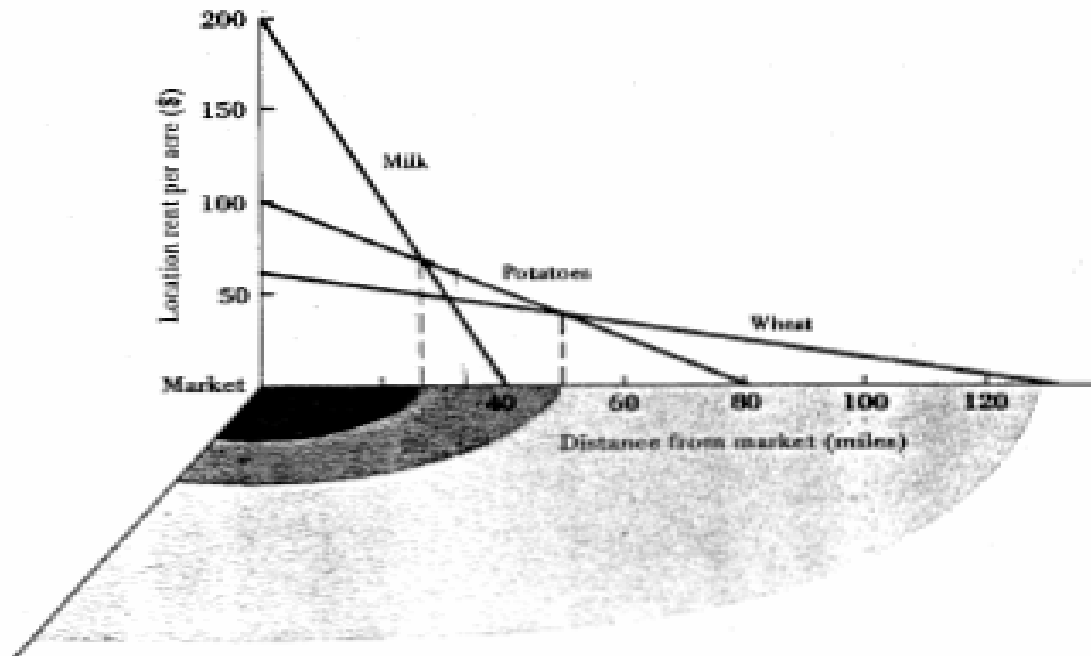


GGR220Y Lecture 4

Modelling the Allocation of Land to Competing Uses:
Sinclair and Alonso

Introduction

- Last day we examined Von Thunen's model of how land is allocated to competing agricultural uses.
- The key to Von Thunen's model is the allocative mechanism – Location Rent.



Location Rent

- LR is a measure of the surplus to a farmer of a given crop on a given parcel of land.
- LR is a measure of the value of a parcel of land to a farmer of a given crop at a specific distance from the central market.
- **Key Question:**
 - **Exactly how does Von Thunen's concept of LR represent the process which gives land value?**
 - **In other words, what is it about specific parcels of land which translate into value from the farmer's perspective?**
- **Hint:**
 - **What is the sole variable in the LR formula?**

Location Rent Continued...

- **Answer:**

- The only variable in the LR formula is “d”, or distance from market (i.e., accessibility).

$$LR = Y(m - c) - Ytd$$

- Parcels of land are only distinguished in terms of their distance from market.
- E.g., a corn farmer places value on land for corn farming purely on the basis of how far each parcel of land is from the market.

Discussion

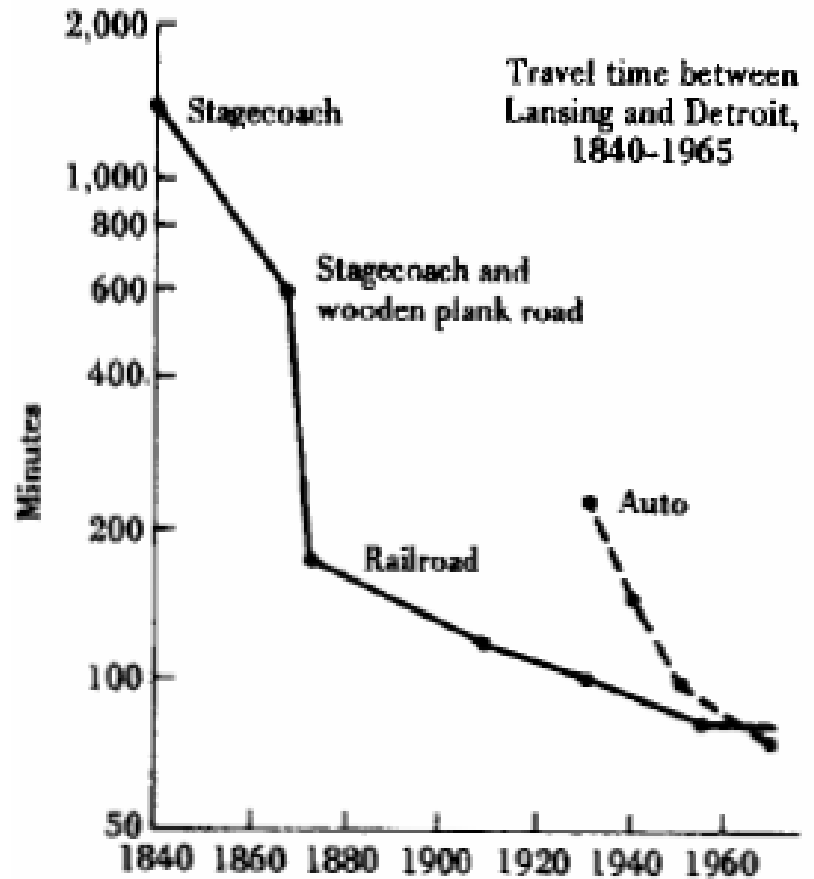
- This very restrictive interpretation of the process which sets the value of land (and hence its use) is due mainly to our very restrictive assumptions.
- In reality, parcels which are very close to the city may have zero value for agriculture if they are unsuitable for that use.
 - Von Thunen's solution holds under the assumption of uniform resource endowments for all parcels of land.
- **Key Question:**
 - Can you envision another process which would act to set differential values on parcels of land even under the assumption of uniform resource endowments?

One Answer: Sinclair's Reversal

- Sinclair (1967) noted that in developed economies especially, LR may in fact be the primary allocative mechanism which acts to set differential values on parcels of land, and influence the way in which they are used.
- **But!**
 - He interpreted the process which determines LR quite differently.
 - In Von Thunen's time, the primary factor influencing how land was utilized (i.e., its value) was distance to a central market.
 - Central places located at the centre of a largely isolated agricultural state were the norm.
 - As well, **the friction of distance was very high.**

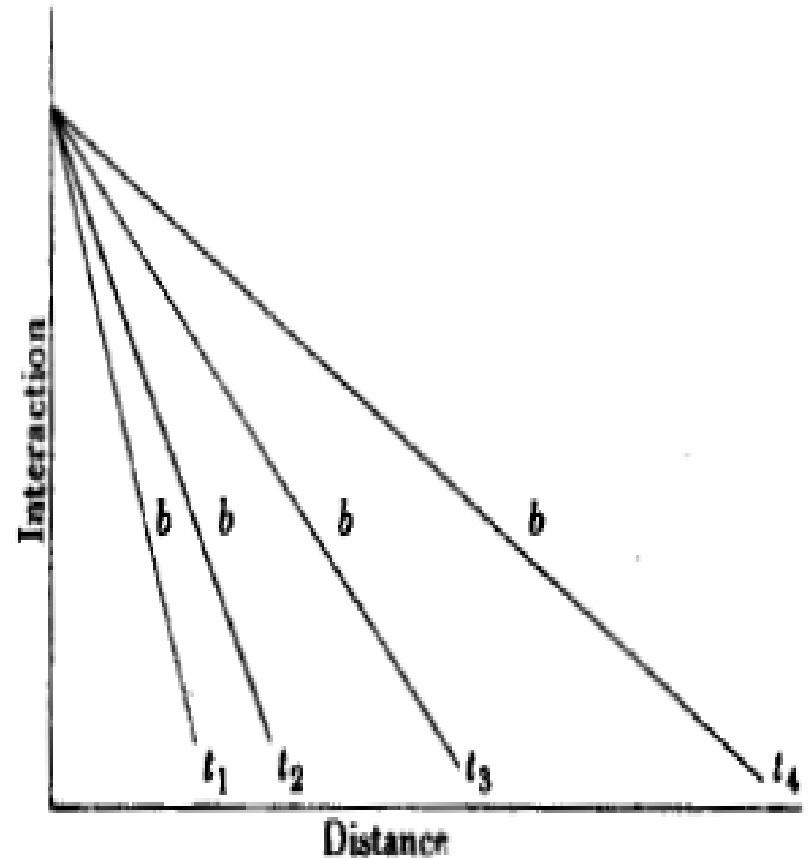
Consider the effect of distance

- Here we see the effect of transportation improvements on the travel time between Lansing and Detroit Michigan over the period from 1840-1965.



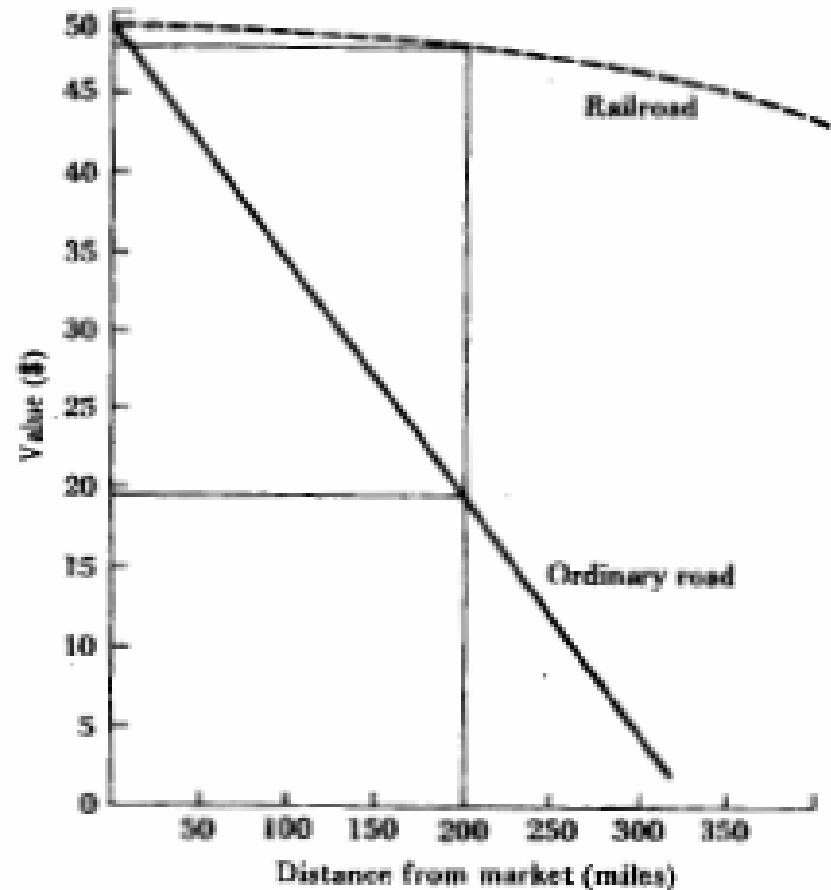
The impact on spatial interaction

- The impact of these improvements has been an overall reduction in the friction of distance.
- In the context of the gravity model, the distance parameter (b or β) has been consistently and dramatically reduced.
- The result has been (as we move from t_1 to t_4) a flattening of the distance decay curves.
- Flatter distance decay curves translate into spatial interaction taking place over greater distances.



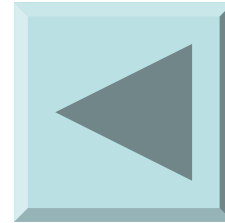
The impact of declining friction of distance on commodity prices

- Here we see the impact of a transportation improvement on the value of wheat in the US in the 1850s.
- While very old, the data illustrates an important point:
 - Declining friction of distance can change the economics of a particular crop/land use.



Von Thunen and Sinclair – Separated by a Century

- Von Thunen was writing in the time of the stagecoach while Sinclair was writing well into the era of the automobile.



- In addition, Sinclair was writing in the US at a time when massive amounts of public investment in transportation infrastructure was further reducing the friction of distance.

Sinclair

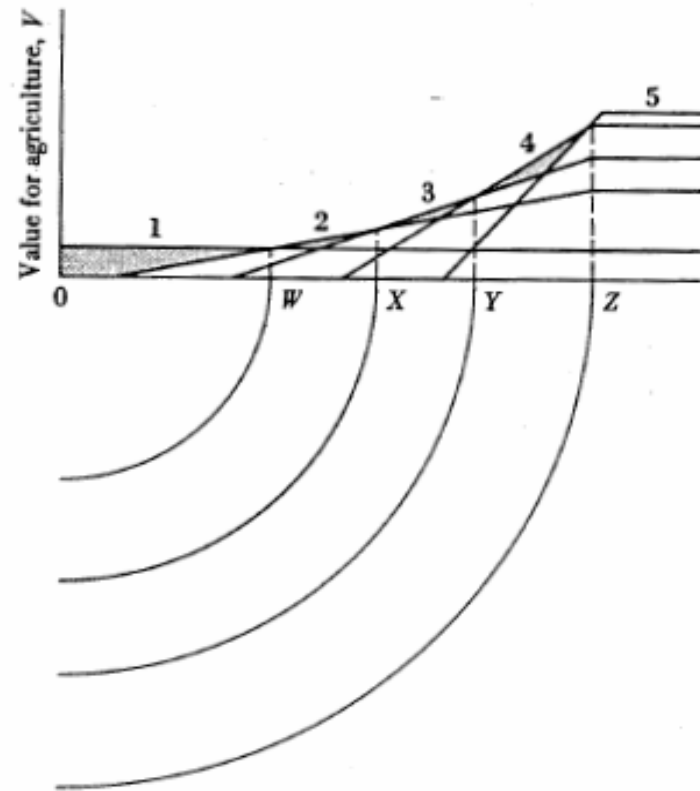
- Sinclair developed his model/explanation in a modern North American context.
- At this time and place, central places were characterized by:
 - less dependence on their immediate hinterlands for the provision of agricultural goods;
 - A much higher degree of openness;
 - Readily accessible and affordable transportation services;
 - An extensive network transportation infrastructure (through public-sector investment); and, not surprisingly,
 - RAMPANT URBAN SPRAWL!

Sinclair's View of the Process

- Recall that Von Thunen hypothesized that land closest to market would be the most valuable, most sought-after and most intensively used for agriculture.
- **Sinclair suggested that the variation in LR over space had much more to do with the trend toward urban sprawl than with distance to market.**
- That is, Sinclair hypothesized that the **probability of urban encroachment** determines the value of a given parcel of land for agricultural use.
- History has proven that urban uses are able to outbid non-urban (i.e., agricultural) uses for land.
- Land closest to the urban-rural fringe has the highest probability of being converted to urban use.
 - Therefore its **ANTICIPATED VALUE** in urban use exceeds that for agricultural use.

Sinclair's Suggested Land Use Zones

- If a farmer or land owner is expecting a higher return from a parcel of land when converted to urban use, then he/she may SPECULATE and withhold this land from production.
- As such, where the probability of encroachment is high, the value of land for agricultural use is very low.
- Hence, land does not begin to have value for agricultural use until the probability for urban conversion becomes very low.
- Note how LR curves are increasing (sloping upward) with distance from the city.



Now lets consider how land use is determined
within cities

How are urban land uses allocated? Alonso

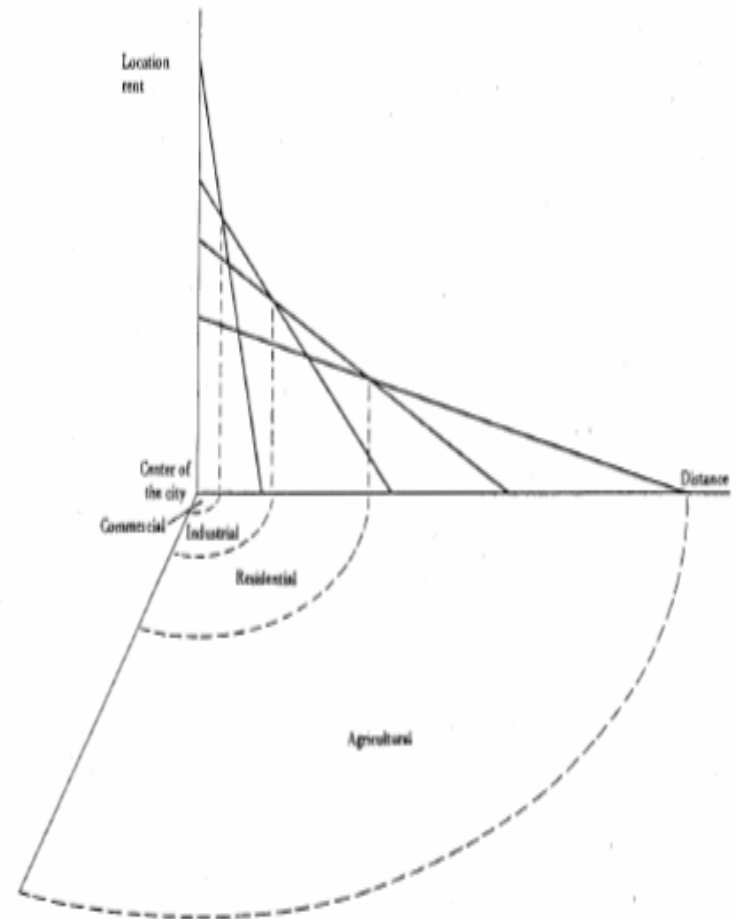
- William Alonso (1964) formally applied Von Thunen's conceptual framework to the task of explaining how land uses are distributed within a central place.
- Like Von Thunen, Alonso began with a set of simplifying assumptions, and made extensive use of the location rent concept.

Alonso's assumptions

- The city has one Central Business District (CBD).
- All employment opportunities are located in the CBD.
- All buying and selling of goods takes place in the CBD.
- ISOTROPIC PLANE.
 - All parcels of land are identical except in terms of their distance from the CBD.
- ECONOMICALLY RATIONAL buyers and sellers.
- Alonso was attempting to represent the situation whereby the CBD was the most accessible and most desirable location in the city.
- Those urban land uses which were able to bid the highest for the use of parcels of land closest to the CBD were able to gain access to these parcels of land.

Spatial Pattern of Urban Land Uses

- Those urban land uses which have the steepest LR curves are those which are least able to bear distance from the CBD, and hence those willing to pay the most for access to parcels closest to the CBD.
 - Retailing uses tend to be located in the CBD.
- While a short journey to work is a desirable thing, residential uses generally cannot outbid retail uses for this land.
 - high intensity residential can compete, as can high value-added services.

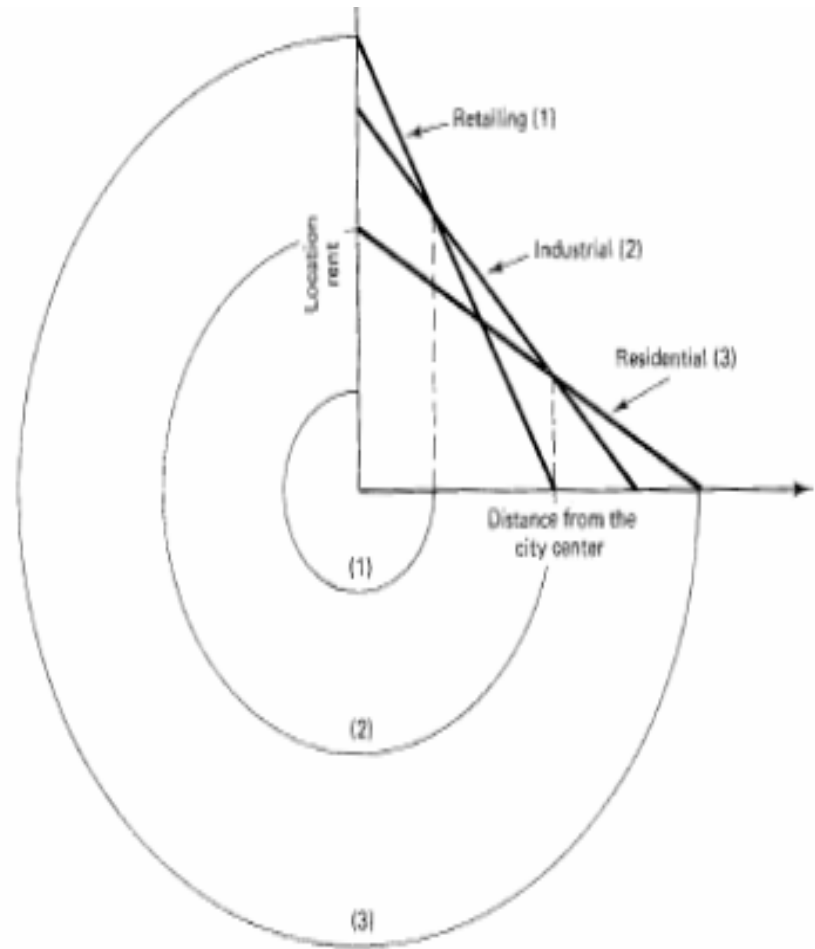


Slope of the Bid-Rent Curves

- Note how those uses with the steepest bid-rent curves tend to be those which are most dependent on access to the market.
- This market can be:
 - a large residential community;
 - A daily flow of commuters past a specific intersection;
 - E.g., retailers define “hot-corners” according to target markets.
 - For some, the hot corners are located in the under-ground network of tunnels connecting office towers in Toronto.
 - For others, it is the flow of automobile-oriented suburbanites who travel to the power centres on weekends.
- In either case, access to these flows is key to a retailers success, and the degree of unfettered access to these flows sets the value of land.

Alonso's Main Postulates

1. Land values decline with increasing distance from the CBD.
2. Land uses will be sorted into concentric zones radiating outward from the CBD, for example;
 1. Retailing
 2. Manufacturing;
 3. Residential



Empirical Validity of Alonso's Postulates

- **Postulate 1 was evaluated by Siefried (1963) in the context of Seattle, WA.**
 - Siefried collected data on MEAN ASSESSED VALUE PER SQUARE FOOT for street intersections radiating outward from the CBD in 4 compass directions;
 - Fit various statistical models to the data in an attempt to determine whether or not the MAV could be explained using distance from the CBD as a variable.
 - Applied a variety of models:
 - linear model $MAV = a - bd$
 - Power function $MAV = ad^{-b}$

Alonso's 1st Postulate

- Here we see an actual land value surface for Topeka Kansas.
- The CBD as the point of maximum accessibility is the point of maximum desirability and hence it has the highest value.
- Siefried sought to evaluate the extent to which this trend held in the context of Seattle, WA.

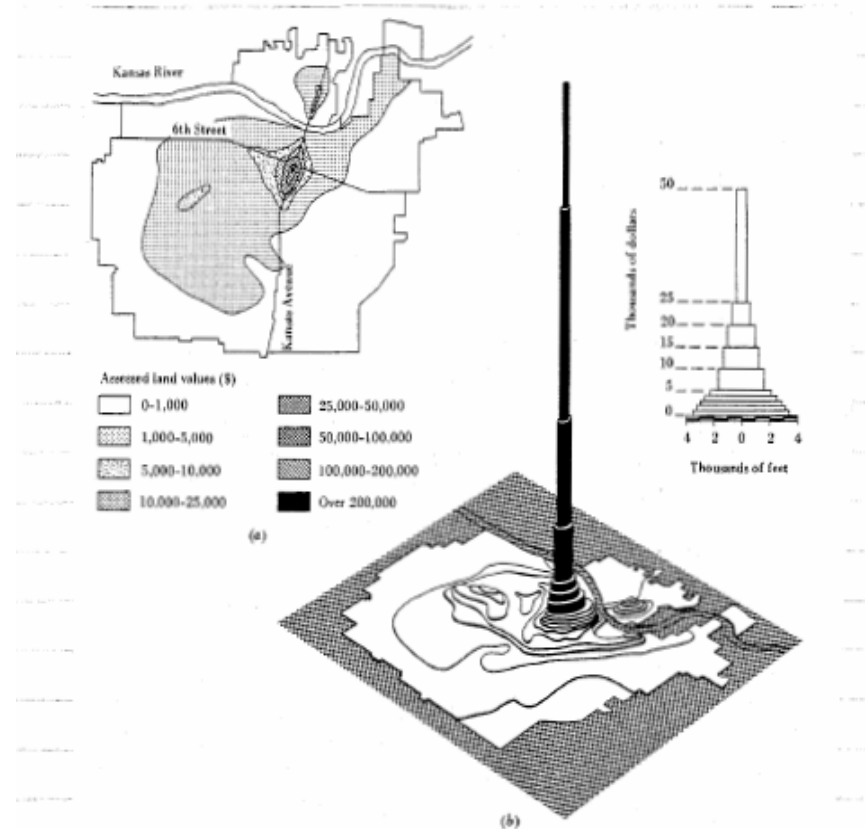


Figure 1.35 The pattern of land values in Topeka, Kansas: (a) Assessed land values, 1954–1959; (b) Isometric land values. Source: D. S. Knos (1962), *The Distribution of Land Values in Topeka, Kansas* (Lawrence: University of Kansas Press), figs. 1 and 2.

Siefried's findings re Postulate 1

- Siefried's findings provide strong support for Alonso's first proposition.
- All slope terms (b 's) were negative and significant as Alonso's model predicts.

TABLE 2.5 CORRELATION AND REGRESSION RESULTS FOR LAND VALUE GRADIENTS IN SEATTLE, WASHINGTON

	North	South	East	West
Linear function				
r	-0.275	-0.356	-0.454	-0.959
b	-0.240	-0.048	-0.244	-8.610
Power function				
r	-0.795	-0.928	-0.895	-0.914
b	-0.807	-1.078	-1.576	-2.343

Source: W. R. Siefried, "The centrality of urban land values," *Land Economics*, 39 (1963), Table I, p. 280.

Postulate 2

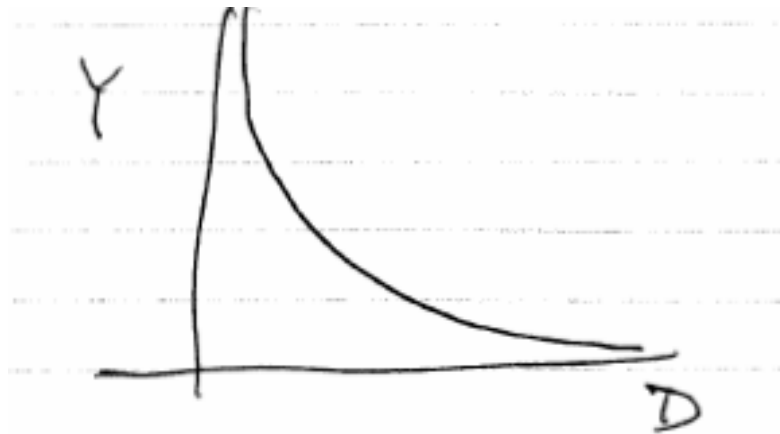
- Alonso's 2nd postulate regarding the zonation of land uses was assessed by Mills (1972) using a sample of 18 US Metropolitan areas.
- Mills measured employment densities by industry at various distances from the CBD.
- He sought to model employment density gradients (for given types of employment e.g., retailing, manufacturing etc.) as a function of distance from the CBD.
- If Alonso's postulate is to be substantiated, we would expect to see the density gradients correlating negatively with distance from the CBD, and with some uses have much larger negative slopes than others.

Mill's approach

- Defined the following functional form for the relationship between density gradients and distance;

$$\textit{Density} = ae^{-bD}$$

- The hypothesized relationship looked like (Y=Employment Density):



Mills' Findings

- For all periods, as predicted by the Alonso model, the density gradient for retailing is the steepest.
 - Implying that this use is most dependent on access to the CBD.
- All density gradients have become less steep over time implying that all urban land uses are becoming less sensitive to distance over time;
 - i.e., the strict zonal pattern is eroding as the friction of distance becomes less and less important in spatial interaction decisions.

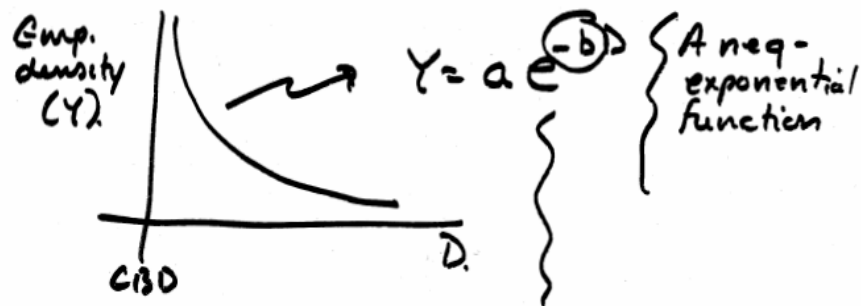
Findings

Slope of density gradients

Land use	1948	1954	1958	1963
Restel.	-0.58	-0.47	-0.42	-0.38
Mfg.	-0.68	-0.55	-0.48	-0.42
Retail	-0.88	-0.75	-0.59	-0.44

↓

What was estimated here?



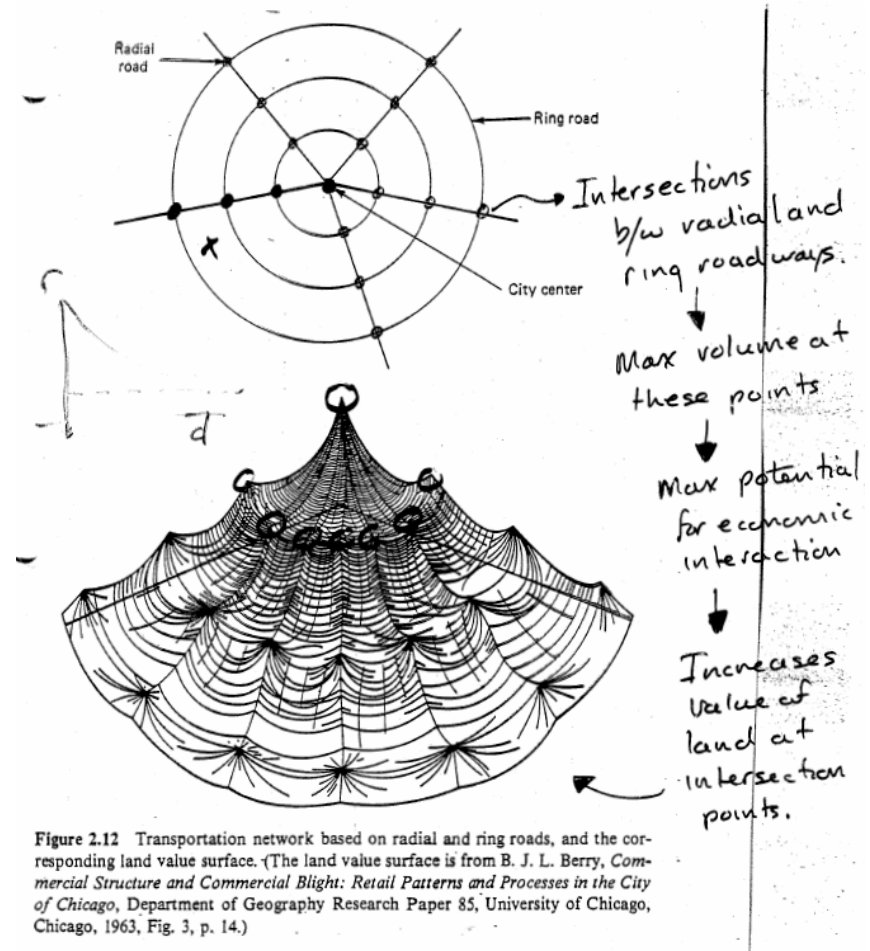
In linear form.

$$\ln Y = \ln a - bD$$

↳ In each case "b" is a slope term *

Polynuclear Profiles

- Mills' findings that all density gradients are becoming less steep over time, is also likely due to the fact that metropolitan areas are now characterized by multiple cores.
- The secondary, tertiary etc. agglomerations represent local optima in terms of accessibility.



Another view of the polynuclear profile

- Here we see why the strictly negative slopes on the density gradients may be becoming less steep over time.
- Secondary nodes are beginning to become more important and likely usurping much of what used to be the sole domain of the dominant CBD.
- Indeed, current research suggests that suburban municipalities of 5,000 or more employees have been growing rapidly in number.
 - As a result, suburban nucleations are accounting for an increasing share of total employment in urban areas.

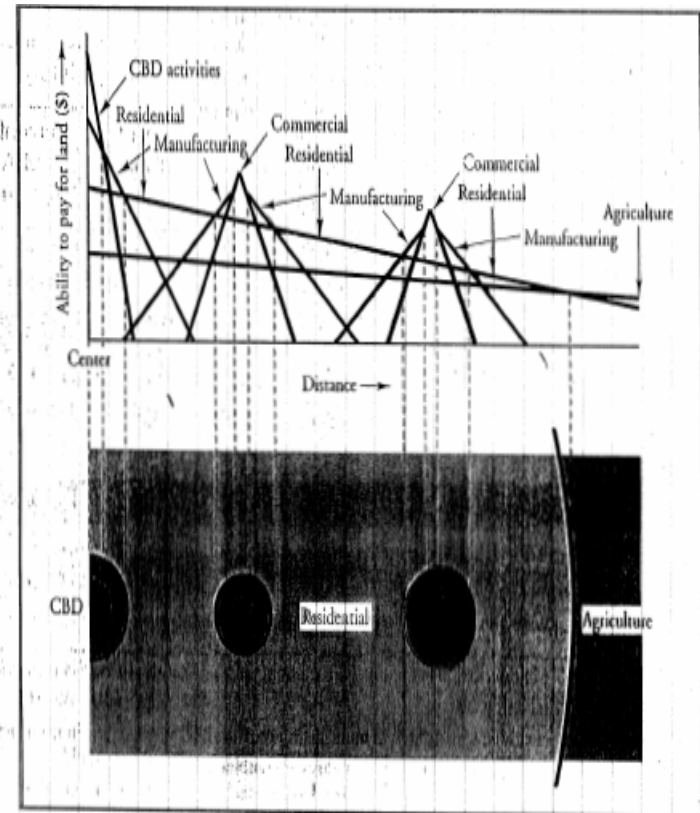


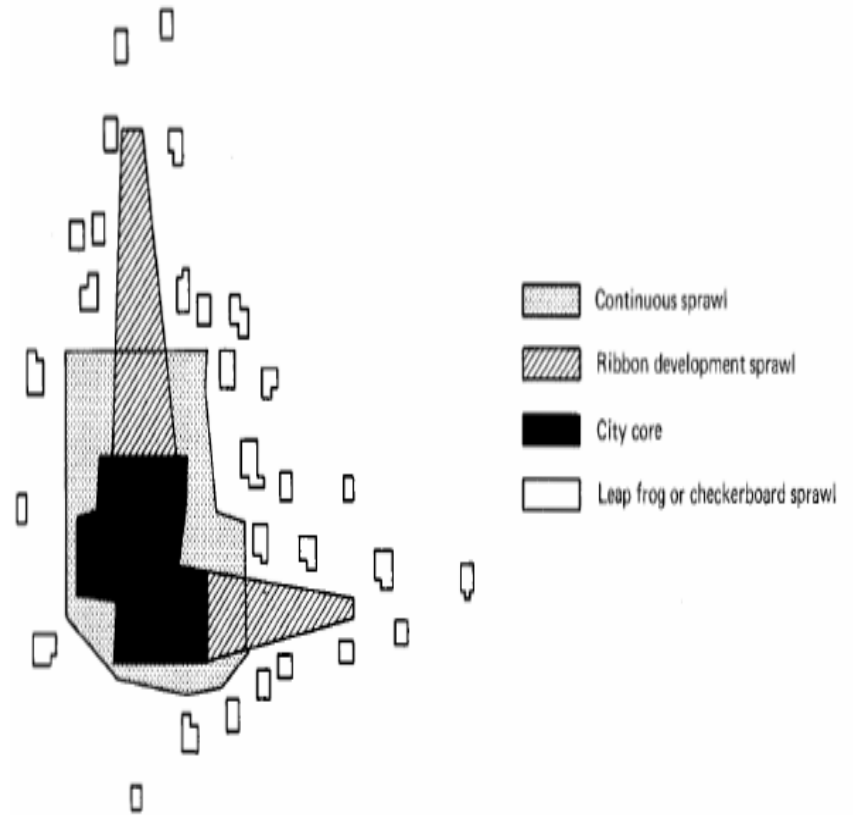
Figure 3.17 Hypothetical land-use zones in a multicentered city (From M. Yeates, *The North American City*, Fourth Edition, Harper & Row, Publishers, Inc., copyright © 1990, p. 132. Reprinted by permission of HarperCollins Publishers, Inc.)

Two Related Real-World Planning Issues

- Urban land use and land value theory, and the concepts of location rent and bidding generally, can be of use in the analysis and understanding of many real world planning issues.
- Two issues which have received the most attention from academics and professionals include;
 1. Urban Sprawl.
 2. Loss of Agricultural Land to Urban Uses

Issue 1: Urban Sprawl

- Urban Sprawl refers to continuous expansion of urban uses around large cities.
- Characteristically, there is always a zone of land that is in the process of being converted from rural to urban use.
- Three main types of sprawl:
 - Continuous
 - Ribbon
 - Leap frog or checkerboard

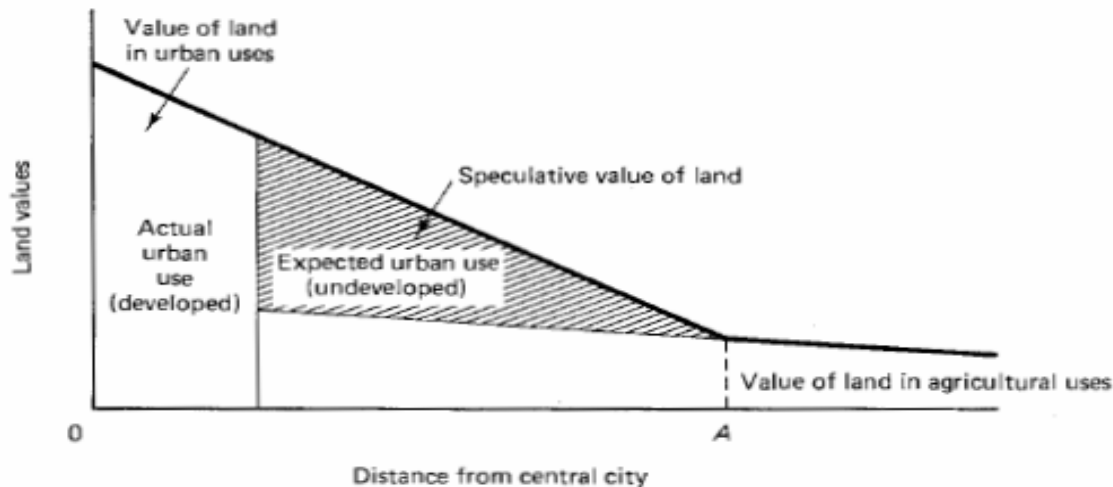


Causes

- The phenomenon of urban sprawl can be effectively analyzed using urban land use and land value theory (e.g., Alonso).
- The causes of sprawl include:
 - **Response to physical terrain:**
 - Encourages leap-frog sprawl;
 - **Difference in tax/development charge regimes;**
 - **Different planning/zoning regulations** at the urban-rural fringe relative to those which hold in the city-proper:
 - larger lot sizes in the fringe areas;
 - Less demanding building codes;
 - **Land Speculation (see next slide).**

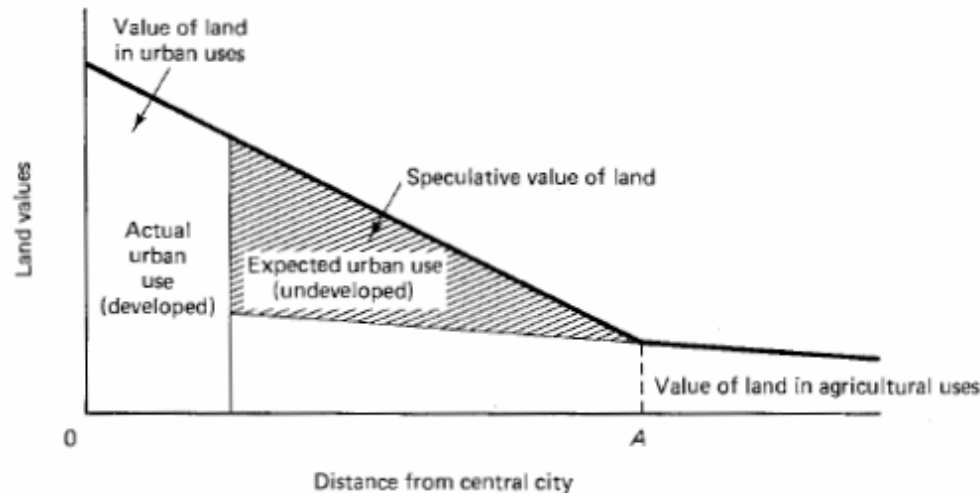
Land Speculation

- Speculation results in some land being with-held from development, while other land may be developed prematurely.
- Cadwallader (1985) notes that land values at the edge of an expanding urban core are comprised of two components:
 - A value for agricultural use; and,
 - A speculative value associated with potential urban use.



Speculation Continued...

- The speculative component decreases with increasing distance from the central core until it effectively goes to zero at a given distance from the core.
- This speculative value is a function of investor's assessment of the risk of urban encroachment.
- Once encroachment is deemed improbable in the foreseeable future, the speculative value goes to zero.



Effects of Speculation

- If a land owner foresees urban encroachment, he/she may withhold a parcel from development to await conversion OR he/she may allow agricultural users to farm the land on short-term leases, and for easily harvested short-term crops.
- Can result in:
 - Inefficient use of the agricultural land (i.e., longer-term crops may be more profitable on the parcel, but the land owner wishes to remain as liquid as possible so as not to forgo the opportunity to convert to urban use.
 - A seemingly random spatial pattern of urban and agricultural uses – i.e., leap-frog sprawl.

A Peak at the Sprawl Debate

- [Urban Sprawl in the Greater Toronto Area \(GTA\).](#)
 - (<http://www.effective-writer.com/Author/sprawl-article.htm>)

Criticisms of Alonso

- Buyers and sellers do not have perfect information
- Large corporations and government intervention casts doubt on the idea of a free market for land;
- It overlooks the inertia of the past that leaves many activities in sub-optimal locations.
- Provides little information re the process of historical change.
- Insufficient attention paid to the constraining nature of the political economic structure in which the land and housing markets are located.