Clustering, City Size, and Growth

EC330, Set 04

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Contents

Housekeeping

PS01 due on Sun, Oct 16th @ 11:59p

- We will be going over material for questions 4 & 5 today
- Must be submitted on Canvas as a PDF

Reading

- Finish chapter 3 by end of this week

Last time: *Why do cities exist?*

We discussed some **fundamentals** that lead existence, the **main takeaway:**

Incentives must exist to justify higher land prices within a city

Two **incentives:**

- benefits of **centralized exchange** (trading cities)
- benefits of **centralized production** (factory cities)

Other questions:

Why do cities grow beyond one factory?

Why are there differences in size across cities?

Where do cities emerge?

Why do firms cluster?

Why do firms cluster?

Can we explain why there might be **more than** one firm?

- Which of the **5 axioms** is relevant to the number of firms within a city?

A5: Competition generates zero economic profit

Suppose a firm makes a **positive** economic profit.

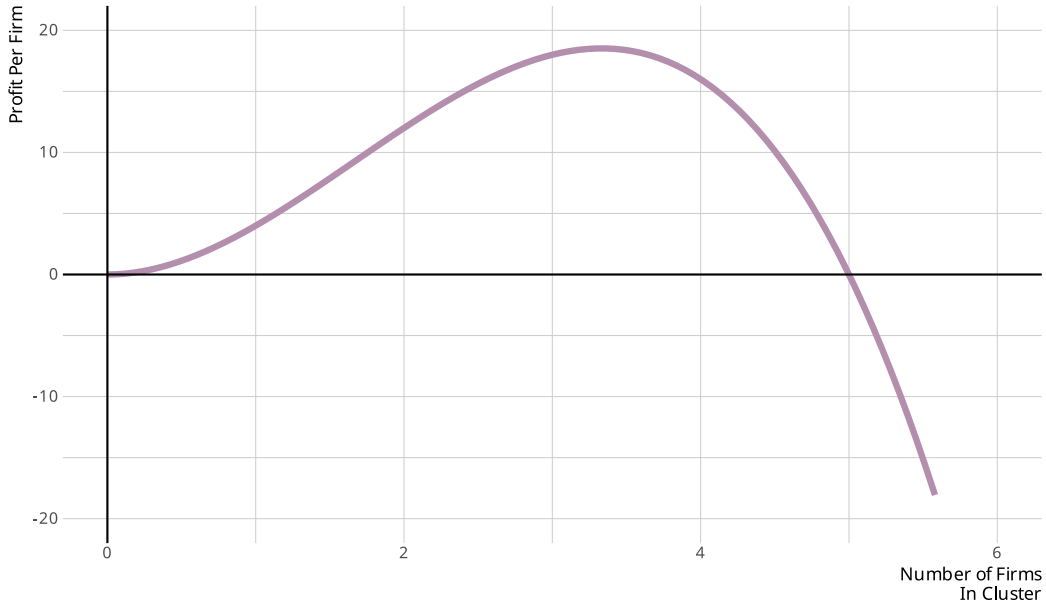
- then additional firms enter the market
- $\Pi \rightarrow 0$

Suppose a firm makes a **negative** economic profit

- then firms exit
- $\Pi \rightarrow 0$

Clustering example

How many firms are in the cluster?



Data

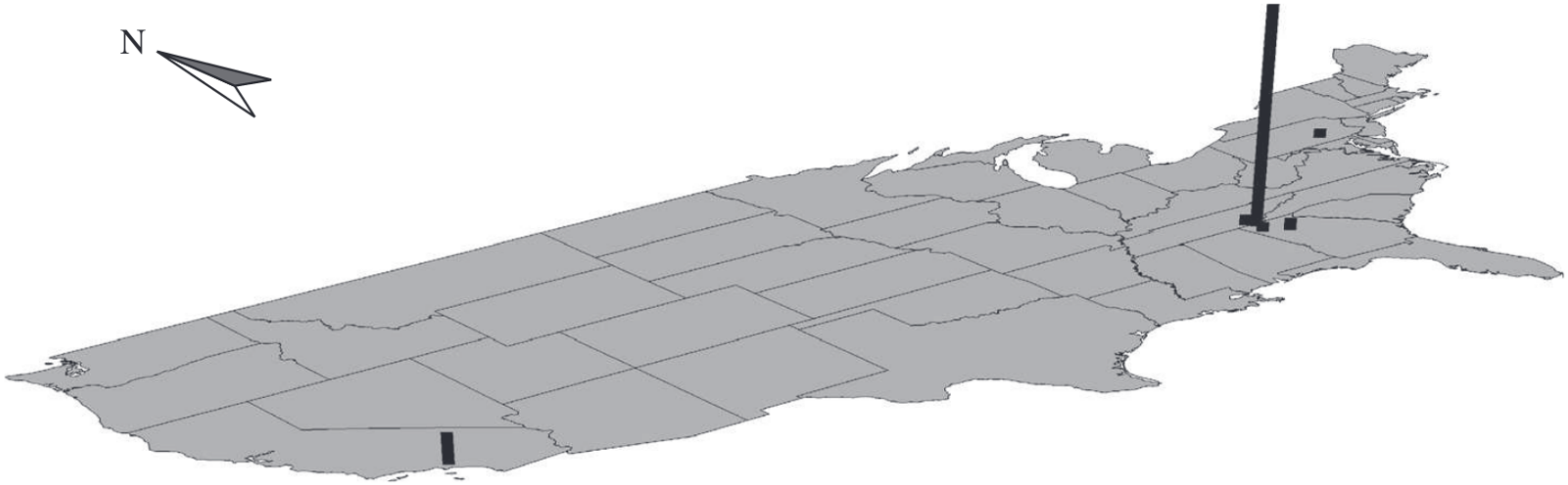
Data

TABLE 3–1 Select Industrial Clusters in U.S. Metropolitan Areas, 2004

Product	Metropolitan Area	2004 Employment	Nationwide Employment (%)
Aircraft engines	Hartford, CT	15,619	22.67
	Phoenix, AZ	7,500	10.89
	Cincinnati, OH	6,957	10.10
	Indianapolis, IN	4,045	5.87
Biopharmaceutical products	New York, NY	51,604	27.21
	Chicago, IL	19,754	10.42
	Philadelphia, PA	11,383	6.00
	San Francisco, CA	10,706	5.65
Computer software	Seattle, WA	36,454	11.10
	San Francisco, CA	31,353	9.54
	San Jose, CA	29,221	8.89
	Boston, MA	23,415	7.13
Elevators and moving stairways	Bloomington, IN	1,750	20.03
	New York, NY	1,170	13.39
Financial services	New York, NY	427,296	12.97
	Chicago, IL	151,499	4.60
	Los Angeles, CA	142,337	4.32
	Boston, MA	133,342	4.05
Video production and distribution	Los Angeles, CA	161,561	44.00
	San Francisco, CA	28,394	7.73
	New York, NY	27,541	7.50

Data

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.

Data

MAP 3–2 Job Clusters: Costume Jewelry

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

Which axiom do these data relate to?

A2: Self-reinforcing effects generate extreme outcomes

Why do firms cluster?

Why do **within-industry** firms locate in same city?

Why might profits **increase** as more firms cluster?

There exists some economic mechanisms that incentives **within-industry** firms locate near one another

- We categorize these mechanisms broadly as **agglomeration economies**

Agglomeration

Definition: Agglomeration Economies

Benefits that come when firms and people locate near one another together in cities and industrial clusters

> Agglomeration economies are the benefits that come when firms and people locate near one another together in cities and industrial clusters. These benefits all ultimately come from transport costs savings: the only real difference between a nearby firm and one across the continent is that it is easier to connect with a neighbor. Of course, transportation costs must be interpreted broadly, and they include the difficulties in exchanging goods, people, and ideas

Source: Ed. Glaeser

Benefits of agglomeration

- **(i) Sharing intermediate inputs**
- **(ii) Labor matching**
- **(iii) Knowledge spillovers**

Agglomeration - Sharing inputs

Similar firms **share inputs** to benefit from economies of scale

Firms will share intermediate input suppliers to help **reduce costs**

- If costs **go down**, then Π goes **up**

Example: High tech firms

- Rapidly changing goods that require sophisticated intermediate inputs
- Electronic components and testing facilities
- Firms rent capital/labor from intermediate firms

There exists an **optimal cluster size** that maximizes input sharing benefits

Example - Sharing inputs

Agglomeration - Labor matching

In models of labor markets, we typically assume that firms and workers match perfectly

In the real world this is rarely the case

- Firms and workers are not always perfectly matched
- Mismatches **require training** to eliminate skill gap. **Training is costly**
- Think of the training you may need for your first job

A large city will reduce these costs

Agglomeration - Labor matching

Consider a labor pool of software programmers

The skill sets of these programmers vary greatly

- Coding languages: C, Javascript, Python, Rust, etc.
- Programming tasks: graphics, AI/ML, OS development etc.

Clustering **attracts** more of the kind of workers they want

Better for firm if they can find a worker to fill role immediately

- Firms have higher probability in a cluster

Agglomeration - Knowledge spillovers

Knowledge spillovers: Exchange of ideas across individuals within a space

- One of most important external benefit of a college campus (classroom) is the **peer effects**

Examples:

- Graduate school
- Jam sessions
- Attending seminars, workshops, and conferences

Knowledge spillovers increase with more people and more knowledge

$\Rightarrow$ Knowledge Spillovers $\uparrow \longrightarrow$ Productivity $\uparrow$

Urban settings: Silicon Valley, Wall Street, etc.

Types of agglomeration

Distinctions between two types of agglomeration

(i) *Localization economies*

- Economic forces that incentivise clustering of firms **within-industry**
- Local to a particular industry
- Examples: Silicon Valley; biopharmaceuticals

(ii) *Urbanization economies*

- Economic forces that cause clustering of firms **across-industry**
- The presence of one firm attracts firms from different industries
- Examples: Universities; corporate headquarters

Localization

Localization economy: occurs when an increase in the size of an industry leads to an increase in productivity of production

Evidence of higher **labor productivity**

- Higher output $\rightarrow$ more productive workers (Henderson, 1986)
- Tech workers benefit more from **knowledge spillovers** than manufacturing (Mun & Huchinson, 1995)

Evidence of higher **rates of entry**

- More firms are born where **output is higher**; that is, where the industry is clustered (Carlton, 1986)

Urbanization

Urbanization economy: occurs when **growth** in population increases in productivity within the economy

Sharing inputs: banks, accountants, hotels, transportation

Pooling: workers move **across-industry**

- low demand to high demand

Matching: common skills across sectors (excel, for example)

Result in **large and diverse** cities

Examples

Two major examples of **localization** & **urbanization** economies:

(i) Silicon Valley

- firms locate close to share **high-skilled labor pool** despite high rents

(ii) Los Angeles

- no super dominant industries
- large, diverse, and growing workforce

City Size

City Size

Why are some cities big while others are small?

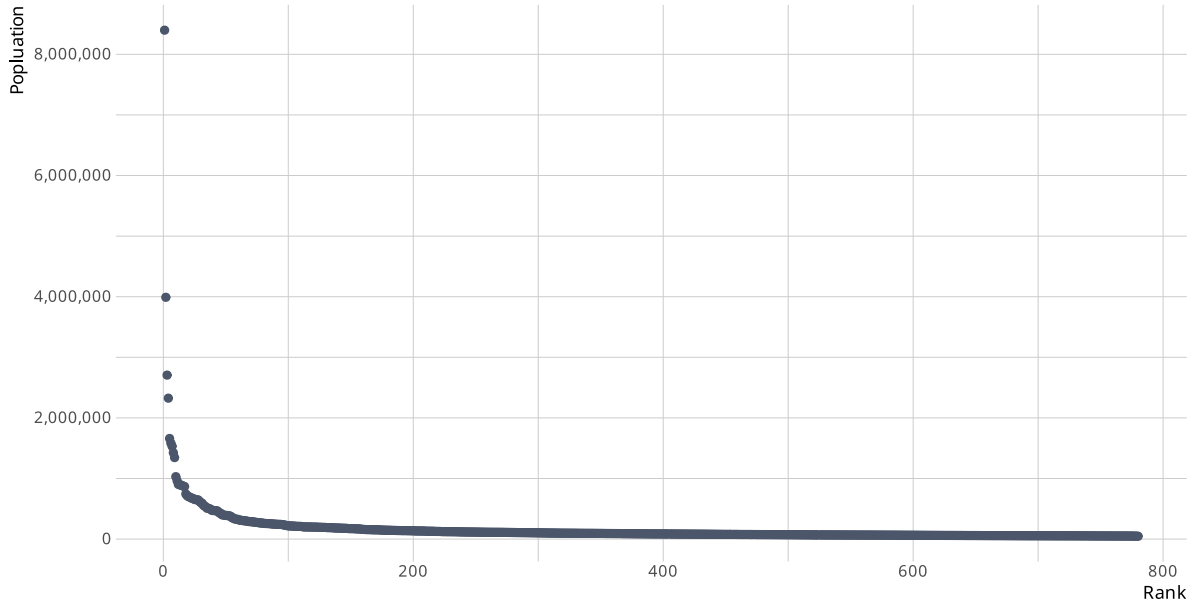
- We've shown why **agglomeration** explain **firms** clustering.
- How does **agglomeration** explain why **people** cluster?

Agglomeration increases productivity among its **firms** and **people**

- leads to higher **wages** in larger cities
- higher wages incentivises migration decisions

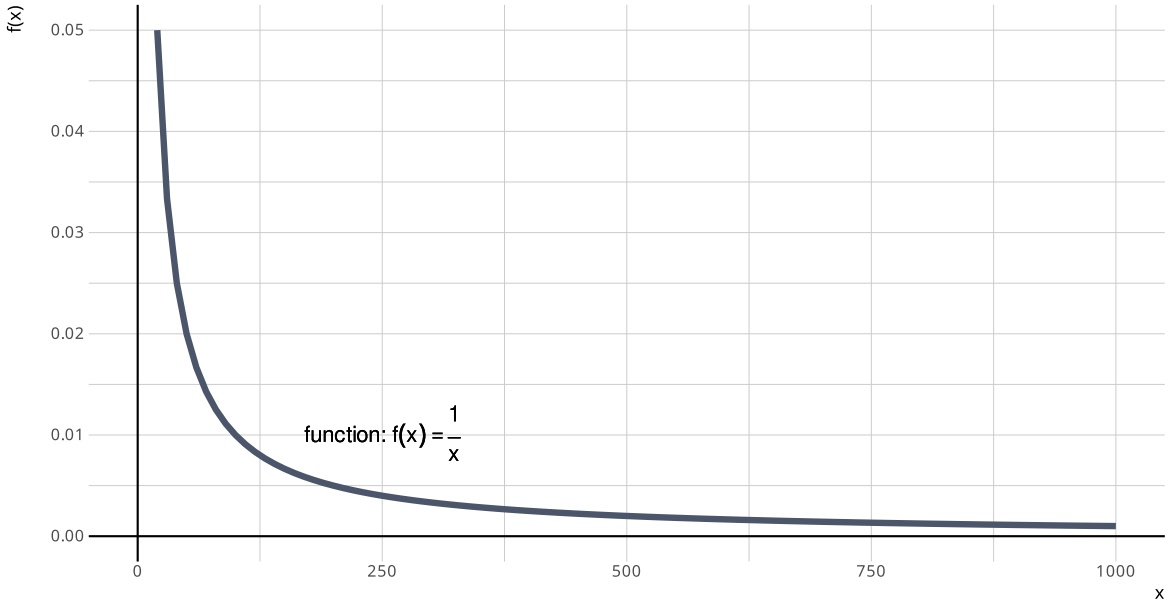
Let's look at some **data** of city populations in the US

City Size in the US

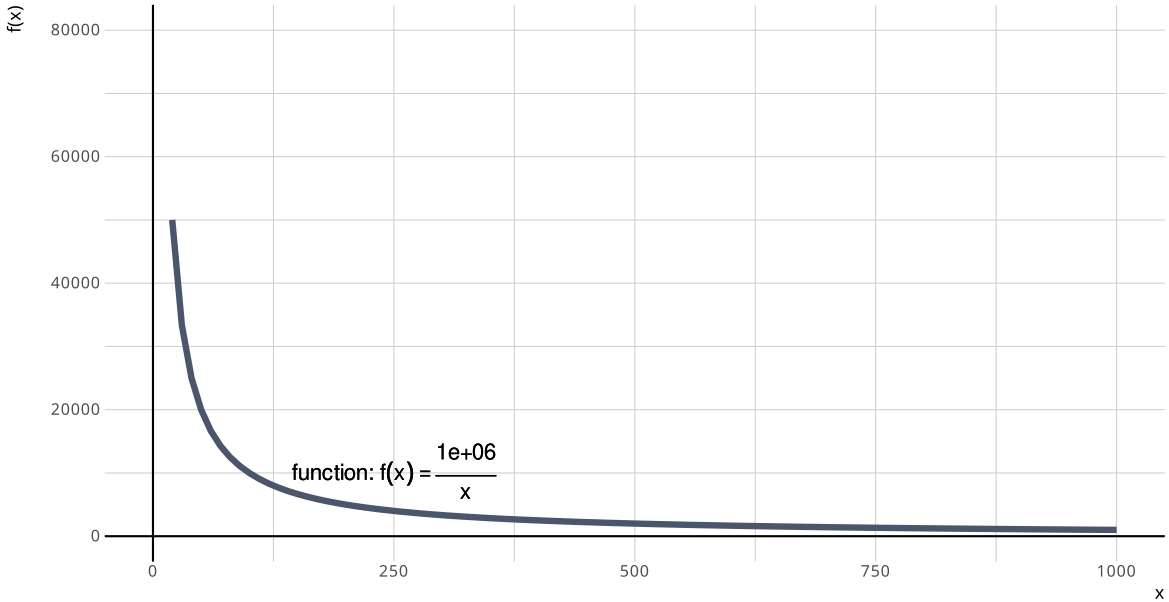


A functional relationship exists between population and rank within a country

What Function? f(x) = 1/x



What Function? Zipf's law



Size: Zipf's Law

Zipf's law of city size can be expressed as:

$$R = \frac{C}{N}$$

Where:

- R represents a country's population rank
- C represents a constant for a country/region
- N represents the population level

We can use this function to approximate city size based on rank

Zipf's Law: Example

Assume the **third** largest city in a region has **200,000 people** (N)

- Use *Zipf's law* to estimate the population in the **fifth-largest** city

Two steps:

(i) Calculate the constant C:

$$3 = \frac{C}{200,000}$$
$$C = 600,000$$

(ii) Use that info to calculate the population of the **fifth-largest** city:

$$5 = \frac{600,000}{Pop_5} \implies Pop_5 = 120,000$$

Zipf's Law: Intuition

What does *Zipf's law* describe about the relationship between **rank** and **city size**?

- a few cities will be big
- there is a **big drop** in population as rank increases
- most low rank (high number) cities are **pretty similar** in size

Example: Zipf's Law

(i). Assume that the Zipf's Law for cities is exactly true. If the **fourth-largest** city in a region has **2.5 million** people, how many people live in the region's **largest** city? Show your work.

(ii). How many people live in the region's **tenth-largest** city? Show your work.

Primate Cities

Definition: A **primate city** is

> A major city that works as the **financial, political, and population center of a country** and is not rivaled in any of these aspects by any other city in that country.
>
> "*at least twice as large as the next largest city and more than twice as significant.*"

Examples:

City	Percent of Total Population
Seoul, South Korea	45.8%
Santiago, Chile	35.5%
Buenos Aires, Argentina	33.7%
Lima, Peru	31.7%

Primate Cities

What might generate primate cities?

- Large **economies of scale** in exchange
- Inadequate **transportation infrastructure** elsewhere

Political factors:

- Easier for dictators to bribe, surveil populations of a primary city?
- Capital cities with dictatorships are *45%* larger than capital cities of other countries
- Is this relationship **causal**? †

† Maybe somebody does. But you definitely can't say from the 45% number. Much of modern econ is about figuring out when relationships *are* causal. For a completely unrelated, but informative and entertaining example, see this video.

Zipf's Law

Why is *Zipf's Law* generally accurate in describing city size?

A2: *Self-reinforcing effects* *generate extreme outcomes*

"Winner take all" situations

- policies, agglomeration, knowledge spillovers, etc.
- Wages grow, workers in, firms enter, $\rightarrow$ labor demand $\uparrow \rightarrow$ wages grow

What slows this process down?

Increases in costs lead to **diseconomies of scale**

Size

Why do costs increase as workers move in? (Diseconomies of scale?)

(i) Commute costs

- More people $\implies$ more congestion (all else equal)

(ii) Pollution

- More workers $\implies$ more production $\implies$ more **pollution**

(iii) Disease

- Early 1900's (US), living in a city $\rightarrow$ life expectancy $\downarrow$ 5 years
- Now, the US's largest cities life expectancy exceeds the national average
- Life expectancy in cities is, typically, lower than rural areas

Review: Utility

Use it to **model** the value individuals place on different city attributes

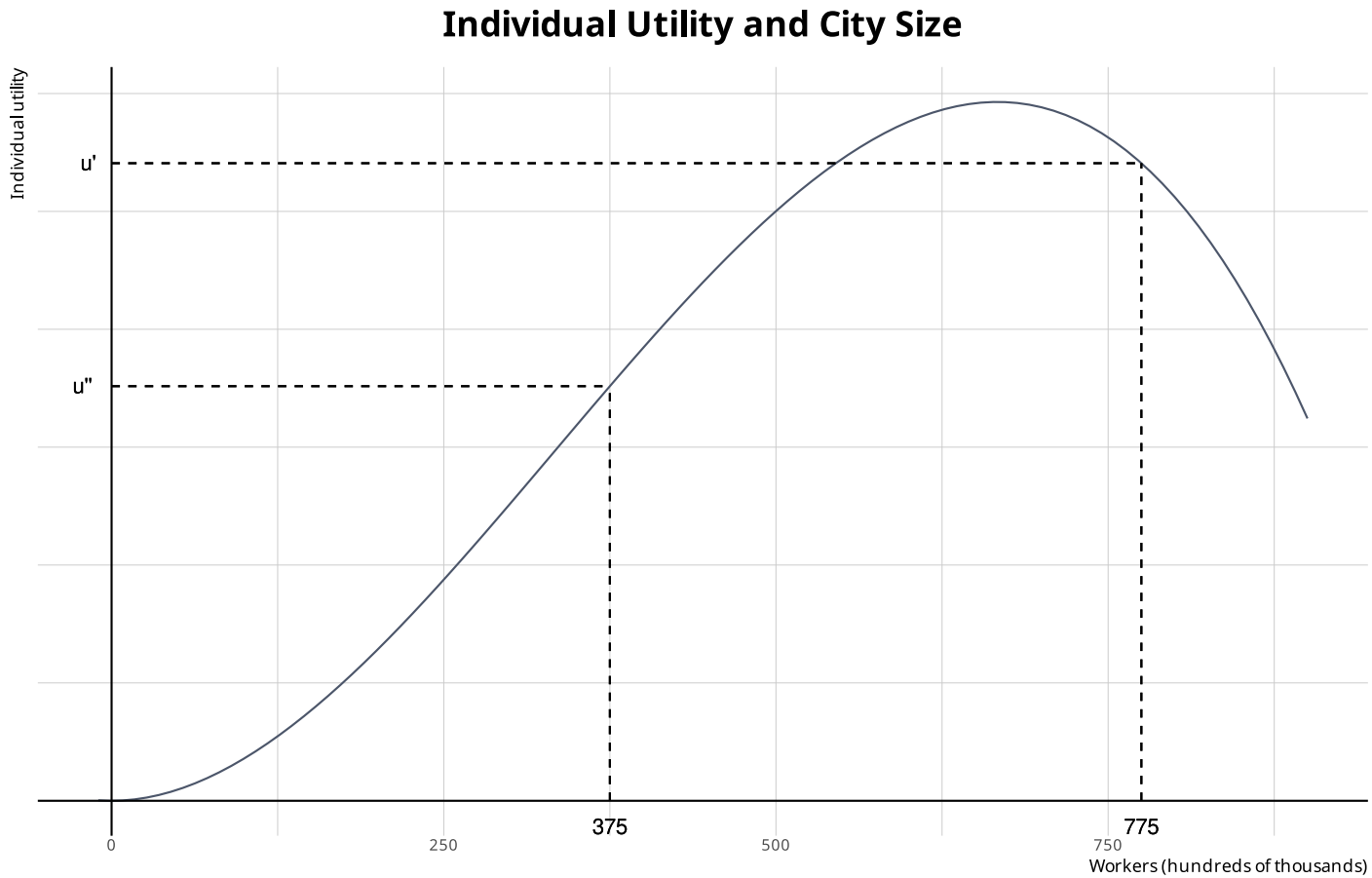
Utility is an abstract notion of peoples preferences

Assumptions:

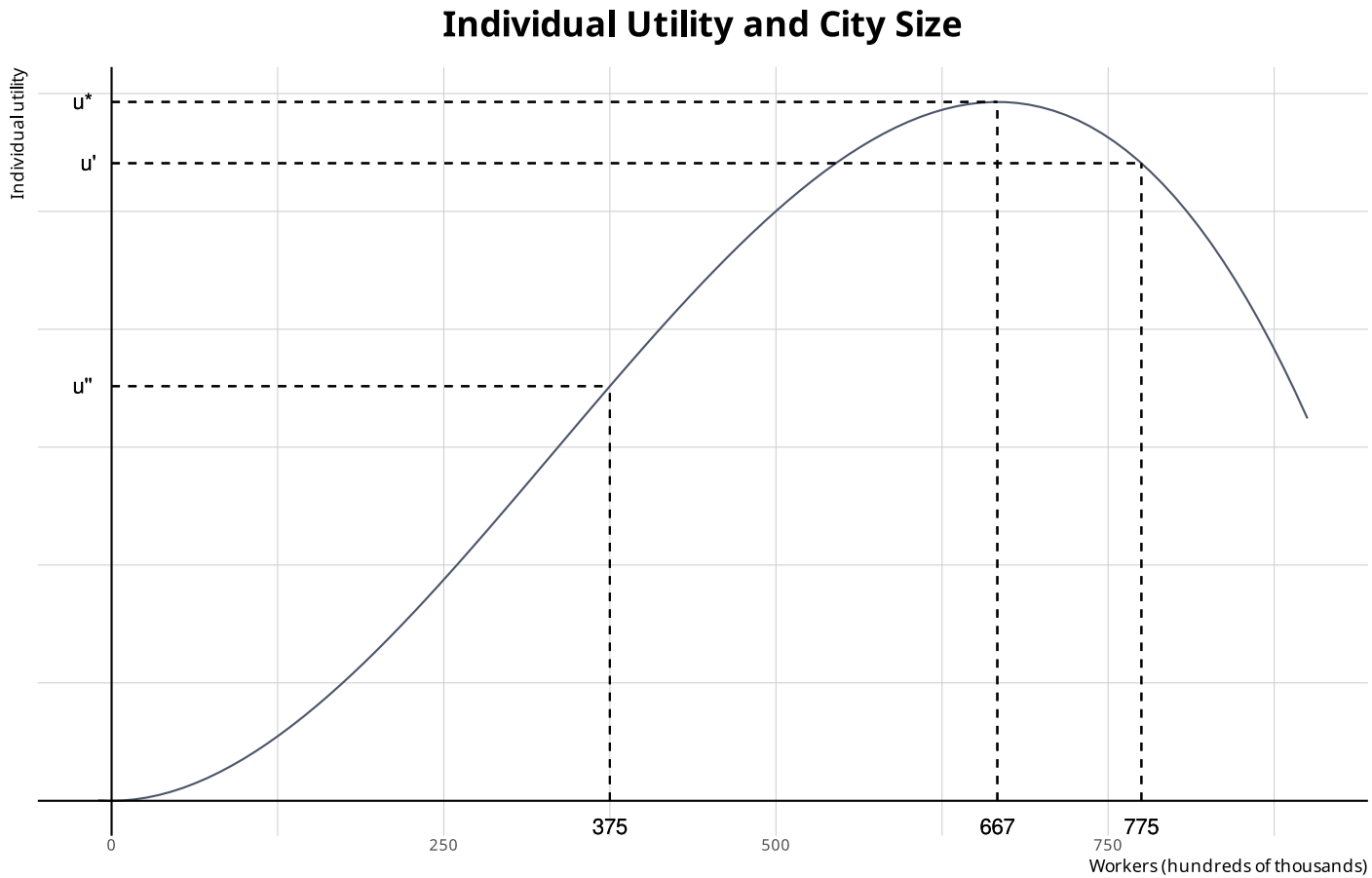
- **(i)** Higher levels of utility are **preferred** to lower levels. And more consumption is better than less
- **(ii)** ***Ordinal, not cardinal.*** Only the **rank** matters, not the **level**
- **(iii)** Marginal utility is diminishing (marginal value is diminishing)

Similar to business' maximizing profits, individuals maximize utility

Modeling City Size



Modeling City Size



Locational Equilibrium

Locational Equilibrium occurs when utility levels (valuations) across cities are the same for all workers

In a system of cities, **migration** has a **self-correcting** effect

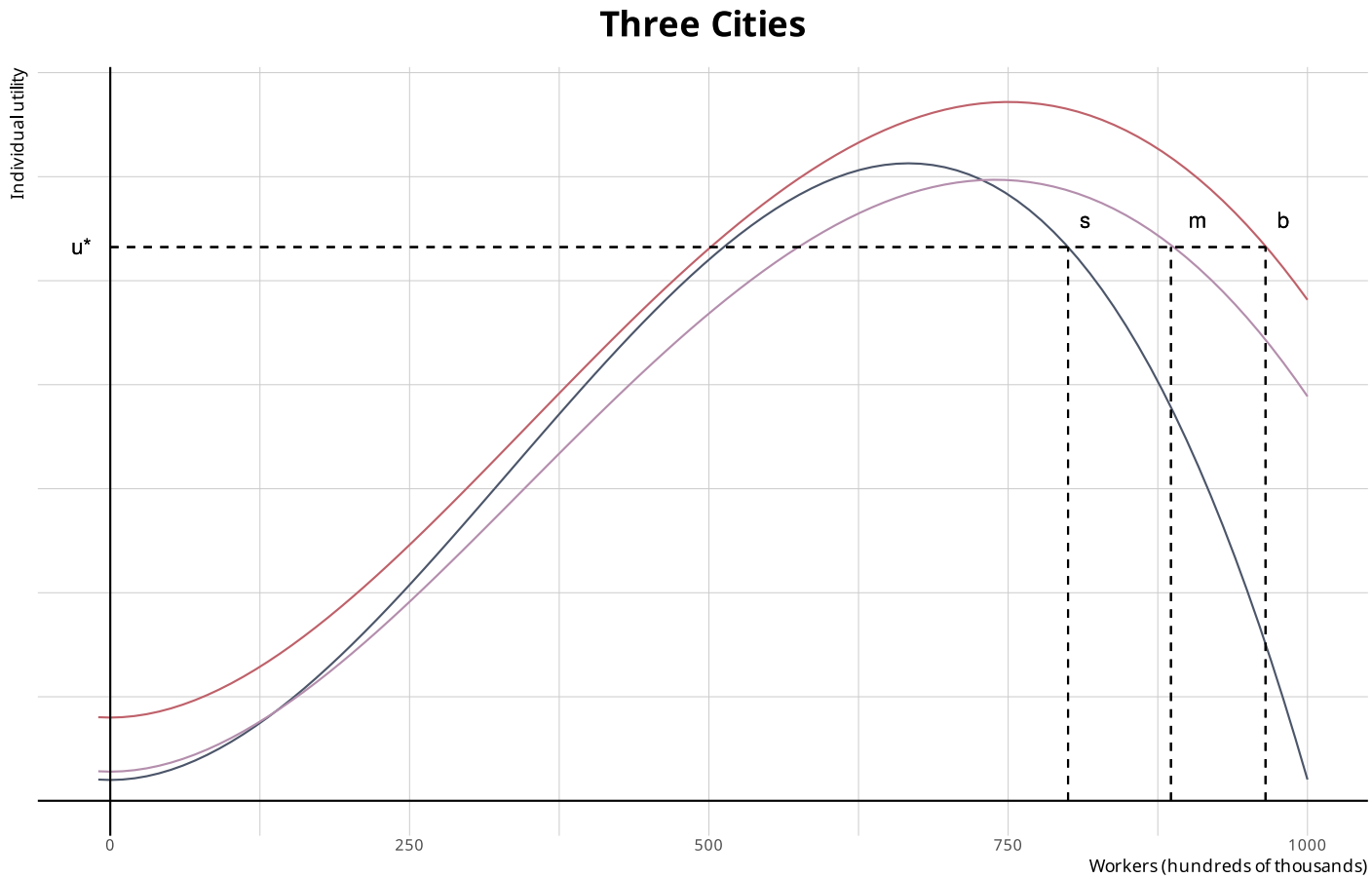
Locational Eq is stable when the utility curve is downward sloping

- which implies cities tend to be too large rather than too small

We usually do this by **worker type** (demographic, income, education, etc)

- For now, we will just consider the case when **all workers are equivalent**

Locational Eq Graph



Locational Eq: Implications

Why is this framework useful?

- If utility really has this shape, what does this mean for policy?

Policies that impact the ***spatial distribution*** *of the population can have far flung effects on individuals it was not designed to impact,* ***via migration***

Example:

- Local school quality improvements $\rightarrow$ increased prices. Higher utility from school quality, lower from higher prices. Some people may be displaced? (Gentrification)
- Net effect could be positive, but there will be winners and losers

More on this later in the term when we study ***place-based*** *policies*

Growth

Growth

Econ in General: Defined as an increase in per-capita income

Urban Economics: Defined as an increase ***utility level*** of a typical resident

Urban definition accounts for factors **other than wage.** Such as:

(i). Increases in natural resources (gold is found under a city)

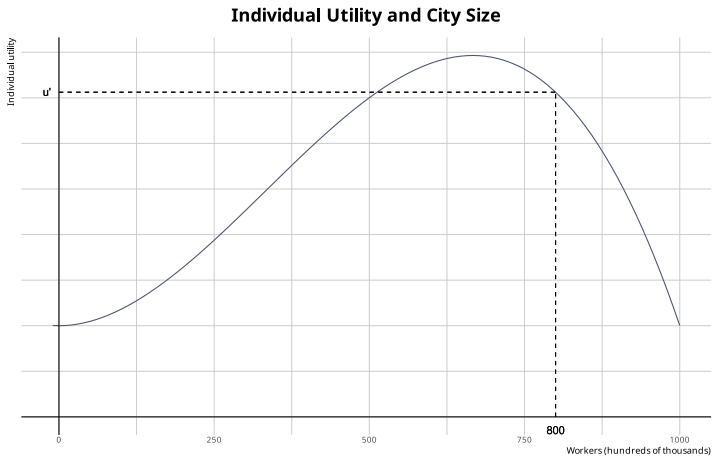
(ii). Increases in physical capital (computers 💻)

(iii). Increases in human capital (education 🎓)

(iv). Technological progress (computers invented)

(v). Agglomeration Economies 🏙

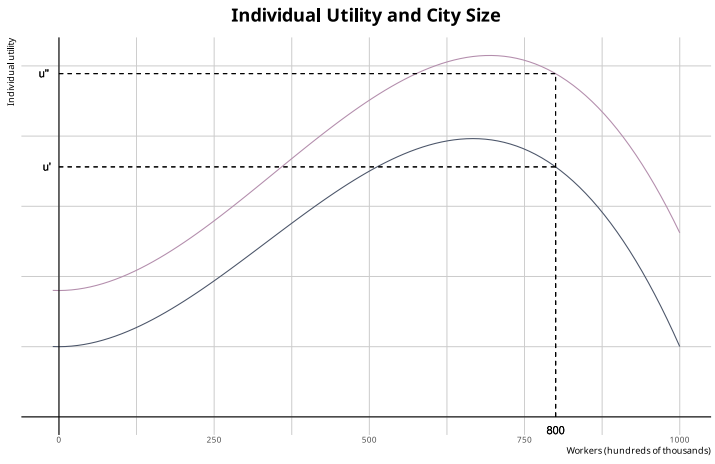
Example: Innovation



Initially: 2 cities, both with same utility curve

Population each city: 800k (total pop, 1.6 m)

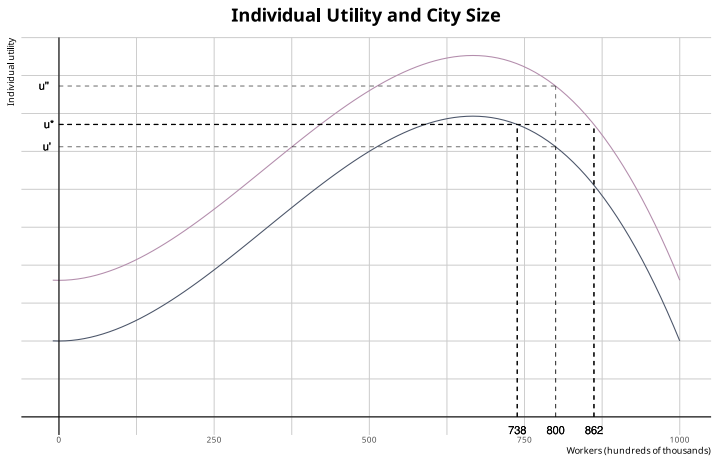
Example: Innovation



Productivity shock brings one city's curve up (due to say, higher wages)

In the absence of migration, utility is now higher in the higher productivity city

Example: Innovation



Migration induces workers toward the more productive city and away from the less productive city

- **New locational eq** (u^*): utility is equalized (higher than before). populations change

Note: We are implicitly assuming

- People are identical and perfectly mobile

In real life high-skilled workers are far more mobile than low skilled

Example Recap

Consider two cities: each with an equilibrium population of 800k and the same utility per worker curve

- **Innovation** (tech progress) in one city shifts utility per worker curve up
- Workers in the innovative city enjoy a higher level of utility
- Workers migrate from the city that failed to innovate

Eventually, a new equilibrium is reached where **utility per worker** is the **same across both cities**

- Innovative city is larger

Economy - Wide Growth

Note: If there is an **innovation for the entire economy**, then **both cities** experience upward shift of utility curve

- Since there is no utility gap, there is **no migration**
- Still economic growth, but city sizes stay the same

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