Econ 330: Urban Economics

Lecture 04

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19 October, 2021

Lecture 04: Clustering, City Size, and Growth

Schedule

Today:

(i). Clustering

(ii). City size

(iii). Introduction to growth

Upcoming:

- **Reading** (Chapter 3 & 4)
- **Problem set 01 due on Tuesday, October 19th**

Last Time

We discussed some **fundamentals** that lead to the existence of cities

Main takeaway:

Need some reason for the higher land prices within a city to be justified

- Economies of scale

Questions:

Why do cities grow beyond one factory?

Why are there differences in size across cities?

Where do cities emerge?

Firm clustering

Clustering

So we explained **why** cities exist..

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

Where to start?

***Axiom 5:** Competition generates zero economic profit*

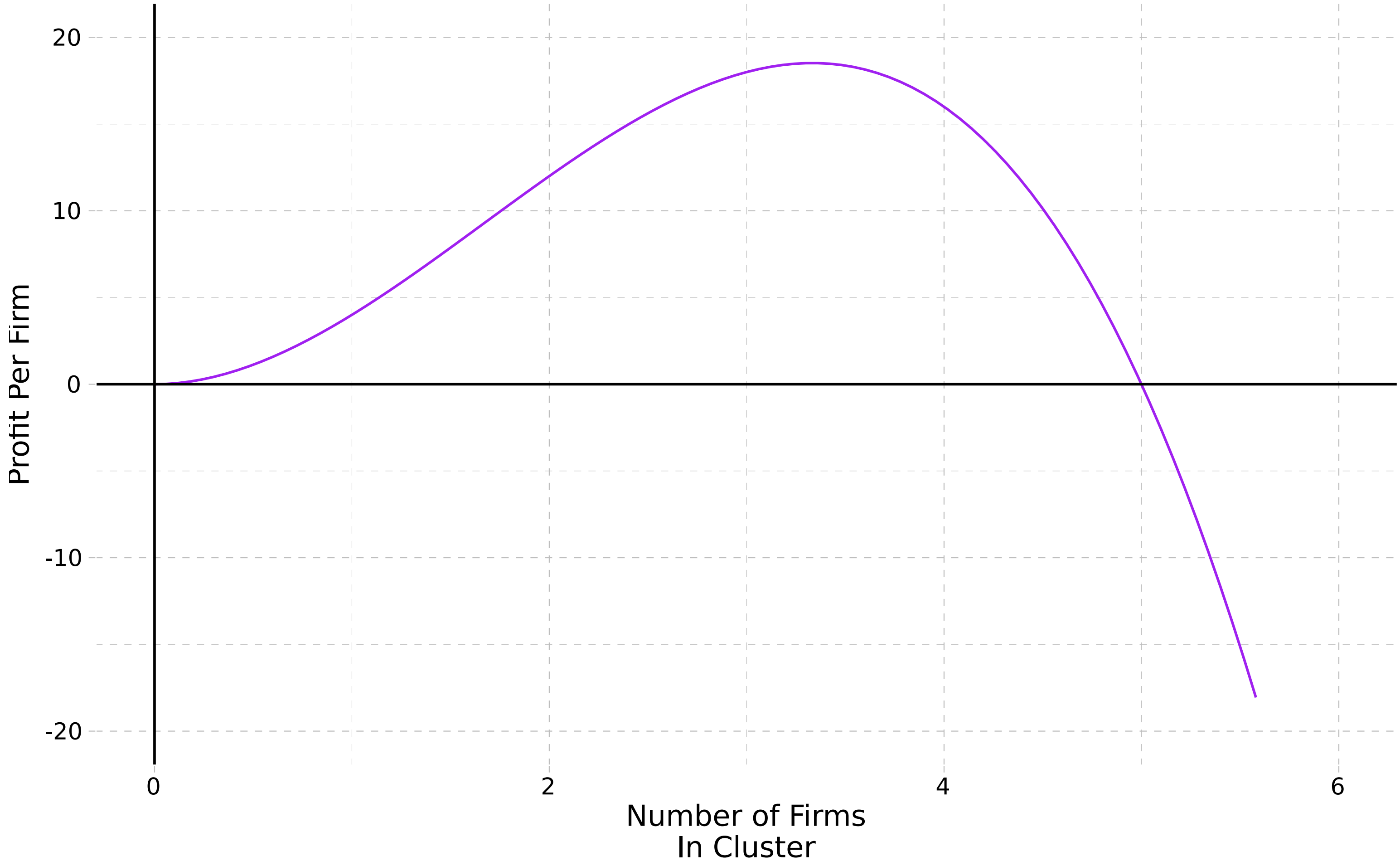
Suppose a firm makes a positive economic profit.

$\Rightarrow$ additional firms enter the market

$\Rightarrow \Pi \rightarrow 0$

Clustering example

How many firms are in the cluster?



Data: Firm clustering

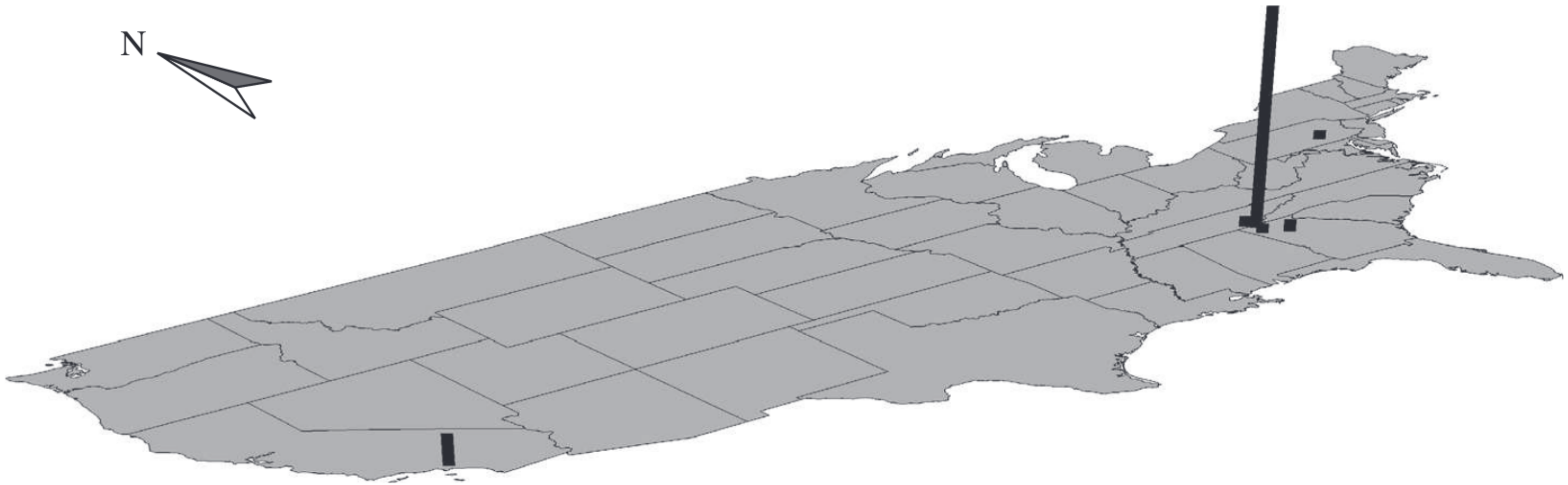
Clustering

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

Clustering

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.

Clustering

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

Clustering

Why might profit increase ($\Pi \uparrow$) initially as more firms **cluster**?

Firms may mutually benefit from clustering due to:

- **(i).** Sharing intermediate inputs
- **(ii).** Labor matching
- **(iii).** Knowledge spillovers
- **(iv).** Labor pool sharing

Let's look at these in some more detail

(i). Sharing inputs

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

Example: High tech firms

- Rapidly changing goods that require sophisticated intermediate inputs
  - Electronic components and testing facilities
- Firms will share intermediate input suppliers to help reduce costs
  - Costs $\downarrow \quad \Rightarrow \quad \Pi \uparrow$

Exists a optimal cluster size that maximizes the benefits of sharing inputs

(ii). 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

(ii). 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

(ii). Labor matching: HS model

Model assumptions:

(i). Variation in worker skills: Workers have a unique skill set described by an "address" on a circle

(ii). Firm entry: Firms enter the market and pick a good with an associated skill requirement

(iii). Training costs: Workers incur the cost associated with closing the gap on the circle between their own skill and the skill requirement to produce the good

(iv). Competition for workers: Each firm offers a wage to anyone who meets the skill requirement; workers accept the highest net wage

- Net wage = gross wage - training costs

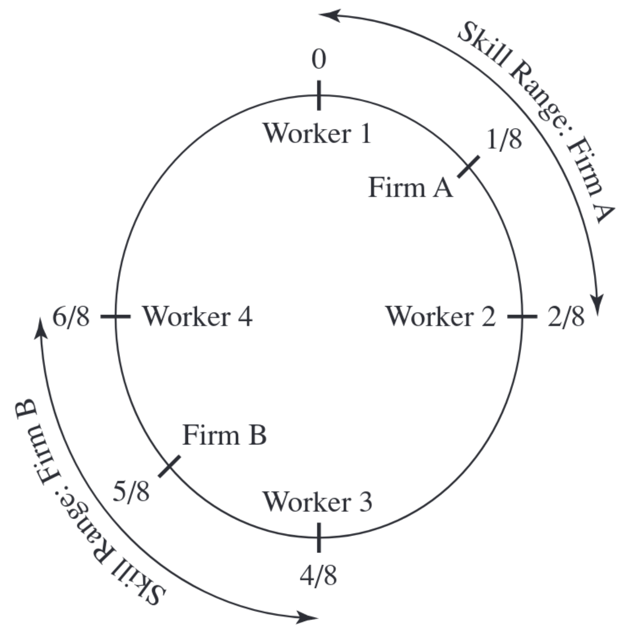
Additionally, assume

- **A4: Production is subject to economies of scale** to ensure firms hire more than one worker
- **A5: Competition generates zero economic profit** to ensure perfect competition

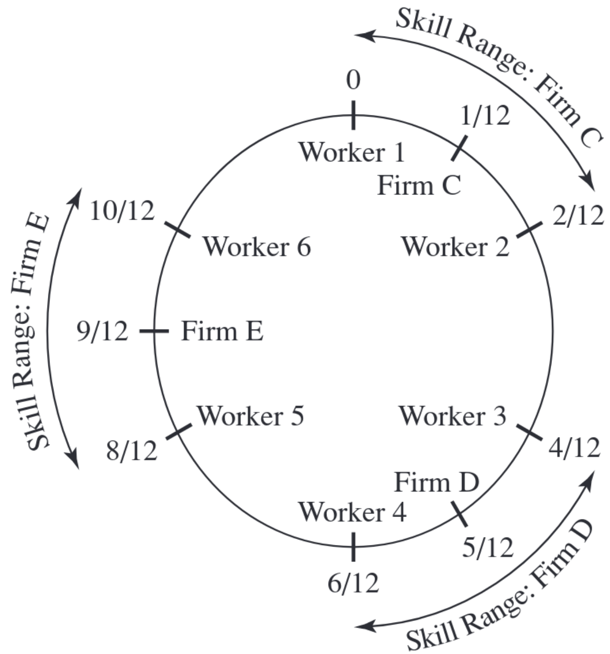
(ii). Labor matching: HS model

Consider two cities:

- City A: two firms, four workers (four skill types)



- City B: three firms, six workers (six skill types)



(iii). 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.

Agglomeration economies

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

Agglomeration economies

Let's refine our language with definitions:

i. ***Localization economies***

- The economic forces that cause clustering that act on firms *within the same* industry
- Local to a particular industry
- Example: Firms in the software industry cluster in Silicon Valley

ii. ***Urbanization economies***

- The economic forces that cause clustering that act on firms *across different* industries
- The presence of one firm attracts firms from different industries
- Example: Universities; corporate headquarters

Localization Economies

A ***localization economy*** occurs when an increase in the size of an industry leads to an increase in productivity of production

Why?

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 Economies

Urbanization Economies- the size of a city increases in productivity

Why?

Sharing intermediate goods: (banks, accountants, hotels, transportation)

Pooling: workers move from industries with low demand to high demand

- across sector

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

Urbanization Economies result in **large, diverse cities**

Examples

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

1) **Silicon Valley**

- **Localization**: firms locate close to each other to share high-skilled labor pool despite very high rents

2) **Los Angeles**

- **Urbanization**: No super dominant industries, yet it continues to grow

City Size

City Size

Why are some cities big while others are small?

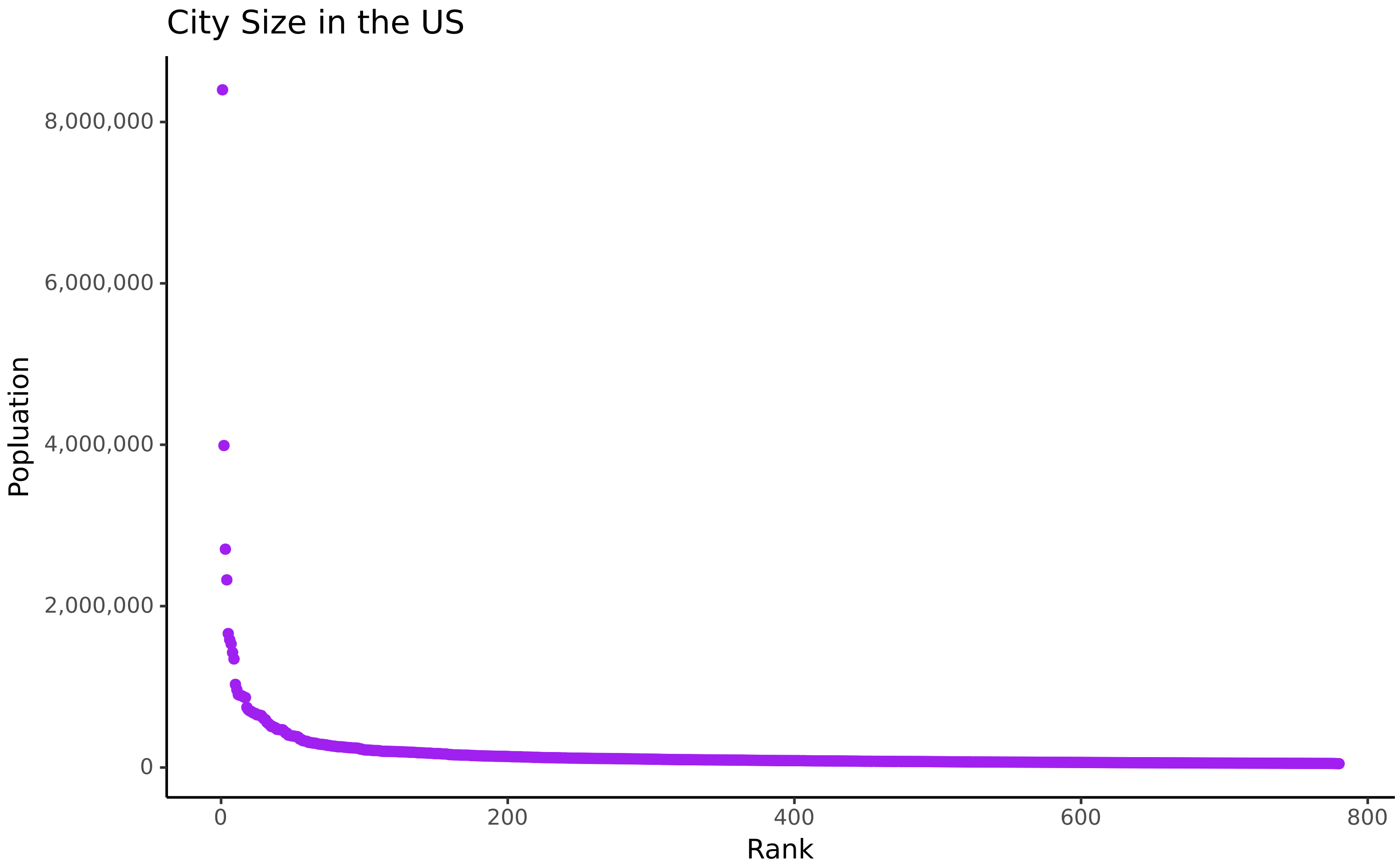
We've seen why agglomeration economies explain why **firms** cluster.

But how to agglomeration economies explain why **people** cluster?

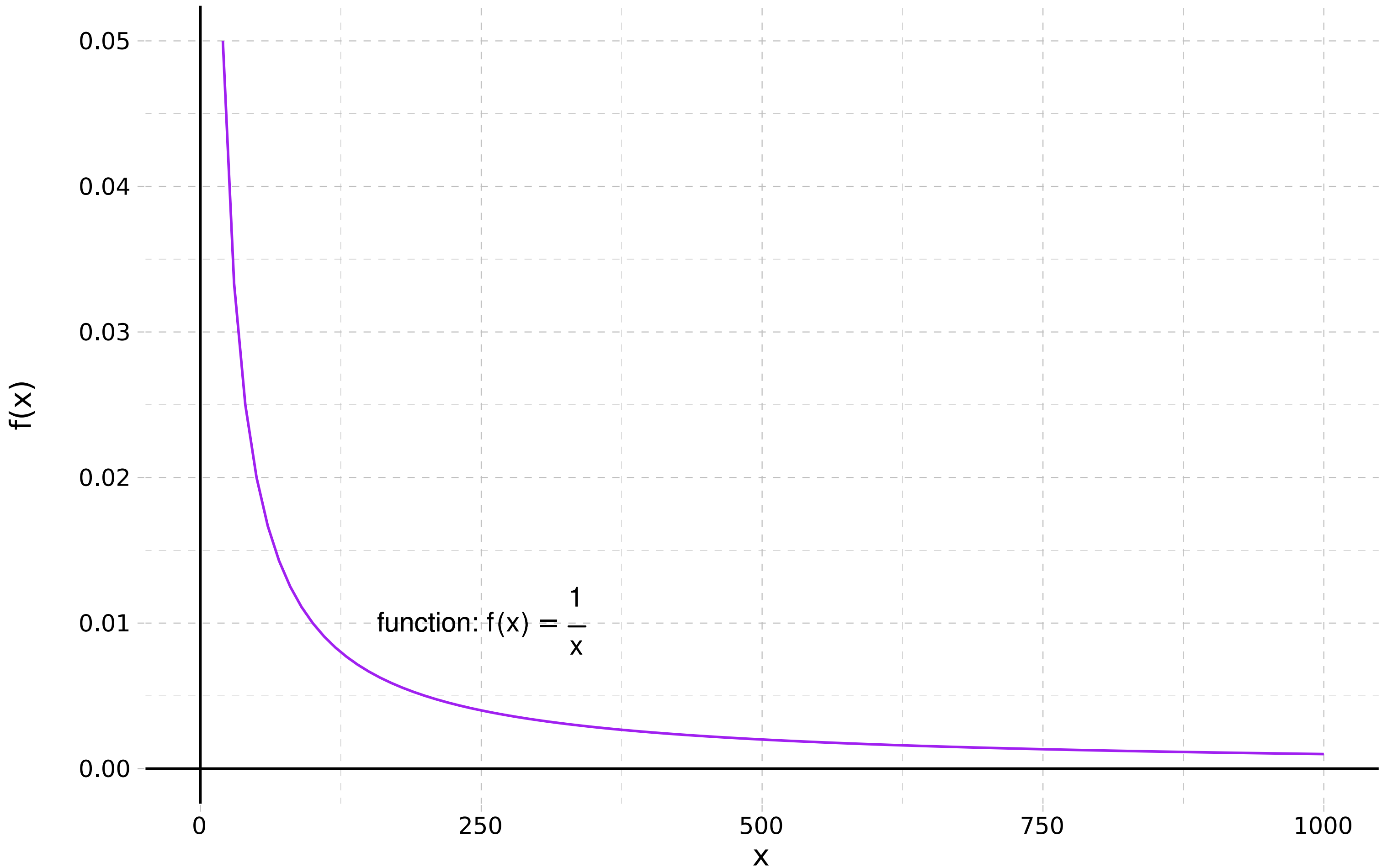
- Agglomeration economies increase productivity and lead to higher wages in larger cities

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

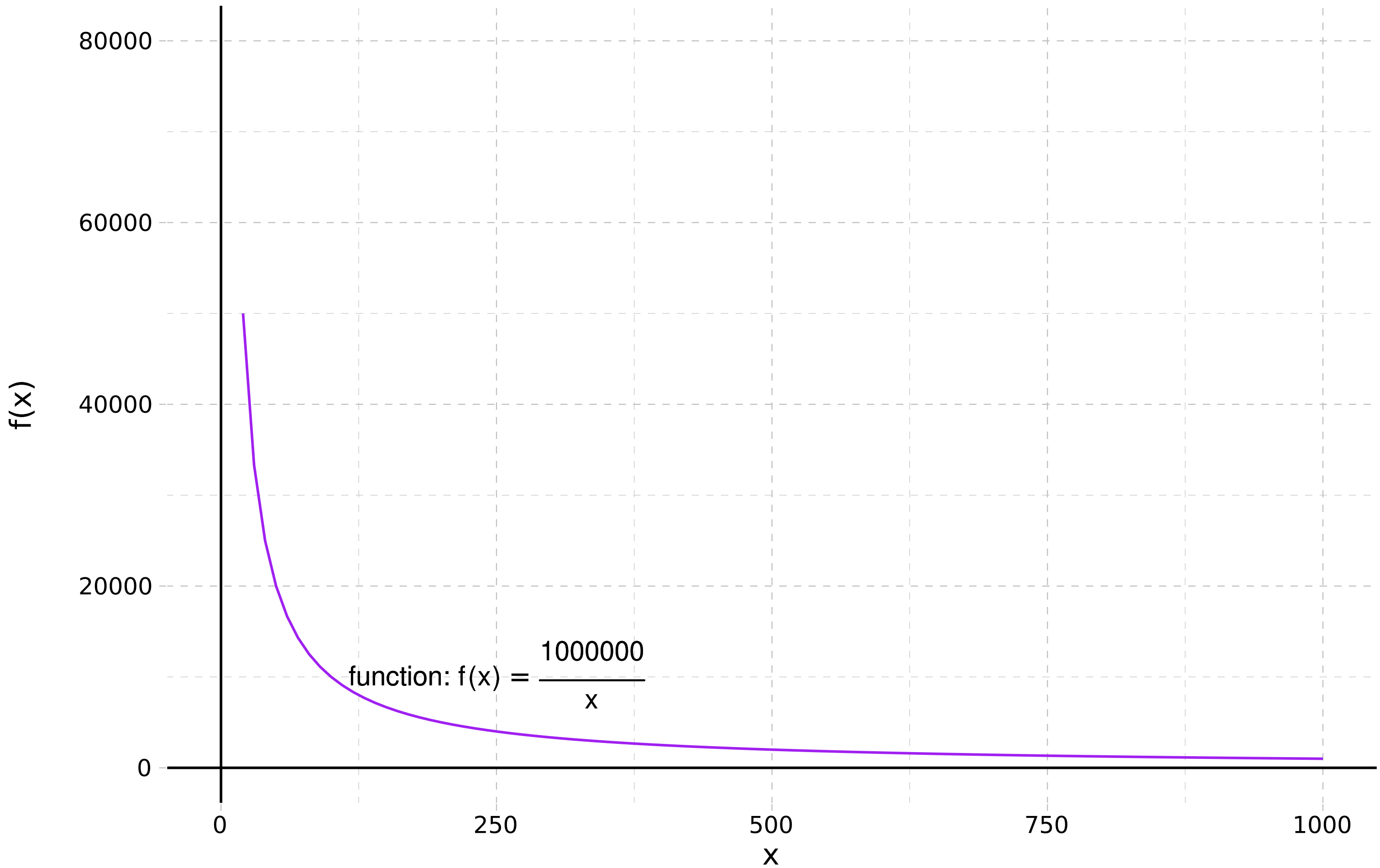
City Size in the US



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:

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

Where

- C represents a constant for a country/region
- N represents the population level

We can use the function described by Zipf's law to approximate city size based on rank

Zipf's Law: Example

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

- Use Zipf's law to figure out how many people are in the *fifth-largest* city

Two steps:

1) Calculate the constant C:

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

2) Use that info to calculate the population of the 5th largest city:

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

Zipf's Law: Example

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

Zipf's Law: Intuition

Q: In words, what does **Zipf's law** tell us about the relationship between **rank** and **city size**?

A1: In words, this equation says:

- **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%

Why 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.

Why Zipf's Law?

Q: *Why does Zipf's Law* do pretty well in general at describing city size?

A: **Axiom 2**: ***Self-reinforcing effects*** *generate extreme outcomes*

- "Winner take all" situations from policies, agglomeration, knowledge spillovers, etc.

- Wages grow, workers in, firms enter, $\rightarrow$ labor demand $\uparrow$ $\rightarrow$ wages grow . 🔁

Q: 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 increase**

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

(ii). **Pollution** increases

- 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

Utility

Utility is an abstract notion of peoples preferences. A few assumptions:

What we use to model the values individuals place on different city attributes

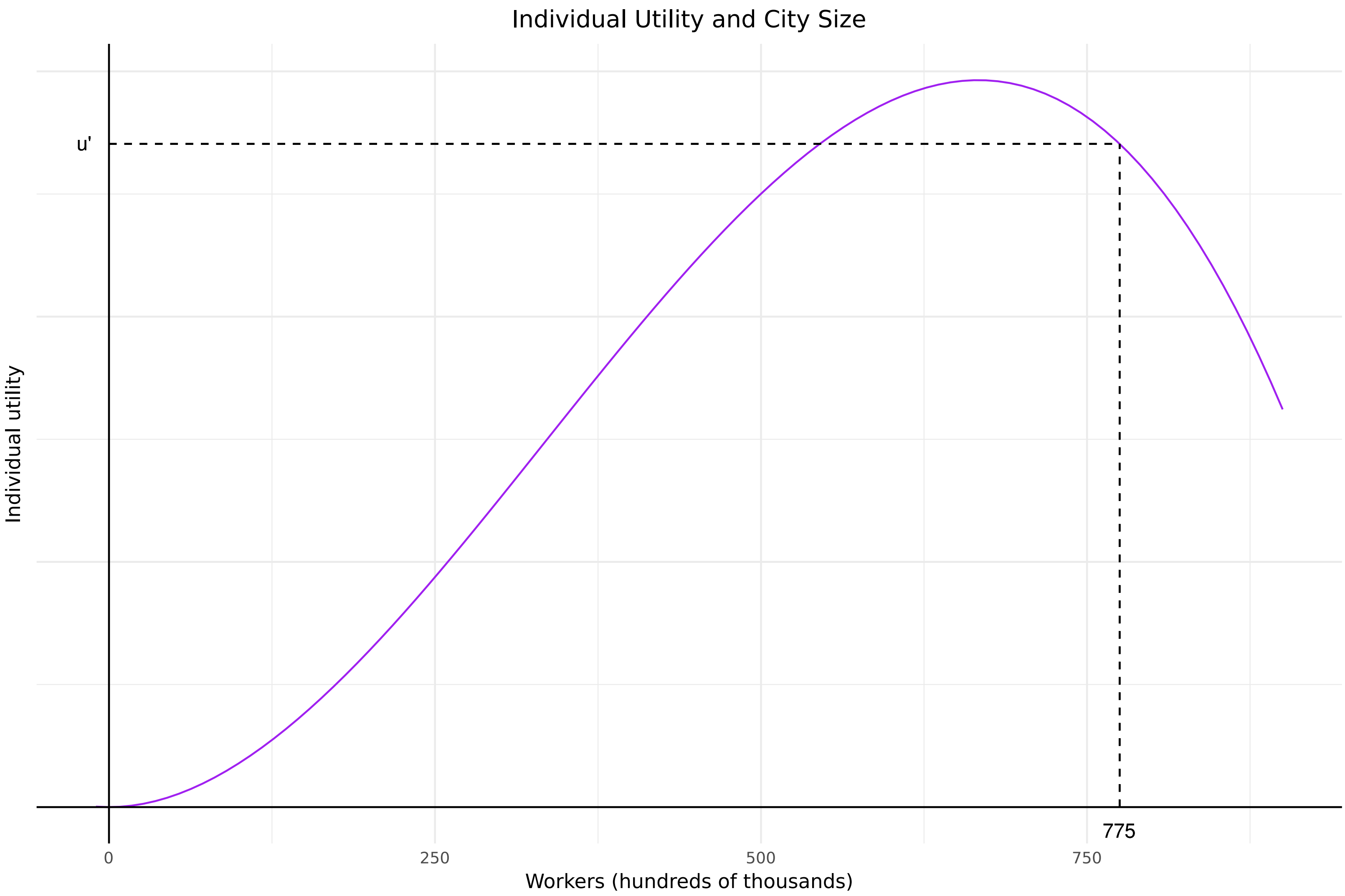
(i). Higher levels of utility are **preferred** to lower levels. And more consumption is better than less

(ii). ***Ordinal, not cardinal.*** Only the **rank** matters, not the **level**

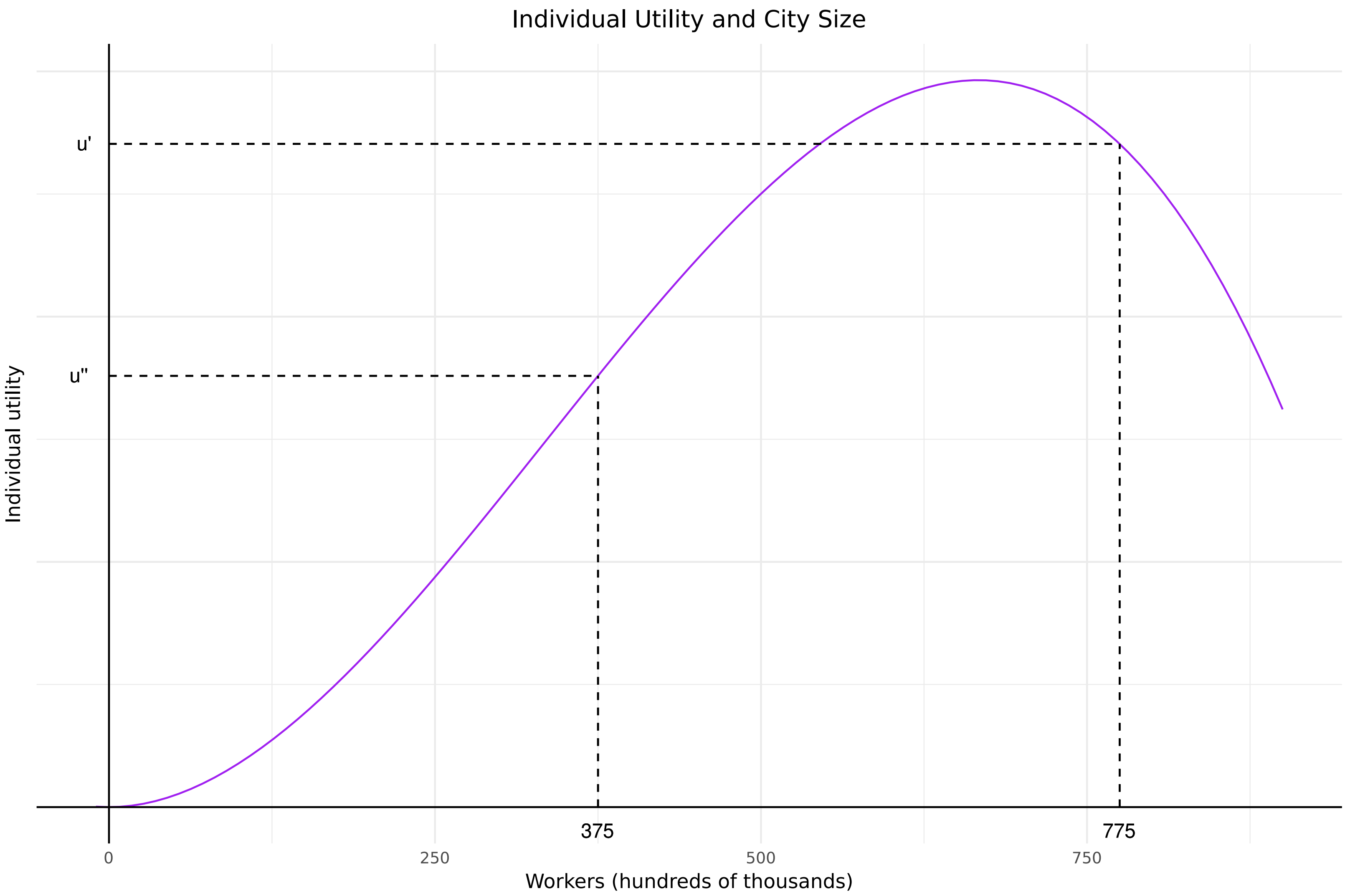
(iii). Marginal utility is diminishing (marginal value is diminishing)

Similar to the assumption that firms maximize profits, we also assume that individuals maximize utility

Modeling City Size



Modeling City Size



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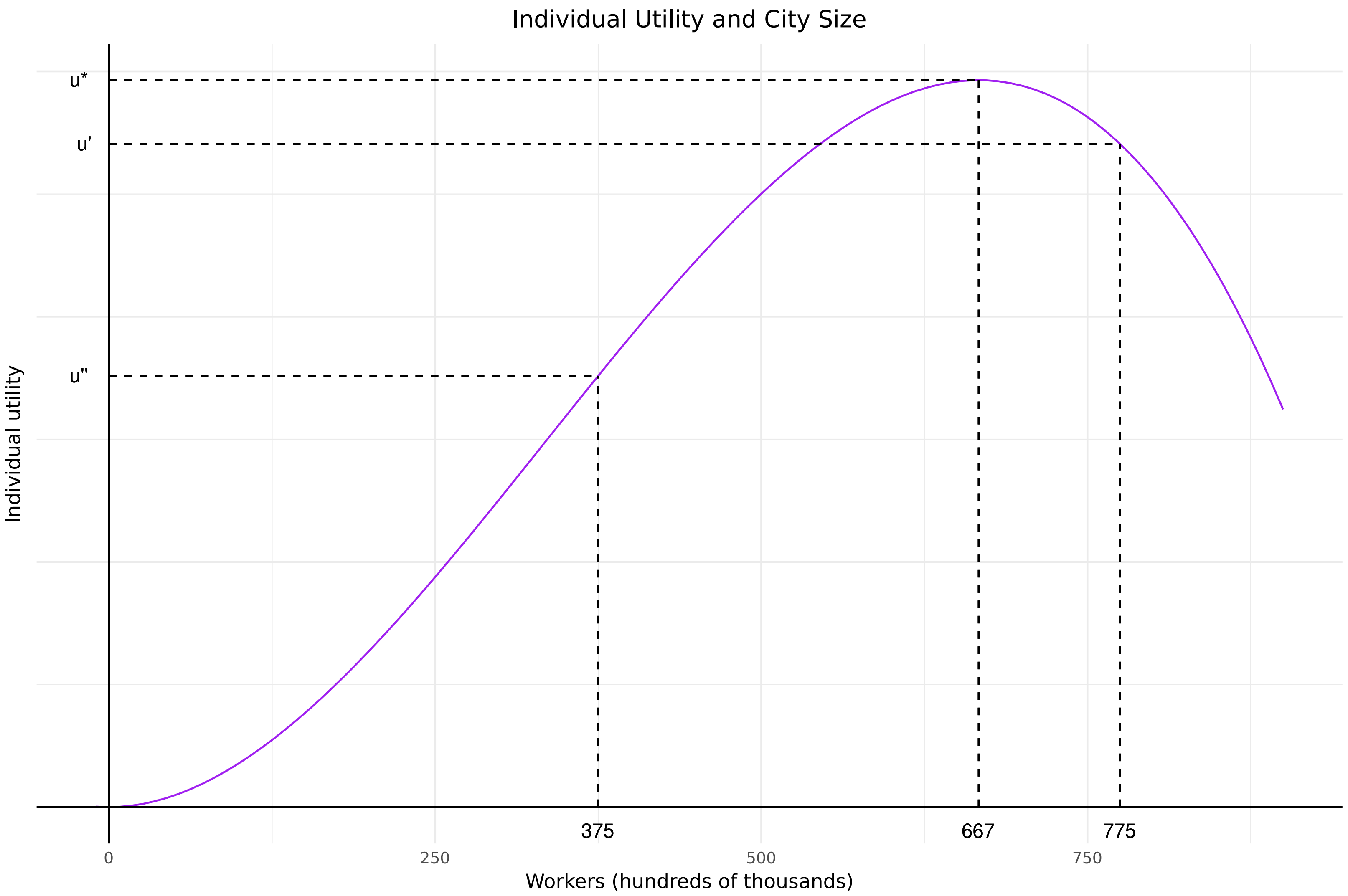


Locational Equilibrium

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

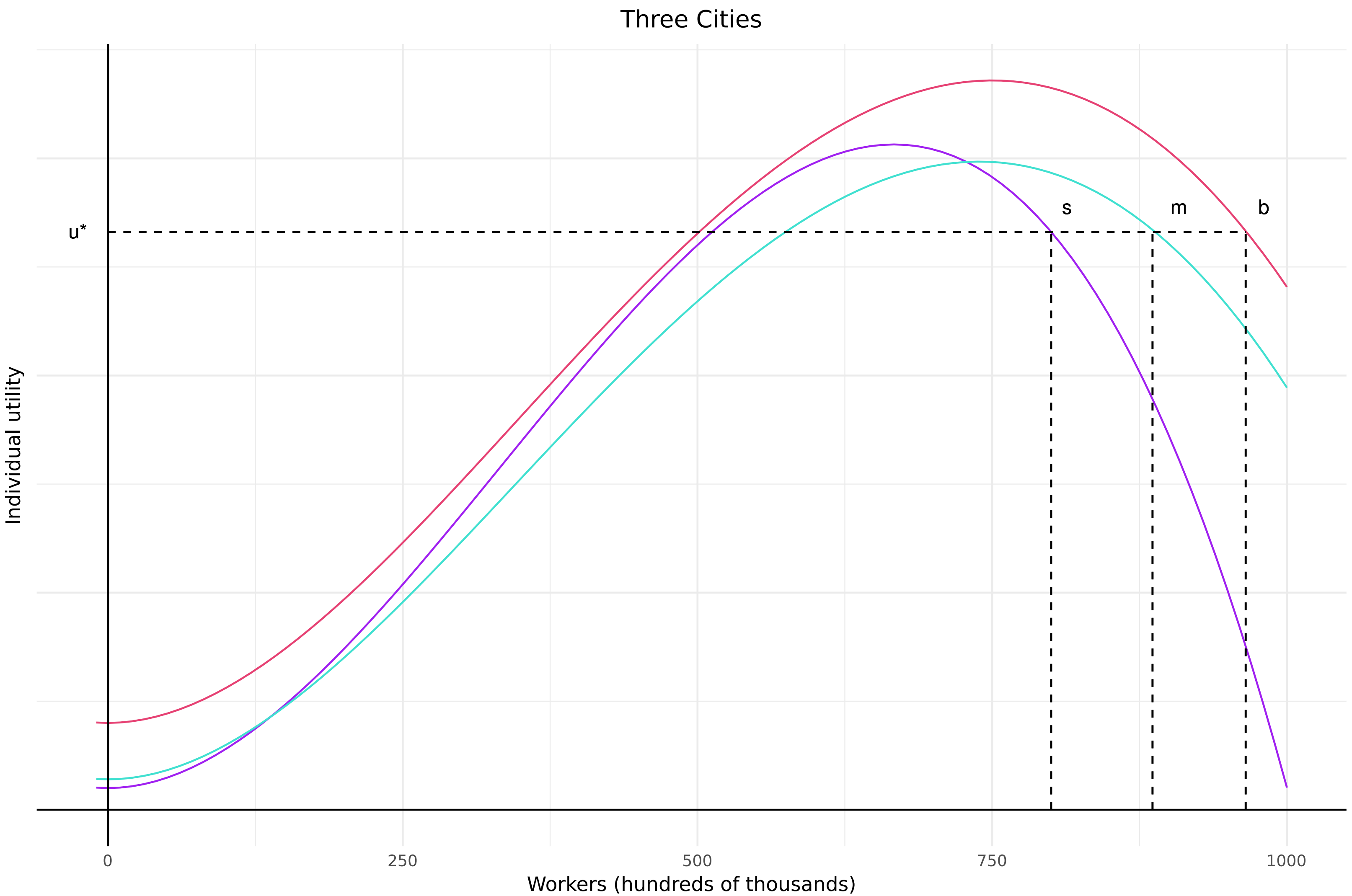
- Locational Eq is stable when the utility curve is downward sloping
  - $\implies$ Cities tend to be too large rather than too small

In practice, we usually do this by **worker type** (demographic, income level, education, etc)

- For now, we will just consider the case when **all workers are equivalent** (*but not cities*)

- This assumption is mostly for accounting purposes. Best to start simple.

Locational Eq Graph



Locational Eq: Implications

Back to the **real world**: *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 (**place-based** policies).

Intro to 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)

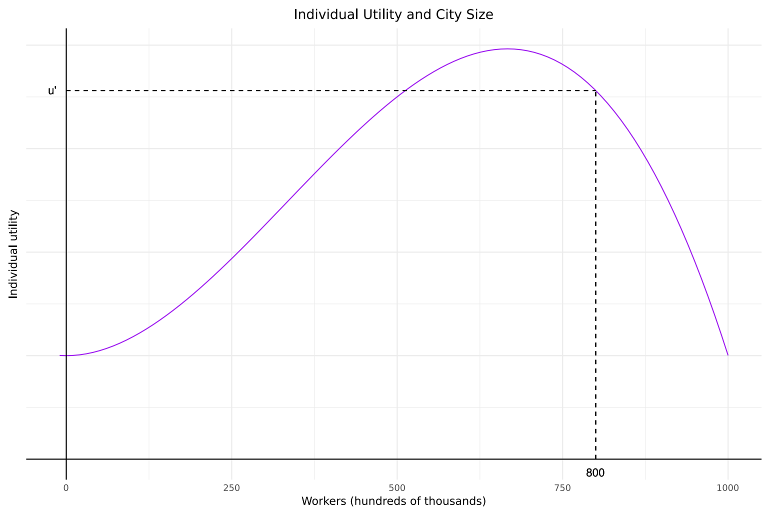
(ii). Increases in physical capital (computers 💻)

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

(iv). Technological progress (computers invented)

(v). Agglomeration Economies 🏙

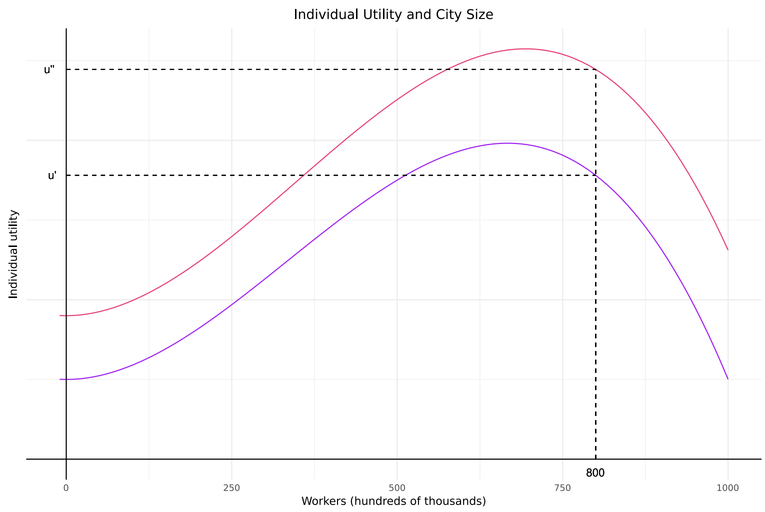
Example: Innovation



Initially: 2 cities, both with same utility curve

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

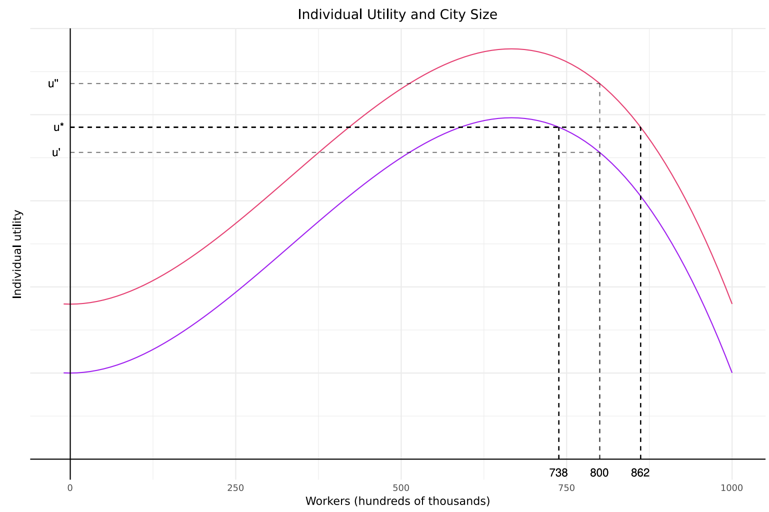
Example: Innovation



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 generally 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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