Lectures on Urban Economics Chapter 1: Why Cities Exist

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Uneven Landscape

- Spatial Population Distribution
  - Cities occupy 2 percent of land area in the US but account for about 80 Percent of population.
  - In 1990, Tokyo, Osaka, and Nagoya together made up for a third of the Japanese population, or about 2.6% of East Asia's, but for as much as 40% of Japanese GDP and 29% of East Asia's manufacturing production.

Uneven Landscape

- Concentration of economic activities
  - "Agglomeration" of industrial production
  - Co-agglomeration of industries…..
  - Three largest metros in Japan account for 2/3 of the GDP.
- Metropolitan areas
  - New York City (NYC) v.s. New York Metropolitan Statistical Areas (MSAs)

Why are there cities?

- Uneven distribution of natural resources
- Military historian – defense
- Sociologists – social interaction
- Economists – Production and Consumption
  - Scale economies (within a firm or an individual)
  - Agglomeration economies (across firms or individuals)

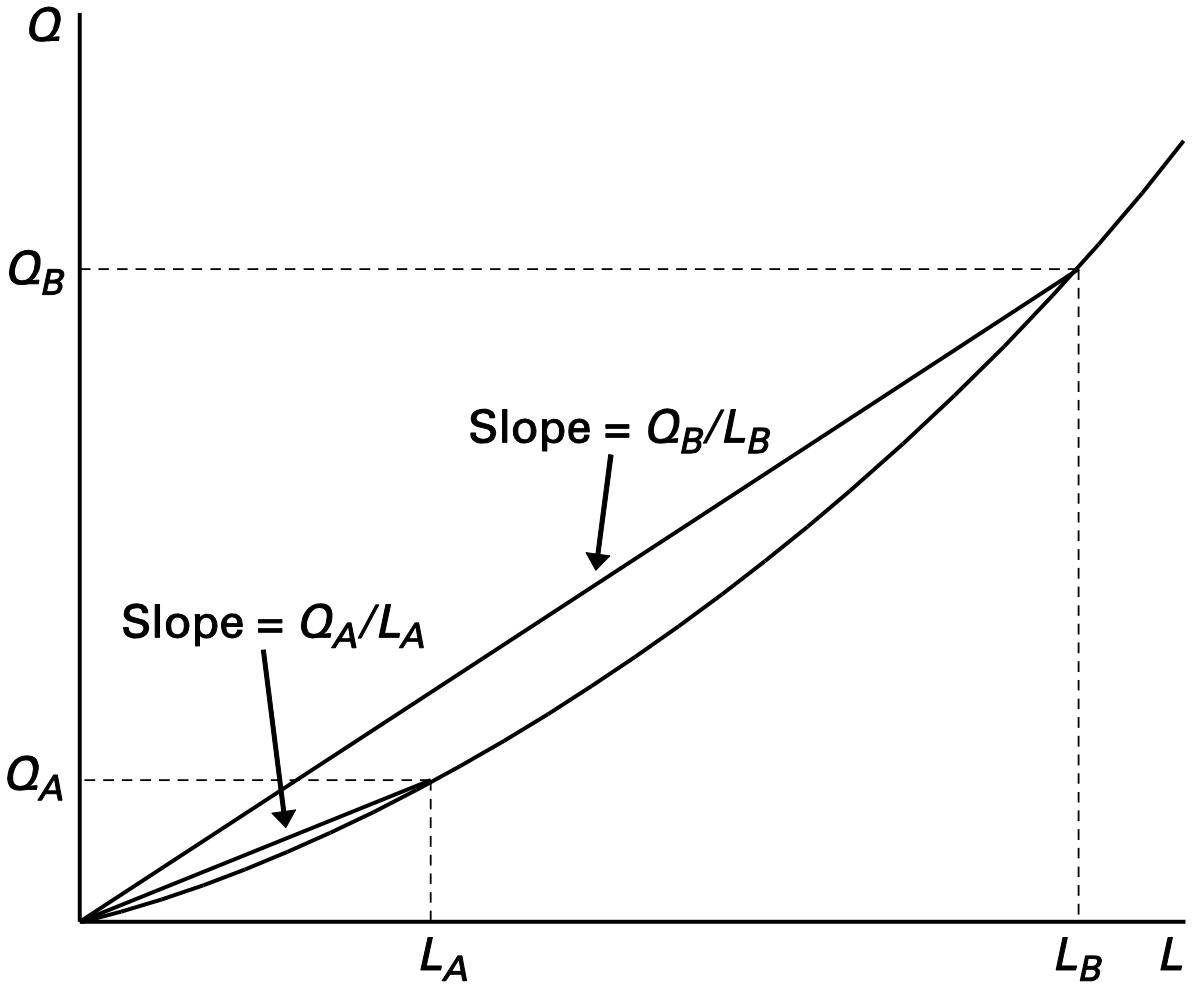
Scale economies

- Microeconomics: Average cost being downward sloping
  - Cost per unit of output is less with larger scale of output
  - An equivalent way: output per unit of input is higher with larger quantity produced
  - Sources of scale economies: fixed cost of production (R&D, capital, etc); division of labor

Scale economies

- Imagine a production technology: fixed cost production F, and constant marginal cost c.
- Draw average cost curve, marginal cost curve.
- Natural monopoly.

Figure 1.1 Scale economies



Division of labor

- Adam Smith's pin factory story
- Labor is more productive when specializing in a smaller set of tasks.
- Larger amount of labor enables specialization (hence, division of labor)
  - A population of 100.
  - 100 tasks, 1 factory with 1 worker
  - 100 tasks, 1 factory with 1000 workers

Table 1.1: Basket Output of the Island Economy

Production Arrangement	Number of factories (a)	Workers per factory (b)	Output per worker (c)	Output per factory ($b \times c$)	Total output ($a \times b \times c$)
Backyard factories	100	1	α	1α	$100 \times 1\alpha = 100\alpha$
1 Large factory	1	100	β	100β	$1 \times 100\beta = 100\beta$

Company Towns

- Such “increasing returns to scale” (another word for scale economies) would not be enough to generate cities.
- Auto plant (2000 workers) that export
  - Local goods and services that feed them
  - There is a limit, say, 25,000.
- Why are there big cities, such as Chicago or Houston, or….Singapore?

Agglomeration Economies

- Definition: production advantage accrued by locating near other producers
- Positive externalities
- A conceptual classification
  - Pecuniary agglomeration economies (pecuniary externalities)
  - Technological agglomeration economies (knowledge spillover)

Pecuniary Agglomeration Economies

- The reduction in input prices when locating near other firms.
  - Competition effect: where there are many firms, there are many input suppliers who compete with each other, resulting in lower input prices
  - Home market effect: when there are numerous kinds of inputs, the probability of finding a necessary input at where there are more firms is larger. Savings on transportation cost implies lower input prices.

New Economic Geography

- Labor market is a good example for both.
- Such force is self-reinforcing: the reason there are cheaper input prices is because there are many firms that attract input suppliers. Seeing that the input prices are cheaper, firms outside big cities have incentives to move there, resulting in larger number of firms.
- Input-output circular causation – Krugman and Venables (1995, QJE)

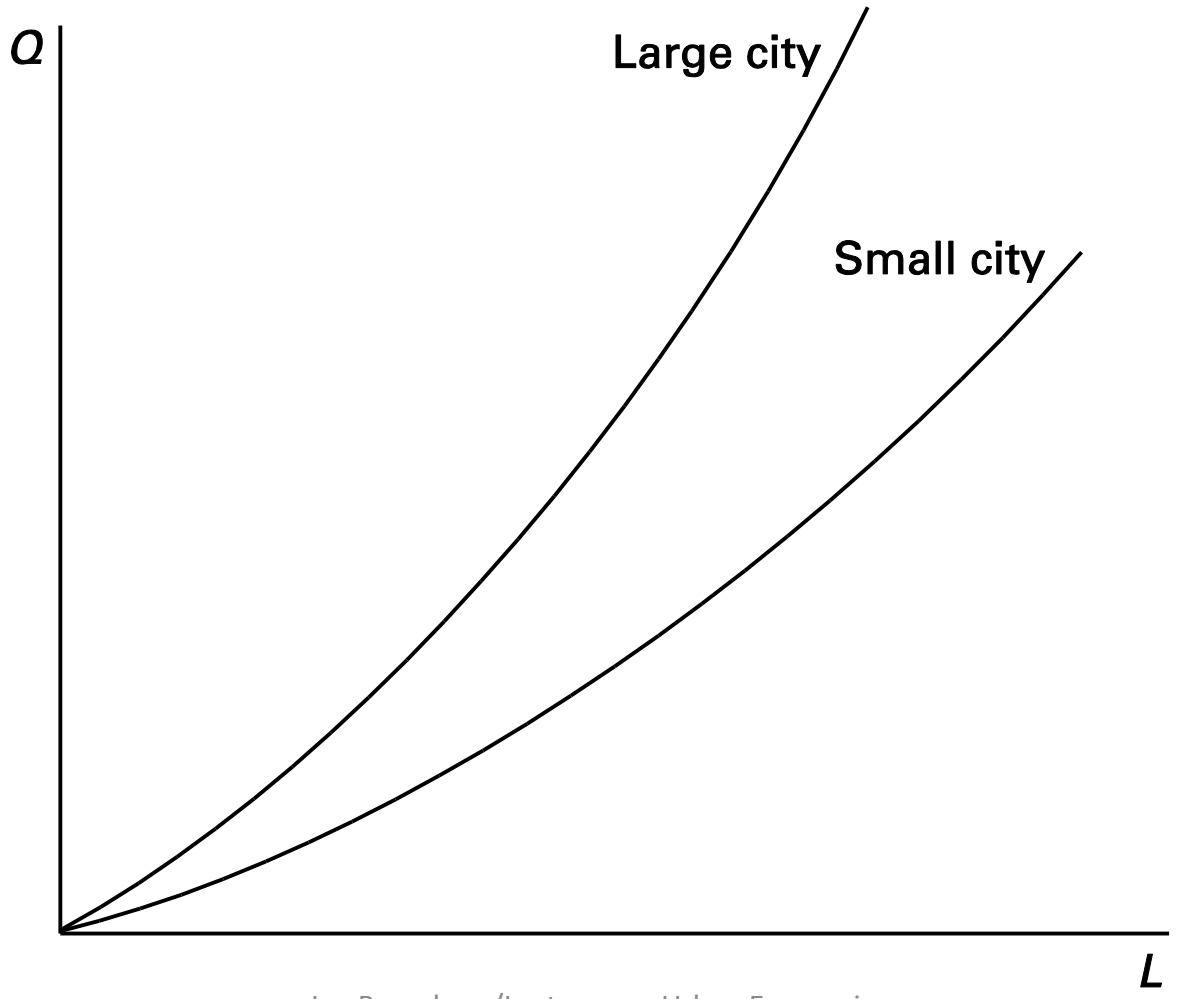
New Economic Geography

- Note that Home Market Effect can be more general: when there are numerous kinds of (consumption) goods and services, consumers in a big city enjoys lower prices of goods due to savings in transportation cost. Then, more consumers means larger market, which attracts firms.
- Firms-consumers Circular causation – Krugman (1991, JPE)
- These are Nobel prize ideas….we will come back to this.

Technological Agglomeration Economies

- Knowledge spillover across firms within an industry
  - Idea exchanges in the CBD (financial industry and the skyscrapers…..)
  - Worker productivity and own-industry employment (localization economies)
  - Hard to disentangle this kind of externality from pecuniary externalities empirically
  - Also, spatial sorting produces similar result.

Figure 1.2 Technological agglomeration economies



Technological Agglomeration Economies

- Knowledge spillover across industries
  - Forces of co-agglomeration of industries
  - Worker productivity and total employment (and hence city size) (urbanization economies)
  - Hard to disentangle this kind of externality from pecuniary externalities empirically
  - Spatial sorting produces similar result.

Technological Agglomeration Economies

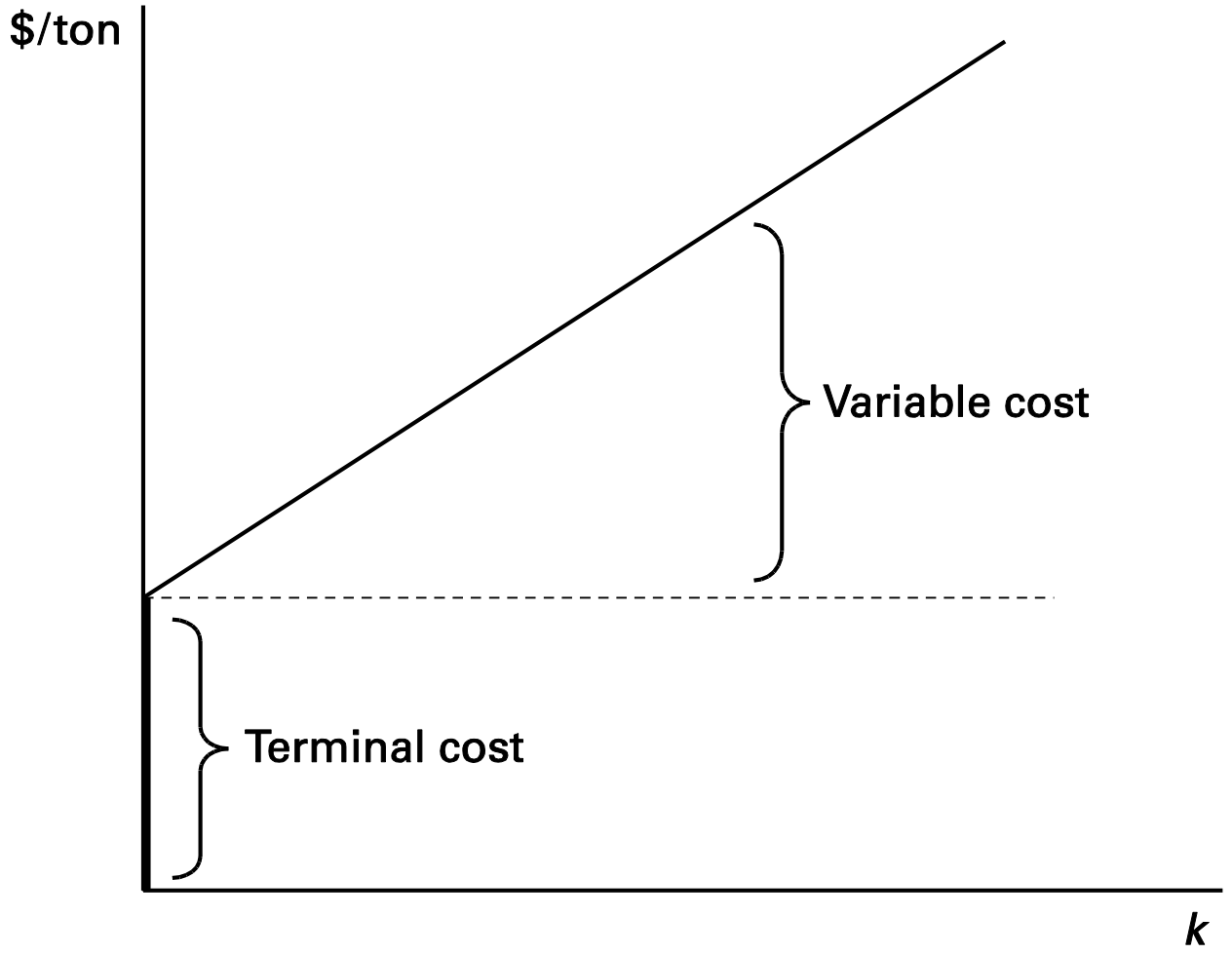
- Other channels of technological agglomeration economies: competition effect
  - In a larger labor market, each worker work harder, get educated, etc. (not only they are willing to accept lower wages—pecuniary externality)

Transport Cost and Firm Locations

- Imagine a production process requires some inputs at the "mine," which is far from the market by a distance D. The firm needs to decide its location on the line segment between the mine and the market.
- Shipping requires two parts of costs
  - Terminal cost
  - Variable cost
  - Then, there is *economies of distance*.

Figure 1.3 Mine versus market

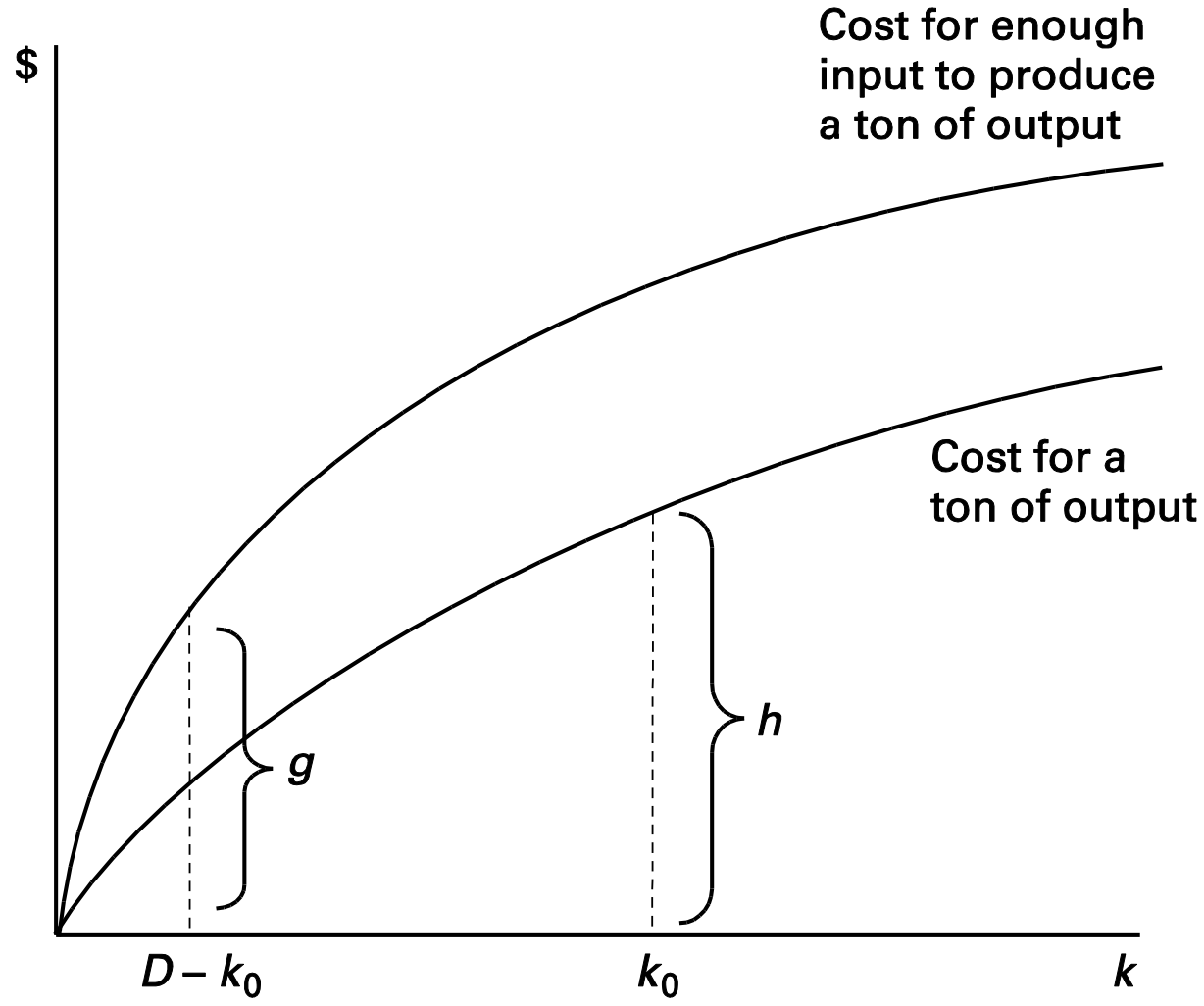
Figure 1.4 Transport costs



Transport Cost and Firm Locations

- Another form of economies of distance is without terminal cost, but having a concave variable cost.
- Imagine a *weight-losing* production process.
- When choosing k0, the total cost is g+h. Not sure of the value of k0.

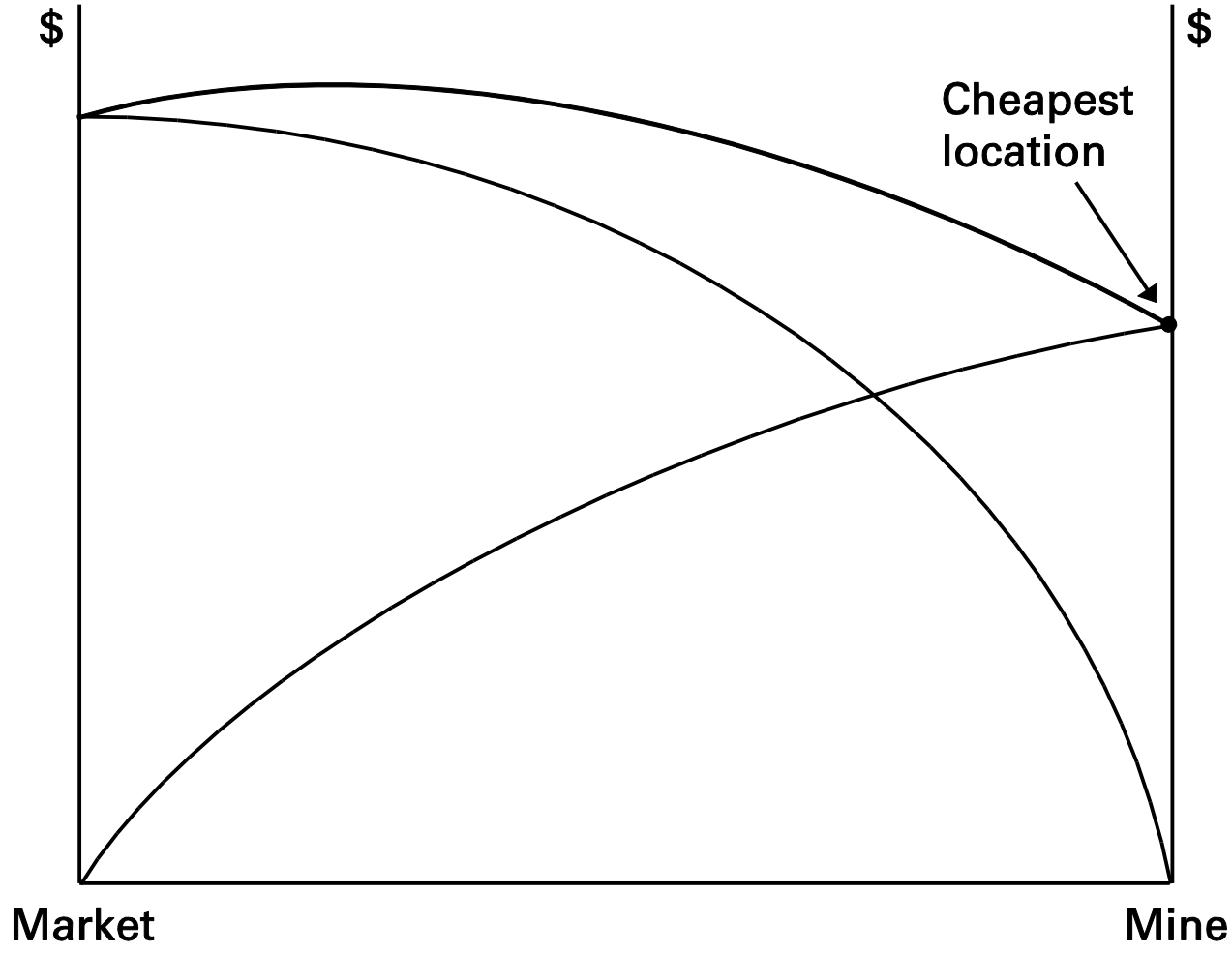
Figure 1.5 Input and output shipping



Transport Cost and Firm Locations

- It's obvious however, to plot like Figure 1.6.
- Solution: Market.
- Why: Economies of distance implies only choosing either the market or the mine.
- Then, since it is weight-losing process, choosing the market is optimal.
- Get reverse result when the production is weight-gaining process…..such as soft drinks.

Figure 1.6 Transport-cost-minimizing location



A Simplified New Economic Geography Model

- Adapted from Krugman (1991).
- Main ingredients in his model:
  - a number of varieties, each of which is subject scale economies in production
  - mobile workers and firms. Immobile people (farmers)
  - Transport cost
  - love for variety
- In that model, there is trade across locations.

A Simplified New Economic Geography Model

- That model is too involved for undergraduate courses. Here, we simplify by
  - Having only one good/variety
  - No workers. Firms are mobile.
  - Love for variety, and hence trade, is an agglomeration force in Krugman (1991).
- We focus on how the interaction between scale economies and transport cost give rise to cities.

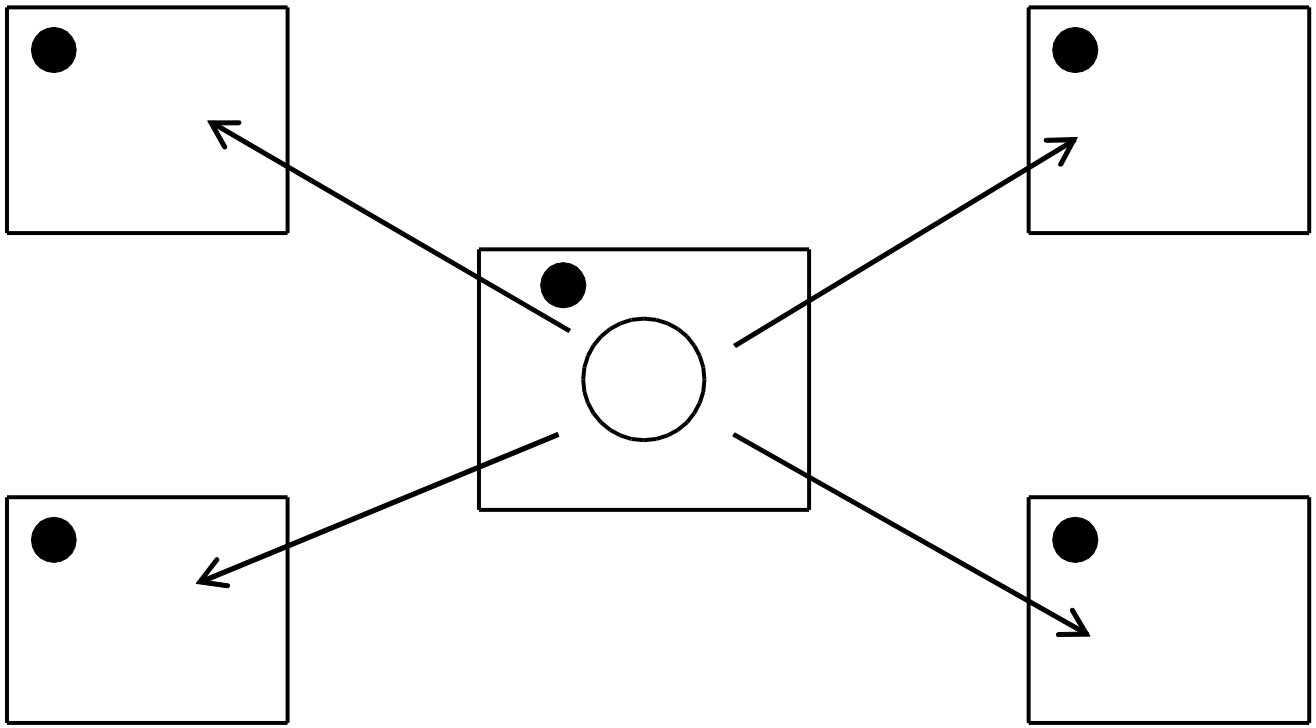
A Simplified New Economic Geography Model

- Here, we focus on how interaction between scale economies and transport cost give rise to cities.
- Five regions with a total population N.
- N/5 in each region.
- Each person eat one unit of a good.
- Cost function C(Q). C(Q)/Q decreasing in Q.

A Simplified New Economic Geography Model

- Two possibilities. Centralized production and dispersed production.
- C(Q)/Q decreasing in Q.
  - $C(N/5)/(N/5)=\lambda$.
  - $C(N)/(N)=\theta$
  - $\lambda > \theta$.
- T: the shipping cost per unit of output (across regions).

Figure 1.7 Scale economies versus transport costs



A Simplified New Economic Geography Model

- Total cost in dispersed production:
  - $\lambda^* (N/5)*5 = \lambda N$
- Total cost in centralized production:
  - $\Theta N + (4N/5)*T$
- Centralized production if and only if
  - $\lambda - \Theta > 4T/5$
- Simply a tug of war between $\lambda - \Theta$ (scale economies) and $4T/5$ (transport cost).

Another Simplified New Economic Geography Model

- This is a nicely simple model illustrate how scale economies and transport cost matters.
- No pecuniary externality.
- Let's illustrate Krugman (1991) by another simple example.
  - 2 goods. 2 locations. Transport cost T.
  - Both firms and workers (L) are mobile.
  - Farmers are immobile. N/2 at each region.

Another Simplified New Economic Geography Model

- Observe:
  - Either workers are dispersed (L/2 at each region) or centralized (L in only one of the region, 0 at the other). Firms cannot operate where there is no workers.
- Total cost for each good
  - Centralized production: C(L+N) + TN/2.
  - Dispersed production: 2*C((L+N)/2)

Another Simplified New Economic Geography Model

- Four scenarios
  - (a) Both goods dispersed: total cost
  - (b) One good dispersed, the other centralized
  - (c) Both goods centralized in the same location
  - (d) Both goods centralized, but in different locations.

Another Simplified New Economic Geography Model

- Supposing fixed cost of production F and constant marginal cost c. So, C(Q) = F + c*Q.
- If there are multiple firms, Bertrand competition in price implies that there is only one firm in equilibrium (monopoly) for each good. Thus, we can eliminate scenarios (a) and (b).
- So, we focus on comparing scenario (c) and (d). Total cost:

Another Simplified New Economic Geography Model

- Total cost (TC)
  - (c) Both goods centralized in the same location
    - $TC_c = 2(F + c*(L+N)) + TN$.
  - (d) Both goods centralized, but in different locations. (working population is dispersed.)
    - $TC_d = 2*(F + c*(L+N)) + T(L+N)$
    - $TC_c - TC_d = - TL < 0$.
  - Optimal allocation is to have both goods centralized in the same location – agglomeration. TC_d

Another Simplified New Economic Geography Model

- In the second model, locating together saves transport cost, while in the first, locating together increases transport cost.
- Difference of multiple-good and one-good models.
- Imagine there are prices, then workers and farmers in the location where firms agglomerate enjoys savings on transport cost, hence price……pecuniary externality (from workers' view)
- When will we observe dispersion?

Retail Agglomeration

- So far, scale economies, pecuniary and technological agglomeration economies. Mainly across firms or workers.
- Why are there shopping district (sometimes formed naturally) and malls?

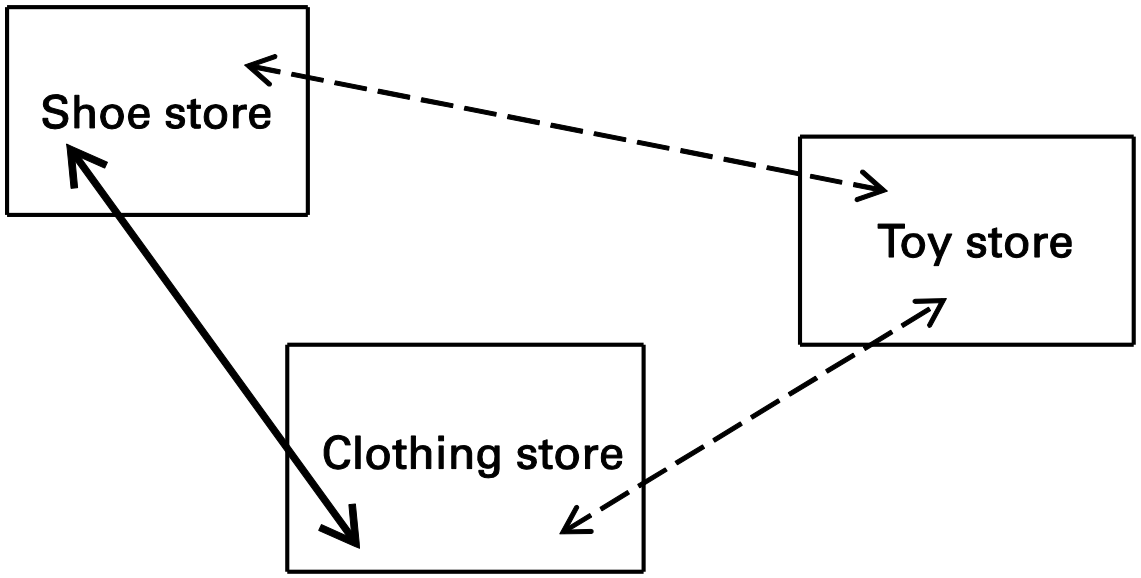
Retail Agglomeration

- Now, look at inter-store externalities via consumers.
  - One-stop shopping (people buy different goods)
  - Comparison shopping (people buy one good, but there are different varieties to pick from).
  - Spatially separated locations increases consumers' cost.
  - Competition lowers down prices chargeable by firms.

Retail Agglomeration

- Reasons behind malls?
- Since there are positive externalities, mall owners maximizes such positive externalities, which increases individual firms' profit, so as to maximize rents.
- Malls are efficient in that sense. Good for consumers, but much of the pie on the firms' side is taken by mall owners.

Figure 1.8 Inter-store externalities



Other Causes of Cities

- Other Causes not mentioned in the textbook:
  - Diversity promotes creativity (one explicit form of knowledge spillover)
  - Comparative advantage and gains from trade
  - Infrastructure/Public good provision
  - Relative Locational advantages (different from natural advantages)
  - Search/match frictions (marriage market?)

Comparative advantage

- A simple example.
  - Two persons, A and B, two islands. At the same island or different islands?
  - Two goods, a and b. Transport cost T.
  - A is good at good a, and B is good at good b.
  - If located at two different islands, incurring transport cost. Suppose T very large so that they would rather not specialize (no trade).

Comparative advantage

- A simple example.
  - But, they can choose to be together to start with. No transport cost is incurred. They specialize at what they are good at, and there are gains from trade.
  - If they are equally good at the two goods. Then, there is no need to agglomerate.

Comparative advantage

- Why is NEG appealing?
  - Industrialization
  - diminishing transport cost.
- The story of comparative advantage explains Ancient cities such as trading cities like Venice.