CHAPTER 1
INTRODUCTION AND AXIOMS OF URBAN ECONOMICS

Urban Economics: Economics meets geography
Economics: profit-max and utility-max choices
Geography: location and the spatial distribution of activity

Urban economics
- Profit-max and Utility-max location choices
- Consequences of location choices

Part 1: Market forces in the development of cities
- Why do cities exist?
- Why do competing firms cluster?
- Why do cities vary in size?
- What causes urban growth and decline?
- Who benefits from urban growth?

Part 2: Land use within cities
- Why does the price of land vary within cities?
- Why do people and firms build up instead of out?
- Why are there dozens of municipalities in the typical metro area?
- What are the consequences of race and income segregation?
- What are the effects of land-use controls and zoning?

Part 3: Urban transportation
- What is the marginal external cost of automobile travel?
- Why do so few people take mass transit?
- What would be required for light-rail system to pay for itself?

Part 4: Crime and public policy
- Are criminals rational?
- What is the optimum level of crime?
- How effective is education in reducing crime?
- Why are crime rates higher in large cities?
- Why did crime rates drop in the 1990s?

Part 5: Housing and Public Policy
- Why is housing different from other goods?
- How do changes in one housing submarket (e.g., high-income housing) affect other submarkets (middle-income housing)?
- What is the bang per buck of public housing?
- What are the tradeoffs from housing allowances (cash)?
- How much tax revenue is lost because of the mortgage subsidy?

Part 6: Local Government
- What is the rationale for our fragmented system of local government?
- Does majority rule generate efficient choices?
- Who bears the cost of the property tax?
- How do local governments respond to intergovernmental grants?

What is a City?
Place with a relatively high population density

Census definitions
- Urban area: minimum population = 2,500
- Urban population: People living in urban areas
- Metropolitan area: at least 50k people
- Micropolitan area: 10k to 50k people
- Principal city: largest municipality in metro area

 Why Do Cities Exist?
Conditions for cities
- Agricultural surplus
- Urban production to exchange for food
- Transportation system for exchange

TABLE 1-1: Largest Metropolitan Areas in the United States, 2005

<table>
<thead>
<tr>
<th>Metropolitan Area</th>
<th>Population in 2000</th>
<th>Percent Change 2000-2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York—Northern New Jersey—Long Island, NY-NJ-PA</td>
<td>18,757,320</td>
<td>2.3</td>
</tr>
<tr>
<td>Los Angeles—Long Beach—Santa Ana, CA</td>
<td>12,923,547</td>
<td>4.5</td>
</tr>
<tr>
<td>Chicago—Naperville—Joliet, IL-IN-WI</td>
<td>9,641,956</td>
<td>3.8</td>
</tr>
<tr>
<td>Philadelphia—Camden—Wilmington, PA-NJ-DE-MD</td>
<td>6,523,330</td>
<td>2.4</td>
</tr>
<tr>
<td>Dallas—Fort Worth—Arlington, TX</td>
<td>5,419,675</td>
<td>12.7</td>
</tr>
<tr>
<td>Miami—Fort Lauderdale—Miami Beach, FL</td>
<td>5,127,500</td>
<td>8.1</td>
</tr>
<tr>
<td>Houston—Sugar Land—Baytown, TX</td>
<td>5,296,477</td>
<td>12.0</td>
</tr>
<tr>
<td>Washington—Arlington—Alexandria, DC-VA-MD-WV</td>
<td>5,134,466</td>
<td>8.3</td>
</tr>
<tr>
<td>Atlanta—Sandy Springs—Marietta, GA</td>
<td>4,517,731</td>
<td>15.6</td>
</tr>
<tr>
<td>Boston—Worcester—Lawrence, MA</td>
<td>4,485,135</td>
<td>6.8</td>
</tr>
<tr>
<td>Boston—Cambridge—Quincy, MA-MI</td>
<td>4,413,630</td>
<td>6.5</td>
</tr>
<tr>
<td>San Francisco—Oakland—Pomona, CA</td>
<td>4,157,688</td>
<td>6.7</td>
</tr>
<tr>
<td>Riverside—San Bernardino—Ontario, CA</td>
<td>3,689,258</td>
<td>20.3</td>
</tr>
<tr>
<td>Phoenix—Scottsdale, AZ</td>
<td>3,616,477</td>
<td>18.9</td>
</tr>
<tr>
<td>Seattle—Tacoma—Bellevue, WA</td>
<td>3,303,314</td>
<td>5.2</td>
</tr>
<tr>
<td>Minneapolis—St. Paul—Eagan, MN-MN</td>
<td>3,140,779</td>
<td>8.0</td>
</tr>
<tr>
<td>San Diego—Carlsbad—San Marcos, CA</td>
<td>2,533,062</td>
<td>4.3</td>
</tr>
<tr>
<td>St. Louis—MO-IL</td>
<td>2,773,316</td>
<td>3.0</td>
</tr>
<tr>
<td>Honolulu—Waimanalo, HI</td>
<td>2,655,675</td>
<td>4.0</td>
</tr>
<tr>
<td>Tampa—St. Petersburg—Clearwater, FL</td>
<td>2,476,056</td>
<td>10.5</td>
</tr>
<tr>
<td>Pittsburgh, PA</td>
<td>2,386,376</td>
<td>-19</td>
</tr>
<tr>
<td>Denver—Aurora, CO</td>
<td>2,199,994</td>
<td>8.3</td>
</tr>
<tr>
<td>Cleveland—Elyria Mentor, OH</td>
<td>2,162,116</td>
<td>-1.0</td>
</tr>
<tr>
<td>Portland—Vancouver—Gresham, OR-WA</td>
<td>1,953,960</td>
<td>8.7</td>
</tr>
<tr>
<td>Cincinnati—Middletown—Dayton, OH-IN</td>
<td>1,693,140</td>
<td>3.0</td>
</tr>
<tr>
<td>Lawrence—Topeka—Olathe—Pawnee, KS</td>
<td>1,642,288</td>
<td>13.7</td>
</tr>
<tr>
<td>Kansas City, MO-KS</td>
<td>1,617,494</td>
<td>6.1</td>
</tr>
<tr>
<td>Orlando—Kissimmee—San Rafeal, FL</td>
<td>1,533,255</td>
<td>17.6</td>
</tr>
<tr>
<td>San Antonio—New Braunfels, TX</td>
<td>1,489,507</td>
<td>10.4</td>
</tr>
<tr>
<td>San Jose—Sunnyvale—Santa Clara, CA</td>
<td>1,175,988</td>
<td>1.1</td>
</tr>
<tr>
<td>Las Vegas—Paradise, NV</td>
<td>1,163,584</td>
<td>24.3</td>
</tr>
</tbody>
</table>

Figure 1.1: Percent of U.S. Population in Urban Areas, 1800-2010

FIGURE 1–2 Urbanization Rates, by World Region, (1960–2000)
Axiom 1: Prices Adjust to Achieve Locational Equilibrium
Locational equilibrium: No incentive to move
Examples of prices behind locational equilibrium
- Rent on beach house > Rent on highway house
- Wage in Coolsville < Wage in Dullsville
- Land rent in center > Land rent on fringe

Axiom 2: Self-Reinforcing Effects Generate Extreme Outcomes
- Self-reinforcing effect: leads to changes in same direction
- Auto row attracts comparison shoppers
- Cluster of artists attracts other artists

Axiom 3: Externalities Cause Inefficiency
- Cost or benefit of a transaction experienced by someone else
- External cost: burning gasoline affects breathers
- External benefit: painting a peeling house increases property values

Axiom 4: Production is Subject to Economies of Scale
Economies of scale: Average cost decreases as quantity increases
- Indivisible inputs: Required to produce one or a thousand units
- Factor specialization: Benefits from continuity and repetition

Axiom 5: Competition Generates Zero Economic Profit
Entry into market continues until economic profit is zero. Economic cost includes explicit cost and opportunity cost of time and funds. Firms earn just enough to stay in business, but not enough to attract entrants

**TABLE 1-2 Populations and Projected Populations of Large World Cities**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokyo</td>
<td>Japan</td>
<td>26.0</td>
<td>20.2</td>
<td>35.3</td>
<td>1</td>
</tr>
<tr>
<td>Osaka</td>
<td>Japan</td>
<td>18.0</td>
<td>12.2</td>
<td>18.2</td>
<td>11</td>
</tr>
<tr>
<td>Seoul</td>
<td>South Korea</td>
<td>18.0</td>
<td>12.2</td>
<td>18.2</td>
<td>11</td>
</tr>
<tr>
<td>Shanghai</td>
<td>China</td>
<td>23.0</td>
<td>18.0</td>
<td>23.0</td>
<td>13</td>
</tr>
<tr>
<td>Beijing</td>
<td>China</td>
<td>20.0</td>
<td>15.0</td>
<td>20.0</td>
<td>13</td>
</tr>
<tr>
<td>Moscow</td>
<td>Russia</td>
<td>14.0</td>
<td>10.0</td>
<td>14.0</td>
<td>13</td>
</tr>
<tr>
<td>Paris</td>
<td>France</td>
<td>13.0</td>
<td>9.5</td>
<td>13.0</td>
<td>13</td>
</tr>
</tbody>
</table>

**CHAPTER 2
WHY DO CITIES EXIST?**

Introduction—Questions to Address
- What set of assumptions will rule out cities?
- Why do trading cities develop?
- Why do factory cities develop?
- Who benefits from innovations that generate cities?

Backyard Production Model: Assumptions
- No differences in productivity for labor or land
- Constant returns to scale in exchange
- Constant returns to scale in production

Backyard Production Model: Implications
No Trade
- No productivity benefit from specialization and exchange
- Exchange is costly (time) without any benefit

No Cities
- Dense living is costly (bid up price of land) without any benefit
- Result: Uniform price of land and population density

Trading Cities
Drop assumption of equal productivity. Differences in productivity generate comparative advantage

<table>
<thead>
<tr>
<th>TABLE 2-1 Comparative Advantage</th>
</tr>
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<tbody>
<tr>
<td>North</td>
</tr>
<tr>
<td>Bread</td>
</tr>
<tr>
<td>Output per hour</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>Opportunity cost</td>
</tr>
<tr>
<td>3 shirts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 2-2 Specialization and Gains from Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
</tr>
<tr>
<td>Bread</td>
</tr>
<tr>
<td>Change in production from specialization</td>
</tr>
<tr>
<td>-2</td>
</tr>
<tr>
<td>Exchange 4 shirts for 2 leaves</td>
</tr>
<tr>
<td>+2</td>
</tr>
<tr>
<td>Gain from trade</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

Computing the Net Gain From Trade
- Gross gain from trade = 2 shirts for each region
- Net gain = gross gain - transaction time (t)
  - North: If t > 20 min (time for 2 shirts), net gain > 0
  - South: If t < 2 hr (time for 2 shirts), net gain > 0

Scale Economies in Exchange
- In absence of scale economies, households will trade directly. Scale economies in exchange: lower cost for a trading firm. Trade workers live close to firms and bid up land price: higher price of land increases density, generating a trading city

Trading Cities in American History
- Cotton gin and cotton-trade cities
- Transport technology: turnpikes, canals, steamship, railroad

Factory Town
- Drop assumption of constant returns to scale in production. Productivity Numbers
  - Home = 1 shirt per hour
  - Factory = 6 shirts per hour
  - Home or factory: 1 loaf of bread per hour

<table>
<thead>
<tr>
<th>TABLE 2-3 Cost of Factory Shirt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor cost per hour</td>
</tr>
<tr>
<td>Cost of indivisible inputs per hour</td>
</tr>
<tr>
<td>Total cost per hour</td>
</tr>
<tr>
<td>Cost per shirt with 6 shirts produced per hour</td>
</tr>
</tbody>
</table>
Factory Town Develops Around the Factory
Workers live close to factory to economize on commuting time. Competition for land bids up its price - Higher price of land increases density, generating a city - Factory workers paid 1/2 loaf per hour to cover higher cost of living

Factory Towns in the Region

Axiom 5: Competition generates zero economic profit
Firms enter the shirt market until each makes zero economic profit. Factories span the region. Every location lies within market area of a factory. Complete labor specialization, with rural bread and urban shirts. Zero economic profit for firms & locational indifference for workers

Land Rent in the Region: Axiom 1
Locational indifference in rural areas
- Lower travel cost at locations close to factory city
- Rural households bid up the price of land near cities

Locational indifference between rural and urban areas
- Factory wage compensates for higher land prices in cities

Location Orientation: Market Orientation
Market-oriented firm: More costly to transport output than inputs
Shirt example: assume input transport cost = 0
Firms oriented toward markets to economize on output transport cost
- Weight gaining activity: produce sugar from beets, lumber from logs
- Fragility gaining: canned or frozen food
- Hazard gaining: deodorizing skunks

System of Towns for Sugar-Beet Processing
Scale economies in processing, so number of plants is relatively small. Farmers sell beets to processing plant offering highest net price. Entry and competition generates zero profit

Other Examples of Materials-Oriented Industries
Steel towns: near coal, then ore
Leather towns near forest for tannin
Lumber towns near forests

Innovation Cities
Cities facilitate knowledge spillovers and are centers of innovation. Innovation (as measured by number of patents) increases with the education level of a city's workforce.

Model of innovation city.
1. No scale economies in production or exchange
2. Alternative to self-sufficiency is innovation—generating ideas to sell to others
3. Innovation facilitated by collaboration, which is enhanced by education

Figure 2-4: Innovation City

Other Examples of Materials-Oriented Industries
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Leather towns near forest for tannin
Lumber towns near forests

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1. No scale economies in production or exchange
2. Alternative to self-sufficiency is innovation—generating ideas to sell to others
3. Innovation facilitated by collaboration, which is enhanced by education

Figure 2-4: Innovation City

Return to innovation increases at a decreasing rate with size of workforce. Cost of living increases with size of workforce. Self-sufficient wage independent of size of workforce. Payoff from solo innovation < self-sufficient wage. Payoff from collaborative innovation > wage for up to n workers. Stable equilibrium: n workers
CHAPTER 3
WHY DO FIRM CLUSTER?

Why do firms locate close to one another?
Localization economies: firms in an industry cluster
Urbanization economies: firms in different industries cluster

Firms cluster to

- Share intermediate inputs
- Share a labor pool
- Get better matches of workers and labor tasks
- Share knowledge

<table>
<thead>
<tr>
<th>Product</th>
<th>Metropolitan Area</th>
<th>2004 Employment</th>
<th>Nationwide Employment (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>Hartford, CT</td>
<td>15,619</td>
<td>22.67</td>
</tr>
<tr>
<td>Pharras, AZ</td>
<td>7,500</td>
<td></td>
<td>10.10</td>
</tr>
<tr>
<td>Cincinnati, OH</td>
<td>9,407</td>
<td></td>
<td>10.10</td>
</tr>
<tr>
<td>Indianapolis, IN</td>
<td>4,000</td>
<td></td>
<td>5.07</td>
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<tr>
<td>Biopharmaceuticals</td>
<td>New York, NY</td>
<td>51,604</td>
<td>27.2</td>
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<tr>
<td>Philadelphia, PA</td>
<td>13,755</td>
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<td>10.42</td>
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<tr>
<td>San Francisco, CA</td>
<td>13,756</td>
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<td>5.46</td>
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<tr>
<td>Computer software</td>
<td>Seattle, WA</td>
<td>54,454</td>
<td>11.10</td>
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<tr>
<td>San Francisco, CA</td>
<td>35,280</td>
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<td>9.28</td>
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<tr>
<td>Sacramento, CA</td>
<td>22,220</td>
<td></td>
<td>8.00</td>
</tr>
<tr>
<td>Boston, MA</td>
<td>29,015</td>
<td></td>
<td>7.18</td>
</tr>
<tr>
<td>Elevators and moving stairways</td>
<td>Bloomington, IN</td>
<td>1,720</td>
<td>20.05</td>
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<td>New York, NY</td>
<td>1,170</td>
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<td>Financial services</td>
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<td>Chicago, IL</td>
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<td>Los Angeles, CA</td>
<td>142,187</td>
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<td>Boston, MA</td>
<td>138,142</td>
<td></td>
<td>4.80</td>
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<td>Video production and distribution</td>
<td>Los Angeles, CA</td>
<td>161,261</td>
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<tr>
<td>San Francisco, CA</td>
<td>28,394</td>
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</tr>
<tr>
<td>New York, NY</td>
<td>27,546</td>
<td></td>
<td>7.25</td>
</tr>
</tbody>
</table>

Another Example: High-Technology Firms
Rapidly changing products necessitates intermediate inputs
- Electronic components
- Testing facilities
Firms share intermediate input suppliers to exploit scale economies. Face time in design and fabrication requires proximity and cluster

Self-Reinforcing Effects of Clustering
The Tradeoffs
- Benefit: Localization economies reduce cost of intermediate input
- Cost: Competition for workers increases labor cost

Starting with isolated firms, will a cluster form?
How many firms will join the cluster?

Self-Reinforcing Effects and Clustering

Clustering to Share Intermediate Inputs
An Example: Dressmakers produce high fashion dresses
- Rapid changes in fashion and output: Firms are small & nimble
- Scale economies in buttons large relative to demand of single dressmaker
- Face time required to design and fabricate buttons to fit dresses
- Dressmakers share a button-maker, and cluster to facilitate face time

Clustering to Share a Labor Pool
Varying demand for each firm: Software & TV programs. Fixed industry-wide demand: zero-sum changes in demand across firms
Example: success of one firm’s GIS software at expense of others

Locational equilibrium: Wage in cluster = expected wage in isolated site = $10

FIGURE 3-1 Clustering and the Average Cost of Intermediate Inputs

MAP 3-1 Job Clusters: Carpets and Rugs

The bars show employment in the production of carpets and rugs, with 16,796 jobs in Dalton, GA, and smaller clusters in Los Angeles; Atlanta; Chattanooga, TN; Harrisburg, PA; and Rome, GA.

Clustering to Share a Labor Pool

FIGURE 3-3 Clustering to Share a Labor Pool
Computing Profits
Labor Demand: marginal benefit = revenue contribution = MRP
Profit from an individual worker = MRP - wage
Profit from workforce: Triangle between demand curve and wage line
Panel A: Expected profit for isolated firm = $48
Panel B: Expected profit for isolated firm = (1/2) ($147 + $3) = $75

Move to Cluster Increases Expected Profit
- High demand (good news): more profit in cluster because of lower wage and more workers
- Low demand (bad news): less profit in cluster because of higher wage
Good news dominates bad because firms respond to changes in demand
- High demand: hire more workers to exploit lower wage in cluster
- Low demand: hire fewer workers to cushion blow of higher wage in cluster

Profit triangles

Clustering to Share Knowledge
Firms in an industry share ideas and knowledge. Mysteries of trade are “in the air”. Innovations are promptly discussed, improved, and adopted

Evidence of Knowledge Spillovers
Spillovers more important in idea industries. Most innovative industries are the most likely to cluster. Spillovers have range of a few miles

Evidence of Localization: Productivity & Births
Higher Labor Productivity
- Henderson: Elasticity (output per worker, industry output) = 0.02 to 0.11
- Mun & Hutchinson: Productivity elasticity = 0.27
Firm Births
- Carlton: Elasticity (births, industry output) = 0.43
- Head, Reis, Swenson: Japanese plants cluster
- Rosenthal & Strange: births more numerous in locations close to industry concentrations
Henderson, Kuncor, Turner: growth more rapid close to existing concentrations
Rosenthal & Strange: rapid growth close to locations with existing jobs
Localization economies attenuate rapidly

Urbanization Economies
Agglomeration Economies Across Industries. Result in large diverse cities
Sharing, Pooling, and Matching.
- Intermediate goods: business services (banking, accounting), hotels, transport services
- Pooling: Workers move from industries with low demand to industries with high demand
- Matching: Common skills and inter-industry matching, e.g., computer programmers
Corporate HQ and Functional Specialization
Corporations cluster in cities to share firms providing business services. Large cities increasingly specialized in managerial functions. Small cities increasingly specialized in production

Clustering to Facilitate Labor Matches
Firms and workers not always perfectly matched. Mismatches require training costs to eliminate skill gap. Show that larger city generates better matches

A Model of Labor Matching
Workers have varying skills on circle
- Each firm enters market with a skill requirement on unit circle
- Workers incur training cost to close gap
Scale economies in production: 2 workers per firm.

Monopolistic competition: Zero economic profit & Wage = MRP
- Competition: Unrestricted entry generates zero economic profit
- Firms are differentiated with respect to skill requirement
- Firms offer wage and workers accept highest net wage

Figure 3-4 Skills Matching

Table 3-2 Number of Workers, Skills Gap, and Net Wage

<table>
<thead>
<tr>
<th>Number of Workers</th>
<th>Skills Gap</th>
<th>Training Cost</th>
<th>Net Wage</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>1/2</td>
<td>$21/6 - $5</td>
<td>$12 - $5</td>
</tr>
<tr>
<td>6</td>
<td>1/2</td>
<td>$21/6 - $5</td>
<td>$12 - $5</td>
</tr>
<tr>
<td>12</td>
<td>1/24</td>
<td>$24/12 - $10</td>
<td>$12 - $10</td>
</tr>
<tr>
<td>12</td>
<td>1/24</td>
<td>$24/12 - $10</td>
<td>$12 - $10</td>
</tr>
</tbody>
</table>

Urbanization Economies and Knowledge Spillovers
Diverse city is fertile ground for new ideas. Bulk of patents issued to people in large cities. Disproportionate number of patent citations from same city.
- Local nature of citations decreases over time as knowledge diffused. University patents are most fertile, followed by corporate patents
Evidence of Urbanization Economies.
- Elasticity of productivity w.r.t. population is 0.03 to 0.08
- Diversity promotes employment growth, especially in innovative industries
Other Benefits of Urban Size
Joint Labor Supply
- Large cities offer better employment opportunities for two-earner families
- History: metal-processing firms (men) located close to textile mills (women)
- Current: power couples attracted to cities, with better employment matches
Learning Opportunities
- Human capital increased by learning through imitation
- Urban migrants acquire skills and experience permanent increase in wage
- Social Opportunities: Better matches of social interest in large city
CHAPTER 4
CITY SIZE

Why Do Cities Vary in Size and Scope?

<table>
<thead>
<tr>
<th>TABLE 4-1</th>
<th>Size Distribution of Urban Areas, 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Range</td>
<td>Number of Urban Areas</td>
</tr>
<tr>
<td>Greater than 10 million</td>
<td>2</td>
</tr>
<tr>
<td>5 million to 10 million</td>
<td>4</td>
</tr>
<tr>
<td>1 million to 5 million</td>
<td>43</td>
</tr>
<tr>
<td>100,000 to 1 million</td>
<td>334</td>
</tr>
<tr>
<td>Less than 100,000</td>
<td>549</td>
</tr>
</tbody>
</table>

Utility and City Size
Localization and urbanization economies increase productivity & wage
Commute time increases with city size, decreasing leisure time

<table>
<thead>
<tr>
<th>TABLE 4-2 Utility and City Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worker (millions)</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>

Locational Equilibrium Within a City
C: Differences in commute cost offset by differences in land rent
E: Equal shares of land rent, averaging $15
Utility = Labor income + rental income - commute cost - rent paid

<table>
<thead>
<tr>
<th>TABLE 4-3</th>
<th>Commuting, Land Rent, and Utility within a City</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Distance</td>
</tr>
<tr>
<td>0 miles</td>
<td>0</td>
</tr>
<tr>
<td>5 miles</td>
<td>$10</td>
</tr>
<tr>
<td>10 miles</td>
<td>$20</td>
</tr>
</tbody>
</table>

System of Cities in a Region
Divide fixed number of workers among cities in region
- Six cities, each with 1 million workers
- Three cities, each with 2 million workers

Specialized and Diverse Cities
Two types of cities are complementary. Many firms start in diverse city, which foster new ideas. Maturing firms relocate to specialized cities to exploit localization economies.

A Model of Laboratory Cities
Firm gropes for ideal process production process for new product by building prototypes, imitating other firms in the process. Once ideal process found, firm produces large quantity in a specialized city. Location for experimentation: Diverse city or series of specialized cities?
1. Diverse city: Relatively high prototype cost, given lack of localization economies
2. Specialized cities: Move from one city to another until ideal process found

Diverse city is more profitable if moving costs are relatively large

Example: The Radio Industry in New York
Early firms were “small, numerous, agile, nervous, and heavily reliant on subcontractors”. NYC provided a wide variety of intermediate inputs and workers. Once technology settled, firms relocated to economize on labor cost

Evidence of Laboratory Cities
French firms: 7 of 10 relocations from diverse to specialized city
Most innovative firms have highest frequency of moves from diverse to specialized

Differences in City Size: Introduction
Why do cities differ in size and scope?

Preview: Differences in localization & urbanization economies
Introduction of local goods amplifies differences in size

**FIGURE 4-3** Differences in City Sizes from Differences in Agglomeration Economies

Local Goods and City Size
Some local goods (haircuts, groceries, pizza) sold in all cities, large & small
- Per-capita demand large relative to scale economies in production

Local employment roughly proportional to population
Some local products (brain surgery, opera) sold only in large cities
- Per-capita demand small relative to scale economies in production
- Local employment concentrated in larger cities

Larger cities have wider variety: pizzas, haircuts, opera, brain surgery

**FIGURE 4-4** The Introduction of Local Goods Amplifies Differences in City Size

**FIGURE 4-5** Size Distribution of U.S. Urban Areas

**The Rank-Size Rule**
Rank = C / Nb
Rank-size rule holds if b = 1: Rank  N = C
Empirical results
- Median estimate b = 1.09: Close to rank-size rule, but more even distribution
- Definition of economic city: b = 1.02

**The Puzzle of the Large Primary City**

**TABLE 4-4** Population of Largest Cities as Share of National Population

<table>
<thead>
<tr>
<th>Metropolitan Area</th>
<th>Population</th>
<th>Share of National Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokyo</td>
<td>19,637,361</td>
<td>15.26%</td>
</tr>
<tr>
<td>Mexico City</td>
<td>16,465,417</td>
<td>20.97%</td>
</tr>
<tr>
<td>São Paulo</td>
<td>15,536,682</td>
<td>11.66%</td>
</tr>
<tr>
<td>Buenos Aires</td>
<td>10,796,291</td>
<td>8.55%</td>
</tr>
<tr>
<td>Santiago, Chile</td>
<td>8,229,049</td>
<td>6.48%</td>
</tr>
<tr>
<td>Montevideo, Uruguay</td>
<td>1,197,430</td>
<td>39.36%</td>
</tr>
</tbody>
</table>

Reasons for Large Primary Cities
- Trading and indivisibilities in import/export facilities
- Neglect of intra-national transportation facilities
Politics: Dictators retain power by bribing likely rebels in large capital city (Roman circus)

CHAPTER 5
URBAN GROWTH

Sources of Economic Growth
- Capital deepening
- Increase in human capital
- Technological progress
- Agglomeration economies: Localization and urbanization economies

FIGURE 5-1 Urban Economic Growth from Technological Progress

In the initial equilibrium shown by point i, a region’s workforce is divided equally between two cities of 6 million workers. Innovation in one city shifts its utility curve upward, and in the absence of migration, the innovative city moves to point j.

Regionwide Innovation and Income
Both cities experience upward shift of utility curve. No utility gap at original populations, so no migration. Increase in utility in both cities

Human Capital and Economic Growth
Increase in human capital increases per-capita income
- Workers are more productive
- Increase in rate of technological progress

External benefits from increase in human capital
- Labor is complementary across skill levels
- Wage benefits from 1% increase in college’s college share: high-school dropouts (1.9%); high-school graduates (1.6%); college graduates (0.4%)
- Proximity to star researchers an important factor in birth of biotechnology firms

Urban Labor Demand Curve: Negative Slope
Substitution effect of an increase in the wage. Firms substitute other inputs for relatively expensive labor. Output effect of an increase in the wage
- Increase production cost => increase in price => decrease in output
- Decrease in output decreases quantity of labor demanded

Shifting the Urban Labor Demand Curve
What causes an increase in labor demand (shift curve to right)?
- Increase demand for export goods
- Decrease production cost => decrease output price => increase output
- Increase productivity
- Decrease tax
- Increase public services

Land use policies: accommodate firms seeking expansion or relocation

Figure 5.2 Agglomeration Economies and Urban-Labor Demand

Export versus Local Employment and the Multiplier
Export product: sold to people living outside the city
Local product: sold to local residents

Related through the multiplier process
- Export workers spend portion of income on local products
- Local workers spend portion of income on other local products
Employment multiplier: change in total employment per additional export job

<table>
<thead>
<tr>
<th>Industry</th>
<th>Portland Metropolitan Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frozen food manufacturing</td>
<td>2.40</td>
</tr>
<tr>
<td>Wines</td>
<td>2.74</td>
</tr>
<tr>
<td>Textile and fabric finishing</td>
<td>1.82</td>
</tr>
<tr>
<td>Mills</td>
<td>2.88</td>
</tr>
<tr>
<td>Paper and paper products</td>
<td>1.92</td>
</tr>
<tr>
<td>Engine manufacturing</td>
<td>2.13</td>
</tr>
<tr>
<td>Textile and fabric finishing</td>
<td>2.33</td>
</tr>
<tr>
<td>Milling</td>
<td>1.46</td>
</tr>
<tr>
<td>Fiber optic cable manufacturing</td>
<td>2.71</td>
</tr>
<tr>
<td>Heavy duty truck manufacturing</td>
<td>2.55</td>
</tr>
<tr>
<td>Motorcycle, bicycle, and parts manufacturing</td>
<td>1.92</td>
</tr>
<tr>
<td>Software publishers</td>
<td>2.17</td>
</tr>
<tr>
<td>Insurance carriers</td>
<td>2.49</td>
</tr>
<tr>
<td>Legal services</td>
<td>1.76</td>
</tr>
<tr>
<td>Architectural and engineering</td>
<td>1.74</td>
</tr>
<tr>
<td>Architectural and engineering</td>
<td>1.58</td>
</tr>
<tr>
<td>Custom computer programming</td>
<td>2.21</td>
</tr>
<tr>
<td>Computer systems design services</td>
<td>1.60</td>
</tr>
<tr>
<td>Other computer-related services</td>
<td>1.66</td>
</tr>
<tr>
<td>Management consulting services</td>
<td>1.66</td>
</tr>
<tr>
<td>Environmental and other technical consulting</td>
<td>1.78</td>
</tr>
<tr>
<td>Scientific research and development services</td>
<td>1.51</td>
</tr>
<tr>
<td>Advertising and related services</td>
<td>1.67</td>
</tr>
<tr>
<td>Hospitals</td>
<td>2.13</td>
</tr>
<tr>
<td>Spectator sports</td>
<td>1.54</td>
</tr>
<tr>
<td>Independent artists, writers, and performers</td>
<td>2.77</td>
</tr>
<tr>
<td>Museums, historical sites, parks</td>
<td>2.19</td>
</tr>
</tbody>
</table>

Urban Labor Supply Curve: Positive Slope
Simplifying assumptions: fixed hours per worker; fixed participation rate
Positive slope: Migration in response to wage differences. Increase in wage attracts workers to the city.

Axiom 1: Growing city offer higher wage to offset higher cost of living
- Elasticity (living cost, total employment) = 0.20
- Elasticity (wage, total employment) = 0.20
- Elasticity (labor supply, wage) = 5.0

Shifting the Urban Labor Supply Curve
What causes an increase in labor supply (shift curve to right)?
- Improve amenities such as environmental quality
- Decrease disamenities such as crime
- Decrease residential taxes such as property tax or sales tax
- Improve residential public services

Taxes and Firm Location Choices
Low-tax city grows faster, ceteris paribus (public services)
- Elasticity (business activity, taxes)
  - Intericty location: -0.10 to -0.60
  - Intracty location: -1.0 to -3.0
- Manufacturers more sensitive to tax differences
- High taxes on capital repels capital-intensive industries

Public Services and Location Decisions
High-service city grows faster, ceteris paribus (taxes). Growth promoted by High tax that supports public services [infrastructure, education, safety]. Growth inhibited by High tax that supports redistributive programs

Subsidies and Incentive Programs
Tax abatements, guaranteed loans, subsidized land and public services. Economic development programs have small effects

Professional Sports, Stadiums, and Jobs
What are the benefits of a $150 million stadium?
Small employment benefits
- Small positive effect in 1/4 of cases; negative effect in 1/5 of cases
- Arizona: 340 jobs for $240 million
- Money spent largely by locals, replacing other local spending

Other benefits—Civic/tribal pride and cohesion worth the price tag?

Tradeoffs from Environmental Policy
Environmental policy decreases labor demand
- Increases production cost of polluting good => increase price
- Increase in price => decrease output and labor demand

Improvement in environment increases labor supply
Net effects on total employment logically indeterminate

Pollution Tax and the Distribution of Employment
Both industries (steel and clean) experience lower wages.
- Steel: lower wages offset by pollution tax, so decrease employment.
- Clean industry: lower wages increase total employment

Projecting Changes in Total Employment
\[ \Delta \text{Total employment} = \Delta \text{Export employment} \times \text{Employment multiplier} \]

Table 5-1: Employment multipliers for metropolitan area

Problems with employment-multiplier approach
- Horizontal shift of labor demand, not change in equilibrium employment
- Focuses on jobs rather than income
- Suggests that fate of city in hands of outsiders (export consumers)

FIGURE 5-1 Distribution of 1,000 New Jobs between Original Residents and Newcomers

Urban Land Rent

Chapter 6
URBAN LAND RENT

Introduction to Land Rent
Market value: amount paid to take ownership
Land rent: periodic payment from user to owner

Bid Rent for Farm Land Depends on Fertility
WTP for hectare of land = Total revenue - non-land costs
Bid rent per hectare = WTP divided by lot size

<table>
<thead>
<tr>
<th>Fertility and Land Rent</th>
<th>Price of Corn ($/bushel)</th>
<th>Quantity (bushel/acre)</th>
<th>Total Revenue ($/acre)</th>
<th>Non-land Cost ($/acre)</th>
<th>WTP for Land ($/acre)</th>
<th>Bid Rent per Hectare ($/hectare)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low fertility</td>
<td>$100</td>
<td>2</td>
<td>$200</td>
<td>$150</td>
<td>$50</td>
<td>$50</td>
</tr>
<tr>
<td>High fertility</td>
<td>$100</td>
<td>4</td>
<td>$400</td>
<td>$150</td>
<td>$250</td>
<td>$250</td>
</tr>
</tbody>
</table>

Bid Rent for Urban Land Depends on Accessibility
WTP: Maximum amount for lot large enough for production facility
WTP = Total revenue - non-land costs

One part of non-land cost is cost of freight to highway
Bid rent per hectare = WTP divided by lot size

<table>
<thead>
<tr>
<th>Computing the Manufacturing Bid Rent</th>
<th>Distance (mi)</th>
<th>Total Revenue ($ million)</th>
<th>Production Cost ($ million)</th>
<th>WTP for Land ($ million)</th>
<th>Bid Rent per Hectare ($ million/hectare)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance (mi)</td>
<td>Total Revenue ($ million)</td>
<td>Production Cost ($ million)</td>
<td>WTP for Land ($ million)</td>
<td>Bid Rent per Hectare ($ million/hectare)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>$250</td>
<td>$100</td>
<td>$150</td>
<td>$250</td>
<td>$250</td>
</tr>
<tr>
<td>2</td>
<td>$250</td>
<td>$50</td>
<td>$150</td>
<td>$250</td>
<td>$250</td>
</tr>
<tr>
<td>2</td>
<td>$250</td>
<td>$50</td>
<td>$150</td>
<td>$250</td>
<td>$250</td>
</tr>
</tbody>
</table>

FIGURE 6-1 Freight Cost and Manufacturing Bid Rent Curve

Axiom 1: Price of land adjusts for locational equilibrium
Each firm earns zero economic profit ather paying for land. Variation in freight cost generates variation in land rent

Bid Rent for Office Land Depends on Accessibility
Office firms gather, process, and distribute information. Principle of median location: Travel distance minimized at median location. Total travel distance increases at increasing rate as distance to center increase

<table>
<thead>
<tr>
<th>Travel Distance (mi)</th>
<th>Average</th>
<th>Less Educated</th>
<th>Younger</th>
<th>Black</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-124</td>
<td>0.40</td>
<td>0.47</td>
<td>0.41</td>
<td>0.49</td>
</tr>
<tr>
<td>5-125</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-126</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban Land Rent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Muhammad Firman  (University of Indonesia - Accounting)
Office Bid Rent without Factor Substitution

\[ WTP = \text{Total Revenue} - \text{non-land costs} \]

One part of non-land cost is travel costs of office workers.

\[ \text{Bid rent per hectare} = \frac{WTP}{\text{size of production site}} \]

Role of Factor Substitution

Capital and land are input substitutes in production of office space. Building up increases capital cost and decreases land cost. Capital costs increase with building height:

1. Vertical transportation systems
2. Reinforcement for weight bearing

Office Bid Rent with Factor Substitution

\[ WTP = \text{Total Revenue} - \text{non-land costs} \]

One part of non-land cost is travel costs of office workers.

\[ \text{Bid rent per hectare} = \frac{WTP}{\text{size of production site}} \]

Options for Building Heights

- Low Rent: Short building is least costly
- Medium Rent: Medium building is least costly
- High Rent: Tall building is least costly

Simple Model of Housing Prices

Commuting cost is only location factor. One member of household commutes to employment area. Monetary (not time) cost of commuting
Noncommuting travel insignificant. Ubiquitous public services, taxes, and amenities

Model with No Consumer Substitution
Each household occupies standard (1,000 sf) dwelling. Each household has $800 per month to spend on housing and commuting. Monthly commuting cost is $50 per mile from employment center.

Housing Price & Locational Indifference
Price of housing per square foot of living space
Axiom 1: Housing price adjusts to offset commuting costs
Locational indifference: ΔP / Δx = -t / h = -50 / 1,000 = -0.05

Residential Bid Rent with Fixed Factor Proportions
Each firm uses 1 hectare of land and $K of capital to produce Q sf of housing. Total revenue = P(x) Q is convex because housing-price curve is convex. Leftover principle: Willingness to pay = P(x) Q - K = Bid rent for land

Role of Factor Substitution
Response to higher land rent is taller buildings on smaller lots. Cost savings from factor substitution increase bid rent for land. Result: bid-rent curve is more convex

Population Density within City
Lower price of housing: higher consumption of housing (square feet)
Lower price of land: higher consumption of land per sf of housing
Larger suburban footprint (land per household) and lower population density

<table>
<thead>
<tr>
<th>TABLE 6-4 Population Density in Suburbs versus Central City</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing (square feet)</td>
</tr>
<tr>
<td>Suburb 2000</td>
</tr>
<tr>
<td>City center 1000</td>
</tr>
</tbody>
</table>

Relax Assumptions: Time Cost of Commuting
Commuting comes at expense of work or leisure
Commuting time valued at 1/3 to 1/2 wage

Relax Assumptions: Two earners per household
Common workplace: commuting cost double, increasing slope of housing-price curve
Different workplaces: two points of orientation
  - Change in residence causes ambiguous change in commute cost
  - Slope of housing-price curve ambiguous

Relax Assumptions: Noncommuting travel
Uniform distribution of destinations: offsetting changes in noncommuting travel
Concentrated destinations: many points of orientation
  - Change in residence causes ambiguous change in travel cost
  - Slope of housing-price curve ambiguous

Relax Assumptions: Public service, taxes, amenities
Ceteris paribus, housing and land prices higher in location with
  - Superior public goods
  - Low taxes, ceteris paribus
  - Positive amenities
Example: Cleaner air means higher housing and land prices

Land Use Patterns: Transportation Features of City
Manufactures export output on highways
  - Intercity highway goes through city center
  - Circumferential highway (beltway)
Office firms exchange information in central area
Workers drive to workplaces

FIGURE 6-9 Panel C: Maximum Bid Rent of Employers

FIGURE 6-10 Bid Rents and Land Use Patterns

FIGURE 6-9 Panel A: Bid Rent of the Office Sector

FIGURE 6-9 Panel B: Bid Rent of the Manufacturing Sector

FIGURE 6-10 Bid Rents and Land Use Patterns

FIGURE 6-10 Bid Rents and Land Use Patterns

FIGURE 6-10 Bid Rents and Land Use Patterns
CHAPTER 7

LAND USE PATTERNS

Subcenters: Los Angeles and Chicago
Conventional definition: Density ≥ 25 workers per hectare; Total employment ≥ 10,000

Los Angeles: 28 subcenters
- Employment density (workers per hectare): 90 in CBD; average of 45 in subcenters
- Subcenters contain 23% of metro employment
- Types: Industrial, Service, Entertainment

Chicago: 20 subcenters; old industrial areas (9), old satellite cities (3), new mixed (5)

MAP 7-3 Distribution of Office Employment: Portland and Boston

The Spatial Distribution of Population
For U.S. metropolitan areas, 36% in central cities, 64% in other municipalities. Population shares are 20% (3 mile) and 65% (10 mile). Median residence is 8 miles from center.

CHAPTER 7

LAND USE PATTERNS

continues to serve as place for face time. Employment density decreases as distance to center increases. Subcenter firms benefit from proximity to firms in center. Firms in different subcenters interact.

The Spatial Distribution of Population
For U.S. metropolitan areas, 36% in central cities, 64% in other municipalities. Population shares are 20% (3 mile) and 65% (10 mile). Median residence is 8 miles from center.

MAP 7-4 Population Density: Portland

Subcenters in a Metropolitan Economy
Subcenters are numerous in both old and new metropolitan areas. Most jobs are dispersed rather than concentrated in CBDs and subcenters. Many subcenters are specialized, indicating localization economies. CBD
Variation in Population Density within Cities
Paris: Density near center is 6 times the density at 20 km
New York: Density near center is 4 times the density at 20 km

Density Gradient: Percentage change in density per mile from center
- Boston: Gradient = 0.13
- Density gradient in U.S. metro areas in range 0.05 to 0.15

The Rise of the Monocentric City: Review

Innovations in Intracity Transportation:
Timing: Omnibus (1827); Cable cars (1873); Electric Trolley (1886); Subways (1895). Decrease in travel cost increased feasible radius of city.
Hub-and-spoke system: large concentrations of employment in metro center.

The Technology of Building Construction
1. Starting point in early 1800s: Masonry and post-beam with 16-inch timbers
2. Balloon-frame building (1832), fastened with cheap nails
3. Office buildings: masonry to cast iron (1848, 5 stories) to steel (1885, 11 stories)
4. Elevator (1854): Increased feasible building height. Elevator increased the bid rents on upper floors

The Primitive Technology of Freight
Intericity freight: ship or rail
Intracity freight: horse-drawn wagons to port or rail terminal

The Demise of the Monocentric City?
What caused decentralization of employment?
What caused decentralization of population?

Decentralization of Manufacturing: Intracity Truck
The intracity truck (1910): Twice as fast and half as costly as horse wagon. Truck decreased cost of moving output relative to the cost of moving workers. Firms moved closer to low-wage suburbs.

The Technology of Building Construction
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What caused decentralization of population?

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Other Factors in Decentralization of Manufacturing
Automatic replace streetcars; Improved access between streetcar lines. Single-story manufacturing plants increases pull to low-rent suburbs.
Air freight: orientation toward suburban airports.
Decentralization of Office Employment
Before 1970s: Suburbs activities were paper-processing back-office operations. New information technology decoupled info processing (suburb) & decision making (CBD).

Decentralization of Population
Mills: Density gradient was 1.22 in 1880 & 0.31 in 1963 (24% within 3 miles). Three-mile share of population: 88% (1880), 24% (1963), 20% (2000). Decentralization is worldwide phenomenon.

Reasons for Decentralization of Population
Increase in income: Ambiguous effect because higher income
- Increases demand for housing & land, pulling people to low-price suburbs
- Increases the opportunity cost of commuting
- Lower commuting cost decreases the relative cost of suburban living
- New housing in suburbs
- Central city problems: fiscal problems, crime, education

Urban Sprawl: Facts
1950-1990: Urban land increased 2.7 times as fast as urban population.

Variation in density across US cities
- NYC (40 people per hectare), LA (21), Phoenix (18)
- Chicago (15), Boston (14)
- Higher density in western cities: Higher land prices

TABLE 7-5 Population Density in Atlanta and Barcelona

<table>
<thead>
<tr>
<th></th>
<th>Atlanta</th>
<th>Barcelona</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (millions)</td>
<td>2.5</td>
<td>1.8</td>
</tr>
<tr>
<td>Average density (people per hectare)</td>
<td>6</td>
<td>71</td>
</tr>
<tr>
<td>Land per person (square meters)</td>
<td>1,712</td>
<td>56</td>
</tr>
<tr>
<td>Maximum distance between two locations (kilometers)</td>
<td>338</td>
<td>37</td>
</tr>
<tr>
<td>Percent of trips walking</td>
<td>Less than 1</td>
<td>20</td>
</tr>
<tr>
<td>Percent of trips on public transit</td>
<td>4.5</td>
<td>30</td>
</tr>
</tbody>
</table>

The Causes of Sprawl
Lower commuting cost and higher income
Culture: Higher density among Asians and immigrants

Government policies
- Congestion: Underpricing of commuting encourages long commutes
- Mortgage subsidy increases housing consumption
- Underpricing of fringe infrastructure
- Zoning: Minimum lot sizes to exclude high-density housing

Glaeser and Kahn Study
Automobile & truck: Eliminated orientation toward central infrastructure (streetcar hub, port, rail terminal). Sprawl is ubiquitous, despite differences in income. Subsidies for housing and highways: Too small to matter?

European Policies and Sprawl
Higher cost of personal transportation: gas tax and auto sales tax
Promote small neighborhood shops that facilitate high-density living
- Expensive electricity and freezers?
- Restrictions on location and prices of large retailers

Agriculture subsidies allow fringe farmers to outbid urban uses.
Transportation infrastructure favors mass transit

The Consequences of Sprawl
Suburban life: more land, same residential energy, 30% more travel.
Environmental quality: cleaner cars offset increased mileage. Greenhouse gases increase with mileage. Loss of farmland hasn’t increased agriculture prices

Sprawl and Transit Ridership
Support intermediate bus service: 31 people per hectare (NY & Honolulu)
- 60% of Barcelona residents live within 600 meters of transit station
- 4% of Atlanta residents live within 800 meters of transit station

Policy Responses to Sprawl?
If distortions eliminated, would density change by a little or a lot?
If anti-sprawl policies increase density, what are the benefits and costs?

Economics of Skyscrapers
Marginal principle: Increase height as long as MB > MC
Profit-maximizing height: MB = MC

What happens when developers try to build the tallest?

FIGURE 7-4 Are Skyscrapers 'Too Tall?'

Building profit is maximized at the height where marginal benefit equals marginal cost. For a height of 80 floors, building profit is $200 lower than the $900 maximum. If the price for the tallest is $200, the first firm will win the contest with a building of at least 80 floors.

The Tallest-Building Game
Profit from losing contest = $900 (50-floor building)
To win contest, firm 1 must make 2's profit from winning < $900
- Firm 1 chooses 51: Firm 2 = 52; profit just below $1100
- Firm 1 chooses 80: Firm 2 = 81; profit < $900
- Firm 1 chooses 80: Firm 2 = 50; profit = $900

Implications of Skyscraper Game
Large gap between tallest and second tallest; observed in real cities
Wasteful competition dissipates profit
- Total profit with (51, 50) approximately $2,000 = $900 + $200 + $900
- Total profit with (80, 50) equal to $1800 = $700 + $200 + $900

CHAPTER 8
NEIGHBORHOOD CHOICE

Introduction
Extend model of residential choice beyond commuting cost
- Why do people segregate by income, race, education?
- What are the consequences of segregation?

Diversity versus Segregation

MAP 8-1 Income Segregation: Boston

MAP 8-2 Segregation with Respect to Educational Attainment: Denver

A Model of Sorting for Local Public Goods

Fragmented system of local government provides choice. City with 3 voters with differing demands (WTP) for parks. Cost of parks = $60 per acre; shared equally by citizens with head tax. Collective choice: Majority rules.

FIGURE 8-1 Diversity of Demand for Local Public Good

With a tax of $30 per person per acre, Lois prefers 6 acres, Marian prefers 12 acres, and Hiram prefers 28 acres.

Majority Rule and the Median Voter
Series of binary elections
Winning size is preferred size of median voter

TABLE 8-1 The Median Voter Always Wins

Formation of Homogeneous Municipalities
Metro area initially has 3 diverse municipalities, each with 3 citizens. Sorting by park demand makes allows everyone to get preferred park
- Lois types form municipality with small park
- Marian types form municipality with medium park
- Hiram types form municipality with large park

Homogeneous municipalities accommodate diversity in demand

Municipality Formation for Tax Purposes
So far, assume that each citizen/voter in a municipality pays the same tax
What if tax base varies across citizens?

TABLE 8-2 Municipality Formation for Tax Purposes

Implications of Variation in Tax Base
Variation in tax base increases number of communities from 3 to 9

Real cities
- Tax on property
  - Variation in property value causes municipal formation

Neighborhood Externalities
Externalities for kids
- Positive adult role models for kids
- Classmates in school: focused vs. disruptive

Adult externalities: Job information, drug use
Positive externalities increase with income and education level

Neighborhood Choice: Introduction
- Who gets the desirable neighbors?
- Segregated or integrated neighborhoods?
- Sorting or mixing with respect to income, age, race?
- Implications for the price of land?

Bidding for Lots in Desirable Neighborhoods
Focus on positive externalities that increase with income and education level. What is income mix of neighborhoods—segregated, or integrated?

Model setup
- Two neighborhoods, A and B, each with 100 lots
- Two income groups (high and low), each with 100 households
- Only difference between neighborhoods is income mix

Looking for a Stable Equilibrium
Starting point: Integrated (50-50) neighborhood. Small move toward segregation: Self-reinforcing or self-correcting?

Different Outcomes (Stable Equilibria)
- Segregation: Figure 8-2
- Integration: Figure 8-3
- Mixed: Figure 8-4

**TABLE 8-3** Lot Size and Integration

<table>
<thead>
<tr>
<th></th>
<th>Premium for High-Income Community</th>
<th>Premium per Unit of Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low income</td>
<td>$5</td>
<td>$5</td>
</tr>
<tr>
<td>High income</td>
<td>$8</td>
<td>$4</td>
</tr>
</tbody>
</table>

Rent Premium in Mixed Neighborhoods
Premium = $24
Each household in A (high & low income) pays $24 extra
High-income households in B have inferior income mix but pay $24 less in rent

**TABLE 8-4** Variation in High School Achievement, Portland Public Schools

<table>
<thead>
<tr>
<th>High School</th>
<th>Percent Meeting or Exceeding in Math</th>
<th>Percent Economically Disadvantaged</th>
<th>Percent Nonwhite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lincoln</td>
<td>80</td>
<td>12</td>
<td>21</td>
</tr>
<tr>
<td>Franklin</td>
<td>73</td>
<td>50</td>
<td>46</td>
</tr>
<tr>
<td>Wilson</td>
<td>72</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Cleveland</td>
<td>69</td>
<td>30</td>
<td>28</td>
</tr>
<tr>
<td>Grant</td>
<td>68</td>
<td>26</td>
<td>36</td>
</tr>
<tr>
<td>Benson</td>
<td>49</td>
<td>61</td>
<td>71</td>
</tr>
<tr>
<td>Madison</td>
<td>45</td>
<td>70</td>
<td>66</td>
</tr>
<tr>
<td>Jefferson</td>
<td>44</td>
<td>68</td>
<td>74</td>
</tr>
</tbody>
</table>

Role of Lot Size
Land as "normal" good: High-income households choose larger lots. Larger lot means smaller premium per unit of land. Pair of low-income households outbids single high-income household. Result: Integration rather than segregation

Minimum Lot Size Zoning and Segregation
MLS increases premium per unit land for low-income household. Low-income households more likely to be outbid for lots in A. MLS promotes segregation

Schools and Neighborhood Choice: Introduction
How does achievement vary across neighborhoods?
How do local schools affect location choices?
Education Production Function
Achievement = f (H, P, T, S)
- Home environment (H) most important input
- Favorable peers (P) are smart, motivated, not disruptive
- Teachers (T) vary in productivity
Smaller class size (S) promotes learning
- Largest gains for low-income students
- Higher graduation rates and college attendance

Education and Income Sorting
Fiscal sorting: Demand for school spending increases with income
Peer sorting: WTP for better school peers increases with income

Crime and Neighborhood Choice: Introduction
How does crime vary across neighborhoods?
How does variation in crime affect location choices and housing prices?

Implications of Spatial Variation in Crime
Elasticity of house value with respect to crime rate = -0.067
WTP for low-crime neighborhood increases with income
Result: Income segregation

Measuring Racial Segregation
Blacks: 2/3 in central cities; 1/3 in suburbs; Reverse for whites. US Index of dissimilarity = 0.64: 64% of must relocate for integration. 1980-2000, index decreased in 203 of 220 metropolitan areas; average reduction was 12%. Small reductions in most segregated cities (Detroit, Milwaukee, New York, Newark, Chicago, Cleveland)

Racial Preferences and Neighborhood Choice
Blacks: majority prefer integration; integration means 50-50 split
Whites: majority prefer segregation; integration means 80-20 split

Other Reasons for Racial Segregation
Racial segregation as a byproduct of income segregation: Small contribution. Minimum lot size zoning excludes low-income households
Racial steering (reflecting prejudice) reduces access of black households
Public housing concentrates low-income households. Alternative: Portable vouchers reduce concentration

The Spatial Mismatch
Concentration of low-income & minority workers in central city, far from suburban jobs
- Longer commuting time and higher commuting time
- Lower employment rates for black youths
Inferior access explains 25% of black-white employment gap. Inferior access explains 31% of Hispanic-white gap. Mismatch more important in large cities

CHAPTER 9
ZONING AND GROWTH CONTROLS

Zoning and Growth Controls: Introduction
Government role in urban land market
Zoning to separate different land uses into separate zones
Growth controls limit population growth
Who wins and who loses?

The Early History of Zoning
Comprehensive zoning started in 1916
Did change in transportation technology generate zoning?
- Truck: Replaced horse cart, causing industry to move to suburbs
- Bus: Low-income (high density) households between streetcar spokes
- Zoning to exclude industry and high-density housing?

Zoning as Environmental Policy
Industrial Pollution
- Zoning separates residents from pollution
- Zoning doesn’t reduce pollution, but moves it around
- Economic approach: internalize externality with pollution tax
Retail Externalities: Congestion, noise, parking
High Density Housing: Congestion, parking, blocked views
Alternative: Performance standards for traffic, noise, parking, views

Fiscal Zoning
Some communities eagerly host firms that generate fiscal surplus
Fiscal deficit: Tax contribution less than cost of public services
Minimum lot size zoning (MLS)

Large household in small dwelling more likely to generate deficit. MLS exploits complementarity of housing and land.
Target lot size: \( s = \frac{v^*}{(5 \cdot r)} \)
\( v^* = \) target property value; \( r = \) market value of land
Example: \( s = \frac{200,000}{(5 \cdot 80,000)} = 0.50 \)

Minimum Lot Zoning and the Space Externality
Externality: larger lot generates more space and higher utility for neighbors. External benefit means that lots smaller than socially efficient size. MLS: increase space and enforce reciprocity in space decisions

Zoning for Open Space
Public land: Parks and Greenbelts
Restrictions on Private Land: Preservation of farm or forest land
- What is the efficient level of open space?
- How does zoning affect the efficiency of the land market?

Legal Environment: Substantive Due Process
Law must serve legitimate public purpose using reasonable means. Ambler: Zoning promotes health, safety, morals, general welfare. No consideration of cost, only benefit. Example: Chinese laundries in San Francisco

Legal Environment: Equal Protection
Law must be applied in non-discriminatory fashion.
Does exclusionary zoning constitute discrimination?
- Euclid: effects of zoning on outsiders unimportant
- Los Altos: discrimination on basis of income is OK
State courts adopt more activist role
- Mount Laurel (NJ): City accommodates “fair share” of low-income residents
- Livermore (CA): Consider interests of insiders and outsiders

Legal Environment: Just Compensation
Should property owners be compensated for losses in value from zoning? Compensation required for physical invasion (occupation) of land
Harm prevention rule: Compensation not required if zoning promotes public welfare
Diminution of value rule
- Compensation required if property value drops by sufficiently large amount
- No guidance on what’s large enough
- Rule is not widely applied

Houston: City Without Zoning
Land use controlled by voluntary agreements among landowners
- Residential: Detailed restrictions on design, appearance, maintenance
- Industrial: Limit activities

How does Houston compare to zoned cities?
- Similar distribution of industry and retailers
- More strip development
Urban Growth Boundaries: Introduction
Policy confines development to sites within the boundary. Explicit prohibition or restricted urban services.

1991: One quarter of cities used growth boundaries

**FIGURE 9-2 Effects of Precise Growth Control in a Two-City Region**

The initial equilibrium is shown by point $i$. Each of the two cities has a population of 4 million. A growth-control policy that reduces the population of the control city to 3 million (point $c$) and increases the population of the uncontrolled city to 5 million (point $a$), opens a utility gap of $29 (= $80 - $56$). The resulting increase in the price of land in the controlled city shifts the city’s utility curve downward until equilibrium is restored at points $e$ and $n$.

Winners and Losers from Growth Boundaries
Workers throughout the region lose as utility drops
- Uncontrolled city grows, pulling down utility
- In control city, competition raises rent until utility drops to level in uncontrolled city

Utility loss: Inefficiency of cities of different size
Landowners in control city: Generally winners because price of land increases

Urban Growth Boundary and the Land Market
How does a growth boundary affect land rent within the city? Who wins and who loses?

**Figure 9-3 Urban Growth Boundary and the Land Market**

Urban Growth Boundaries and Density
So far, consider growth boundary combined with minimum lot size. What happens when city allows density within boundary to increase?

**FIGURE 9-4 Effects of an Urban Growth Boundary in a Two-City Region**

The initial equilibrium is shown by point $i$. Each of the two cities has a population of 4 million. If the control city does not limit lot size, the increase in the price of land resulting from a growth boundary will increase density, generating a population of 3.5 million (point $f$). Regional equilibrium is restored at point $f$ and $c$, with a common utility level of $57$ and a total of 8 million people in the two cities, with 3.5 million in the control city and 4.5 million in the other city.
Portland’s Urban Growth Boundary
Metropolitan boundary periodically expanded to accommodate growth combined with policies designed to increase density. Objective: Direct development to locations with efficient use of public infrastructure.

Municipal versus Metropolitan Growth Boundaries
Most boundaries around municipalities, not metropolitan areas. Logic: Displacement of workers and residents decreases common utility level. Municipal controls displace congestion and pollution to nearby municipalities.

Tradeoffs with Growth Boundaries and Open Space
- Decrease utility of workers/renters
  - Increase value of land within the boundary
  - Homeowners: Higher land prices benefit owners

Benefits versus Costs of Open Space
- Benefits from open space near city
  - Cost is higher housing prices and higher density (less private space)
  - Reading, England: Relaxation of policies would generate a net gain

Other Growth Control Policies: Building Permits
- Consider city that sets maximum number of building permits below equilibrium
- What are the implications for housing and land prices?

FIGURE 9-5 Market Effects of Limit on Building Permits

If the number of building permits is limited to 80, the supply curve for housing is the kinked curve $b$. The new equilibrium is shown by point $x$. The marginal cost of production ($160,000$) is the difference between the price and the marginal cost that is the developer’s willingness to pay for the building permit ($90,000$).

Allocating Building Permits
Profit per dwelling = Price ($250k) - Marginal cost ($160k) = $90k
Auction to highest bidder: price of permit = $90
Permits to builders promote city’s objectives?
Permits to winner of building beauty contest?

Development and Impact Fees
Development fee can close gap: Regular tax revenue - Cost of public services
Development fee addresses fiscal problem
Example: impact fee per job to improve transportation infrastructure

TABLE 9-1 Housing Regulations and Housing Prices

<table>
<thead>
<tr>
<th>Metropolitan Area</th>
<th>Wharton index</th>
<th>Price Premium ($)</th>
<th>Municipality</th>
<th>Wharton index</th>
<th>Price Premium ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanta</td>
<td>0.04</td>
<td>5410</td>
<td>0.07</td>
<td>80,006</td>
<td></td>
</tr>
<tr>
<td>Boston</td>
<td>1.54</td>
<td>197,132</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicago</td>
<td>0.06</td>
<td>7480</td>
<td>-1.15</td>
<td>-147,209</td>
<td></td>
</tr>
<tr>
<td>Dallas</td>
<td>-0.35</td>
<td>-44,863</td>
<td>-0.04</td>
<td>-17,021</td>
<td></td>
</tr>
<tr>
<td>San Francisco</td>
<td>0.90</td>
<td>115,267</td>
<td>1.96</td>
<td>250,086</td>
<td></td>
</tr>
<tr>
<td>Seattle</td>
<td>1.01</td>
<td>120,218</td>
<td>2.39</td>
<td>305,059</td>
<td></td>
</tr>
<tr>
<td>Premium permit index</td>
<td>120,916</td>
<td></td>
<td>120,008</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CHAPTER 10
EXTERNALITIES FROM AUTOS

Introduction
Axiom 3: Externalities cause inefficiency
Solution: Internalize the externalities with pricing (taxes)
Automobile externalities: congestion, environmental damage, collisions

TABLE 10-1 Purposes of Travel

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Share of Travel (percent)</th>
<th>Average Trip Length (miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social and recreational</td>
<td>20</td>
<td>11.26</td>
</tr>
<tr>
<td>To/from work</td>
<td>19</td>
<td>12.14</td>
</tr>
<tr>
<td>All other family and personal business</td>
<td>19</td>
<td>7.68</td>
</tr>
<tr>
<td>Shopping</td>
<td>14</td>
<td>7.02</td>
</tr>
<tr>
<td>Work-related business</td>
<td>9</td>
<td>26.28</td>
</tr>
<tr>
<td>School/college</td>
<td>6</td>
<td>6.92</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>43.08</td>
</tr>
</tbody>
</table>


FIGURE 10-1 Modal Choice for U.S. Commuters

FIGURE 9-6 Housing Regulation and Housing Prices

Housing regulation generates a relatively inelastic supply and a kink in the supply curve at the initial equilibrium (point $a$). An increase in demand generates a relatively large increase in price (to $p^*$) and a relatively small increase in quantity (to $N^*$).
Congestion
Nationwide cost of congestion
- Typical commuter spent 47 hours per year in traffic
- Sum of time and fuel cost = $63 billion (5 times amount in 1982)

Modeling congestion
- Commute distance = 10 miles
- Monetary Cost = $0.20 per mile
- Time cost = opportunity cost of $0.10 per mile
Will the imposition of a congestion tax cause the city to grow or shrink? Congestion tax improves efficiency of urban economy Consider two-city region with fixed population

**FIGURE 10-5** Congestion Tax in Peak versus Off-Peak Periods

During the peak travel period, traffic volume is relatively high, generating a large gap between the private and social cost of travel (shown by points $p$ and $q$) and thus a higher congestion tax. During the off-peak period, the gap between the social and private cost of travel is lower (points $r$ and $x$), so the congestion tax is lower.

**Practicalities of Congestion Taxes**

**Estimates of Congestion Taxes**

- San Francisco: $0.03$ to $0.05$ (off peak); $0.17$ to $0.65$ (peak)
- Minneapolis: average of $0.09$; up to $0.21$ on most congested routes
- Los Angeles: $0.15$ average for peak

**Implementing the Congestion Tax**

- Vehicle identification system (VIS) allows tracking and billing
- Singapore: $2$ for central zone; Electronic pricing for variable charges
- Toronto: Fees on Express Toll Road depend on time of day

**A Congestion Tax Reduces Traffic Volume by**

1. Modal substitution: switch to carpool, transit
2. Time of travel: switch to off-peak travel
3. Travel route: switch to less congested route
4. Location choices: change residence or workplace, cutting travel distance

**HOV and HOT Lanes**

- HOV: high occupancy vehicle lane for carpools and buses
- HOT: high occupancy or toll; pay to use HOV lanes

**California HOT lanes:** Toll varies with traffic volume

**Responses**

- Modal substitution: switch to transit, carpool
- Time of travel: Switch to off-peak travel
- Change routes
- Combine trips

**Alternative to a Congestion Tax: Gasoline Tax**

Encourages modal substitution (1) and location choices (4). Does not affect time of travel (2) or route (3). Gasoline tax applies to driving on uncongested road.

**Alternative to Congestion Tax: Transit Subsidy**

Idea is to match underpricing of car travel with underpricing of mass transit. Encourages modal substitution (1). Does not affect time of travel (2), route (3), location choice (4)

**Problems**

- Inelastic demand for mass transit; zero price increases ridership by 1/3
- Only a fraction of new riders are diverted auto drivers

**Alternative to a Congestion Tax: Eliminate Parking Subsidy**

Subsidies cut drive-alone cost and increase number of cars by 19% (Shoup). Eliminate subsidies shifts auto demand to left, decreasing volume.

**Evidence of responsiveness**

- Ottawa pricing decreased drivers by 23%
- LA pricing decreased solo drivers by 44%

**Road Capacity Decision**

How wide a road to build?

**FIGURE 10-6** Expand Capacity until Congestion Tax Revenue Equals Road Cost

The congestion tax per vehicle is the gap between the private and social trip cost (the gap between points $i$ and $d$ for a two-lane road). The average road cost is the gap between the average total cost and the private trip cost (the gap between $i$ and $f$ for a two-lane road). For a two-lane road, tax revenue per vehicle equals the average road cost. Capacity should be expanded.
Capacity Expansion and Latent Demand

Wider road has lower time cost and larger quantity demanded. Figure 10-6: Double width decreases trip cost from $3.60 (k) to $3.00 (f). When capacity doubles, why not go from point k to point m?

- Law of demand: Increase in volume partly offsets cost savings from wider road

Who Pays for Roads?

Use fees for autos and trucks: gas, oil, auto parts. Revenue from fees no longer cover cost of roads and highways. Urban road users come closer to covering costs

Autos and Air Pollution

Pollution and Greenhouse Gases

- Pollutants: VOC, CO, NOx, SO2 generate smog and particulates
- Transport responsible for 2/3 of CO, 1/2 of VOC, 2/5 of NOx
- Poor air quality exacerbates respiratory problems & causes premature death
- Greenhouse gases from automobiles

Internalizing pollution externalities

- Economic approach: Tax = marginal external cost
- Monitoring device allows direct charge for emissions
- One-time pollution tax depends on expected emissions, but not mileage

GREENHOUSE GASES AND A CARBON TAX

Carbon tax: External costs per ton of carbon = $25 to $100
Carbon tax of $50 means gasoline tax = $0.13 per gallon
Extend Figure 10-7: Shift supply curve upward by $0.13

MOTOR VEHICLE ACCIDENTS

Cost of MV Accidents

- Annual cost in US: 3.1 million injuries, 40,000 deaths, $300 billion
- External cost of collisions = 4.4 cents per mile (vs. 10 cents per mile for fuel)

Accidents and Congestion

- Parry: $5 billion per year lost from accident delays
- Quick response policies: cruising tow trucks, loop detectors, helicopters

VEHICLE SAFETY POLICIES: BIKERS BEWARE

Vehicle Safety Act of 1966: Mandated safety features

Seat-belt and other safety laws didn’t have expected effect

- Small reduction in death rates
- Higher collision rates
- Increased injury and death rates for pedestrians and bicyclists

FIGURE 10-8: Speed and Safety Regulations

Accident Costs and VMT Tax

Impose per-mile tax = Marginal external cost from accidents
Figure 10-9: Efficiency Gains from VMT Tax
Perfectly differentiated: Gain = 0.38 cents per mile driven = $9.4 billion per year

TABLE 10-5: External Accident Costs for Different Vehicles and Driver Ages

<table>
<thead>
<tr>
<th>Small Car</th>
<th>Large Car</th>
<th>SUV</th>
<th>Minivan</th>
<th>Pickup</th>
<th>&lt;25 years</th>
<th>25-79 years</th>
<th>&gt;70 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5.60</td>
<td>$3.94</td>
<td>$3.59</td>
<td>$3.04</td>
<td>$5.25</td>
<td>18.87</td>
<td>3.62</td>
<td>5.43</td>
</tr>
</tbody>
</table>

FIGURE 10-9: Accident Costs and VMT Tax

A tax of $0.40 per gallon of gasoline shifts the supply curve upward by $0.40, increasing the equilibrium price and decreasing the equilibrium quantity. Half the tax is borne by consumers, and half is shifted backward onto the people who supply the crude oil used to produce gasoline.
Automobiles and Poverty
Recall spatial mismatch discussion from neighborhood chapter

Access to a car
- Urban low-income families: 27% don’t own a car
- Blacks in central cities: 45% don’t have access to a car

Importance of a car
- Switch from mass transit saves 19 minutes each day and expands search area
- Car owners are more likely to complete job training program and get a job

CHAPTER 11
MASS TRANSIT

Mass Transit: Introduction
Why do so few commuters use mass transit?
When are buses better than rail systems (light and heavy)?
What population density is required to support mass transit?
How does transit revenue compare to cost?
How would deregulation affect transit options?

TABLE 11-1 Means of Transportation to Work, 2000

<table>
<thead>
<tr>
<th>Travel Mode</th>
<th>Number of Commuters</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workers 16 years and over</td>
<td>128,279,228</td>
<td>100</td>
</tr>
<tr>
<td>Car, truck, or van</td>
<td>112,716,181</td>
<td>87.9</td>
</tr>
<tr>
<td>Drive alone</td>
<td>97,162,040</td>
<td>75.7</td>
</tr>
<tr>
<td>Carpool</td>
<td>15,534,651</td>
<td>12.2</td>
</tr>
<tr>
<td>Public transportation</td>
<td>6,007,708</td>
<td>4.7</td>
</tr>
<tr>
<td>Bus or trolley bus</td>
<td>3,366,692</td>
<td>2.5</td>
</tr>
<tr>
<td>Structure or utility car</td>
<td>73,213</td>
<td>0.1</td>
</tr>
<tr>
<td>Subway as demand train</td>
<td>1,885,961</td>
<td>1.5</td>
</tr>
<tr>
<td>Railroad</td>
<td>658,007</td>
<td>0.5</td>
</tr>
<tr>
<td>Ferryboat</td>
<td>44,306</td>
<td>0.2</td>
</tr>
<tr>
<td>Subway or trolley bus</td>
<td>766,141</td>
<td>0.2</td>
</tr>
<tr>
<td>Motorcycle</td>
<td>142,424</td>
<td>0.1</td>
</tr>
<tr>
<td>Bicycle</td>
<td>613,487</td>
<td>0.4</td>
</tr>
<tr>
<td>Walk</td>
<td>7,318,029</td>
<td>2.9</td>
</tr>
<tr>
<td>Other means</td>
<td>909,998</td>
<td>0.7</td>
</tr>
<tr>
<td>Worked at home</td>
<td>4,112,223</td>
<td>3.3</td>
</tr>
</tbody>
</table>

variation in ridership across metropolitan areas
New York: 25% commuters use public transit
Shares 10% - 14%: Chicago, Washington, Philadelphia

Cost of Travel and Modal Choice

Trip cost = \( m + T_a \cdot d_a + T_v \cdot d_v \)

Sum of monetary cost, access cost, and in-vehicle cost. \( m = \) marginal disutility of access time; approximately 80% of wage. \( d_a = \) marginal disutility of in-vehicle time; approximately 50% of wage

Table 11-2 Example of Modal Choice

<table>
<thead>
<tr>
<th></th>
<th>Automobile</th>
<th>Bus</th>
<th>Rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access cost (walk and wait) ($)</td>
<td>0.00</td>
<td>5.76</td>
<td>11.52</td>
</tr>
<tr>
<td>( T_a ) Access time (minutes)</td>
<td>0</td>
<td>24</td>
<td>48</td>
</tr>
<tr>
<td>( d_a ) Marginal disutility per minute ($)</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>In Vehicle cost ($)</td>
<td>12.00</td>
<td>13.50</td>
<td>9.00</td>
</tr>
<tr>
<td>( T_v ) In-vehicle time (minutes)</td>
<td>80</td>
<td>90</td>
<td>60</td>
</tr>
<tr>
<td>( d_v ) Marginal disutility per minute ($)</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
</tr>
<tr>
<td>Total time cost ($)</td>
<td>12.00</td>
<td>19.26</td>
<td>20.52</td>
</tr>
<tr>
<td>Monetary cost ($)</td>
<td>4.00</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>TOTAL COST</td>
<td>16.00</td>
<td>22.26</td>
<td>23.52</td>
</tr>
</tbody>
</table>

Elasticities of Demand for Transit
Overall price elasticity = -0.40
Transit ridership is more elastic with respect to service
- Boston: time elasticity = -0.80, compared to fare elasticity = -0.50
- Service improvements matched with proportionate fare increases ridership
- Ridership more responsive to changes

TABLE 11-3 Price Elasticities of Demand for Bus and Rail Transit

<table>
<thead>
<tr>
<th>Time of day</th>
<th>Bus</th>
<th>Rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak demand</td>
<td>-0.40</td>
<td>-0.34</td>
</tr>
<tr>
<td>Off-Peak</td>
<td>-0.48</td>
<td>-0.30</td>
</tr>
<tr>
<td>Overall</td>
<td>-0.50</td>
<td>-0.30</td>
</tr>
</tbody>
</table>

Figure 11-1: Average Cost for Transit System

AC(operator)
Negatively sloped from conventional scale economies: spread the fixed cost of indivisible inputs

AC(time): rider time cost
Increase in ridership allows more frequent service and lower access time cost. Example: tripling ridership from R1 to R3 decreases time cost from t1 to t3

Figure 11-1 Scale Economies and Mishandling Economies in Transit

The average operator cost curve is negatively sloped because of scale economies (spreading fixed capital cost), and the average time cost curve is negatively sloped because of Mohring economies (more frequent service with more riders).
Optimum Ridership and Price
Marginal cost is less than average cost. Average cost includes fixed cost of indivisible inputs. Mohring economies: marginal time cost < average time cost. Additional rider speeds up the transit system and other riders. Contrast with congestion externality (additional driver slows down others).

Budget-balancing:

\[
\text{Ridership} = R' \text{ and trip cost} = c'
\]

Other Rationales for Transit Subsidies
Exernalities from automobiles: congestion, environmental, collision
- Los Angeles: Justify operating subsidy of 27% for peak bus
- Washington DC rail: Justify operating subsidy of 37% for peak rail
- London: Justify operating subsidy of 50% for peak rail

Incentive Effects of Transit Subsidies
Subsidies lead to higher operator cost from
- excessive compensation
- misallocation of labor
- inefficient input mix (capital and labor)

Solution: Switch from operator-based subsidy to user-side subsidy (per passenger mile)

Designing a Transit System
Long-run perspective: Include capital, operating, and time cost
Compare to cost of automobile system
Transit options: Heavy rail, light rail, bus

System Cost
- Capital: Laying rails and buying transit vehicles
- Operating: Labor, fuel, maintenance

Design Features
Mainline vs. integrated: Modal switches increase access time. Distance between bus and stops and rail stations: Line-haul time versus access time
Frequency of service: Operator cost (capital & operating) vs. access time

Cost of the Auto System
Include private cost (time and $), the cost of building road, pollution cost. Congestion tax revenue covers cost of optimum road. Horizontal AC curve: road widened to accommodate increased traffic. Does not include external cost of greenhouse gases or collisions

Cost of Bus System and Rapid-Rail System
Includes private & public and time & monetary cost of systems

Negatively sloped
- Conventional scale economies: Spread fixed costs over more riders
- Mohring economies: Increase in ridership decreases access time cost

Implications
Figure 11-4 represents costs for city with residential density typical of US cities. Low density (less than 6,000 passenger volume): Auto is most efficient
Bus is less costly than BART for volumes > 30,000
Bus has lower access cost (shorter headways & distances between stops)
Bus has lower capital cost

Implications for Cities with Higher Residential Density
Heavy-rail system less costly than bus for volumes > 30,000
Heavy rail is efficient choice for New York and Chicago
New heavy rail (Washington, Atlanta, Baltimore, Miami): ridership below threshold

Closer Look at Light Rail
Light rail is more costly than bus system
- Higher capital cost: 5x cost ($881m vs. $168m in Long Beach)
- Higher operating cost: $0.38 (Portland's MAX) > $0.35 for bus

Diverts bus passengers: 63% of LA Blue Line former bus riders
Feeder buses impose access costs on riders

<table>
<thead>
<tr>
<th>TABLE 11-6 Minimum Densities to Support Mass Transit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>One bus per hour</td>
</tr>
<tr>
<td>Two buses per hour</td>
</tr>
<tr>
<td>Light rail</td>
</tr>
<tr>
<td>Heavy rail</td>
</tr>
</tbody>
</table>

Role of Density
Few US metro area meet density thresholds for frequent bus service
- NY meets minimum for light rail and bus
- Honolulu meets minimum for intermediate bus service
- 10 most dense metro areas nearly meet minimum for infrequent bus
- Central areas of some metro areas exceed

Regulation of Urban Mass Transit
Public transit monopoly: firms cannot compete
Taxis cannot serve as common carrier

Rationale?
- Prevent cream skimming and undermining cross subsidies for low-volume routes
- Alternative is to directly subsidize low-volume routes

Contracting for Transit Services
Local government specifies services and fares, and accepts low bid
Cost savings of 25-30%
Lower cost for firms: low wage, flexible work rules; minibuses

Paratransit
Services between automobile and conventional bus
Shared-ride taxis (3-4 passengers), jitneys (6-15 passengers)
Subscription bus (10-60 passengers)

The British Experience with Deregulation
Transport Act (1985): entry, competitive bidding, lower subsidies. Results: more minivans, lower costs from lower wages and flexible work rules, elimination of low-volume service

Lessons
- Competition combined with subsidies for low-volume routes
- Competition generates innovation and cuts costs

<table>
<thead>
<tr>
<th>TABLE 11-7 Transit Accessibility of Additional Residents and Jobs in Atlanta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residence Jobs</td>
</tr>
<tr>
<td>Percent within 800 meters of MARTA station</td>
</tr>
<tr>
<td>Percent within 800 meters of bus line</td>
</tr>
<tr>
<td>Percent inaccessible to mass transit</td>
</tr>
</tbody>
</table>

Transit and Land-Use Patterns: BART Case
Objective: Increase employment near transit stations
Clustering negligible outside central business district
Combining rail transit investment with policies that promote density increases employment

CHAPTER 12
EDUCATION

Introduction
- Educational achievement varies across space
- Quality of local schools is important factor in location decisions
- Local education influences economic growth

Spending and Educational Achievement
Table 12-1: Significant interstate variation in k-12 spending
Table 12-2: Student test Scores in different countries
Table 12-3: Student achievement in Selected Cities

<table>
<thead>
<tr>
<th>TABLE 12-1 Per Pupil Spending in Selected States, 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
</tr>
<tr>
<td>Utah</td>
</tr>
<tr>
<td>Oklahoma</td>
</tr>
<tr>
<td>Mississippi</td>
</tr>
<tr>
<td>Tennessee</td>
</tr>
<tr>
<td>Arizona</td>
</tr>
<tr>
<td>Connecticut</td>
</tr>
<tr>
<td>New Jersey</td>
</tr>
<tr>
<td>New York</td>
</tr>
<tr>
<td>District of Columbia</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 12-2 International Student Test Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country</td>
</tr>
<tr>
<td>Chinese Taipei</td>
</tr>
<tr>
<td>Korea, Republic</td>
</tr>
<tr>
<td>Singapore</td>
</tr>
<tr>
<td>Hong Kong SAR</td>
</tr>
<tr>
<td>Japan</td>
</tr>
<tr>
<td>Hungary</td>
</tr>
<tr>
<td>England</td>
</tr>
<tr>
<td>Russian Federation</td>
</tr>
<tr>
<td>United States</td>
</tr>
<tr>
<td>Lithuania</td>
</tr>
<tr>
<td>Czech Republic</td>
</tr>
<tr>
<td>Slovenia</td>
</tr>
<tr>
<td>Australia</td>
</tr>
<tr>
<td>Sweden</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TABLE 12-3 Student Achievement in Selected Cities, 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jurisdiction</td>
</tr>
<tr>
<td>United States</td>
</tr>
<tr>
<td>Large cities</td>
</tr>
<tr>
<td>Sun Cities</td>
</tr>
<tr>
<td>Boston</td>
</tr>
<tr>
<td>New York City</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Production function: Achievement = f(H, P, C, E, T)
H (home): rules for homework; motivation; instructional material
P (classroom peer): boosted by smart & motivated peers
Sweden: increase P (50th to 84th pct) increases A (50th to 54th pct)
Tradeoffs with peer effect: Sorting versus Mixing
Differences in Teacher Productivity
Inner city: Gap between high-quality & low-quality teacher = 1 grade level
Teacher swap: Replace average teacher (50th pct) with superior teacher (84th pct)
  – Average student moves from 50th to 58th student percentile
  – Earnings (58th) - earnings (50th) = $21,311
  – For 20-student class, value of superior 12-356

Characteristics of Productive Teachers
  – List of productivity characteristics is elusive
  – Education level: no evidence that graduate coursework increases productivity
  – Experience increases productivity for first few years
  – Verbal skills increase productivity

Effects of Class Size
Achievement increases as class size decreases
Marginal benefit curve negatively sloped: diminishing returns
Marginal cost curve horizontal at teacher wage
Efficiency: MB = MC

Teacher Compensation: Experience premium puzzle
Teacher compensation increases by roughly $1,000 per year. Productivity doesn’t increase with experience after 3 years. 20-year teacher earns 1.44 times as much as a 3-year teacher.

No-excuse Charter Schools
  – Extended school day
  – Emphasis on discipline
  – High expectations
  – Monitor student performance with frequent testing

Promise Academy
Average student spends twice as much time on schoolwork
Search for superior teachers generates high turnover rate
  – Typical student (math): From 39th to 74th percentile
  – Typical student (read): From 39th to 53rd percentile
Gains: Superior teachers & focused learning

Boarding Schools
Remove student from unfavorable home environment. SEED schools in DC are no-excuse boarding schools.
Large achievement gains
  – Each year generates gain 9 percentile points (math) & 8 percentile point (read)
  – Gains a bit higher than non-boarding no-excuse schools

Spending Inequalities and Public Policy
Reliance on property tax generates spending inequalities across school districts
Notions of equity developed by states
  1. Adequacy: Minimum statewide standard must be met
  2. Access equality: Voters have access to same effective tax base
  3. Equality: Common level of education for all districts

Foundation Grants
State grant higher for districts with low property tax bases
Grant = Foundation level - Foundation tax rate Local property value per pupil. State sets foundation level & foundation tax rate (rate at which grant decreases as tax base increases)
Ex: Foundation = $8,000; Tax rate = 0.03; Property value per pupil = $200,000

Table 12-4: Tax and Spending Options with a Foundation Grant

<table>
<thead>
<tr>
<th>Local Tax Rate</th>
<th>Local Tax Revenue</th>
<th>Foundation Grant</th>
<th>Education Spending</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>$5,000</td>
<td>$2,000</td>
<td>$3,000</td>
</tr>
<tr>
<td>2.5%</td>
<td>$5,000</td>
<td>$2,000</td>
<td>$3,000</td>
</tr>
</tbody>
</table>

Figure 12-3: Response to Foundation Grant
Grant shifts budget line to right by amount of the grant. If education spending ≥ g', grant equivalent to increase in income. Utility-maximizing point goes from i to f. Increase spending on both education & other goods
Income effect: Increase desired quantities of all “normal” goods
Flypaper effect: Model of median voter underestimates stimulative effect of grant
On average, about 40% of intergovernmental grant spent on target local good. Education: fraction spent is between 30 and 65%. Larger grants for low-spending (low wealth) districts => decrease spending inequality

Matching Grants: Guaranteed Tax Base
- Match rate = 0.25 => Covered $0.80 of local revenue generates $0.20 grant
- Local cost per dollar of spending = 1/(1+0.25) = $0.80
- Matching & non-matching grants have income effect
- Matching grant also has substitution effect: lower opportunity cost of local spending

Guaranteed Tax Base (GTB)
Grant = Local tax rate (Guaranteed tax base per pupil - Local tax base per pupil)

Example
- Guaranteed base = $250,000; Local base = $200,000
- Tax rate = 0.02 => Grant = $1,000; Local revenue = $4,000, for a total of $5,000
- Tax rate = 0.025 => Grant = $1,250; Local 12

Effects of Equalization Plans
States responding to court orders. Decrease in spending inequalities from leveling up
- For low-spending districts, spending increased by 27%
- For medium spending districts, spending increased by 15%
- For high-spending districts, spending unchanged

Michigan: Complete Control of K-12 Finance
Reform
- increased spending in rural districts
- decreased spending in poor urban areas & rich suburban areas

Reform increased achievement where spending increased. smaller class size

Central cities and equalization plans
Urban schools: large number of low-income students
- Higher cost for security, family/health crises
- Weak academic preparation, limited English skills

Equalization programs: relatively small increase in funding or decrease in funding

Education in Central Cities
Relatively low achievement from unfavorable home environment and peers
- Policy: Improve quality of teachers
- Policy: Decrease class size
- Policy: Improve learning environment

CHAPTER 13
CRIME

Introduction to Crime
Economic approach: Criminals respond to incentives
Crime reduced by traditional crime-fighting resources (police, prisons)
Crime reduced by increasing returns to lawful activities (schools)


<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Violent</th>
<th>Property</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>30.4m</td>
<td>4.6m</td>
<td>25.8m</td>
</tr>
<tr>
<td>1970</td>
<td>28.5m</td>
<td>3.5m</td>
<td>25.0m</td>
</tr>
<tr>
<td>1980</td>
<td>27.0m</td>
<td>2.8m</td>
<td>24.2m</td>
</tr>
<tr>
<td>1990</td>
<td>25.5m</td>
<td>2.3m</td>
<td>23.2m</td>
</tr>
<tr>
<td>2000</td>
<td>24.0m</td>
<td>1.9m</td>
<td>22.1m</td>
</tr>
</tbody>
</table>

TABLE 13.2 Criminal Victimization Rates, 2003

<table>
<thead>
<tr>
<th>Population (1,000,000)</th>
<th>Violent Crimes (per 1,000,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (1,000,000)</td>
<td>Violent Crimes (per 1,000,000)</td>
</tr>
<tr>
<td>500,000</td>
<td>20</td>
</tr>
<tr>
<td>1,000,000</td>
<td>15</td>
</tr>
<tr>
<td>1,500,000</td>
<td>10</td>
</tr>
<tr>
<td>2,000,000</td>
<td>5</td>
</tr>
</tbody>
</table>

FIGURE 13.1 The Cost of Crime

The Rational Criminal
Economics of double parking
- 50-50 chance of gaining $44 or losing $36
- Who will take the risk?

People generally risk averse: Need more than +$44 to offset risk of -$36
People differ in aversion to anti-social actions--anguish cost

Muhammad Firman (University of Indonesia - Accounting)
Preventing Crime
Increase probability of prison (probability of failure) to 0.75
Lengthen prison term to 0.51: Decrease failure utility to 7 utils
Decrease the loot to $21: Decrease success utility to 11 utils

Income and Crime: Column 5 in Table 13-3
Income = $400; lawful utility = 20 utils
High-income: Same loot but four times the opportunity cost
EU(crime) = 18.5 utils = 0.50 U(444) + 0.50 U(256)
Implication: Lower crime among high-income people

Morality & Anguish Costs: Column 6 of Table 13-3
Most people averse to committing anti-social acts like crime
Low probability of prison = 0.25
- EU(crime) = 11 utils = 0.75 U(144) + 0.25 U(64)
- EU(crime) > Lawful utility, so commit crime
- If anguish cost = 2 utils, expected utility of crime = 9 utils < Lawful utility

Education and Crime
Education increases wages, decreasing crime
College wage premium = 100%
High-school graduation wage premium = 50%

Lawful Opportunities and Crime
Studies of link between unemployment rate and crime
- Weak relationship between crime and overall unemployment rate
- Teenage crime (first-time offenders) sensitive to unemployment rate

Studies of link between lawful wages and crime
- Increase in lawful wage increases opportunity cost, shifting MC (supply) upward
- Low-skilled workers: Elasticity (crime, wage) between -1.0 and -2.0

Improving job prospects for low-skilled workers reduces crime

Education-Crime Link for High-School Education
Additional year of HS decreases crime participation rate: Reduction of 0.10 percentage points for whites; 0.40 popt for blacks. Graduation decreases crime participation rates of white males: 9% for violent crime; 5% for drug crime; 10% for property crime. Elasticity (Arrest rate, Graduation rate) = -2.0 (violent) and -1.30 (motor vehicle). Effects of preventing a dropout. Cost per year of schooling = $6,000
Reduction in crime = $1,600 per year for rest of work/crime life

Why More Crime in Big Cities?
Elasticity of crime rate with respect to size = 0.15
More loot (25% of difference)
Lower probability of arrest (15% of difference); Table 13-4
More female-headed households (50% of difference)

Empirical Evidence: Crime Supply Elasticities
Elasticity of supply w.r.t. Probability of prison = -0.30
Elasticity of supply w.r.t. Arrest ratio = -0.30
Elasticity of supply w.r.t. Number of police = -0.40 to -0.50

Increasing the Severity of Punishment
Longer prison term increases crime cost, shifting MC (supply) curve upward. Elasticity close to zero. Longer prison term causes offsetting changes
- Harden criminal: lower anguish cost shifts MC (supply) shifts downward
- Prison schooling: skill acquisition shifts MC (supply) downward

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College wage premium = 100%
High-school graduation wage premium = 50%

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More female-headed households (50% of difference)
Role of Legalized Abortion

Crime rates higher among children born to reluctant parents. Abortion decreased number of unwanted births. Availability of abortion in 1970s reduced the number of people maturing in crime-prone years in 1990s—a favorable demographic change. Cut crime rate by 10%; responsible for one third of crime drop. Caution: Other studies show smaller effect.

The Optimal Amount of Crime

How much crime should we choose?

Victim Costs
- Includes costs of injury, recovery time, lost property
- Estimated cost per victim: $370 (larceny), $1,500 (burglary), $4,000 (auto theft), $13,000 (armed robbery), $15,000 (assault)

Are some crimes less expensive to experience than to prevent?

Crime Substitution and Marginal Deterrence
Criminals have options, and alternative crimes are substitutes. Equilibrium:Equal net return for different crimes. Change in cost of one crime causes substitution toward other crimes.

Implications for the Social Cost of Crime
Victim cost of robbery is 8.7 times the cost of burglary. Break even in social cost: 8.7 fewer burglaries offset each additional robbery. Example in Figure 13-9: 3 fewer burglaries for each additional robbery.

Should the Punishment Fit the Crime?
Penalty for burglary less than penalty for armed robbery. Policy objective: Develop penalty menu to generate optimum crime mix.

Prisons and Crime
Overall elasticity of crime w.r.t. prison population:
- Property crime: -0.25
- Violent crime: -0.40

Effects on crime: deterrence, incapacitation, rehabilitation
Deterrence: increase in certainty more effective than increase in severity.

Prisons: Incapacitation
Take criminals out of circulation
Mixed results: each prisoner would have committed 0 - 17 crimes.

Marginal benefits and costs of incarceration
- Marginal benefit = $15,000 in avoided crime
- Excludes benefits of reduced fear and protective measures
- Marginal cost = $36,000 in facility cost and opportunity cost
Prisons: Rehabilitation
Provide criminals with skills required for success in lawful employment.
Two thirds participate in rehabilitation programs, broadly defined. Simple
fact are not encouraging: Roughly 2/3 of former inmates rearrested within
3 years of release. Released inmates account for 10% -12% of crime.

General Ineffectiveness of Rehabilitation Programs
Difficult to change anti-social attitudes. Entrenchment in criminal world
Large increase in skill required to make employment more lucrative than
crime. Rehab for youths passes benefit-cost test: Modest reduction of
costly crime.

CHAPTER 14
WHY HOUSING IS DIFFERENT?

Why is Housing Different?
Heterogeneous: dwellings differ in size, age, style, features, location
Durable: Deterioration rate depends on maintenance and repair decisions
Costly Moving: Adjustment when gap between ideal and actual large

Questions to Address
1. Why do we care about heterogeneity, durability, and moving
costs?
2. Is it efficient for low-income households to live in used
housing?
3. Who benefits from subsidies for new housing?
4. How do growth controls affect the housing market?

Hedonic Pricing Approach
Each dwelling has a different bundle of characteristics. Dwelling features:
quality, age, size. Neighborhood effects: quality of other dwellings. For
each component of the housing bundle, there’s a price

Results of Other Hedonic Studies
Positive influence: proximity to jobs, schools, transit stations, churches.
Negative effects: crime, toxic waste, noisy highways

Housing Quality Ladder
- Normal deterioration moves dwelling down the ladder
- Moderate expense: keep dwelling at same level
- Large expense for remodel & renovate to raise level

Retirement Scenarios
Boarding up: short-lived reduction in price; low opportunity cost of funds
Conversion: Profit from alternative > Conversion cost
Abandonment: Profit from alternative < Conversion cost

Abandonment and Public Policy
Declining income from property and constant property tax. Abandon when
Income < Property tax. A flexible property tax declines with income,
prolonging use. New York: Elasticity(abandonment, property tax) = 1.65
Externalities from abandoned buildings: Eyesores and crime havens.

Durability and Supply Elasticity
Increase in price of housing increases quantity supplied
- Increase the quantity of new dwellings (2-3 percent per year)
- Increase maintenance on used dwellings
Remodel and renovate used dwellings

Supply is Relatively Inelastic for Long Periods
- Most of the stock (97%-98%) is used
- Rate of deterioration relatively slow
- Upgrading (Remodel & renovate) costly, so large price hike required
- Estimates of Supply Elasticity
  - Ozanne & Struyk: 10-year elasticity for used housing = 0.20 to 0.30
  - DeLeeuw & Ekanem: Long-run elasticity for rental housing = 0.30 to 0.70

Moving Costs and Consumer Disequilibrium
Large moving cost: move possessions and detach from neighborhood. Households tolerate mismatch until large enough to justify a move

Filtering and the Housing Stepladder
Over time quality of dwelling decreases

Response to decrease in quality
1. Costly upgrade of old dwelling
2. New house with new materials, technology, fashion
3. Used house filtered down from higher level
4. Filtering: Income level of occupant decreases over time

Moving Costs and Consumer Disequilibrium

Filtering doesn’t always work: Some features don’t filter downward. Wealthiest households remain in highest quality houses

Filtering with Rising Income
Increase in income increases demand for housing quality
Larger advantage of filtering process
Remain in old dwelling: costly upgrade (renovate/remodel) to higher level
Move to vacated dwelling: move up quality ladder

**Effects of Growth Controls [Building Ban]**
Direct effect on high-income: tolerate mismatch or incur high upgrade costs. No filtering to middle-income household: tolerate mismatch or costly upgrade. No filtering to low-income household: tolerate mismatch or costly upgrade. Result: cost of building ban borne by everyone in market

**Price Effects of Growth Controls**
How does ban on new housing (high quality) affect housing prices? Market interactions generate higher prices for all types of housing

**CHAPTER 15
HOUSING POLICY**

**Introduction: Housing Policy**
Low-Income Housing Policy: $30 billion per year
- Public housing, subsidized private housing, vouchers
- Community development programs support local efforts

High-Income Housing Policy: $66 billion per year for mortgage subsidy

**Features of public housing**
About 1.3 million households; budgetary cost about $7 billion
Managed by local housing authorities
Rent no greater than 30% of recipient income

**What are the Benefits of Public Housing?**
Recipient value = $200 (two thirds of market value)  
Production cost = 2 x $540 = $1,080  
Budgetary cost = $840 - $1,080 production cost - $240 rent  
Bang per buck = $200 / $840 = 0.24

**Subsidies for Private Housing**
Section 236 & Section 8 - Project Based
Tenant pays 30% of income as rent (R)
Fair market rent (F) determined by cost or prevailing rent
Government pays owner subsidy: S = F - R
Example: Income = $800; F = $500; S = $500 - $240 = $260
Production efficiency of subsidized new housing: median = 0.75

Tax Credits for Investments in Affordable Housing
Annual tax credit = 9% of cost attributable to low-income housing
Tax credits for 10 years; restrictions in force for 15 years
Rent restricted: maximum rent = 30% of qualifying income
20/50 test: 20% of residents have income ≤ 50% of median income
40/60 Test: 40% of residents have income ≤ 60% of median income

Effects of Tax Credits
Used in projects that produced 700,000 units by 1999
Tax revenue sacrificed = $3.5 billion per year
Each $1.00 generated $0.62 of housing
DiPasquale et al: higher production efficiency: Cost gap is 14% to 19%

Facts on Displacement Effects
Subsidies reduce demand for unsubsidized dwellings and price. Decrease in quantity from reduced incentive to maintain and slower filtering. In long run, best estimate is one-for-one crowding out. No evidence that low-income tax credit program increased total supply

Housing Vouchers: Introduction
Vouchers (like food stamps) allow recipients to choose. Recipient must occupy dwelling meeting minimum standard.
Face value = Fair market rent - 0.30 Income
Fair market rent = 45th percentile of rent in metropolitan area

Vouchers and Prices in Related Submarkets
Faster filtering from medium to moderate: decrease in supply of medium. Slower filter from moderate to low: decrease in supply of low. Estimates of price effects of vouchers. Increase price by 16% overall; implies a low supply elasticity (≤ 0.38). Smaller increase in price for middle-income housing (3.2%). No measurable effect on price of high-income housing

Portable Vouchers: Moving to Opportunity
Some recipients given vouchers to be used in low-poverty areas. Results: Mobile residents. Moved to areas with less poverty, crime, segregation, and better schools.
Children: fewer behavior problems, less crime, better school performance
Adults: No differences in employment or public assistance

Community Development and Urban Renewal
Dozens of Community Development programs

Bang per buck of voucher = $1 (versus 0.24 for public housing)
Mandates: Eliminate blight, renew old areas, new centers of economic activity

Urban Renewal (1949-73)
- Displaced low-income residents
- Replaced by high-income residents, public facilities, commercial operations

Recent Community Development Programs
Community Development Block Grants (CDBG): $4.7 billion
- Housing (40%), public works (20%), economic development (13%), public services (10%)

Recent programs provide more flexibility for local governments
- Homeless funds (McKinney)
- Renovate or demolish public housing (HOPE IV)
- Preserve low-income housing (HOME)

Homelessness
Definition of homeless person
- Sleeps outside, in places not intended for sleeping
- Or sleeps in housing shelters

Problems of homeless: low education, prison time, drug use, mental illness
Elasticity (homelessness, rent on low-quality housing) = 1.25

Housing Policy: Supply versus Demand Policies
Supply: More costly than private housing; limits recipients’ options
Demand: Increase prices for recipients and non-recipients
Best policy depends on metropolitan area. Demand policy superior if elasticity of supply of low-income housing is high
- Relatively Elastic: Small price effects of vouchers
- Relatively Inelastic: Large price effect of vouchers

Supply policies: Focus on preservation of existing supply--rehabilitation
Flexible grants would allow local governments to pick best policy

Features of the Mortgage Subsidy
Tax break reduces tax revenue by $66 billion.
Deduct mortgage interest from gross income;
subsidy rate = marginal tax rate

Household benefit increases with income. Subsidy rate increases with income: 15%, 28%, 31%. Housing consumption & mortgage interest increase with income. About 2/3 of benefit to households with income >

TABLE 14-1 Makeup of U.S. Homeless Population

<table>
<thead>
<tr>
<th>Group</th>
<th>Percent of Homeless Population</th>
<th>Date for Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children under 18</td>
<td>39</td>
<td>2003</td>
</tr>
<tr>
<td>Children under 5</td>
<td>16</td>
<td>2003</td>
</tr>
<tr>
<td>Single men</td>
<td>43</td>
<td>2005</td>
</tr>
<tr>
<td>Single women</td>
<td>17</td>
<td>2005</td>
</tr>
<tr>
<td>Families with children</td>
<td>33</td>
<td>2005</td>
</tr>
<tr>
<td>African American</td>
<td>49</td>
<td>2004</td>
</tr>
<tr>
<td>Caucasian</td>
<td>35</td>
<td>2004</td>
</tr>
<tr>
<td>Hispanic</td>
<td>13</td>
<td>2004</td>
</tr>
<tr>
<td>Native American</td>
<td>2</td>
<td>2004</td>
</tr>
<tr>
<td>Asian</td>
<td>1</td>
<td>2004</td>
</tr>
</tbody>
</table>

Features of Rent Regulation
Rent control started in WWII dropped by all cities except New York. During 1970s, regulations instituted in many cities. Some rent regulations flexible to account for inflation & production cost. Annual rent increases tied to inflation rate. Larger price hikes when cost increases

FIGURE 15-6 The Mortgage Subsidy Increases Housing Consumption

Mortgage Subsidy & Home Ownership
Assumptions about housing

CHAPTER 16
THE ROLE OF LOCAL GOVERNMENT

Introduction: Questions to Address
- What is the role of local government in the federal system?
- Why does voting with majority rule generate inefficient outcomes?
National versus Local Government

- Roles of Government: stabilization, income distribution, resource allocation.
- Stabilization: Monetary & fiscal policy at national level.
- Income distribution: Local efforts undermined by mobility of taxpayers and recipients

Resource allocation by local government
1. Provide local public goods
2. Manage natural monopolies
3. Internalize local externalities

Characteristics of a Local Public Good
1. Non-rival in consumption
2. Non-excludable: impractical to exclude those who don't pay
3. Local: Benefits confined to small geographical area

Assumptions of Tiebout Model: Voting with Feet
- Each household chooses municipality with ideal level of local public good
- Perfect information and mobility
- No inter-jurisdictional spillovers
- No scale economies
- Head tax finances local public good

Sorting: Demand for Local Public Goods
Example in Fig 16-1: Loisville (6 acres), Marianville (12), Hiramville (28)

Evidence of Tiebout Sorting
- Los Angeles: communities are homogeneous w.r.t. demand
- Larger variation in demand means more municipalities
- National: Greater ethnic diversity means more decentralization

Benefit Taxation
Benefit Tax is proportional to private benefit of public good

Practicalities
- Does government know marginal benefit of individual citizens?
- How roughly does benefit increase with income or property value?

FIGURE 16–2 Lindahl or Benefit Taxation

Local Government and Natural Monopolies
Natural monopoly: Increasing returns to scale large relative to demand
Examples: Water, Sewer service, mass transit

FIGURE 16–3 Natural Monopoly in Sewage Services
Local Government and Externalities
Axiom 3: Externalities Cause Inefficiency

Local governments respond to local externalities
- Chapter 8: Education externalities from team work, voting, crime reduction
- Chapter 10: automobile externalities

Public provision is one response to externalities

Education Vouchers
Voucher (coupon) can be used to pay for education, public or private. Schools qualify for vouchers by satisfying basic requirements.

Consequences of vouchers
- Competition fosters efficiency?
- Will peer environment of low-income students deteriorate?

Targeted Vouchers for Low-income Families
Prevents income segregation that could occur with universal voucher

Results
- Higher math test scores; no difference in reading scores
- Students in small public-school classes did just as well
- Benefits of vouchers from small class size?

Will vouchers generate better teachers?

Externalities from Public Safety Programs

Police and crime control
- Capturing externality: Everyone benefits when criminal captured
- Chasing externality: Others bear a cost when criminal flees

Fire protection: Fires can spread

Federalism and Metropolitan Government

When is Local Provision Efficient?
- Diversity in demand: Large
- Externalities: Relatively small in geographical sense (within the jurisdiction)
- Scale economies: Relatively small

Facts on Scale Economies
- Moderate scale economies in water and sewage service
- Other local public goods: scale economies exhausted at population = 100k

Rationale for Metropolitan Government

Interjurisdictional externalities large relative to diversity in demand. Intergovernmental grants to subsidize local activities
- Manage metropolitan networks: highways, disposal, schools, airsheds, watersheds
- Metropolitan government: Portland, Minneapolis-St. Paul

A Closer Look at the Median-Voter Result
Median voter is decisive; majority rule chooses preferences of median voter. Does election format matter?

TABLE 16-3: The Median Voter in a Series of School Budget Elections

<table>
<thead>
<tr>
<th>Voter</th>
<th>Preferred Budget</th>
<th>Vote with $90 Budget</th>
<th>Vote with $80 Budget</th>
<th>Vote with $70 Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>549</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>B</td>
<td>56</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>C</td>
<td>63</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>D</td>
<td>79</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>E</td>
<td>64</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>F</td>
<td>39</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>G</td>
<td>51</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

Implications of the Median-Voter Result
1. No reason to expect voting to generate socially efficient outcome
2. To predict outcome of election, need preferences of median voter
3. Use data to estimate elasticities of demand for local public goods

TABLE 16-4: Income and Price Elasticities of Demand for Local Public Goods

<table>
<thead>
<tr>
<th>Public Good or Service</th>
<th>Price Elasticity</th>
<th>Income Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local expenditures</td>
<td>-0.34 to -0.30</td>
<td>0.34 to 0.39</td>
</tr>
<tr>
<td>Education</td>
<td>-0.20 to -0.21</td>
<td>0.24 to 0.35</td>
</tr>
<tr>
<td>Parks and recreation</td>
<td>-0.19 to -0.19</td>
<td>0.09 to 0.12</td>
</tr>
<tr>
<td>Public safety (police and fire)</td>
<td>-0.19 to -0.10</td>
<td>0.52 to 0.71</td>
</tr>
<tr>
<td>Public works</td>
<td>-0.02 to -0.10</td>
<td>0.70</td>
</tr>
</tbody>
</table>
The Property Tax
Annual tax on market value of property
Value = Structure value + Land value

<table>
<thead>
<tr>
<th>City</th>
<th>Effective Tax Rate</th>
<th>City</th>
<th>Effective Tax Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridgeport, CT</td>
<td>3.86%</td>
<td>Boston</td>
<td>1.10</td>
</tr>
<tr>
<td>Newark</td>
<td>2.95</td>
<td>Minneapolis</td>
<td>1.27</td>
</tr>
<tr>
<td>Milwaukee</td>
<td>2.67</td>
<td>Los Angeles</td>
<td>1.08</td>
</tr>
<tr>
<td>Des Moines</td>
<td>2.28</td>
<td>Phoenix</td>
<td>1.82</td>
</tr>
<tr>
<td>Houston</td>
<td>2.62</td>
<td>Chicago</td>
<td>1.69</td>
</tr>
<tr>
<td>Philadelphia</td>
<td>2.64</td>
<td>New York</td>
<td>0.93</td>
</tr>
<tr>
<td>Jacksonville</td>
<td>1.96</td>
<td>Denver</td>
<td>0.56</td>
</tr>
<tr>
<td>Memphis</td>
<td>1.76</td>
<td>Honolulu</td>
<td>0.57</td>
</tr>
<tr>
<td>Portland</td>
<td>1.46</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Model of Property Tax Incidence
Cost of Characters
- Landowners: Own lots that are fixed in size and number
- Capitalists: Own mobile homes (structures)
- Housing firms: Rent land from landowners and rent mobile homes from capitalists
- Housing firms: Rent housing bundle (land + structure) to consumers

Pre-tax: Housing rent = $5,000 = $4,000 (structure) + $1,000 (land)
Property tax paid in legal terms by housing firm: $800 (structure) + $200 (land)

Why Doesn't the Housing Firm Pay the Tax?
Firm pays $200 less in land rent: Shift land portion backward to land
Firm collect $800 more in rent from tenants: Shift structure portion forward to consumers
$1,000 tax = $200 savings in land rent + $800 extra in tenant payment
Normal consequences of tax in perfectly competitive market

General-Equilibrium Effects of the Structure Tax
General equilibrium: Extend analysis to other markets and other cities
Where do the mobile homes go, and what happens there?
Features of General Equilibrium Model
- Second city in region: Untax
- Fixed total supply of mobile homes (capital)
- Mobile homes move at zero cost between cities

Partial Equilibrium Effects of the Structure Tax
Partial: Effect of tax in one market in single city
Assume perfectly elastic supply of structures (capital) to the city
To get a mobile home, housing firm pays capital owner rent of $4,000
Consumer Mobility and Land Rent

- Price of housing in Taxton ($5,400) > Price in Untax ($4,600)
- Consumer equilibrium: Equal housing prices & unequal land rent

<table>
<thead>
<tr>
<th>TABLE 17-2</th>
<th>General Equilibrium Effects of the Structure Tax with Two Cities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Taxton</td>
</tr>
<tr>
<td>Return to</td>
<td>Structure Tax</td>
</tr>
<tr>
<td>Initial</td>
<td>$4,000</td>
</tr>
<tr>
<td>After change</td>
<td>$3,600</td>
</tr>
<tr>
<td>In land rent</td>
<td>$3,600</td>
</tr>
</tbody>
</table>

Summary of Structure Tax

Capital owners experience $400 decrease in return. Consumers unaffected by the tax. Landowners experience zero-sum changes in land rent from structure tax. Owners in taxing city lose; Owners in untaxed city gain. Housing firms earn zero economic profit before & after the tax.

- Taxton: Pay $800 tax, $400 less in capita, and $400 less in land rent.
- Untax: Pay $400 less in capital & $400 more in land rent

Change Assumptions

Variable Supply of Capital (structures)

- Some mobile homes escape market: Smaller reduction in return to capital
- Part of the structure tax shifted to consumers

Consumers not Perfectly Mobile

- Perfect immobility: stay in Row #2 of Table 17-2
- Between perfect mobility and immobility: Both housing rents and land rents change

<table>
<thead>
<tr>
<th>TABLE 17-3</th>
<th>The Structure Tax with 10 Cities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Taxton</td>
</tr>
<tr>
<td>Return to</td>
<td>Structure Tax</td>
</tr>
<tr>
<td>Initial</td>
<td>$4,000</td>
</tr>
<tr>
<td>Before change</td>
<td>$3,200</td>
</tr>
<tr>
<td>Change in land rent</td>
<td>$3,200</td>
</tr>
</tbody>
</table>

Effects of Property Tax on Property Owners

Property owners (owners of homes and rental properties) own capital & land

- Property owners in taxing city lose
  - Lose as capital owners in region
  - Lose as landowners who bear the land portion
  - Lose as landowners because consumer mobility decreases land rent

- Property owners in untaxed city
  - Lose as capital owners in region
  - Gain as landowners because consumer mobility increases land rent

<table>
<thead>
<tr>
<th>TABLE 17-4</th>
<th>Who Pays the Structure Portion of the Property Tax?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tax Imposed by a Single City</td>
</tr>
<tr>
<td>Effects of the taxing city.</td>
<td>Mobile households: Landowners receive lower land rent.</td>
</tr>
<tr>
<td>Effects in an untaxed city.</td>
<td>Mobile households: Landowners receive higher land rent.</td>
</tr>
<tr>
<td>Regional effects.</td>
<td>Capital owners receive lower return on capital.</td>
</tr>
<tr>
<td></td>
<td>Mobile households and fixed capital: zero-sum changes in land rent.</td>
</tr>
<tr>
<td></td>
<td>Mobile households and variable capital: Assets have higher housing returns; the reduction in return is capital.</td>
</tr>
<tr>
<td></td>
<td>Mobile households: Consumers pay higher housing returns.</td>
</tr>
<tr>
<td></td>
<td>Mobile households and variable supply of capital: Consumers pay higher housing rents; the reduction in return is capital.</td>
</tr>
</tbody>
</table>

Perspectives: Mayor vs. President

Mayor of one of many cities

- Return to capital decreases by 1/50 of tax
- Land rent decreases by 49/50 of tax

- If consumers are not perfectly mobile, some of the land portion borne by them
- President: Effect of uniform nationwide property tax
  - Common tax rate means capital has nowhere to flee
  - If national supply of capital fixed, tax borne by capital owners

What About the Business Property Tax?

Products replace housing services: books, haircuts, manufactured goods. Structure tax borne by capital owners throughout the region. Effects on consumers depends on mobility.

- Tax exporting
  - If outsiders consume some of city’s products, they pay taxes
    - Limit: law of demand and firm location choices

Property Tax as User Fee?

- Tiebout: Households sort with respect to property value (the tax base)
- Tax liability depends on level of local public good, not property value. Property tax is a user fee, not a tax on housing; people get what they pay for.

- Realism of Tiebout and user-fee view of property tax
  - Imperfect sorting in metropolitan areas
  - Central cities: single municipality serves large diverse population

<table>
<thead>
<tr>
<th>TABLE 17-5</th>
<th>Municipality Formation for Tax Purposes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tax Rate</td>
</tr>
<tr>
<td>Mixed municipality</td>
<td>0.02</td>
</tr>
<tr>
<td>All $100k houses</td>
<td>0.06</td>
</tr>
<tr>
<td>All $500k houses</td>
<td>0.02</td>
</tr>
<tr>
<td>All $100k houses</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Limits on Property Tax Rates

2/3 of states limit tax rate of specific types of local government 1/4 of states limit tax rate of local government as a whole

Most limits in range 10 to 20 mills (1% to 2%)

Limits on Growth Rate of Property Tax Revenue

Half of states limit annual growth rate of property tax revenue

Most limits in range 4 - 6 percent

- Some states peg maximum growth rate to inflation
- In many states local governments allow voter overrides

Modern Tax Revolt Started in 1978

1960-75: Tax share high by recent historical standards
1978-95: Dozens of states enacted new limits, dropping tax share

Citizens expected tax cuts without service cuts

- Evidence of revenue substitution
  - Increase in grants from state government
  - Increase in non-tax revenue (fees and charges)
Overview of Intergovernmental Grants
Intergovernmental grants provide 2/5 of local revenue
Local government: education (1/2), welfare, housing, highways, hospitals
Municipalities: welfare & housing (1/4), education (1/5)

Types of Grants
1. Categorical or conditional grants: spent on specific program
2. Lump-sum grant: fixed amount
3. Matching grant: grant depends on local effort (spending)

Why a Larger Stimulative Effect for Matching Grant?
Both grants have income effect: Expansion of budget set increases consumption
Matching grant also has a substitution effect
- Decrease in opportunity cost of targeted good (special education)
- Lower opportunity cost: substitute special education for other goods

Summary: The Stimulative Effects of Grants
Flypaper effect
- Grant has larger stimulative effect than increase in income
- Additional $ of income increases local spending by $0.10
- Additional $ of lump-sum grant increases local spending by $0.40

Reason for flypaper effect: Do bureaucrats hide grants from voters?
Changes in Welfare Grant Policy
National government provides grants to support local spending on welfare
Old matching grant policy: $0.22 of local generates $0.78 grant
New lump-sum policy $140 lump-sum grant

Intergovernmental Grants for Education
Principle of Fiscal Neutrality
- Spending on education may not be a function of local wealth
- Application of principle: Eliminate spending inequalities through grants

Foundation grant: Lump sum grant
Guaranteed Tax Base: Matching grant

Foundation Grant
Lump-sum grant determined by wealth of local community
Grant = $F \cdot t \cdot V$

Example: $F = $5,000; t = 0.015$
For $V = $200,000, Grant = $2,000 = $5,000 - $3,000
For $V = $100,000, Grant = $3,500 = $5,000 - $1,500

Guaranteed Tax Base Plan
Grant = $t \cdot (G - V)$

Example: $G = $300,000; V = $200,000$
For $t = 2.0\%$, Grant = $2,000$
For $t = 2.5$, Grant = $2,500