.20 (-2.34)	-0.29 (-1.39)	-0.17 (-1.40)	0.11 (3.89)
$R^2$	0.69	0.74	0.89	0.75

\* t-statistics are in parentheses.

Source: Adapted from Wilson and Casavan (1991), table 1, p. 433

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## 6.5. Summary

## Summary (1)

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- ▶ In a perfectly competitive market structure, buyers and sellers are price-takers; firms produce a homogenous product; there is freedom of entry and exit; and all relevant information is available to market participants. Whereas positive, zero, and negative economic profits are consistent with short-run equilibrium, only zero economic profits or a normal return on investment is consistent with long-run equilibrium. In perfectly competitive markets, inputs are optimally employed, goods are optimally distributed, and society is producing the socially efficient output mix.





## Summary (2)

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- ▶ The demand for transportation is derived from the demand for goods and services that are produced in locations separate from their points of consumption. Inter-regional passenger and freight flows reflect differences in the opportunity costs of producing goods and services at various locations. In an empirical model of inter-regional goods' flows, the demand for transportation generally depends upon the delivered price, income at the destination, and the price of substitutes.



## Summary (3)

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- ▶ A monopolistically competitive market structure is similar to a perfectly competitive market structure, except that firms produce a heterogeneous product, so that its demand curve is slightly downward-sloping. Although these firms have some monopoly power, in the long run monopolistically competitive firms make zero economic profits. An oligopoly has few competitors, and the distinguishing characteristic of this market structure is that each competitor will behave strategically, making own decisions in light of competitors' expected responses.



## Summary (4)

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- ▶ In a monopolistic market structure, one firm faces the full downward-sloping market demand curve which gives the monopolist market power; that is, the ability to price above marginal cost of production. In long-run equilibrium, monopolists make pure economic profits – that is, economic rents – and society suffers an efficiency loss from too few goods coming on to the market. Over time, rent-seeking behavior, rent-sharing, capitalization, and reduced incentives to innovate cause monopoly rents to dissipate.



## Summary (5)

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- ▶ Price discrimination occurs when a monopolist charges different prices in different markets for goods that cost the same to produce, or charges a uniform price for goods that have different costs of production. In each case, a profit-maximizing monopolist will set a price for the good that is inversely related to the good's price elasticity of demand.



## Summary (6)

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- ▶ When production of a good is subject to economies of scale so large that the optimal number of firms in the industry is one, the resulting market structure is a natural monopoly. Actions taken by the government to deal with natural monopolies are marginal cost pricing combined with subsidizing the firm's losses, rate of return regulation, and government operation.



## Summary (7)

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- ▶ The four-firm concentration ratio, the eight-firm concentration ratio, and the Hirschman-Herfindahl index are three commonly used measures to evaluate the extent to which a market is concentrated. Although by these measures, the less-than-truckload motor carrier industry is moderately concentrated, competition from freight forwarders and brokers prevents these firms from exploiting their market power.



## Summary (8)

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- ▶ The passage of the 1978 Airline Deregulation Act led to a hub-and-spoke passenger distribution network. Empirical evidence presented suggests that an effect of the Act was to decrease concentration at the hub airports for all flights. However, increased concentration was observed for direct flights in comparison with flights that involve a change of plane.



## Summary (9)

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- ▶ Under perfect competition, the level of actual competition disciplines competitors' pricing behavior. Under perfect contestability, the threat of entry disciplines incumbents' pricing behavior. Empirical evidence suggests that contestability in the airline market is imperfect. Although potential competitors play a positive role disciplining the pricing behavior of incumbents, the effect of actual competitors on a firm's pricing behavior is stronger.





## Summary (10)

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- ▶ Under regulation, motor carriers in general and the less-than-truckload sector in particular characterized a monopoly market structure with positive economic profits. Empirical studies indicate that operating certificates had a positive value, consistent with making economic profits, and that the value of these certificates depended upon the level of demand, and on cost-related operating characteristics. Consistent with economic theory, motor carrier economic profits were partially dissipated through rent-sharing with labor.



## Summary (11)

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- ▶ The equilibrium price in imperfect competition depends upon demand- and cost- related factors and the regulatory environment. To reduce market power and lower prices, it is important to introduce changes in the regulatory environment that have net pro-competitive effects on the industry. This is borne out in an empirical model of shopping conferences, where a regulatory change included competitive provisions and anticompetitive provisions. The equilibrium price fell (rose) when the regulatory change resulted in a more (less) competitive environment.

