Community Development, Economic Development, or Community Economic Development?

Concepts, Tools and Practices

Location Theory: A Brief Overview Part II

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Location Theory:
A Brief Overview
Neoclassical Location Theory

In Part I of these discussions on location theory we talked about land use and city size and introduced the notions of neoclassical firm location theory.

There we talked about firms locating to minimize transportation cost of inputs being shipped to the firm and outputs being shifted to markets. These types of decisions are most relevant to manufacturing firms.

Here we will talk about firms that are more concerned with the location of their customers. These tend to be retail and personal service firms and some business service firms.

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The least cost approach to location selects the site by assuming that the firm sells its total output to a given point market (i.e., effectively eliminating demand from the location decision).

The demand maximization approach, however, reaches the location decision by explicitly incorporating demand into the decision.

This approach is most common for retail and many service firms.

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The demand maximization approach to location decisions contends that each seller will select a site to control as large a market area as possible.

The seller exercises some monopoly control over that portion of the market area she can supply at a lower price than rivals. Consumer behavior and the location decisions of competitors determine the size market the firm controls.

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In our spatial world we have a unique situation where the market has characteristics of both competitive markets and spatial monopolies.

- **Over the whole of the economic plane competition determines the *at store* price of the good or service. Thus all firms in essence charge the same at store price.**

- **But consumers are looking at what is called the *effective price* of the good or service.**

- **The effective price is composed of two parts, the at store price plus the cost of transportation to the firm.**

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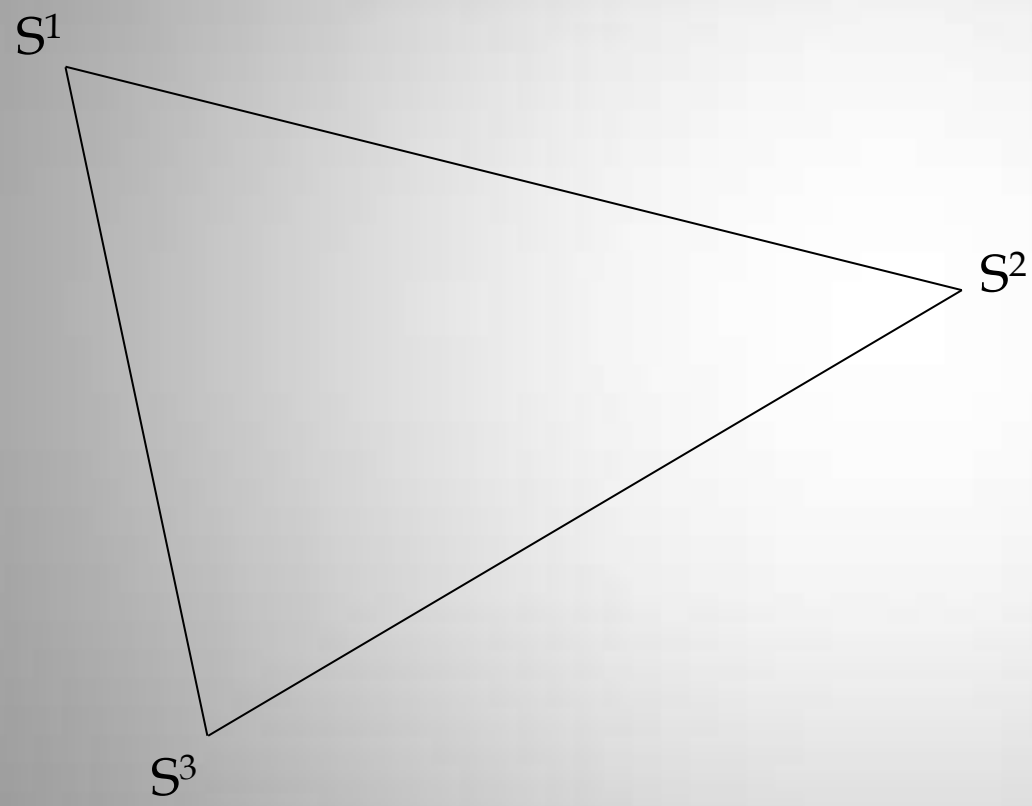
Neoclassical Location Theory



For the demand maximization approach lets say that there are potential customers randomly scattered on the economic plane defined by three communities S^1, S^2, and S^3.

The question then is twofold:

(1) where will potential customers elect to go shopping and

(2) where will firms locate to maximize the demand for their goods and/or services?

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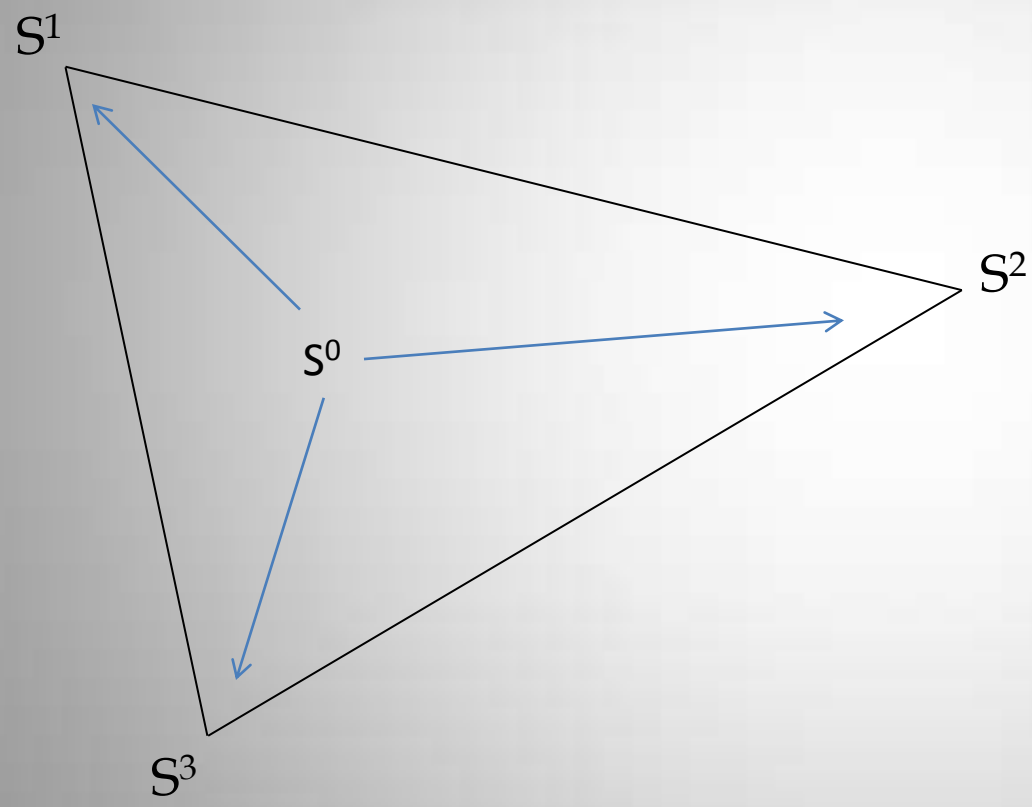

Pick a customer or consumer at random who is located at a place (S^0).

Where will that customer shop (S^1, S^2, or S^3)?

Where will firms locate to maximize demand?

A key piece of the puzzle is "effect price".

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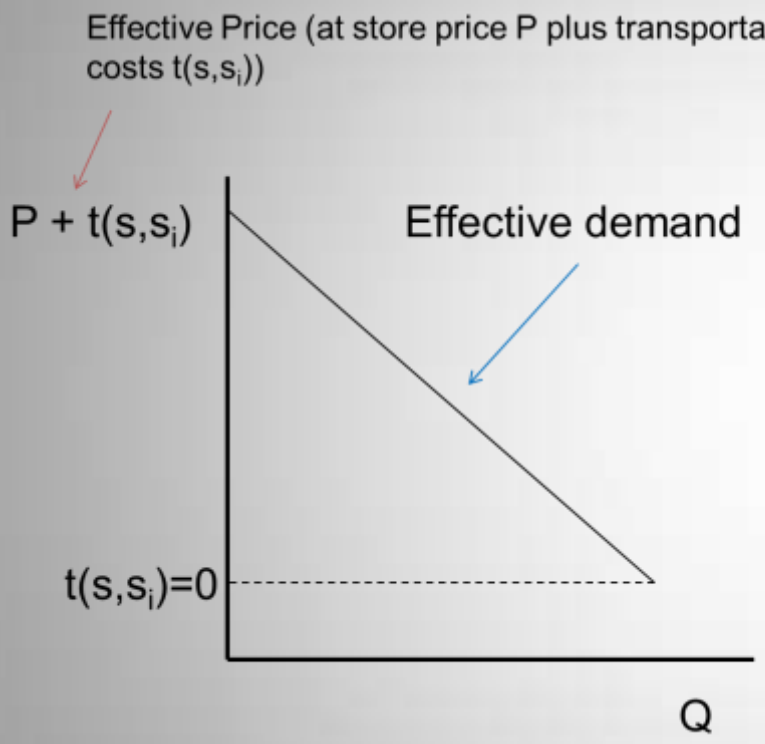

At location $t(s,s_i)=0$ the consumer essentially lives at the business and incurs no transportation costs.

But as the consumer moves away from the store or business transportation costs become positive ($t(s,s_i)>0$) and effective demand starts to decline.

At some distance, call it $t(s,s_i)^*$ the effective price drives demand to zero: the business is simply too far away to make purchases at.

For a given level of income, as more of that income is spent on transportation to the business, there is less to actually spend at the business.

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The classic example of the demand maximization problem has come to be known as the case of Hotelling's beach vendors.

- **Imagine a beach that is bordered on both ends by cliffs and a number of beach goers evenly distributed across the beach.**
- **On this beach are two refreshment vendors selling identical products at identical prices.**
- **From the perspective of the patrons they will select the vendor that is physically closest to them.**
- **The vendors are mobile and can locate their shop at any location on the beach each morning.**

Hotelling

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Given this structure one can view the Hotelling problem in a game theoretic framework:

how will the two vendors react to each other's location decision with the objective of the game to maximize the number of beach patrons buying from a particular vendor? (i.e., buying from me rather than my competitor)

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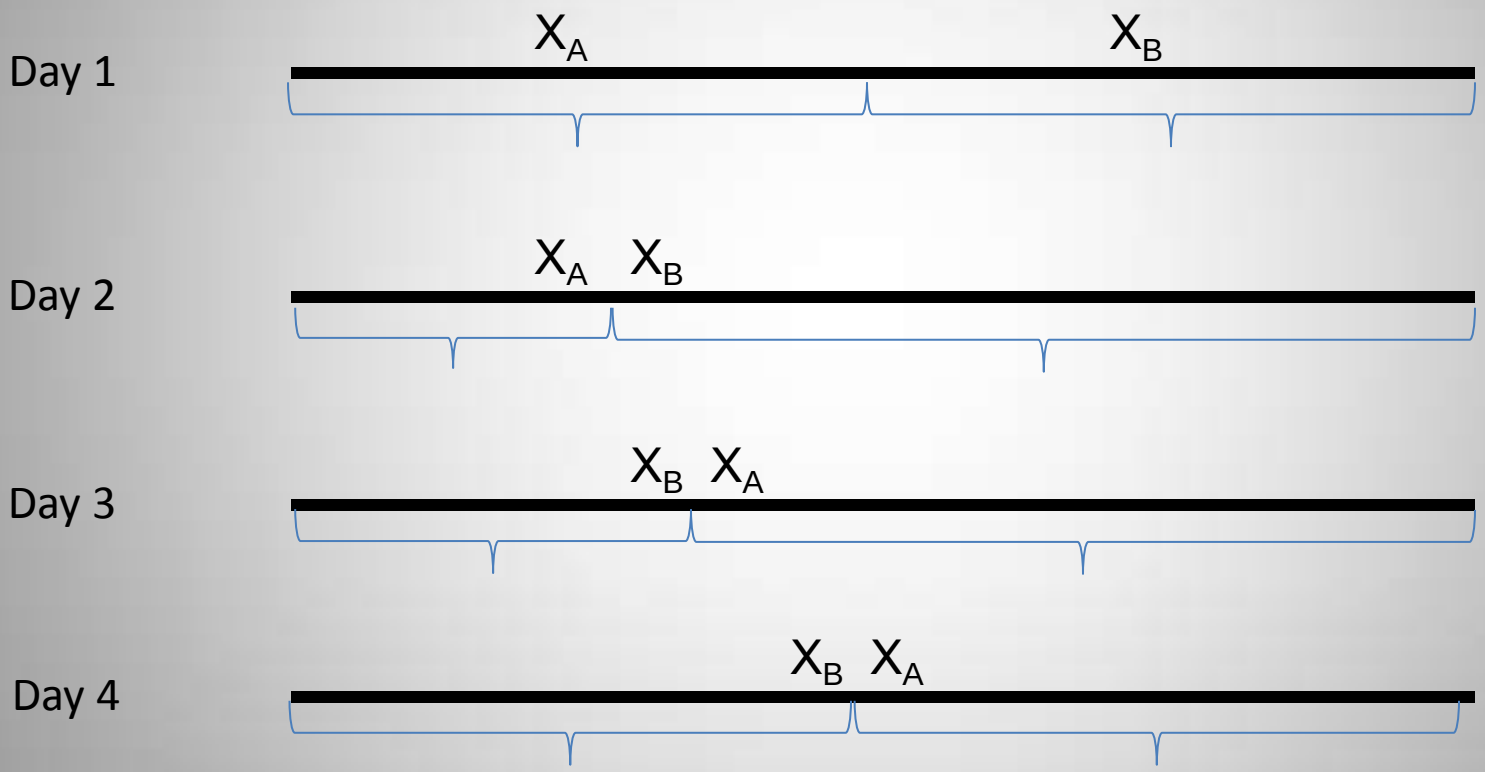

Is this the "social optimal"?

NO: Aggregate transportation cost is maximized.

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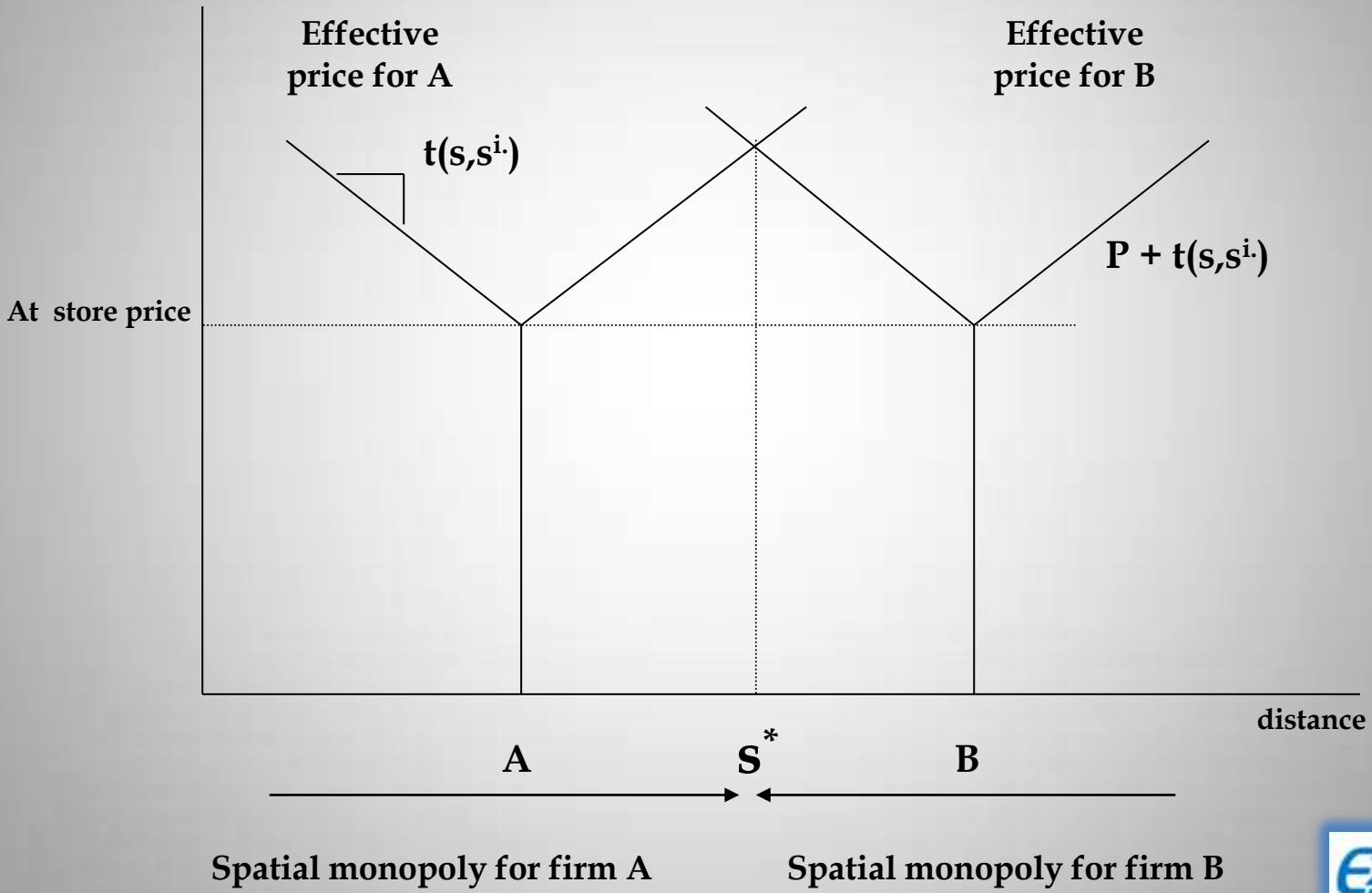

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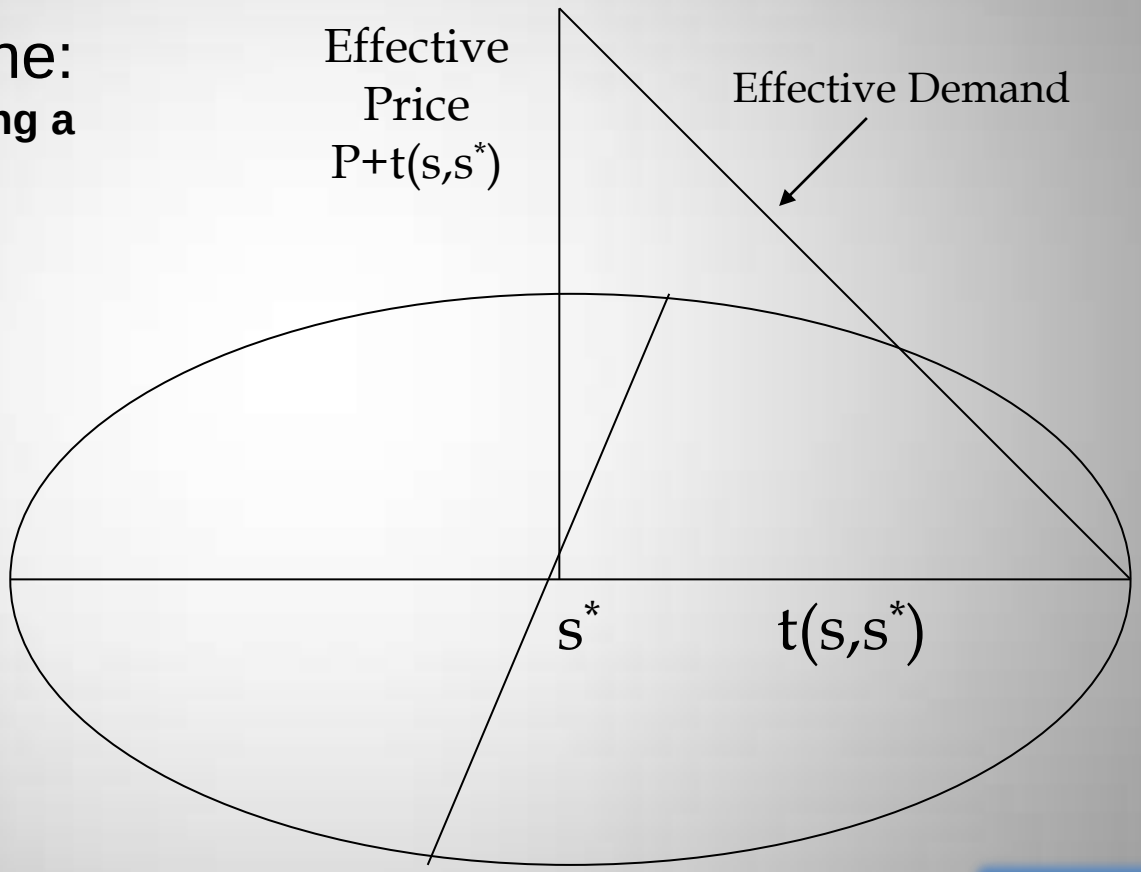
Neoclassical Location Theory

Löschian demand cone:

moving from an economy along a line (e.g. a beach) to one on a plane by rotating the effective demand curve 360^0.



German economist (1906-1945) Much of his work in USA (Iowa) and extended the work begun by Christaller.

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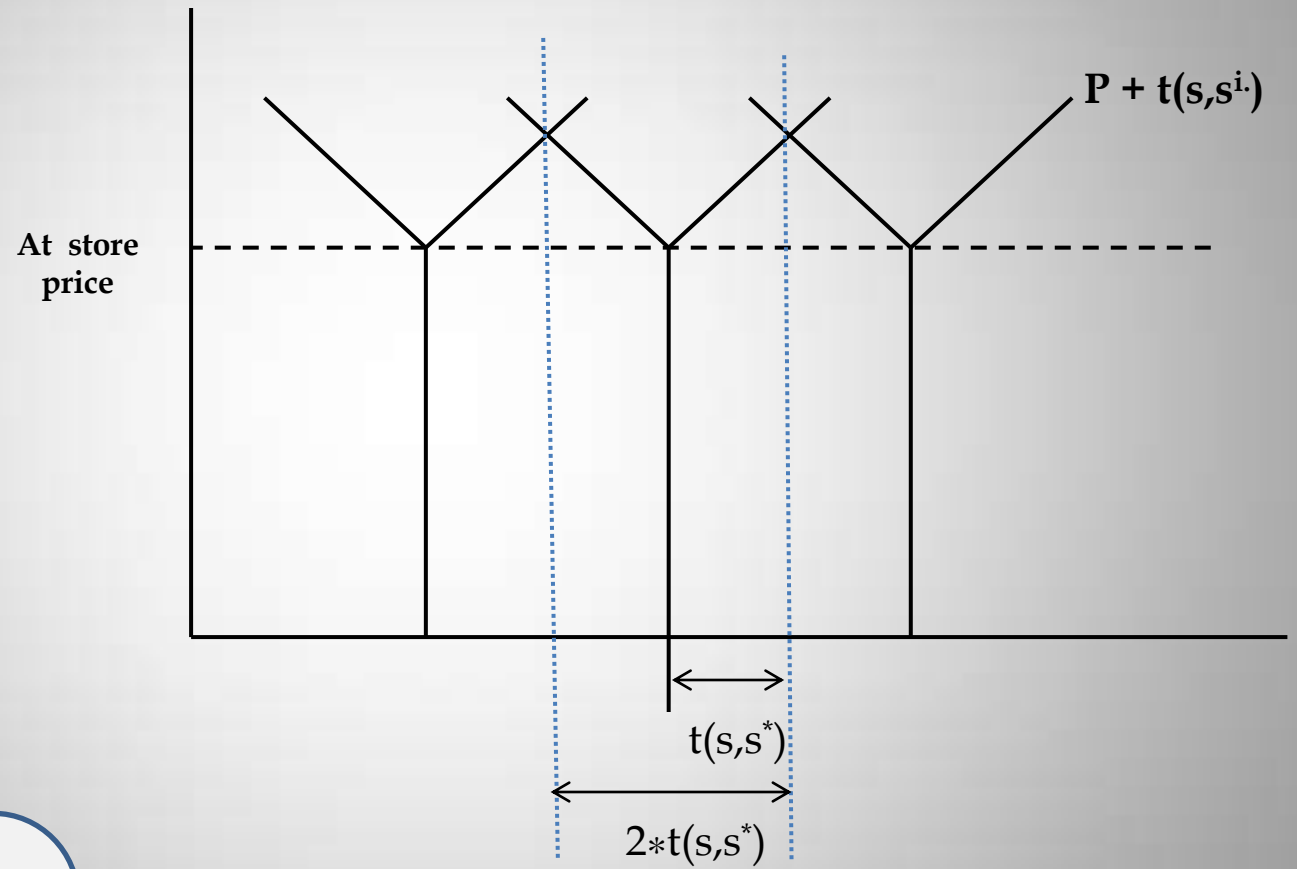
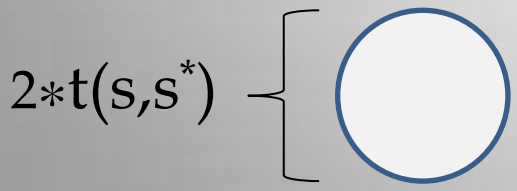
Suppose that the distance that defines the market area for any given firm is $t(s,s^*)$.

In other words, all customers that are within the distance $t(s,s^*)$ of any given business will conduct business at that business.





The base of the Löschian demand cone

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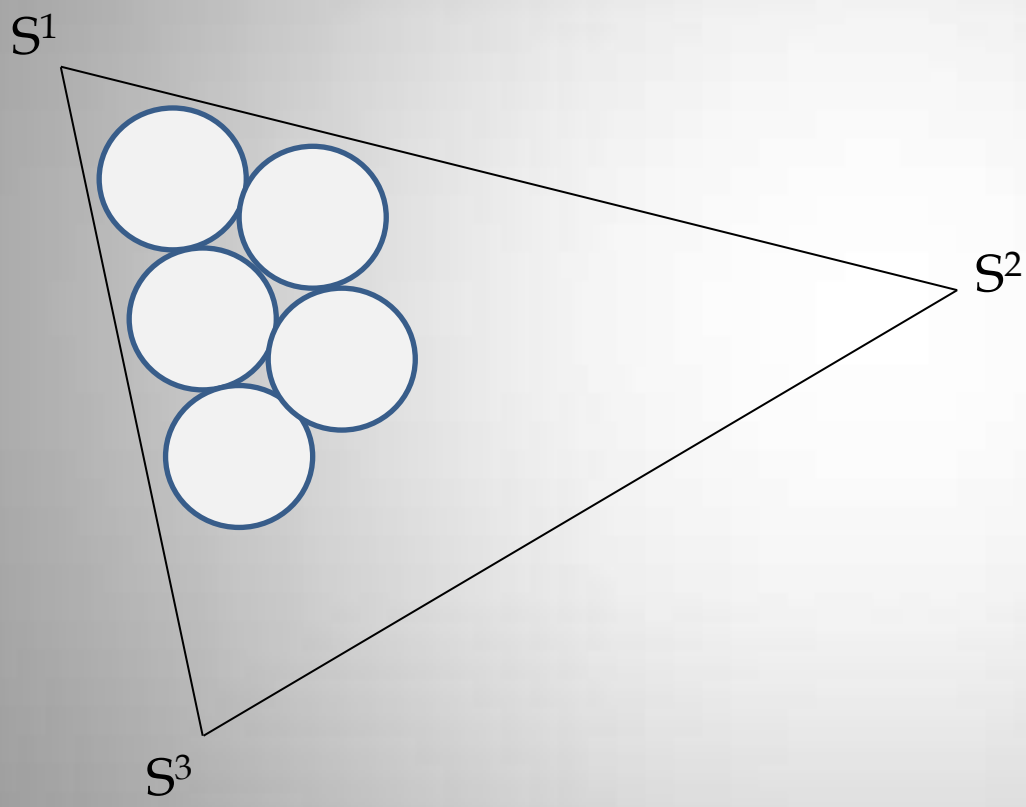
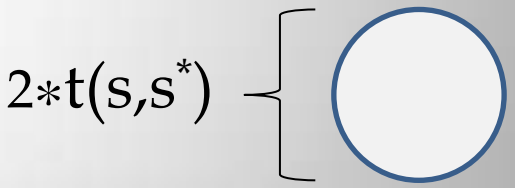


Given the notion of effective prices and the Löschian demand cone it becomes clear that there is a "limit" to the distance that a customer will travel to consumer a good or service.



What we will find is a series of businesses "popping up" across the economic plane. Each one servicing a specific geographic area.

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So far we have only looked at the demand side of the market, what about the supply side?

One must keep in mind that in neoclassical economics a key element is the interaction of demand and supply.

As we have discussed elsewhere, the supply curve is driven by the cost structure of the firm. Indeed, in the aggregate, the supply curve for a particular industry *is* the cost curve.

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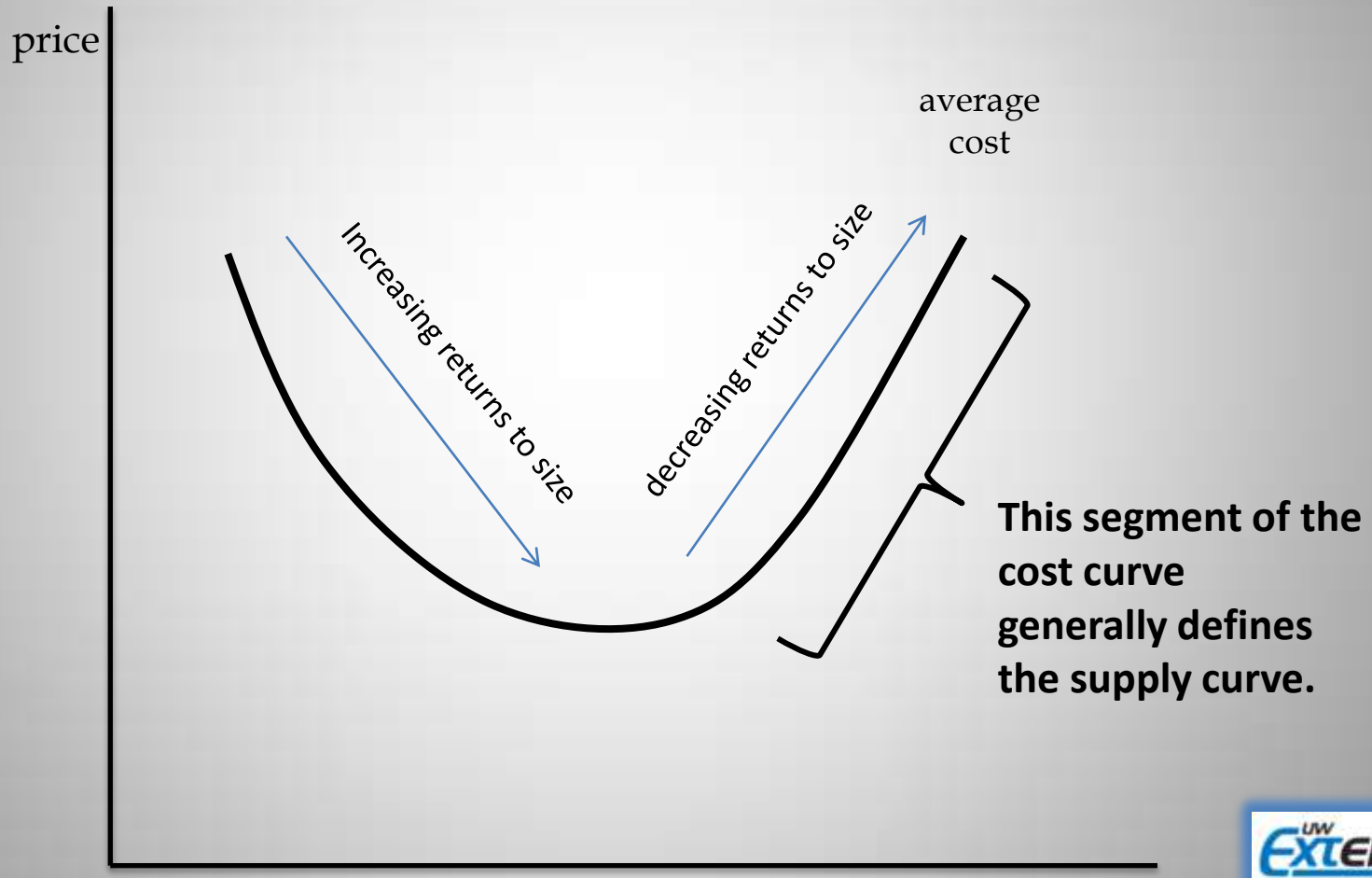
Intro the "supply" side of the problem



This segment of the cost curve generally defines the supply curve.

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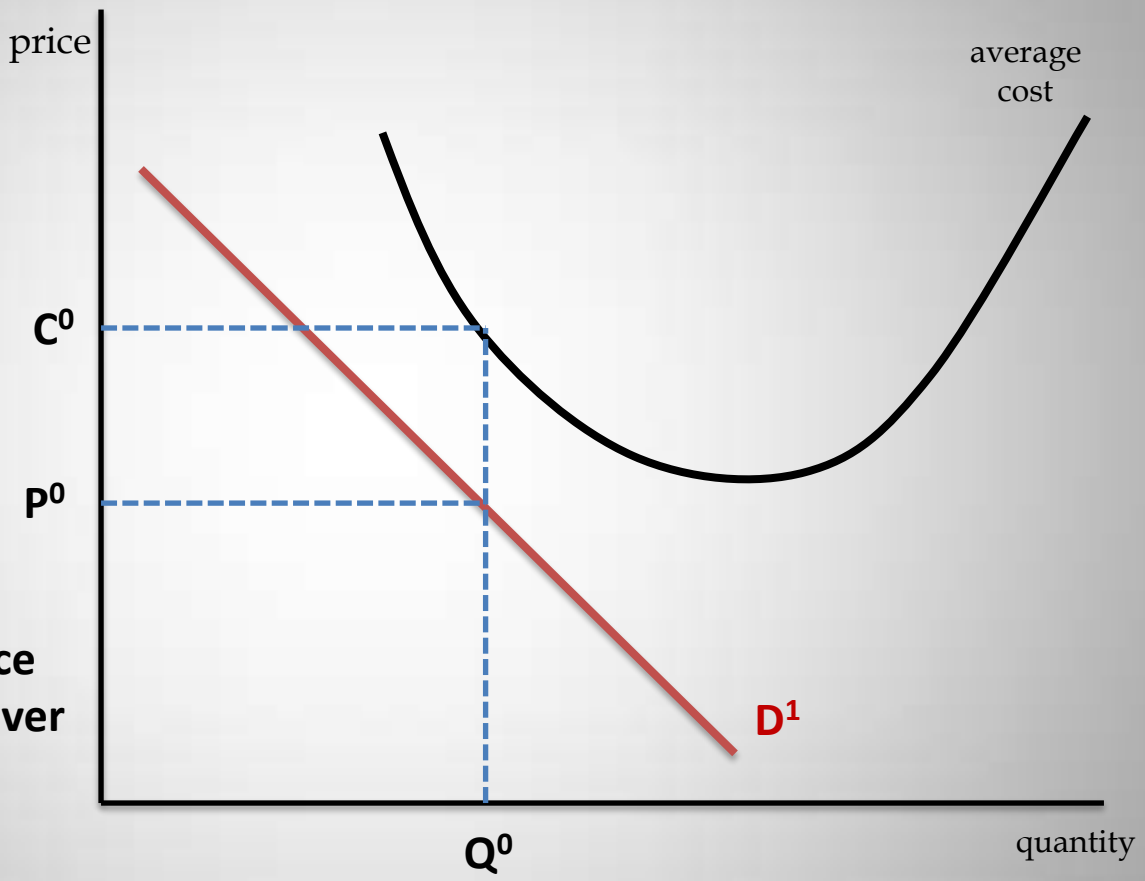
Suppose we have a given cost and demand structure (D^1).



For a given quantity (Q^0), "average revenue" or price (P^0) is not sufficient to cover "average costs" (C^0).

The firm is loosing money and will cease to operate.

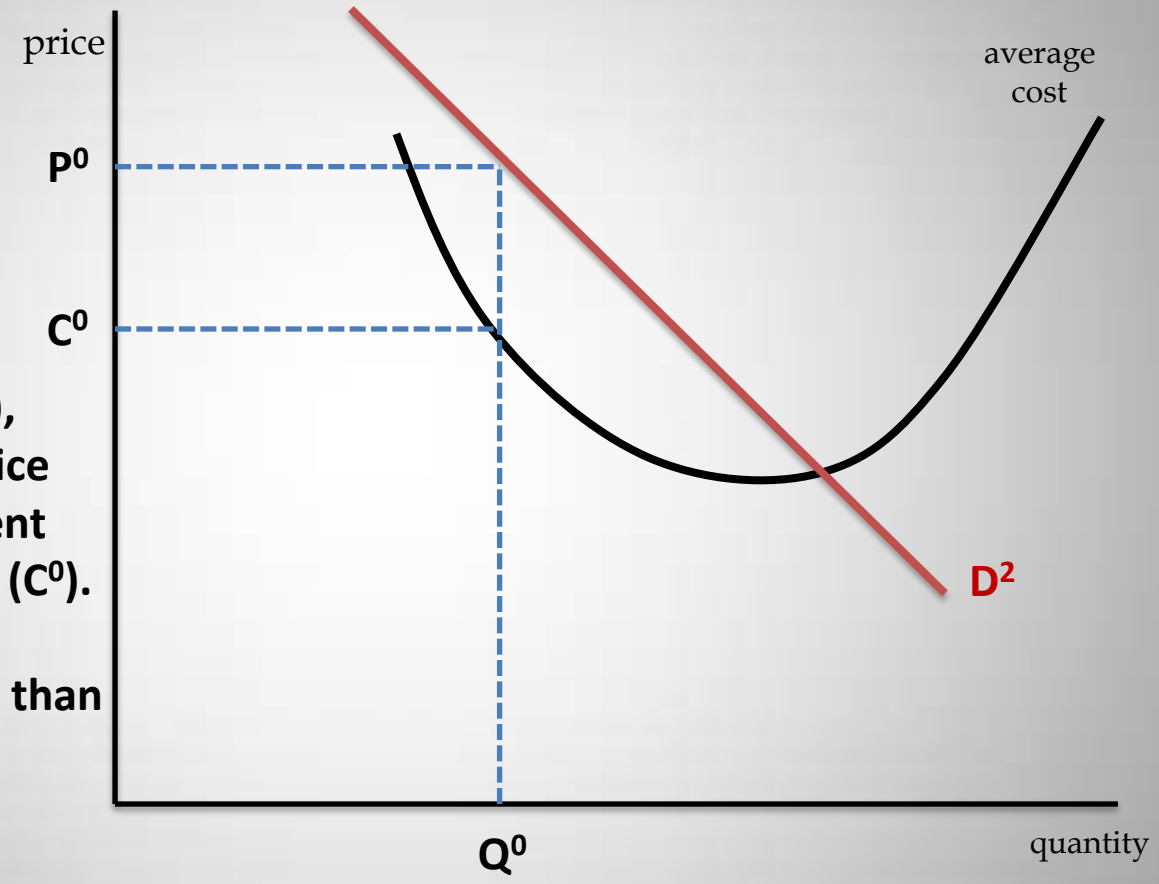
Location Theory: A Brief Overview

Neoclassical Location Theory

Suppose we have a given cost and demand structure (D^2).

For a given quantity (Q^0), "average revenue" or price (P^0) is more than sufficient to cover "average costs" (C^0).

The firm is making more than a "normal profit" .



In competitive markets if a firm is making more than a normal profit competing firms will enter the market taking some of the market.

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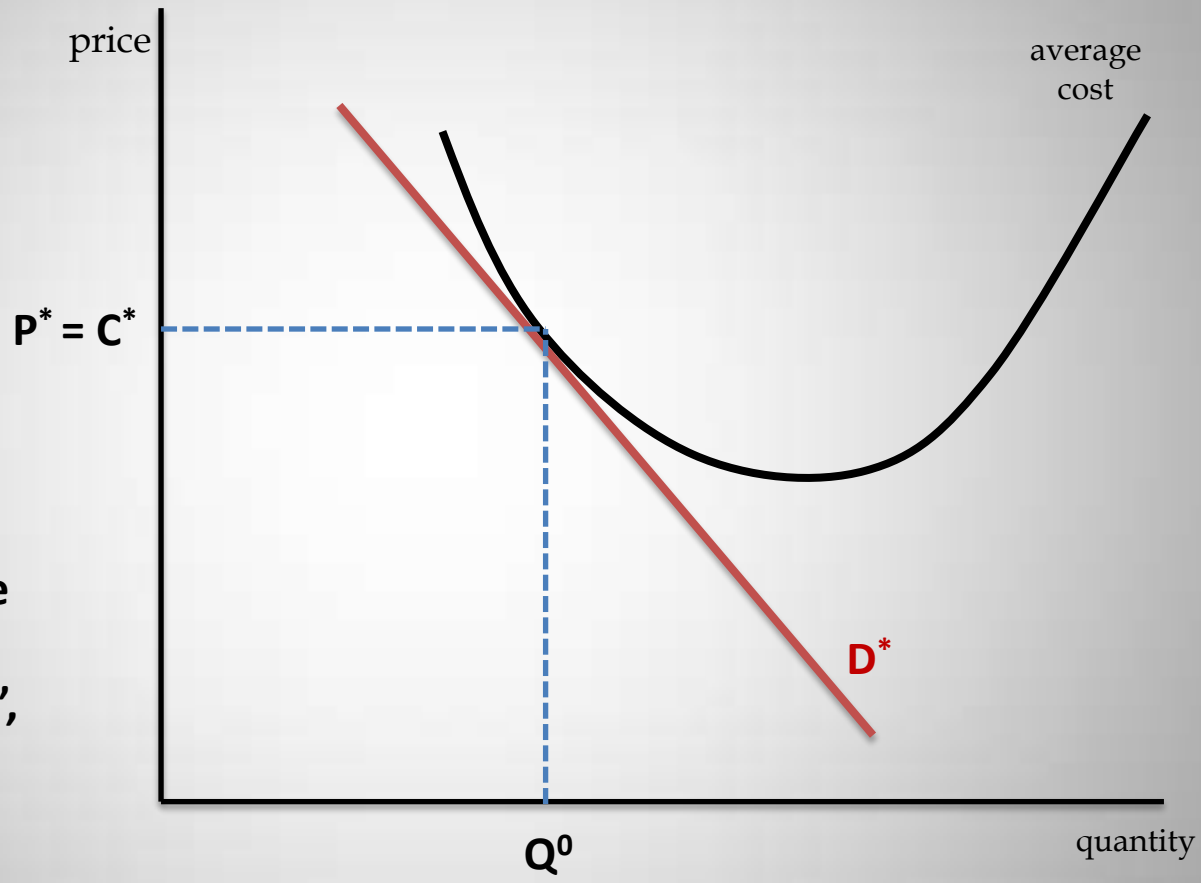

In competitive markets firms enter and leave the market until all firms are making a "normal profit", or $P^* = C^*$.

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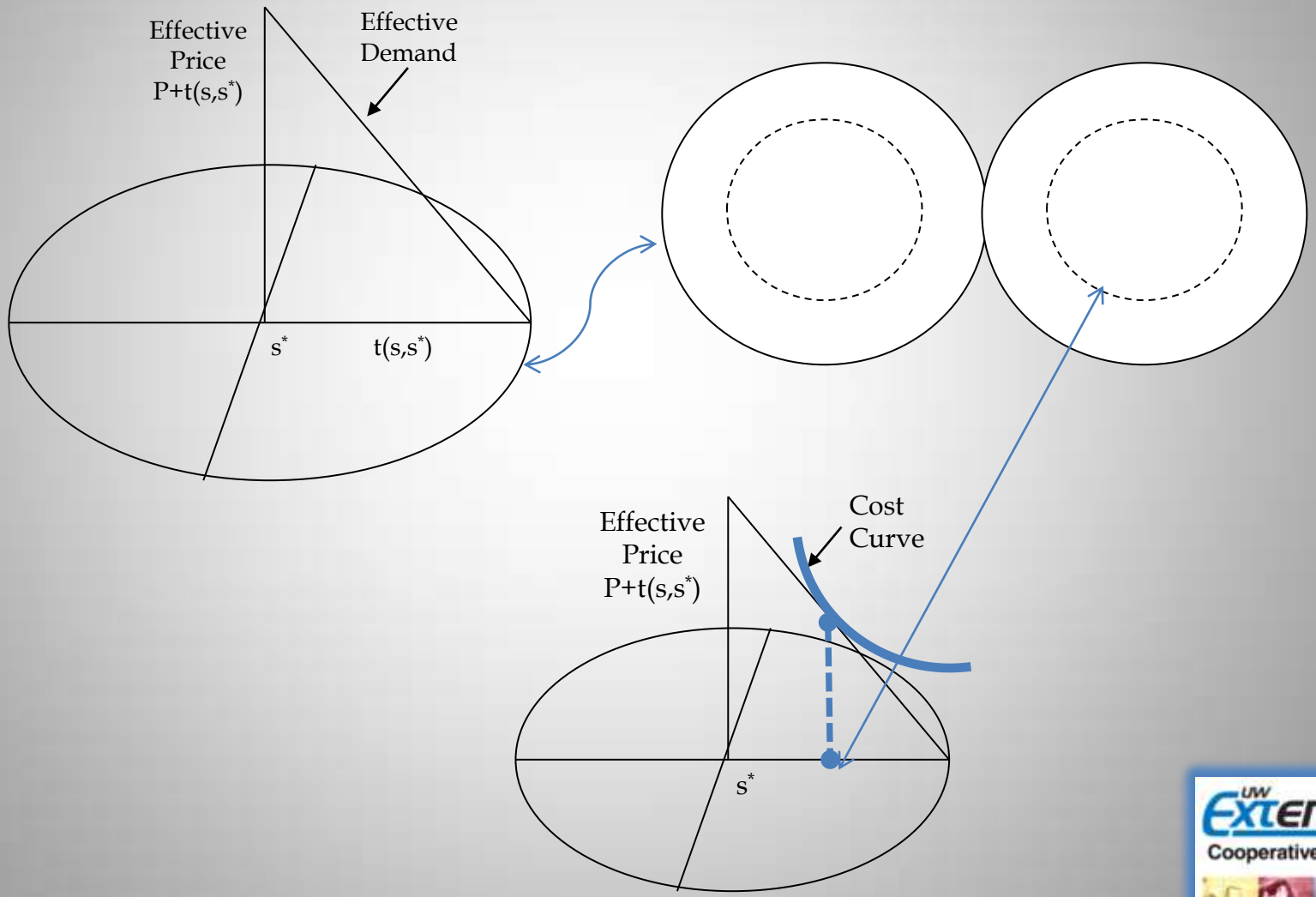

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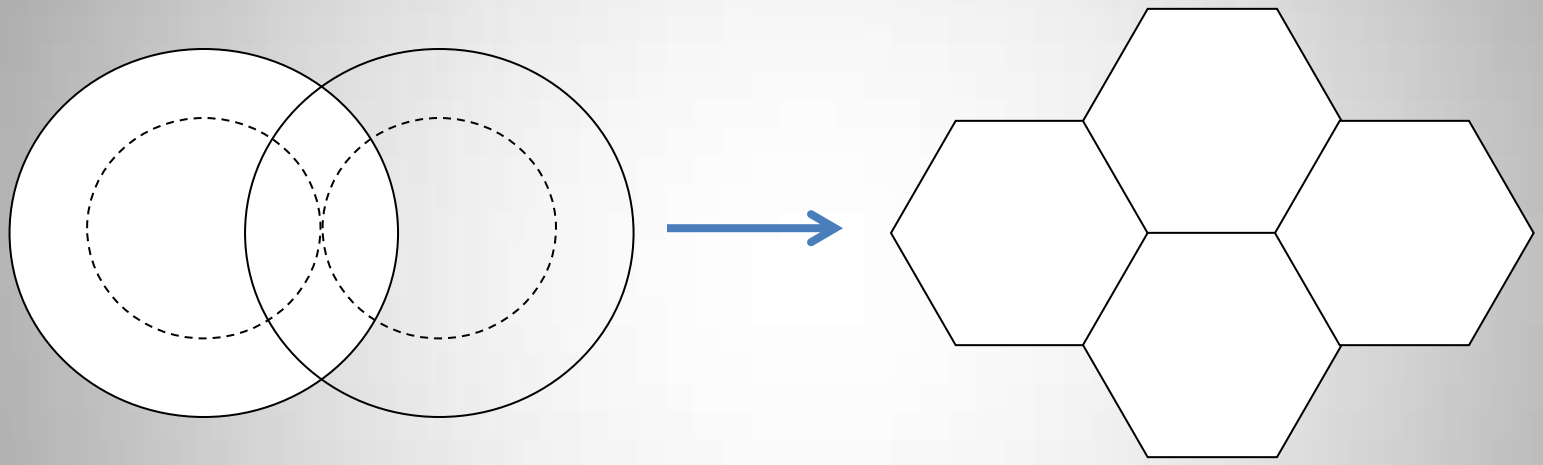

A problem with circular markets given by the Löschian demand cone is that there are parts of the economic plane that are not serviced by a business. To solve this little problem we end up with these hexagon shaped markets.

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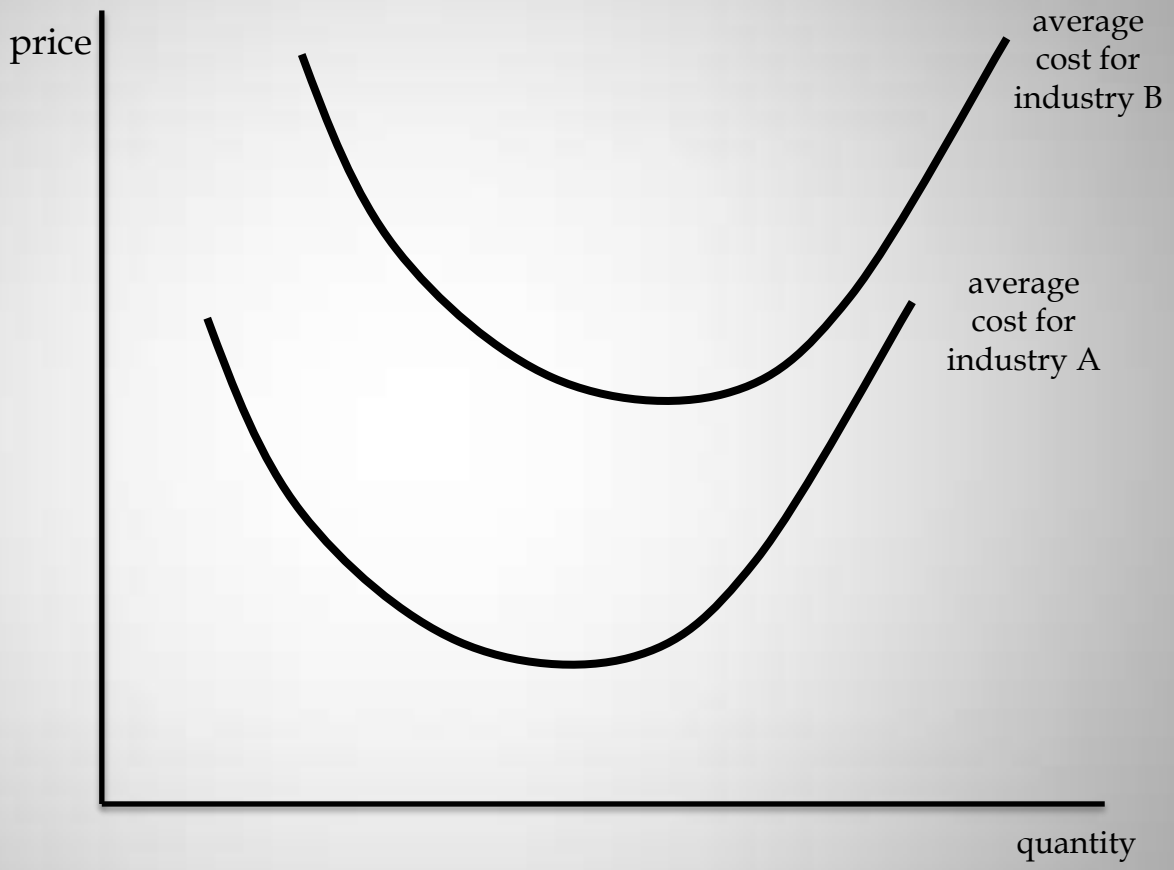
Now the cost structure is different across different industries: some businesses face higher cost structures than other businesses.

In this example, the cost structure of industry "B" is higher than the cost structure of industry "A".



How this play out in the markets given that we live in a spatial world?

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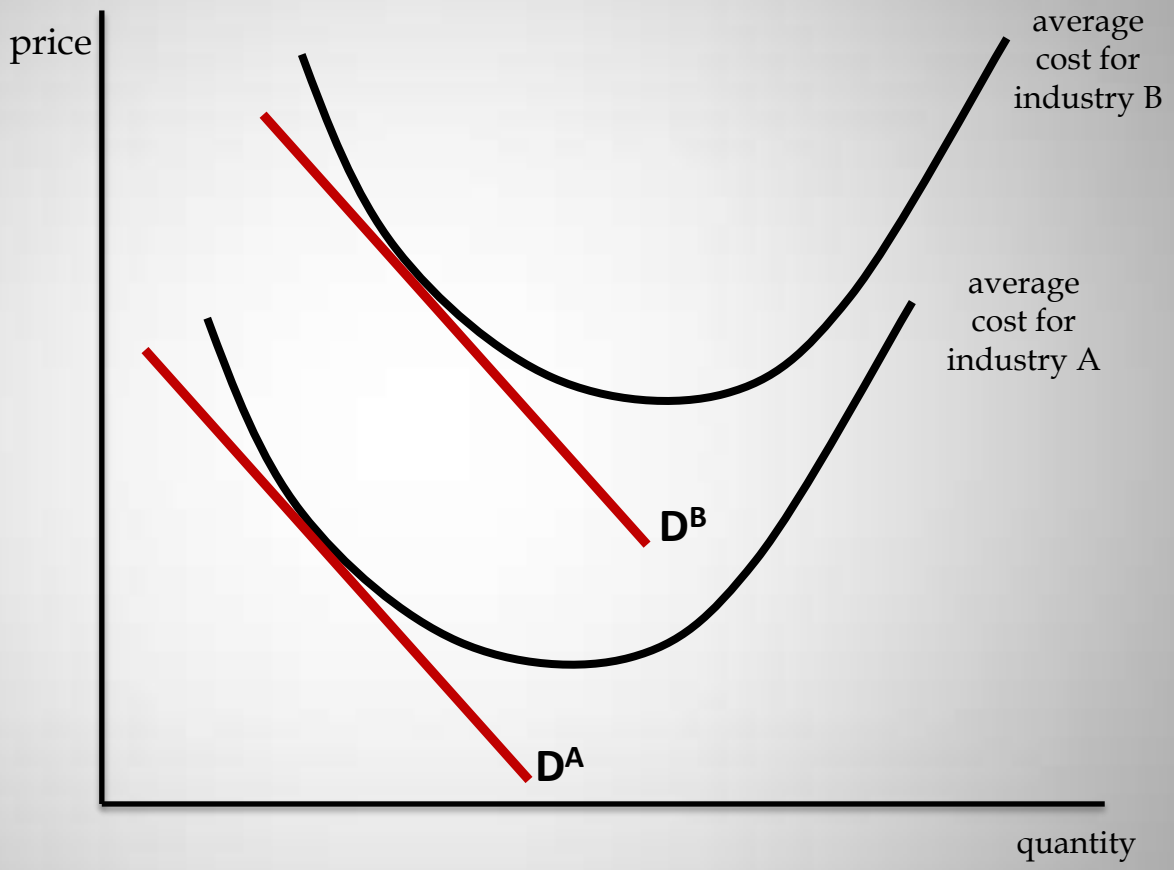
The key is the underlying demand structure required to support the cost structure of a given firm.

A firm in industry "A" needs a demand structure consistent with D^A while a firm in industry "B" need a demand structure with D^B.



Firms in industry "B" needs a bigger market to support a higher cost structure than firms in industry "A".

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Firms in industry "B" needs a bigger market to support a higher cost structure than firms in industry "A".

If incomes along with tastes and preferences are the same across all consumers, there is only one means for demand to differ across industries: population size.

Now if customers are evenly distributed across the economic plane, the only means for population size to vary is the geographic size of the market.

Firms with higher cost structures must be able to draw customers from a greater geographic distance.

What we end up with is a network of overlapping markets: or a hierarchy of central places.

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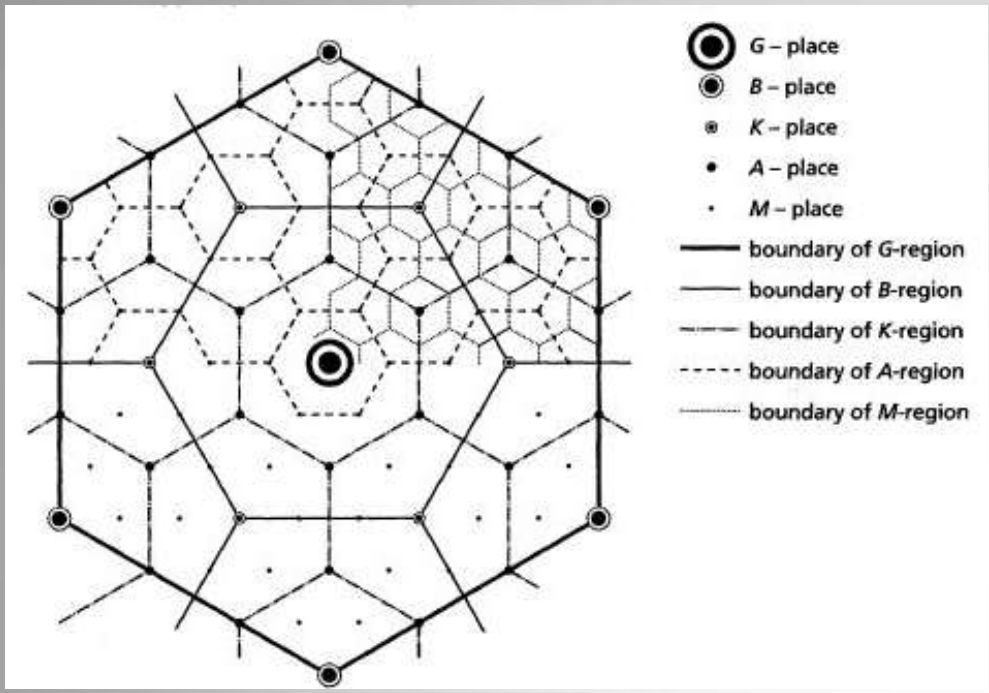

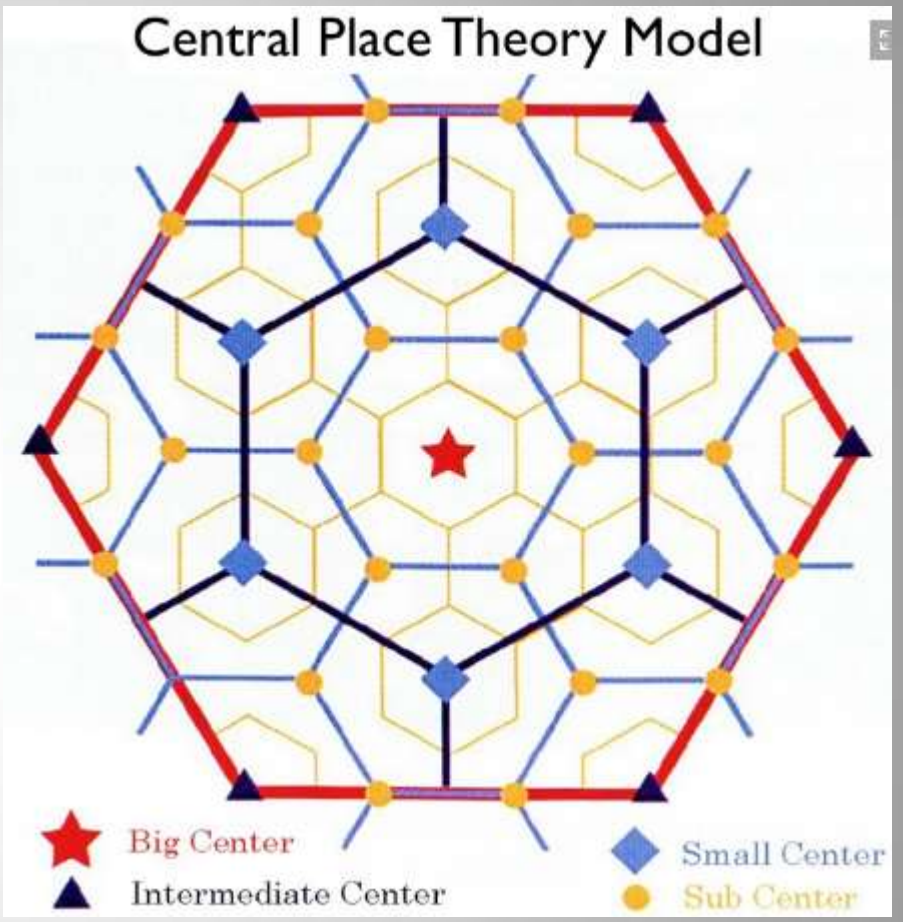

Firms with the highest cost structures will locate in "G places" or "Big Centers" while firms with the lowest cost structures will locate in "M places" or "Sub Centers".

There will also be a lot fewer high cost firms and many more lower cost firms.

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The *range* of a good or service is the maximum distance people will travel to purchase that good or service at a particular location.

Demand *threshold* is the minimum market required to support a particular good or service and still yield a normal profit for the merchant.

Industry	Threshold
Full-service restaurants	1,197
Limited-service restaurants	1,710
Drinking places (alcoholic beverages)	1,830
Offices of physicians (except mental health specialists)	2,541
Gasoline stations with convenience stores	2,592
Offices of lawyers	2,677
Offices of dentists	2,824
Child day care services	3,044
Hotels (except casino hotels) and motels	5,565
Offices of chiropractors	5,565
Supermarkets and other grocery (except convenience) stores	5,910
Engineering services	6,793
Residential mental retardation facilities	6,992
Offices of certified public accountants	7,635
Automotive parts and accessories stores	7,802
Custom computer programming services	7,920
Other building material dealers	8,009

Wisconsin 2010

Wisconsin 2010

Industry	Threshold	Industry	Threshold
Full-service restaurants	1,197	All other miscellaneous store retailers (except tobacco stores)	16,598
Limited-service restaurants	1,710	Offices of mental health practitioners (except physicians)	16,598
Drinking places (alcoholic beverages)	1,830	Home health care services	16,744
Offices of physicians (except mental health specialists)	2,541	Offices of optometrists	17,196
Gasoline stations with convenience stores	2,592	Florists	18,179
Offices of lawyers	2,677	Photography studios, portrait	19,611
Offices of dentists	2,824	Floor covering stores	19,678
Child day care services	3,044	All other home furnishings stores	19,746
Hotels (except casino hotels) and motels	5,565	Child and youth services	20,451
Offices of chiropractors	5,565	Tire dealers	20,599
Supermarkets and other grocery (except convenience) stores	5,910	Other gasoline stations	20,899
Engineering services	6,793	Bowling centers	21,447
Residential mental retardation facilities	6,992	Architectural services	22,814
Offices of certified public accountants	7,635	Graphic design services	23,663
Automotive parts and accessories stores	7,802	Electronic shopping	24,162
Custom computer programming services	7,920	Vocational rehabilitation services	24,472
Other building material dealers	8,009	Optical goods stores	25,226
Snack and nonalcoholic beverage bars	8,263	Offices of all other miscellaneous health practitioners	25,338
Administrative management and general management consulting s	8,384	Continuing care retirement communities	25,564
Pharmacies and drug stores	8,396	Other scientific and technical consulting services	26,511
Homes for the elderly	8,534	Household appliance stores	27,531
Veterinary services	8,598	Liquefied petroleum gas (bottled gas) dealers	27,798
Fitness and recreational sports centers	8,783	Hobby, toy, and game stores	27,934
Other individual and family services	8,976	Advertising agencies	27,934
Other accounting services	9,497	Caterers	29,216
New car dealers	10,046	Residential mental health and substance abuse facilities	29,518
Gift, novelty, and souvenir stores	10,393	All other specialty food stores	30,298
Radio, television, and other electronics stores	11,055	Other clothing stores	30,460
Services for the elderly and persons with disabilities	11,119	Independent artists, writers, and performers	31,122
Sporting goods stores	11,317	All other professional, scientific, and technical services	31,122
Women's clothing stores	11,362	Discount department stores	31,638
All other general merchandise stores	11,592	Computer and software stores	32,171
Used car dealers	12,341	Book stores	33,101
Other direct selling establishments	12,476	Title abstract and settlement offices	33,101
Tax preparation services	12,613	Convenience stores	34,086
Hardware stores	12,985	Surveying and mapping (except geophysical) services	34,290
Offices of physical, occupational and speech therapists, and audiol	13,194	Other computer related services	34,290
Computer systems design services	13,256	All other health and personal care stores	34,496
All other amusement and recreation industries	13,700	Boat dealers	34,705
Beer, wine, and liquor stores	13,933	Outpatient mental health and substance abuse centers	35,131
Food service contractors	13,967	Other services related to advertising	35,348
Furniture stores	14,104	All other outpatient care centers	35,790
Golf courses and country clubs	14,352	Food (health) supplement stores	36,015
Nursery, garden center, and farm supply stores	14,424	Pet and pet supplies stores	36,243
Jewelry stores	14,797	Motorcycle, ATV, and personal watercraft dealers	36,708
Shoe stores	15,311	Other residential care facilities	37,184
Family clothing stores	15,603	Paint and wallpaper stores	38,176
Nursing care facilities	15,646	RV (recreational vehicle) parks and campgrounds	39,222
Marketing consulting services	15,732	Mail-order houses	39,492
Used merchandise stores	16,040	Offices of physicians, mental health specialists	39,492

Wisconsin 2010

Industry	Threshold	Industry	Threshold
Cosmetics, beauty supplies, and perfume stores	40,045	Landscape architectural services	98,731
Meat markets	42,106	Amusement arcades	104,116
Testing laboratories	42,734	Heating oil dealers	106,044
General medical and surgical hospitals	43,056	Commercial photography	106,044
Research and development in the physical, engineering, and life sc	43,056	All other motor vehicle dealers	108,045
Environmental consulting services	45,090	Manufactured (mobile) home dealers	112,282
Home centers	45,448	Mobile food services	114,528
Sewing, needlework, and piece goods stores	47,326	All other miscellaneous ambulatory health care services	130,145
Museums	48,121	Blood and organ banks	136,343
Office supplies and stationery stores	48,529	Drafting services	136,343
Building inspection services	48,529	Prerecorded tape, compact disc, and record stores	146,831
Outdoor power equipment stores	51,589	Research and development in biotechnology	150,695
Human resources consulting services	51,589	Direct mail advertising	150,695
Interior design services	53,518	Historical sites	154,768
Public relations agencies	55,062	Translation and interpretation services	159,067
Ambulance services	56,697	Other management consulting services	163,611
Other community housing services	56,697	Window treatment stores	168,423
Children's and infants' clothing stores	59,650	Display advertising	173,527
Offices of podiatrists	60,278	All other legal services	178,950
Vending machine operators	60,919	Industrial design services	190,880
Promoters of performing arts, sports, and similar events without fa	60,919	Rooming and boarding houses	197,462
Men's clothing stores	61,574	Other spectator sports	197,462
Clothing accessories stores	62,243	Racetracks	238,600
Recreational and vacation camps (except campgrounds)	62,927	Emergency and other relief services	248,974
Marinas	65,073	Fruit and vegetable markets	272,686
Art dealers	65,821	Agents and managers for artists, athletes, entertainers, and other p	272,686
All other traveler accommodation	65,821	Media representatives	272,686
Musical instrument and supplies stores	68,171	Zoos and botanical gardens	301,389
Freestanding ambulatory surgical and emergency centers	68,171	Sports teams and clubs	318,133
Computer facilities management services	68,171	Nature parks and other similar institutions	318,133
Process, physical distribution, and logistics consulting services	68,171	Skiing facilities	318,133
Musical groups and artists	71,580	Research and development in the social sciences and humanities	318,133
Recreational vehicle dealers	72,486	Camera and photographic supplies stores	336,847
Warehouse clubs and supercenters	77,384	Other gambling industries	440,492
Payroll services	77,384	Specialty (except psychiatric and substance abuse) hospitals	477,200
Tobacco stores	79,533	Advertising material distribution services	477,200
Cafeterias, grill buffets, and buffets	80,653	HMO medical centers	520,582
Department stores (except discount department stores)	81,806	Amusement and theme parks	572,640
Diagnostic imaging centers	81,806	Psychiatric and substance abuse hospitals	572,640
Temporary shelters	82,991	Fish and seafood markets	636,266
Baked goods stores	84,212	News dealers and newsstands	636,266
Theater companies and dinner theaters	85,469	Dance companies	715,800
Medical laboratories	86,764	Other performing arts companies	715,800
Community food services	86,764	Media buying agencies	818,057
Promoters of performing arts, sports, and similar events with facilit	88,098	Other specialized design services	954,400
Confectionery and nut stores	90,895	Luggage and leather goods stores	1,145,280
Family planning centers	90,895	Casino hotels	1,145,280
Kidney dialysis centers	93,875	Casinos (except casino hotels)	1,145,280
Bed-and-breakfast inns	95,440	Other fuel dealers	1,431,600
Marketing research and public opinion polling	95,440	Geophysical surveying and mapping services	1,431,600

Location Theory: A Brief Overview

Neoclassical Location Theory

These simple market thresholds give us significant insights into how firm location from a demand maximization approach works.

Given the theory behind Central Place Theory we would expect most small rural "hamlets" to have a restaurant, tavern and gas station with a convenience store.

We would expect only larger places to have leather goods stores or mobile home dealerships.

We would expect to see more used car dealerships than new car dealerships.

Most important, we would expect to see many "low function" areas and few "high function" areas (small rural hamlets vs larger cities).

Location Theory: A Brief Overview

Neoclassical Location Theory

Two additional concepts come into play:

(1) frequency of purchases and

(2) heterogeneity in demand.

Items that are purchased on a more frequent bases (e.g., milk) will tend to have a lower market threshold because people are less willing to travel greater distances on a frequent basis.

Why are people willing to pay more for a gallon of milk at a close by convenience store (e.g., Kwik Trip or 7-11 Store) rather than travel to a lower cost super market grocery store?

The "effect price" is the same, but because the travel cost is lower these stores can charge higher in-store prices.

Location Theory: A Brief Overview

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Two additional concepts come into play:

(1) frequency of purchases and

(2) heterogeneity in demand.

Notice the population threshold for "women's clothing" store: 11,362

Now compare to a "men's clothing " store: 61,574

Why the large difference? Probably not the cost structures. Frequency of shopping?

By the same logic, more specialized businesses, such as furniture stores, would have higher market thresholds and serve a larger geographic market.

Location Theory: A Brief Overview

Neoclassical Location Theory

Two additional concepts come into play:

(1) frequency of purchases and

(2) heterogeneity in demand.

The assumption that all consumers scattered across are identical is somewhat unreasonable.

Regions (communities) vary by income levels, ethnicity, education, age and general tastes and preference.

For example, compare and contrast the market for an auto parts store across a high income community with a high share of retirees and a working class community with a high share of younger adult males.

Location Theory:
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We can refine our measures of market thresholds and gain insights into the socioeconomic and demographic factors (i.e., demand factors) by estimating a family of market threshold models:

$$N = \alpha + \beta P + \sum_{i=1\ldots m} \gamma_i X_i + \varepsilon.$$

# of Establishments = f(population, plus "other stuff")

$$N = \hat{\alpha} + \hat{\beta} P \rightarrow \frac{N - \hat{\alpha}}{\hat{\beta}} = P^C \quad \Longrightarrow \text{Market Threshold Population}$$

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Neoclassical Location Theory

Figure 1a: Number of Establishments and Market Size Relationship

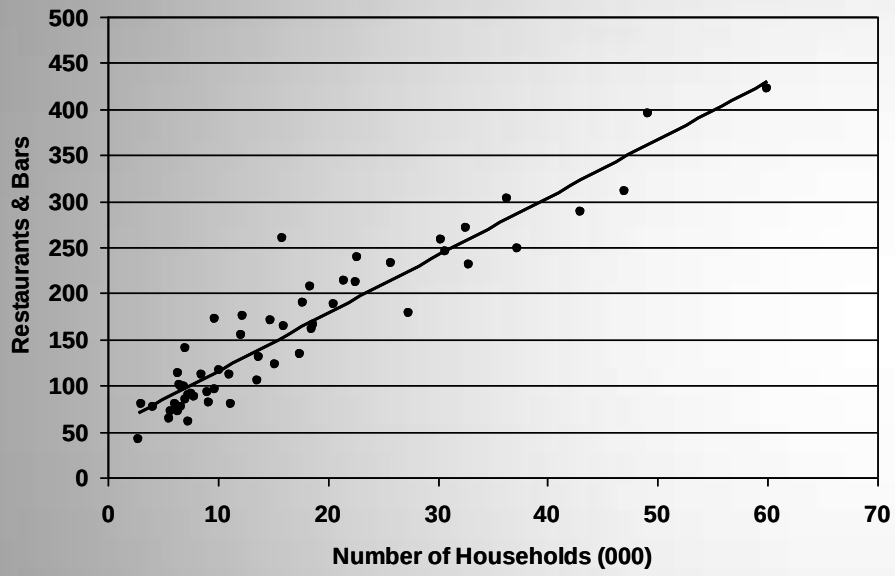
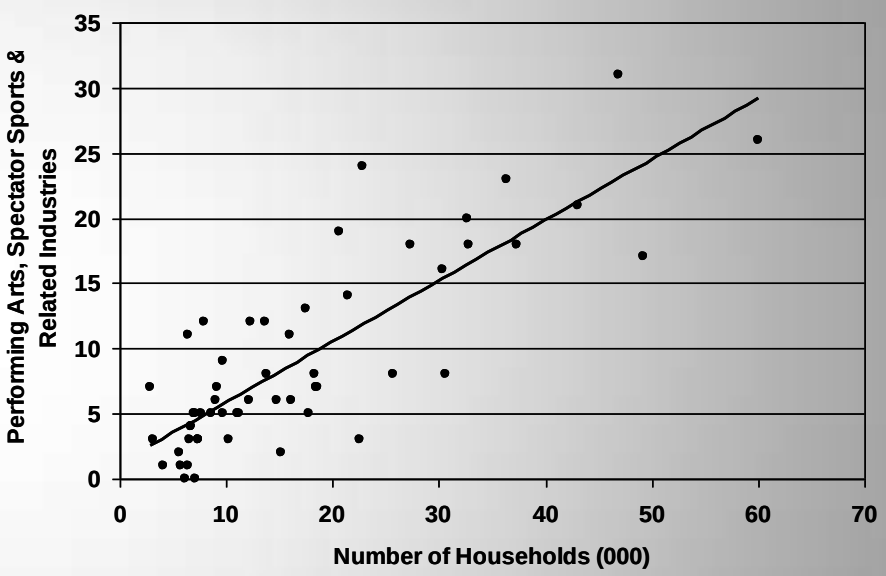


Figure 1b: Number of Establishments and Market Size Relationship



$$N = \alpha + \beta P + \sum_{i=1\ldots m} \gamma_i X_i + \varepsilon; \forall \gamma_i = 0.$$

Or, simply regressing "P" onto "N" with all other variables set to zero. For this study we used number of household rather than population.

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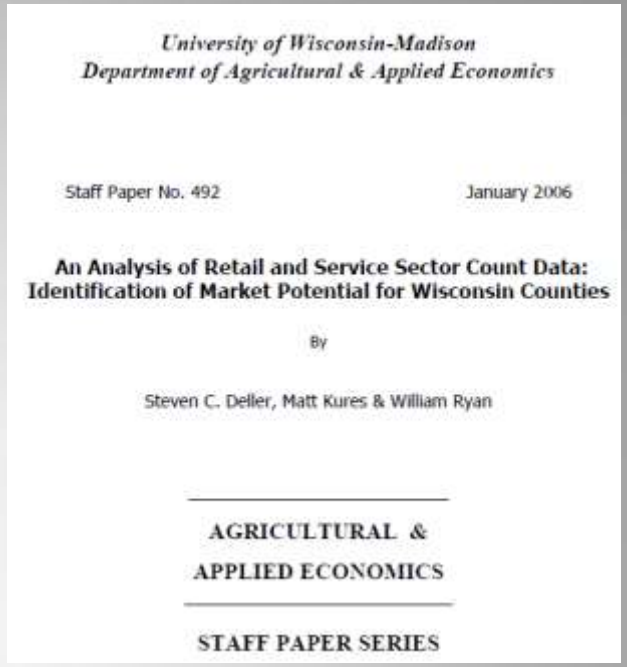
Table 2: Results of Stepwise Regression Analysis

	Food Services & Drinking Places (Restaurants & Bars)	Performing Arts, Spectator Sports & Related Industries	Amusement, Gambling, Recreation Industries
Number of Households	5.2514	0.6815	0.5373
	(25.96)	(25.54)	(11.46)
Number of Persons per Household	---	-11.7771	---
		(2.18)	
Percent of the Population Under Age 17	-5.5083	---	---
	(2.25)		
Percent of the Population Over Age 65	---	---	0.8454
			(1.83)
Percent of Those Over 25 with at Least a HS Degree	---	---	---
Percent of Those over 25 with at Least a Bachelor's Degree	---	---	---
Per Capita Income	---	---	---
Median Household income	---	---	---
Share of Total Income from Wages and Salary	1.0616	-0.1133	0.2591
	(2.63)	(1.92)	(2.73)
Unemployment Rate	5.6432	---	---
	(1.67)		
Gini Coefficient of Income Equality	254.0466	---	
	(1.98)		
Percent of Households with Low Income (<$20,000)	---	---	-1.1735
			(3.69)
Percent of Households with High Income (>$100,000)	---	---	---
Intercept	11.5522	32.0460	15.2310
	(0.16)	(2.37)	(1.90)
R square	0.9632	0.9345	0.8563
F statistics	261.43	247.38	75.95

t-statistic is in parentheses.


University of Wisconsin-Madison
Department of Agricultural & Applied Economics

Staff Paper No. 492 January 2006

An Analysis of Retail and Service Sector Count Data: Identification of Market Potential for Wisconsin Counties

By

Steven C. Deller, Matt Kures & William Ryan

AGRICULTURAL & APPLIED ECONOMICS

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http://www.aae.wisc.edu/pubs/sps/pdf/stpap492.pdf

Uses "stepwise" regression to see which "control" variables are important predictors of number of establishments.

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Table 3: Estimates of Strengths and Weaknesses

	Food Services & Drinking Places (Restaurants & Bars)			Performing Arts, Spectator Sports & Related Industries		
	Observed	Predicted	Error	Observed	Predicted	Error
Adams	93	110	-17	6	8	-2
Ashland	99	115	-16	4	1	3
Barron	161	174	-13	7	10	-3
Bayfield	113	83	30	11	5	6
Buffalo	64	87	-23	2	2	0
Burnett	84	94	-10	0	6	-6
Chippewa	211	182	29	3	13	-10
Columbia	214	181	33	14	13	1
Crawford	76	97	-21	4	1	3
Dane	1053	1087	-34	131	124	7
Dodge	270	256	14	20	17	3
Door	175	157	18	12	9	3
Douglas	207	165	42	8	11	-3
Dunn	122	151	-29	2	5	-3
Eau Claire	249	283	-34	18	20	-2
Forest	76	68	8	1	2	-1

What does the regression model "predict" should be in the county, what do we actually see or "observe" and what is the difference "error"?

Based on the regression analysis we would expect to see 110 (predicted) restaurants and bars, but we see only 93 (observed)….we see fewer (error of -17) businesses of this type than we would expect. Potential for growth?

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- By undertaking this more "sophisticated" analysis we uncovered that the simplistic market threshold estimates (# establishments divided by the population) is actually a pretty good approximation.

- Now in a community setting, which "tool" or data analysis approach is more like to "make sense" to local decision-makers, business owners and concerned citizens?

- We "know" we can use these simplistic tools because they are backed up by more rigorous analysis.

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One of the powers of central place theory is its ability to help the community economist think through how shocks, shifts or changes in the economy will filter through the retail and service markets.

Communities do not function in isolation from their surrounding communities. Any change in the economics of one community will affect not only its own place in the hierarchy but all communities in the hierarchy. The community practitioner needs to understand how shifts to one community can affect all communities in the system.

Location Theory:
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One of the key assumptions of central place theory is an even distribution of homogenous people across the economic plane.

Clearly this assumption does not hold in the real world and lifting the assumption greatly complicates our notion of central places, but it does not destroy it.

People cluster together into cities and villages fundamentally altering the shape of our Löschian demand cones.

Location Theory:
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- **Likewise, external economies of size vary with each community's social and economic characteristics.**
- **This community influence is often expressed as external economies or economies of agglomeration that shift the firm's average cost curve.**
- **By allowing for something other than a homogenous economic plane the rather sterile view of central places becomes much more reflective of the real world.**
- **The idea of multi-purpose shopping trips, business clustering such as shopping malls and market segmentation such as entertainment districts as opposed to office buildings begin to make sense.**

Location Theory:
A Brief Overview

Summary and critique of classical location theory

- **Classical location theory conceives the location decision being made by a profit-maximizing firm located on a homogenous economic plane.**
- **Firms and customers have perfect information and can fully process that information. In addition, firms are perfectly mobile and able to enter and exit spatial markets with no costs.**
- **The approach, while abstract, provides a rigorous framework to begin to think about space in a community economics setting.**
- **As a deductive theory of location it provides an excellent foundation for more in-depth analysis.**

Location Theory:
A Brief Overview

Summary and critique of classical location theory

The classical profit maximization approach yields models with relatively low predictive powers, thus preventing its ready adoption. There are several reasons for this low predictive ability.

- ***First*, the model does not handle personal preferences and psychic incomes/costs related to location decisions. These personal considerations cause the decision maker to maximize total (money and psychic) satisfaction rather than just monetary profit.**

Location Theory:
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***Second*, it assumes that the individual making a location decision has perfect knowledge about the future, which is, of course, not possible.**

- **Differences in opinions about risk and profit potential associated with various locations leads to different location decisions.**

- **A risk-averse owner or firm with limited financial resources may choose a site with less potential profit but less risk of loss.**

Location Theory:
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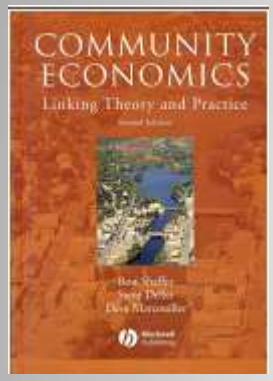
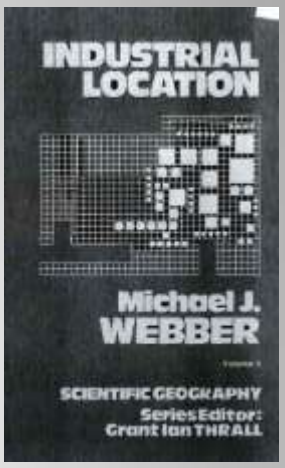
Third, **location decisions are typically made infrequently during the career of a business owner/manager. This infrequency, coupled with imperfect knowledge, often yields site selection criteria such as long-run sales growth with reasonable profits or space for expansion.**

The cost of acquiring additional information about alternative sites deters the business from further inquiry. The result is the selection of a satisficing rather than a profit-maximizing site.

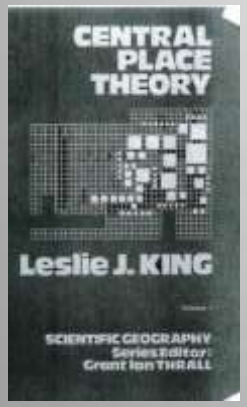
Recommended Readings

Shaffer, R., S.C. Deller and D.W. Marcouiller. (2004). Community Economics: Linking Theory and Practice. Blackwell: Oxford England.





http://rri.wvu.edu/wp-content/uploads/2011/05/3_IndustrialLocation.pdf



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