

Monocentric City Model and the Bid-Rent Function

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Urban Economics
Lecture 11

Set up for the Monocentric City Model

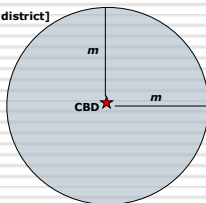
- "Featureless Plain"
- Single transshipment node - e.g., port or railhead
- Transportation cost per unit of output per mile is constant - t
- Exogenous agricultural rent - a

RESULT: two locations (in different directions) equally distant from the transshipment node are equally desirable

Monocentric City Model

CBD - transshipment node [central business district]

m - miles from CBD



Only Firms

- Assume (initially) that there are only firms and that all non-land inputs are *ubiquitous* and available at the same price everywhere
- Each firm occupies a point
- Each firm produces one unit of output which must be shipped from the transshipment point
- All firms maximize profit
- All firms are mobile across the space

Firms' Profits

- Assume output $Q=1$ is produced using inputs: one unit of capital $K=1$, one unit of labor $N=1$, and one unit of land L . Land is represented by a point, and a point cannot be simultaneously occupied by two firms*
- Firm's Profit = $TR - TC$
 - P =price of output at port
 - w =price of labor (wage)
 - k =price of capital (rental rate)
 - t =price of shipping one unit of output one mile
 - $r(m)$ =land rent at a distance m miles from transshipment point

NOTE: We are assuming a special kind of "fixed proportions" production technology; so there is no substitution among inputs

Firms' Profits (continued)

- Profit = $TR - TC$
 - = $PQ - wN - kK - tQm - r(m)L$
 - = $P - w - k - tm - r(m)$ (assuming $Q=N=K=L=1$)
- Profit = $[P - w - k] - tm - r(m)$
 - = constant - $tm - r(m)$
- If each firm is in Long-Run Perfectly Competitive Equilibrium, the **Zero Profit Condition** holds

Firm's Profits (continued)

□ Zero Profit Condition

implies

$$\text{Profit} = [P - w - k] - tm - r(m) = 0$$

$$= \text{constant} - tm - r(m) = 0$$

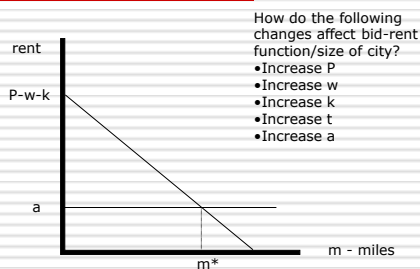
□ Solving for $r(m)$ gives:

$$r(m) = \text{constant} - tm$$

□ This is the equation of a straight line

- Intercept?
- Slope?

Firm's Profits (continued)



Household Mobility and the Bid-Rent Function

- No profit maximization; utility maximization
- No zero profit condition; HH must be *indifferent* to alternative locations in long run equilibrium
- Above condition is equivalent to Zero Profit Condition in the sense that there is no incentive to move

Framework of the Problem

- There is a reference or base level of satisfaction (utility): U_0
- Utility depends directly on non-housing consumption (G), housing (H), and indirectly on commuting cost (t per mile): $U(G,H)$
Utility function represents willingness to substitute between G and H
- All employment is in the CBD

Household Choice of Location

Household Budget

W = wage income

t = commuting cost (round trip) per mile

G = amount of non-housing good consumed (the price of which is assumed to be 1)

Is this OK?

G is the numeraire good

Only relative prices matter (assuming that the price of G is never zero)

H = amount of housing consumed

P_H = price of housing

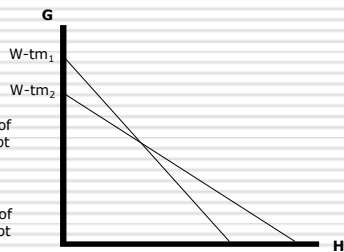
$W - tm = G + P_H H$

Household Choice of Location

Consider two locations, m_1 and m_2 from the CBD

What is the intercept on the horizontal axis of the line whose intercept on the vertical axis is $W - tm_1$?

What is the intercept on the horizontal axis of the line whose intercept on the vertical axis is $W - tm_2$?

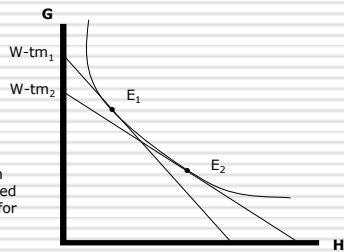


Household Choice of Location

Consider a HH which is indifferent between locations m_1 & m_2 miles from CBD

At which location, 1 or 2, is more housing consumed?

At the location at which less housing is consumed how do HH "make up" for less housing?



Household Locational Choice

- Trace out the bid-rent function (P_H as a function of distance from the CBD)
- Trace out the housing consumption curve (H as a function of distance from the CBD)

Household Location – Teaser Questions

- If the HH has L-shaped indifference curves, what will the locational choice look like?
- If the HH has L-shaped indifference curves, what will the bid-rent function look like?
- If the HH has L-shaped indifference curves what will the housing consumption curve look like?

Household Locational Choice

What other variables might be included in the analysis?

- Household choice variables
- Public choice variables

Household Locational Choice and Mobility

- The "indifference condition" is the equivalent to the Zero Profit Condition
- U_1 = utility (or satisfaction) in location 1
 - U_2 = utility (or satisfaction) in location 2
 - $U_1 = U_2$
- How "indifference condition" is affected by
- HH choice variables
 - Public choice variables
