# Monocentric City Model and the Bid-Rent Function

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Urban Economics

Lecture 11

# Set up for the Monocentric City Model

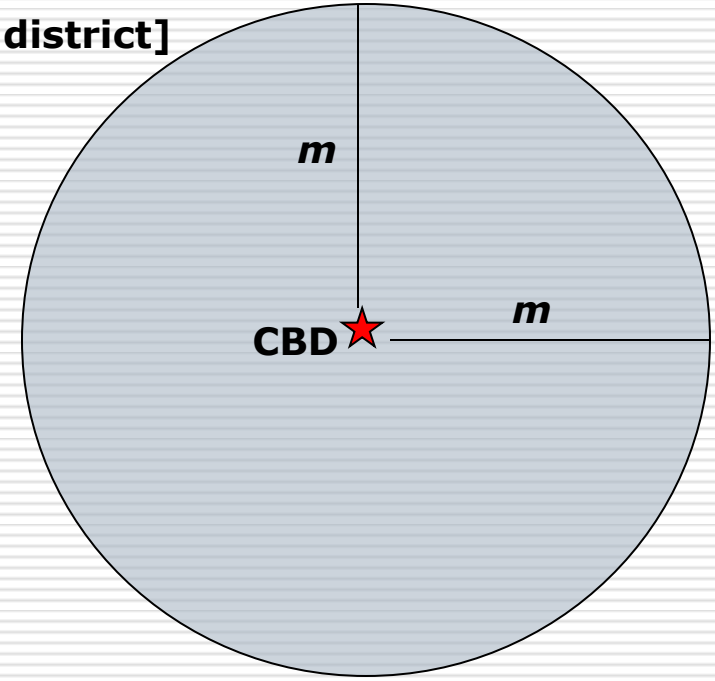
- "Featureless Plain"
- Single transshipment node – e.g., port or railhead
- Transportation cost per unit of output per mile is constant – t
- Exogenous agricultural rent - a

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***

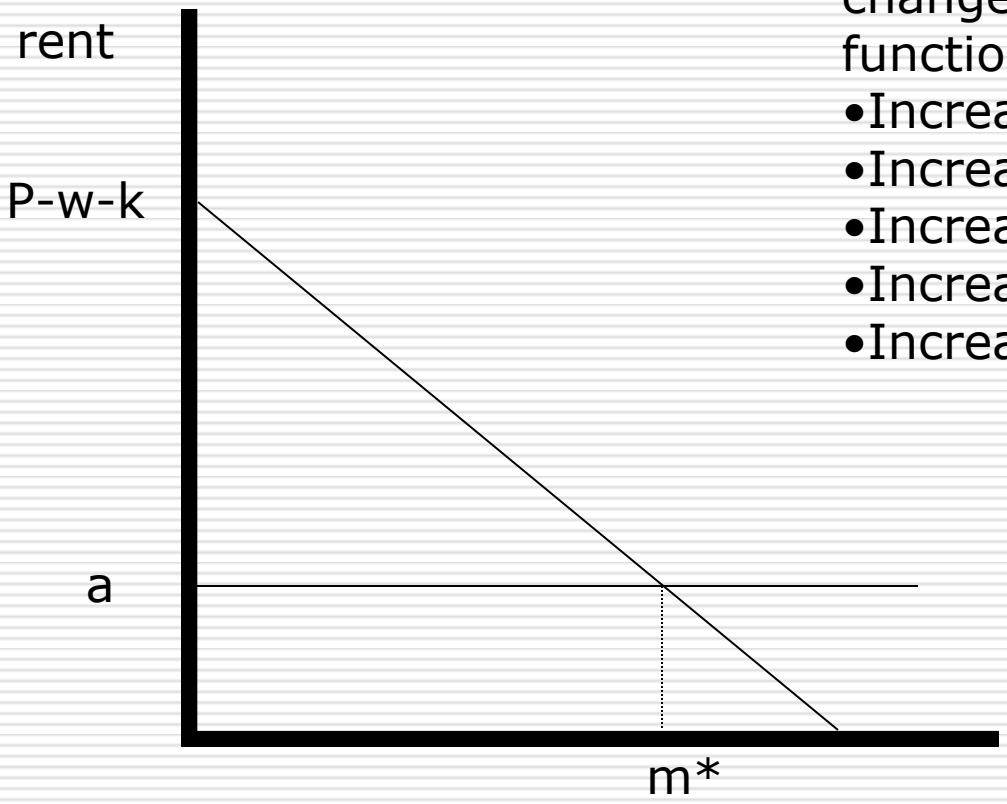
  implies

  Profit=[P-w-k]-tm-r(m)=0

  =constant-tm-r(m) = 0
- Solving for r(m) gives:

  r(m)=constant-tm
- This is the equation of a straight line
  - Intercept?
  - Slope?

# Firm's Profits (continued)




How do the following changes affect bid-rent function/size of city?

- Increase P
- Increase w
- Increase k
- Increase t
- Increase a

# 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 = amoung 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**

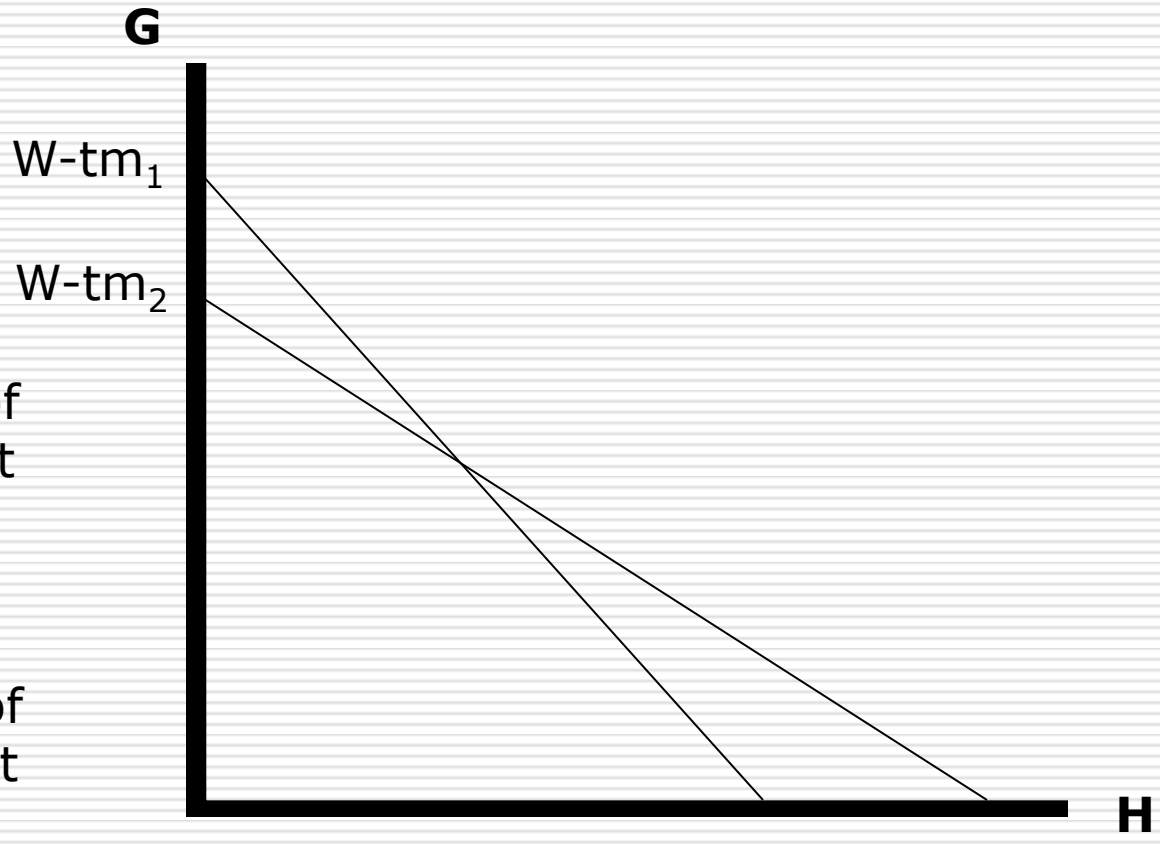
**$W - tm = G + P_H H$**

# 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-$tm_2$?

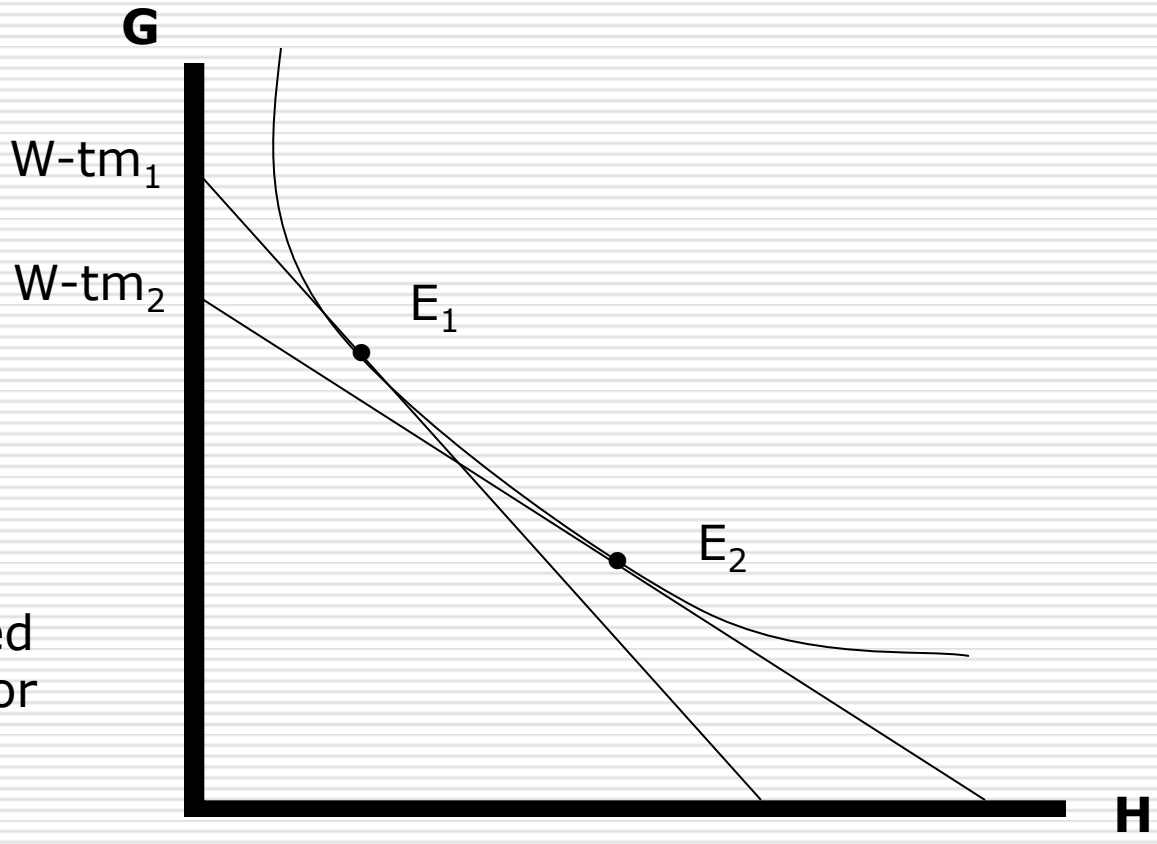


# Household Choice of Location

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 anlaysis?
  - 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