

Econ 330: Urban Economics

Lecture 6

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Lecture V: City Structure

Schedule

Today

- 1) **Bid Rents Continued**
- 2) **City Structure**

Upcoming

- **!! HWI due** (Sunday, April 18th) **!!**
- **Reading** (Chapter IV *ToTC*)

Firm's Bid Rent

What do we use to get the firm's bid - rent equation?

Axiom 5: *Competition generates zero economic profit*

Recall the profit equation:

$$\pi = TR - TC$$

In this model:

- $TR = P * Q$ (fixed, exogenous)
- TC is a function of freight cost, labor cost, and intermediate goods cost:

$$TC(x) = \text{Freight Cost}(x) + \text{Labor Cost}(x) + \text{Land Cost}(x) + \text{Intermediate Input Cost}$$

Firm Bid Rent

From here on out, let's call Intermediate Input Cost = \bar{I}

- Invoking zero economic profit, from the last slide we can write:

$$TR - (\text{Freight Cost}(x) + \text{Labor Cost}(x) + \text{Land Cost}(x) + \bar{I}) = 0$$

- **In words:** The most a firm would be willing to pay for land then is revenue net of non land cost. Rearranging:

$$\text{Land Cost}(x) = TR - \text{Freight Cost}(x) - \text{Labor Cost}(x) - \bar{I}$$

Note: Land Cost = $P(x) * L_m$, where:

- $P(x)$ is the *price of land at x miles away from the center*
- L_m is the *amount of land the manufacturer uses in production* (fixed input at L_m)

Firm Bid Rent: Equation

We can replace land cost with $P(x) * L_m$ to get the equation for the **manufacturing bid rent** curve

$$P(x) * L_m = TR - \text{Freight Cost}(x) - \text{Labor Cost}(x) - \bar{I}$$

Firm Bid Rent: Equation

We can replace land cost with $P(x) * L_m$ to get the equation for the **manufacturing bid rent** curve

$$P(x) * L_m = TR - \text{Freight Cost}(x) - \text{Labor Cost}(x) - \bar{I}$$
$$P(x) = \frac{TR - \text{Freight Cost}(x) - \text{Labor Cost}(x) - \bar{I}}{L_m}$$

In words, this equation says:

- Higher revenues \implies higher land prices **for every distance** x
- An increase in freight costs, labor costs, or intermediate input costs will **decrease** the price for every distance x

Example

Suppose

$$P = 5, Q = 2, FC(x) = 4x, \text{Labor}(x) = 1 - 3x, L_m = 1, \bar{I} = 0$$

- 1) Derive the firm's bid rent curve. Carefully write down your steps
- 2) What is the price the firm is willing to pay for land at $x = 1$?
- 3) Is the WTP higher or lower when we move away from the center?
- 4) What distance away from the center is the WTP zero?

Written Example

Written Ex (backup slide)

Back to Reality

How can a model like this help us understand the industrial revolution?

- What happened to freight costs? **They fell** A few innovations:

Transportation Innovations:

- Omnibus (1827)
- Cable Cars (1873)
- Electric Trolley (1886)
- Subways (1895)

In our model, what do these innovations do? **Decrease labor costs relative to freight**

More History

- The *intracity* truck (1910): twice as fast and half as costly as the horse-drawn wagon[†]
- Truck decreased the cost of moving **output** relative to the cost of moving **workers**
- Manufacturing Firms moved closer to low-wage suburbs

The *intercity* truck (1930): alternative to ships and rail^{††}

- **Highways**: orientation **shifted** from **ports** and **railroad terminals** to **roads**
- **Modern cities**: manufacturers oriented toward highways and beltways (freight costs decreased relative to labor)

[†] Intra = Within ^{††} Inter = Across

Checklist

1) **Bid Rents Continued** 

2) **City Structure**

City Structure

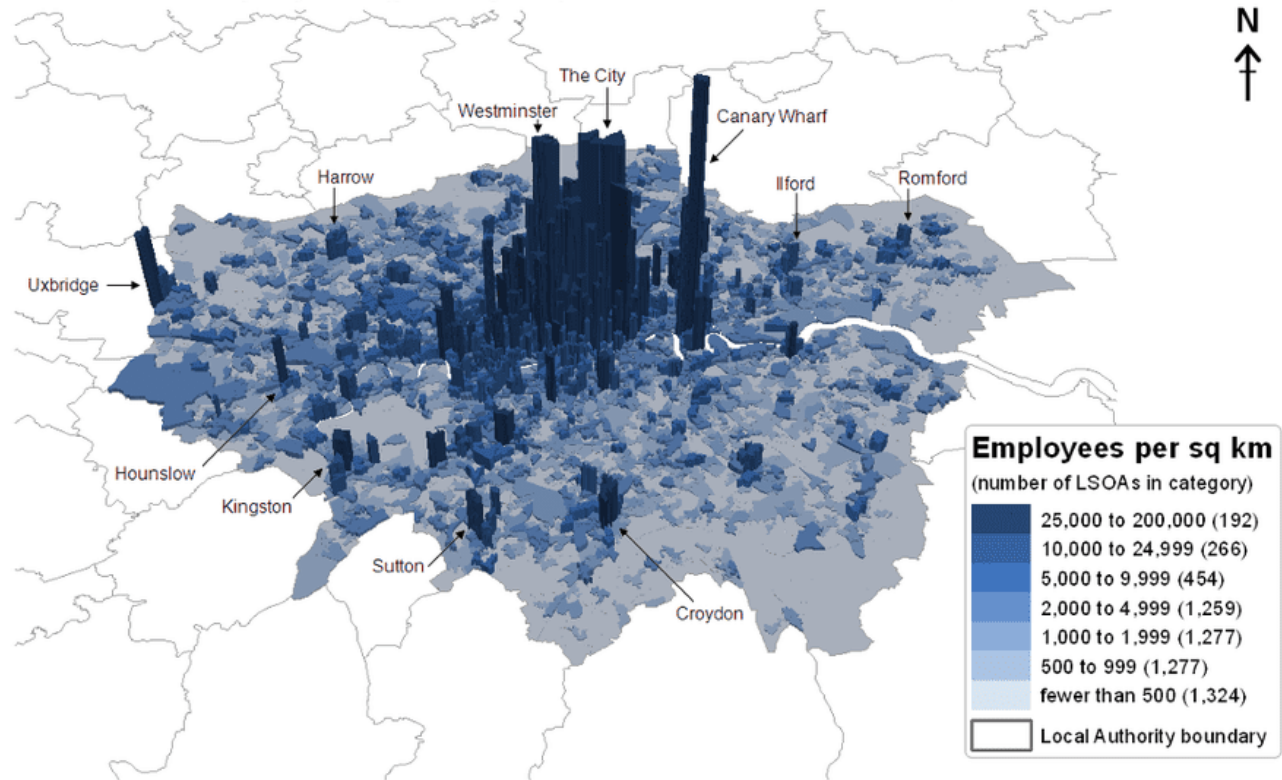
To recap **bid-rent curves**

- **Consumer/commuter/HH bid rents**: maps distance to city center to HH willingness to pay for land (or rents, or housing)
 - **Main tradeoff**: housing costs and commuting costs
 - Reasonable assumption: people substitute housing consumption for lower commuting costs (e.g)
- **Firm (manufacturing) bid rents**: maps distance to city center to firm willingness to pay for land
 - **Main tradeoff**: labor and freight costs
 - Perfectly competitive markets $\implies \pi = 0$

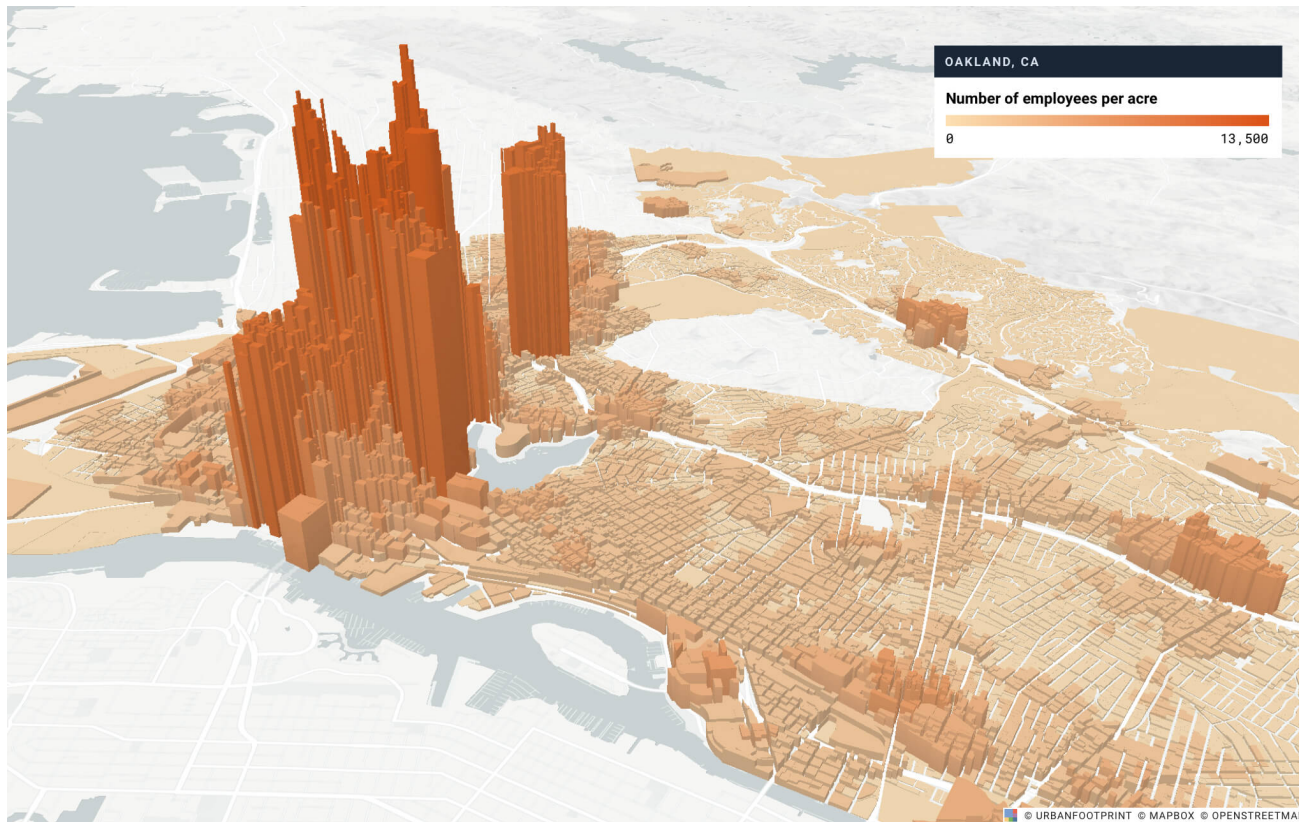
How do we put these together? And why?

Data

Number of employees (per sq km) in each London LSOA, 2013



Data



City Structure

Q: Why do cities look like this?

- Better question: why is employment density so high at the center of cities?

Let's put our bid-rent equations together and try and learn about why

Q2: Why are they called bid-rent curves, anyways?

- Because we assume land goes to the highest bidder! Keep this in mind

Example time!

Assume **offices** compete in perfectly competitive markets and their profit function is:

$$\pi_o = 105 - p(x_o) - (5 + 4 \times x_o)$$

where

- $p(x_o)$ is the offices wtp for land as a function of distance from city center
- $(5 + 4 \times x_o)$ is the office's labor costs as a function as a function of distance from city center

For commuters, assume they allocate $M^* = 100$ between housing and commuting.

Furthermore assume $h = 4$ and $t = 2$

Questions

1) Did we model substitution for commuters? 2) Derive the bid-rent curve for commuters 3) Derive the bid-rent curves for offices 4) Find the maximum distance the WTP for land for offices is greater than zero 5) Find the range that office locate and the range that commuters locate in the city

Written Example: Slide 1

Written Example: Slide 2


Written Example: Slide 3

So What?

Our original question: why is employment density so high at the center of cities? has a simple answer:

- Employers are willing to pay more at the center of cities than households
 - **Economies of Scale + Agglomeration** \implies scaling up and scaling closer is profitable
 - Greater benefits to firms because of the returns to scale and agglomeration
 - Individual households benefit from being close to the center but not by as much as the firms

Checklist

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