

Why Do Firms Cluster?

Econ 438

Michigan State University

Overview

Facts on industry concentration in the U.S.

Localization Economics

Urbanization Economies

Urbanization Economies - from the worker side

Summary

Recap: why do cities exist?

- ▶ Economies of scale
- ▶ Agglomeration → the externalities between firms
- ▶ Questions we try to answer in this chapter: what exactly are those externalities? Or, why do firms cluster?

Not all colocation is due to agglomeration

- ▶ A location has an essential **natural** input for firms in certain industries
 - ▶ 'We are both here because we need to be here'. E.g.: oil extraction business co-locate in area with oil reserve
- ▶ Agglomeration effect among firms (within the same industry, or between different industries)
 - ▶ 'I am here because you are also here'

Sources of agglomeration

- ▶ Localization economics: refers to cost savings when firms of a given industry locate together
- ▶ Urbanization economics: refers to cost saving from locating together of firms across different industries. The location of one industry attracts another
- ▶ Urbanization economies leads to the development of large diverse cities
- ▶ Urbanization and localization economies interact with each other, together they are termed agglomeration economies

Agglomeration Economics

- ▶ Learning
- ▶ Sharing
- ▶ Matching

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Localization Economics

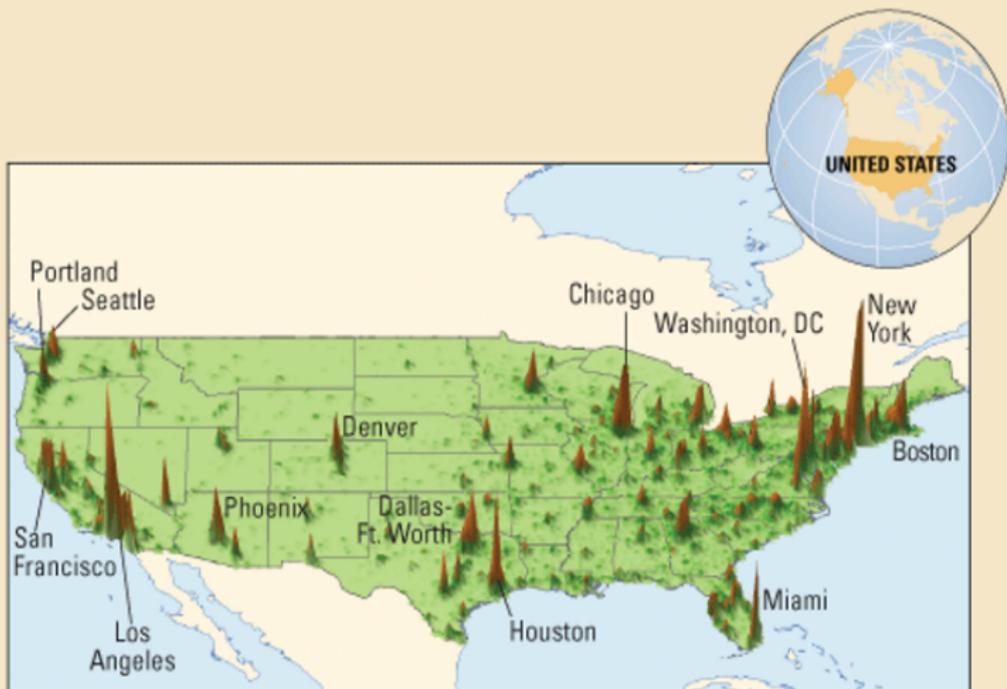
Urbanization Economies

Urbanization Economies - from the worker side

Summary

Economic production per square kilometer in the U.S.

Economic activity is highly clustered in the U.S.

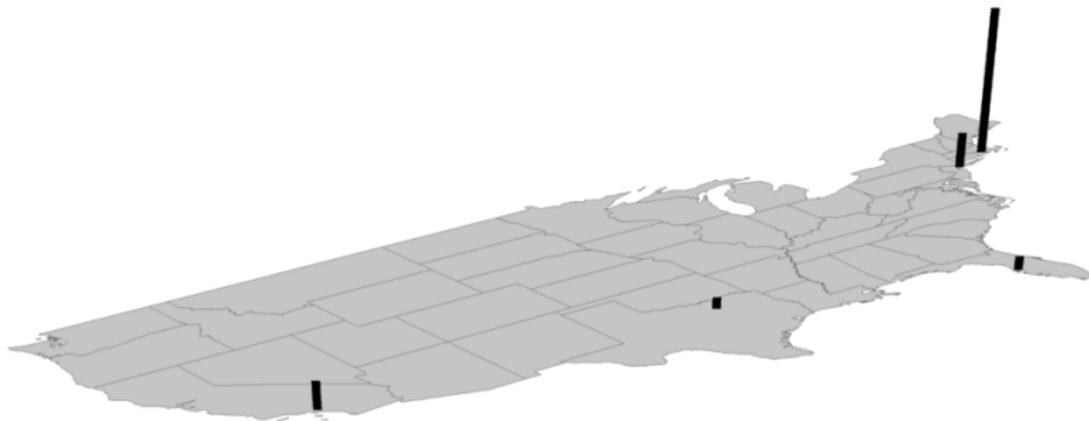


Source: WDR 2009 team and World Bank Development Research Group based on subnational GDP estimates for 2005. See also Nordhaus (2006).

How do firms of a given industry locate?

Industry: Costume Jewelry

Map 3-2 Job Clusters: Costume Jewelry



The bars show employment in the production of costume jewelry, with 4,100 jobs in Providence RA, and smaller clusters in Los Angeles, New York, Tampa FL, and Dallas TX.

How do firms of a given industry locate?

Industry: Carpets and Rugs

Map 3-1 Job Clusters: Carpets and Rugs



The bars show employment in the production of carpets and rugs, with 16,790 jobs in Dalton GA, and smaller clusters in Los Angeles, Atlanta, Chattanooga TN, Harrisburg PA, and Rome GA.

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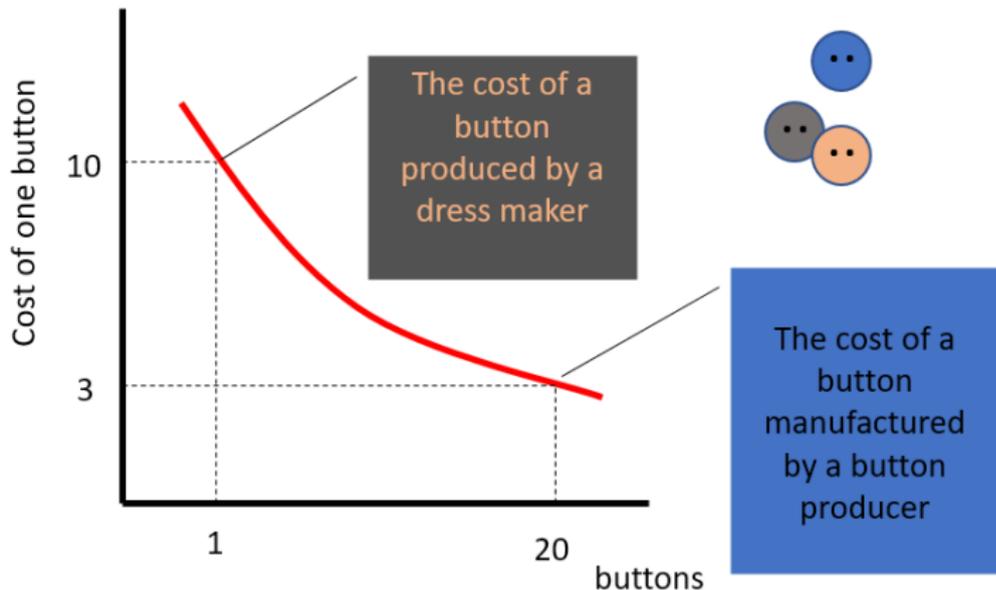
Summary

Firms cluster to share intermediate inputs

- ▶ The Button-Dress model:
 - ▶ Button making is subject to economies of scale. Dressmakers will not make their own buttons. They will buy them from a few independent button makers who can realize cost savings as they face a large demand.

Firms cluster to share intermediate inputs

Economies of scale in button making



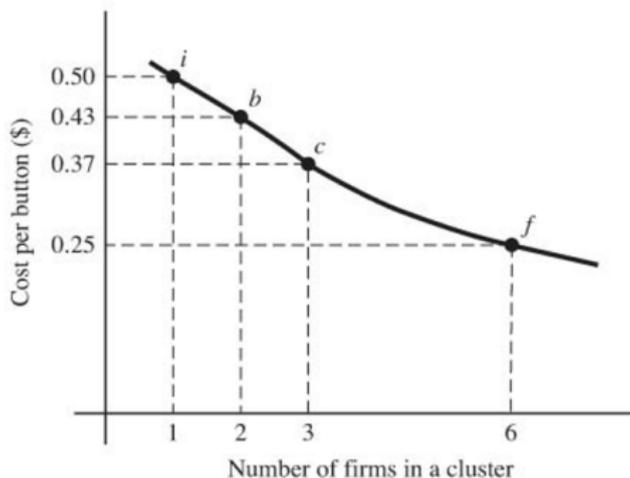
Firms cluster to share intermediate inputs

Overview of model features

- ▶ 1. Firms producing high fashion dresses: **small** and **nimble**
- ▶ 2. **Scale economies** in producing buttons large relative to demand from a single dressmaker
- ▶ 3. **Face time** required to design and fabricate buttons to fit dresses
- ▶ 4. **Variety** in types of buttons demanded (shape, finish, color)
- ▶ 5. **Modification cost**: dress maker pays an extra cost to modify the button to fit its need

Firms cluster to share intermediate inputs

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



An isolated firm has a relatively high unit cost of buttons (point *i*). As the number of dressmakers in a cluster increases, the unit cost of buttons decreases because together the firms generate sufficient demand to realize scale economies in button production and support a wider variety of buttons.

The more firms in a cluster, the lower will be the unit cost of buttons

Firms cluster to share intermediate inputs

Cost saving in a cluster: button cost lower for two reasons

- ▶ Higher total demand for buttons allow button maker to realize economies of scale (Model features 1-3)
- ▶ Button makers can specialize in types of buttons, reducing modification costs (Model features 4-5)

Firms cluster to share intermediate inputs

Overview of model features

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Firms cluster to share intermediate inputs

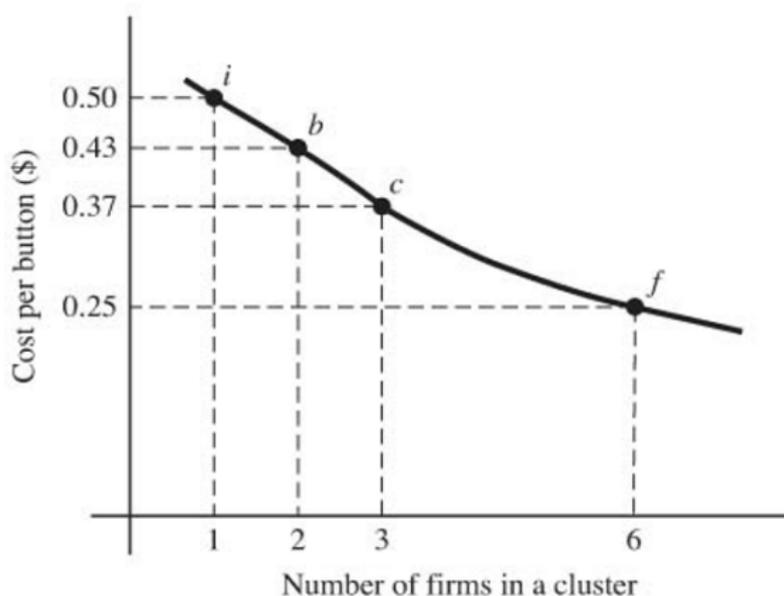
Self-reinforcing effects of clustering

- ▶ tradeoff
 - ▶ Benefit: Localization economies reduce cost of intermediate input
 - ▶ Cost: Competition for workers increases labor cost
- ▶ Starting with isolated firms, will a cluster of firms form?
- ▶ How big will the cluster be?

Firms cluster to share intermediate inputs

Cost of button decreases in the number of firms in the cluster.

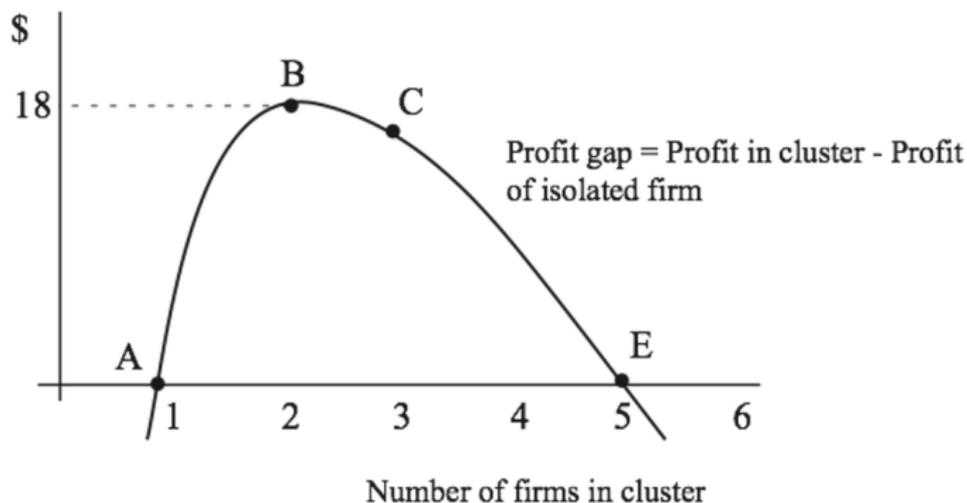
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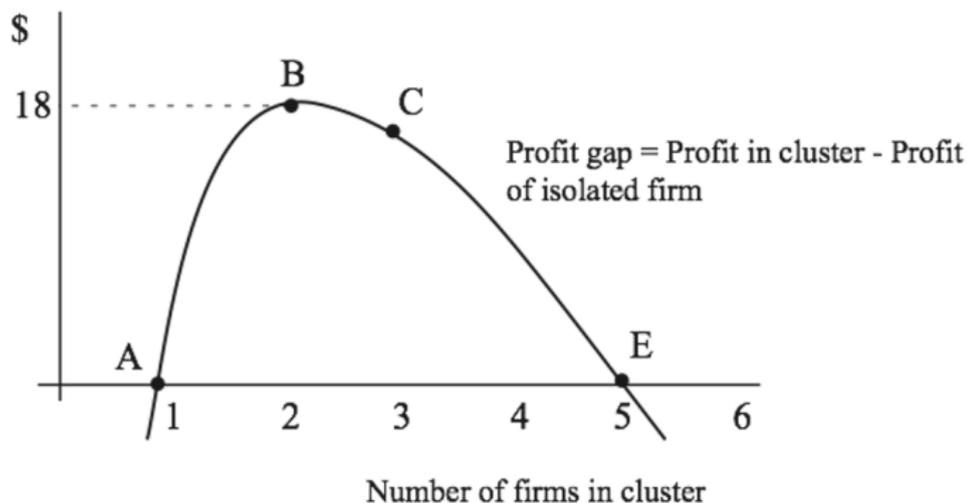
Firms cluster to share intermediate inputs

But cost of labor increases in the number of firms in a cluster. Total cost depends on the number of firms in the cluster. Firms will keep joining as long as the **PROFIT GAP** is **POSITIVE**. In this case: what is the equilibrium number of firms?



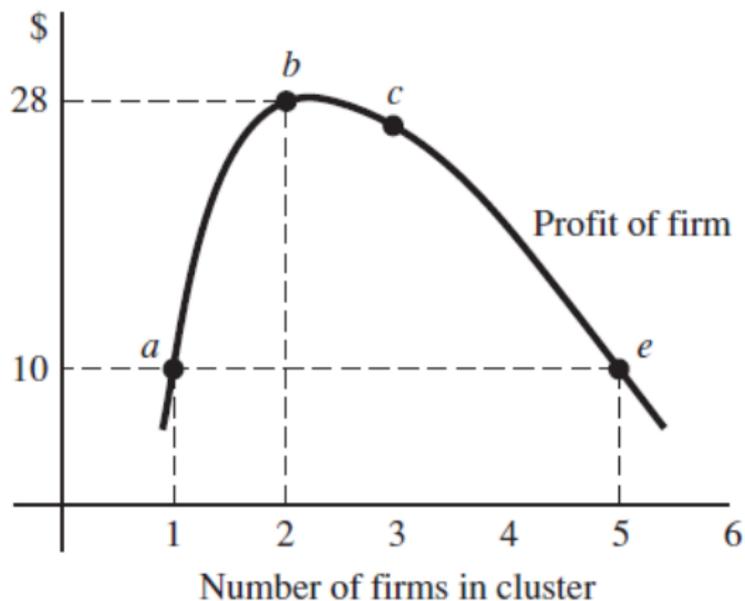
Firms cluster to share intermediate inputs

But cost of labor increases in the number of firms in a cluster. Total cost depends on the number of firms in the cluster. Firm will keep joining as long as the **PROFIT GAP** is **POSITIVE**. In this case: the equilibrium number of firms is 5.



Firms cluster to share intermediate inputs

Finding the cluster size when we have a profit graph: firms will enter as long as profit is higher than in an isolated site, which is **NOT** necessarily the point with maximum profit!



Quiz

7 dress-makers in the economy, A, B, C, D, E, F, G Cost is as follows

# of firms in the cluster	cost of buttons	labor cost
1	100	20
2	70	20
3	40	30
4	30	50
5	20	80
6	10	120
7	10	150

Q1: What is the optimal size of a cluster? How many clusters in the equilibrium? How large is each cluster?

Quiz

# of firms in the cluster	cost of buttons	labor cost	total cost
1	100	20	120
2	70	20	90
3	40	30	70
4	30	50	80
5	20	80	100
6	10	120	130
7	10	150	160

Optimal size is 3. There will be two clusters, one with 4 firms, the other with 3 firms.

Firms cluster to share intermediate inputs

Another example: high-tech 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

Firms cluster to share intermediate inputs

Case study: Shenzhen, China

- ▶ A city in southern China, next to Hong Kong
- ▶ Since the economic reforms in China, it has transformed itself from fishing village into a modern mega city
 - ▶ 35 years ago: a string of villages with around 30,000 peasants.
Now: a 12 million metropolis that produces 90% of the worlds' electronics
- ▶ The cities originally specialized in the manufacturing sector, especially the production and assembly of electronics
- ▶ The complete ecosystem in electronics production gave the city an edge as innovation in electronics become more fast-paced

Firms cluster to share intermediate inputs

Why is this happening?

- ▶ With the **ecosystem in electronics** (factories, product integrators, and design houses), this city could be one-stop-shop for anything consisting of circuits, chips, LEDs, and touchscreens
 - ▶ The interview with the founder of **Royole**, the producer of the world's **thinnest foldable full-colour touchscreen display**, demonstrates the importance of the ecosystem
 - ▶ His team had to develop entirely **new materials** and **factory tools**, including custom-built robots, to make his screens
 - ▶ *'Getting from early-stage research to manufactured product would require a massive amount of ...integrated innovation: "Materials, process, device design, circuit design all needed to be innovated...if you changed one material, you had to change the process"'*
- ▶ In 2014, The Economist declared Shenzhen to be the best place in the world for a hardware innovator to be

Firms cluster to share intermediate inputs

INVESTING

President Trump ordered US firms to ditch China, but many already have and more are on the way

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KEY POINTS

- President Trump rattled Wall Street when he ordered U.S. firms to move production out of China.
- But, in conference calls with investors just this past month, dozens of executives have signaled plans to further diversify their supply chains away amid the intensifying trade war.
- Toymaker Hasbro, Bath & Body Works parent company L Brands, and fashion designer Steven Madden have all outlined plans to substantially reduce their dependence on Chinese manufacturing in the next few years.

TRENDING NOW



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Firms cluster to share intermediate inputs

- ▶ How is this related to the current debate on getting back the 'manufacturing jobs'
 - ▶ **Cons:** tax payer's money to attract manufacturing factory to come back. Those jobs will likely be replaced by robots in a decade anyway. Firms are less likely to be successful without a ecosystems of suppliers and consumers nearby.
 - ▶ **Pros:** a job is a job. Making a place more attractive to the upper and downstream industries.

Firms cluster to attract more customers

Retail agglomeration and the economics of shopping centers:

- ▶ Cities have shopping districts in which stores are concentrated
- ▶ Two forces contribute to the existence of such districts and malls
 - ▶ **The desire by shoppers to limit the cost** (time and money) of shopping trips. Shoppers are more willing to visit a place when stores are in close proximity, so stores can attract more customer traffic when they are concentrated
 - ▶ **The benefit to consumers of comparison shopping**
- ▶ The intense competition between stores makes spatial concentration **less attractive** from the viewpoint of stores, offsetting some retail agglomeration

Firms cluster to attract more customers

Because of the externality, the shops do not sort into the best combination by themselves. The management of a shopping mall become a coordinator: choose the brands and goods being offered to **maximize positive externality** while at the same time minimize **price competition**

- ▶ Shoppers visiting a shoe store in a mall may also visit a clothing store
- ▶ Shoppers visiting a toy store are less likely to visit a tobacco and pipe store
- ▶ Management of the mall can charge different brands differently to ensure the best synergy among shops
- ▶ Pay attention next time when you go to a mall!

Firms cluster to share a labor pool

Key channel for the labor pool sharing

- ▶ Sharing a labor pool is beneficial to firms given significant variation in demand facing each firm, e.g. TV programs, creative arts
- ▶ Industry-wide demand is constant: zero-sum changes in demands facing individual firms
- ▶ A cluster of firms facilitates the transfer of workers from unsuccessful firms to successful ones

Firms cluster to share a labor pool

Cluster vs. Isolated Site

- ▶ A firm has two choices. Either to locate in
 - ▶ an isolated site or
 - ▶ in a cluster
 - ▶ Which option does the firm prefer?
- ▶ This will depend on the labor cost under each
- ▶ There are good times (when demand is high) and bad times (when demand is low)
 - ▶ Larger cities allow firms to be flexible with production

Firms cluster to share a labor pool

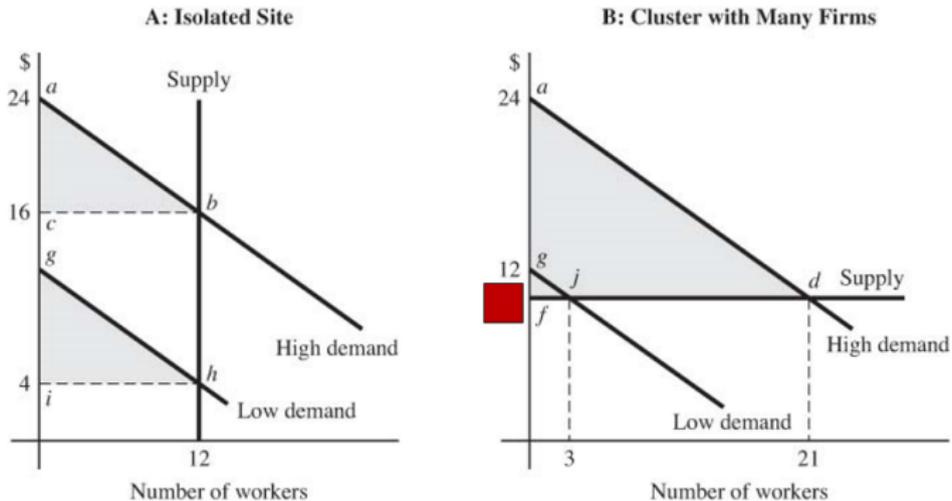
Timing and setup of the model

- ▶ Two sites in the economy: an isolated site, and a cluster
- ▶ Workers first decide which site to work in, once in a site, they cannot switch to another site
 - ▶ Migration is usually a long-run decision
- ▶ Once in a site, each worker is matched with an employer
- ▶ Workers switch to another employer (in the same site) if their current employer is hit by a demand shock
- ▶ How does the labor supply curve look like in each case?
- ▶ Detour: demand and supply curve for individual firm vs. the market

Firms cluster to share a labor pool

Backward induction: how are the wages determined, after migration decision is made?

FIGURE 3–2 Clustering to Share a Labor Pool



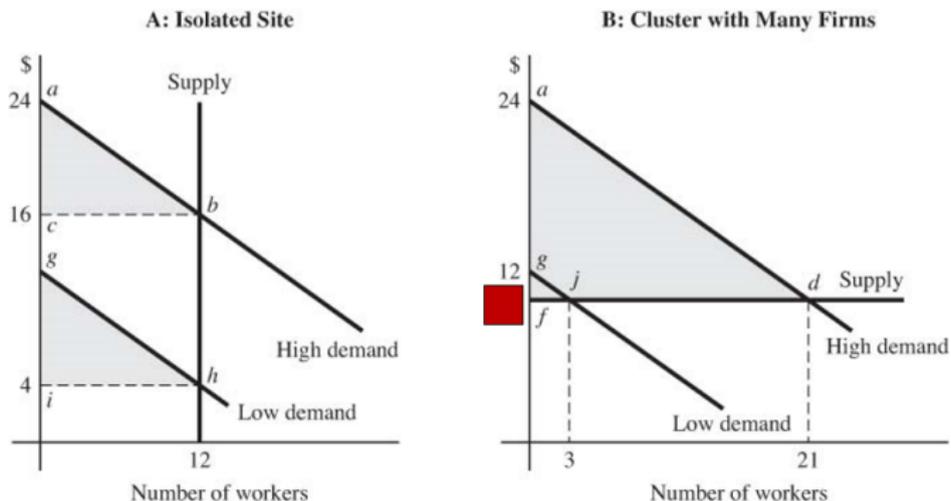
In an isolated site, the firm faces a perfectly inelastic supply of labor (12 workers). The firm hires the same number of workers during high demand and low demand but pays a higher wage during high demand.

What would the wage be in the cluster to ensure locational equilibrium?

Firms cluster to share a labor pool

The wages need to be such that workers are indifferent between living in the two sites

FIGURE 3–2 Clustering to Share a Labor Pool

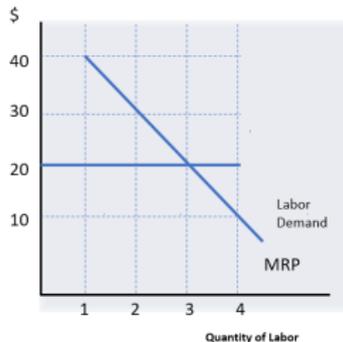
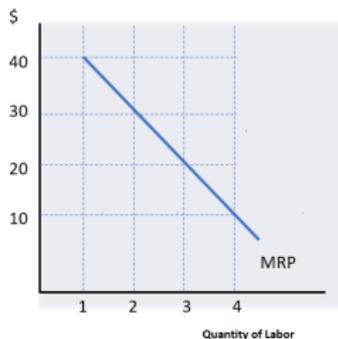


- To achieve locational equilibrium, the wage in the cluster should equal the expected wage in the isolated Site.

- $EW = \frac{1}{2} * 16 + \frac{1}{2} * 4 = 10$

Firms cluster to share a labor pool

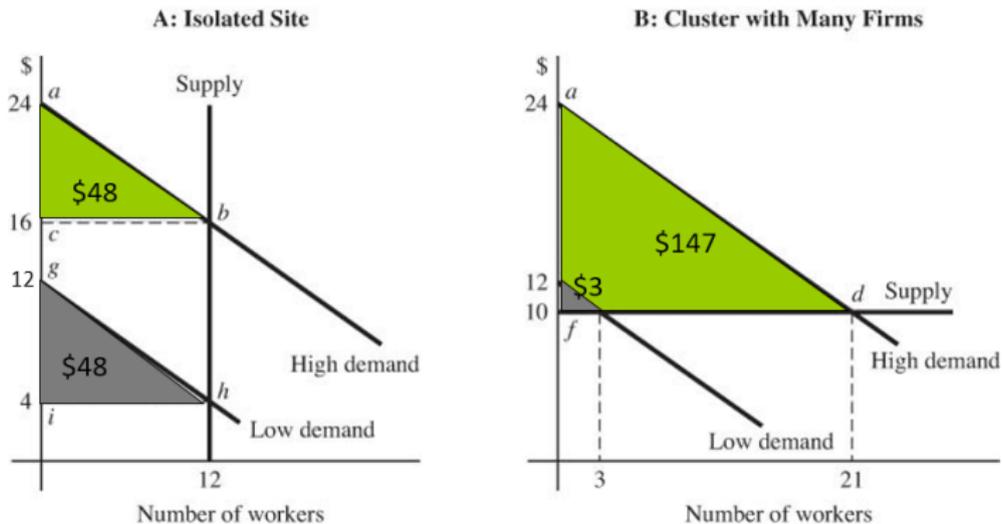
Which location offers a higher profit to firms?



- ▶ Labor demand is the marginal revenue product (MRP); the dollar value created by the extra worker

Firms cluster to share a labor pool

Move to Cluster Increases Expected Profit



Expected profit in an isolated site = $\frac{1}{2} \cdot 48 + \frac{1}{2} \cdot 48 = \48

Expected profit in a cluster = $\frac{1}{2} \cdot 147 + \frac{1}{2} \cdot 3 = \75



Firms cluster to improve labor match quality

Basic idea:

- ▶ Firms and workers not always perfectly matched
- ▶ Mismatches require training costs to eliminate skill gap
- ▶ Show that larger city allows better matches

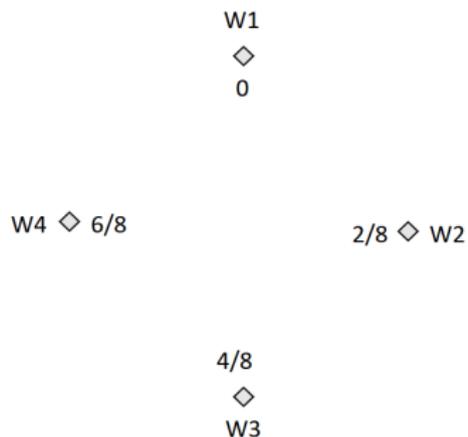
Firms cluster to improve labor match quality

Model setup:

- ▶ Workers have varying skills represented by their positions on unit circle
- ▶ Firms enter the market, choose a product and the corresponding skill requirement (a position on the circle)
- ▶ Each firm hires two workers and offer a salary of \$12 to each of them: each workers' output can sell for \$12, and the competition among firms for workers drive firms' profit to 0
- ▶ Workers incur training cost to adapt to employer's requirement, getting a net wage
- ▶ Workers accept the highest net wage

Firms cluster to improve labor match quality

Skills Matching



Firms cluster to improve labor match quality

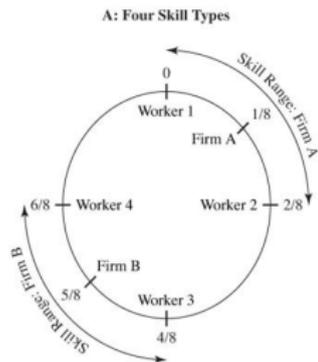
Net wage:

- ▶ The worker incurs the training cost
- ▶ Training cost = skill gap \times unit training cost
- ▶ Net wage = Gross wage - training cost
- ▶ Suppose the gross wage = \$12, the unit training cost is 24 (which is the training cost for a unit of skill difference), then can you calculate the net wage?
- ▶ Net wage = Gross wage - Skills gap \times Unit training cost
 - ▶ Net wage = \$12 - \$24/8 = \$9

Firms cluster to improve labor match quality

More Skill Types

FIGURE 3-3 Skills Matching



With four skill types, worker addresses are $\{0, 2/8, 4/8, 6/8\}$. There are two workers per firm, so two firms will enter with skill requirements $\{1/8, 5/8\}$, and the mismatch per worker is $1/8$.

As the number of workers increases to 6.

Firms cluster to improve labor match quality

- ▶ Workers are better off in a cluster of workers
- ▶ Are firms better off?
- ▶ The higher net wage attracts more workers to live in large numbers in cities, which attracts more firms that compete for workers
- ▶ The net profit to firm will always be zero, but in a more general model where firms and workers split the increase in wage, firms can benefit too

Firms cluster to benefit from knowledge spillovers

- ▶ Firms in an industry share ideas and knowledge
 - ▶ mysteries of trade are “in the air”
 - ▶ innovations are promptly discussed, improved, and adopted
 - ▶ firms benefit directly from having productive and innovative firms near them
- ▶ One of the main motivations for state and local governments to attract large and productive corporations
 - ▶ Billions of dollars are spent in the form of tax cuts and subsidized land (\$ 95 billion in the U.S.)
 - ▶ Are the knowledge spillover strong?

Firms cluster to benefit from knowledge spillovers

Case study: the effect of the “million dollar plants” (Moretti, Hornbeck, and Moretti, 2010)

- ▶ U.S. counties compete for large manufacturing plants, some win, other lose
- ▶ For each manufacturing plant, compare the productivity of incumbent firms in the winning county and the runner-up
- ▶ Five years after opening, the productivity of incumbent plants in the winning counties are 12% higher than the productivity of incumbent plants in the runner-ups

Firms cluster to benefit from knowledge spillovers

Case study: Detroit, the Motor City

- ▶ “there was an explosion in automotive entrepreneurship in Detroit in 1900. Detroit seemed to have had a budding automotive genius on every street corner. Ford Ransom Olds, the Dodge brothers, David Dunbar Buick and the Fisher brothers all worked in the Motor City..Ford was able to open a new company with backing from the Dodge brothers who were making engine and chasis components. They supplied Ford with both financing and parts.” Glaeser (2011)

Evidence of localization economics: productivity & firm births

- ▶ Higher Labor Productivity
 - ▶ Henderson: Elasticity (output per worker, industry output) = 0.02 to 0.11
 - ▶ Mun & Huchinson: 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

Evidence of localization economics: employment growth

- ▶ Henderson, Kuncor, Turner: growth more rapid close to existing concentrations
- ▶ Rosenthal & Strange: rapid growth close to locations with existing jobs
- ▶ Localization economies attenuate rapidly with distance

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Urbanization Economies - from the worker side

Summary

Urbanization economies

- ▶ Cost savings from the clustering of firms from different industries
- ▶ These happen for the same reasons mentioned before
 - ▶ share intermediate input, attract customer, share labor pool, improve quality of match with workers, enjoy knowledge spillover
- ▶ Knowledge spillover could be especially strong in diverse cities
 - ▶ Diverse city is fertile ground for new ideas
 - ▶ Bulk of patents issued to people in large cities
 - ▶ Evidence: Elasticity of productivity w.r.t. population is 0.03 to 0.08. Diversity promotes employment growth, especially in innovative industries

Specialized v.s. diverse cities

- ▶ Specialized (diverse) cities develop because of localization (urbanization) economies
- ▶ Both are important for firms at different stages of product development
 - ▶ Young firms benefit from proximity to a diversity of economic activities
 - ▶ Specialized cities attract mature firms
- ▶ Both are important for different divisions within a firm. With improvements in communication
 - ▶ Headquarters are located in diverse cities
 - ▶ Production units are located in specialized cities

Corporate HQ and Functional Specialization

- ▶ Corporate headquarters cluster in cities to share firms providing business services
- ▶ Large cities increasingly specialized in managerial functions
- ▶ Small cities increasingly specialized in production

TABLE 5 Increase in Functional Specialization of Metropolitan Areas

Population	Percentage Gap between Metropolitan Ratio of Management to Production Workers and the National Ratio		
	1950	1970	1990
5–20 million	+10.2	+22.1	+39.0
1.5 to 5 million	+0.30	+11.0	+25.7
75,000 to 250,000	-2.1	-7.9	-20.7
67,000 to 75,000	-4.0	-31.7	-49.5

Source: Gilles Duranton and Diego Puga. "From Sectoral to Functional Specialization," *Journal of Urban Economics* 57 (2005), pp. 343–70.

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Summary

The benefits of cities for workers

- ▶ Sofar we focus on the benefits for firms to locate in big cities
- ▶ By living in cities, workers get benefits, too
 - ▶ Cities attract workers, which increases the urban size, making cities even more attractive to firms
- ▶ In addition to **better job prospects**, some of the additional benefits are:
 - ▶ **Joint Labor Supply**: historically, metal-processing firms (men) located close to textile mills (women). Currently power couples are attracted to cities
 - ▶ **Learning opportunities**: evidence shows that the skill and experience acquired in large cities results in a permanent increase in wage
 - ▶ **Consumption choices**: more goods you can buy (albeit changing due to the internet)
 - ▶ **Social opportunities**: better matches of social interest in large city

'Urban revival' in America

- ▶ A lot of recent discussion on the 'urban revival' in the U.S. over the past decade



- ▶ →The benefits highlighted in the previous slides are especially attractive to high-income earners

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Urbanization Economies - from the worker side

Summary

Summary

- ▶ Firms cluster for two reasons: localization economies and urbanization economies
- ▶ Four important channels are: share labor pool, share intermediate inputs, improve quality of matches with workers, benefit from knowledge spillovers
- ▶ Consumers benefits from living in cities, too: better job prospects, joint labor supply, learning opportunities, consumption choices, and social interactions
- ▶ Those benefits are driving the high-income earners to move back into urban centers