

GEOGRAPHICAL ECONOMICS

"B"

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week 3

Von Thünen models

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1 Von Thünen Model

Topics for today

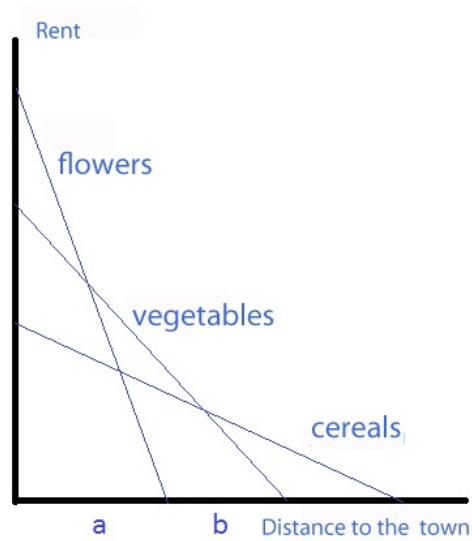
- Von Thünen (1826), Lösch (1954)
- Fujita Thisse 3.2.-3.3
- The basic Von Thünen model
- Formal exposition
- Extensions
- CBD models

1.1 Basis

The basic Von Thünen model

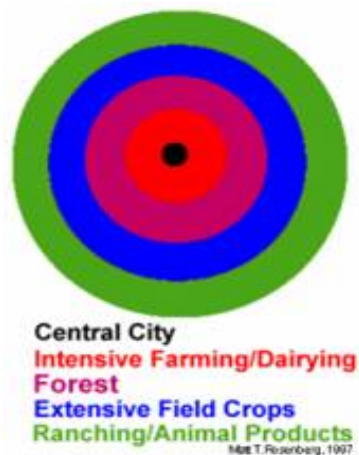
- R = rent
- c = cost of production per unit
- Y = rate of return
- p = price per unit
- F = transportation cost
- m = distance to the market
- $R = Y(p - c) - Y * F * m$

The basic Von Thünen model



A Von Thünen example

- Von Thünen (1826) – monocentric city
- The location of a certain activity depends on the transportation costs.
 - Vegetables/Fruits
 - Wood
 - Wheat
 - Animals

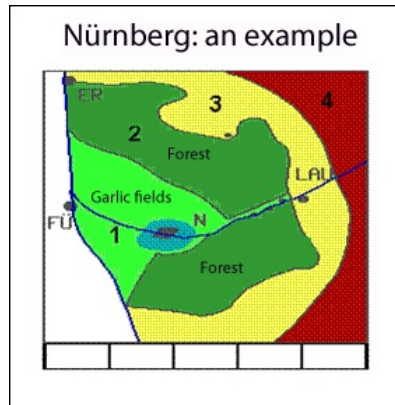


A Von Thünen example

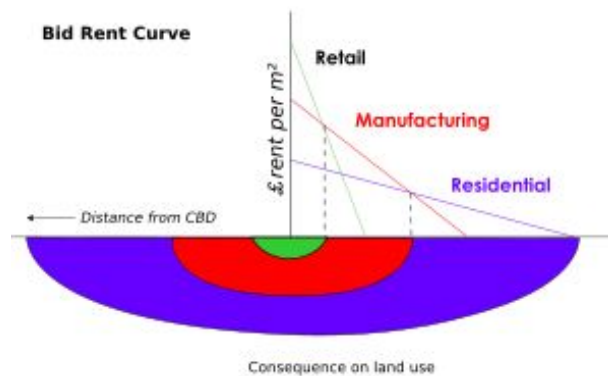
- Garlic cultivation
 - Lots of small enterprises

– Direct marketing

- Forests
- Corn
- Grazing



The same applied to a city



- Von Thünen design game: <http://www.casa.ucl.ac.uk/software/vonthunen.asp>

1.2 CBD: The urban land rent

Assumptions

- City model – trade-off between accessibility and space in residential choice
- Alonso (1964), Mills (1967), Muth (1969)
- Monocentric city's one dimensional model, the center is called the central business district (CBD)
- N identical workers commuting to the CBD
- Income Y
- Utility: $U(z, s)$, where z denotes the composite good, which price is $p_z = 1$, s denotes the lot size of housing

- U is strictly increasing in each good, twice continuously differentiable, and strictly quasi-concave; both z and s are essential goods, s is a normal good. **HW: detailed explanation**
- $R(r)$ is the rent, $T(r)$ is the cost of transportation, which is strictly increasing in r .
- The expenditure constraint of workers at r distance from the CBD: $z + R(r)s + T(r) = Y$

Utility

- $$\max_{r,z,s} U(z,s), z + sR(r) = Y - T(r) \tag{1}$$

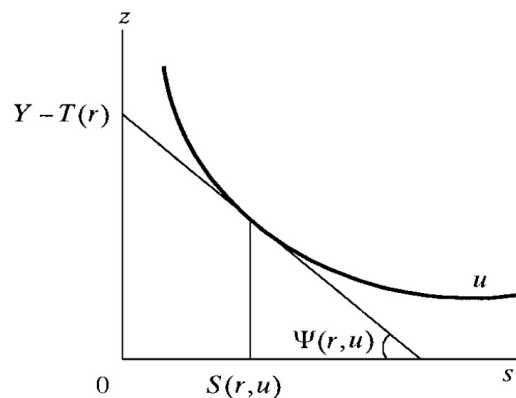
- Each worker is identical, thus $U = u$
- How it differs from the previous model?
- The worker chooses the location (endogeneously)
- This is the point: choice between lot size and transportation costs
- The bid rent function $\Psi(r, u)$ is the maximum rent that a consumer is willing to pay at distance r beside utility u . *Max bid rent, s.t. u*

- $$\Psi[Y - T(r), u] = \max_{z,s} \left\{ \frac{Y - T(r) - z}{s}, U(z,s) = u \right\} \tag{2}$$

- For a consumer residing at distance r and consuming (z,s) , $Y - T(r) - z$ is the money available for land payment; $\frac{Y - T(r) - z}{s}$ represents the rent

Maximizing utility

- We get the rent by choosing a consumption bundle of (z,s) , while $U(z,s) = u$.
- The equilibrium is the tangency point between the budget line of slope $\Psi(r, u)$ and the indifference curve: $S(r, u)$ is the equilibratory lot size in r :



Results

- What is the relationship between rent and distance?

- $\frac{\partial \Psi(r,u)}{\partial r} = -\frac{T'(r)}{S(r,u)} < 0$

- Similarly $\frac{\partial S(r,u)}{\partial r} > 0$

Theorem 1 *The bid rent function is continuously decreasing, while the lot size function is continuously increasing in the distance from the CBD.*

- Further results:
- Each worker who resides further, lives in a bigger flat and consumes less from z .
- Close to the CBD the population density is higher.

CBD vs Thünen

- What is the difference between the Thünian and CBD models?
- von Thünen: the profit of each activity is zero
- CBD: everyone consumes s land, utility is endogeneous (nonzero)

Key terms

- basic Von Thünen model
- bid rent function
- isolated town
- CBD