

Market Areas and Central Place Theory

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This chapter, drawn from the Fifth Edition of *Urban Economics* (McGraw-Hill/Irwin, 2003) examines urban development from the regional perspective. In contrast with earlier chapters, which explore the development of individual cities in isolation, this chapter explores some of the interactions between cities in a regional economy. In a regional economy, there is an urban hierarchy, with cities differing in size and scope. Table 1 shows the hierarchy of cities in the U.S. economy. In *Urban Economics* (Sixth Edition), the urban hierarchy is discussed briefly in Chapter 3, setting the stage for a more thorough explanation of the market forces that generate the hierarchy.

Table 1 Size Distribution of Urban Areas, 2000

Population Range	Number of urban areas
Greater than 10 million	2
5 million to 10 million	4
1 million to 5 million	43
100,000 to 1 million	324
Less than 100,000	549

The chapter is divided into several sections. The first section shows how firms in a market-oriented industry compete for customers and then discusses the equilibrium conditions for a market subject to spatial competition. We then explore the factors that determine the size of the market areas of different industries. The third section uses central place theory to explain how the location patterns of different industries are merged to form a regional system of cities. The final section explores some possible reasons for the development of giant cities in developing countries.

EQUILIBRIUM WITH MONOPOLISTIC COMPETITION

Market-area analysis was developed by Christaller (translated in 1966) and refined by Losch (translated in 1954). A firm's market area is defined as the area over which the firm can underprice its competitors. The firm's net price is the sum of the price charged by the store and the travel costs incurred by consumers. To explain the notion of a market area, consider a region where consumers buy compact discs (CDs) from music stores. The region has the following characteristics:

1. **Common store price.** All music stores have the same production technology and face the same input prices, so they charge the same price for CDs.
2. **Travel costs.** Every consumer buys one CD per trip to the music store. The travel cost (the monetary and time costs of travel) is 50 cents per round-trip mile.
3. **Shape.** The region is rectangular, 60 miles long and 20 miles wide.

Because music stores sell the same product at the same price, they differ only in location.

Pricing with a Monopolist

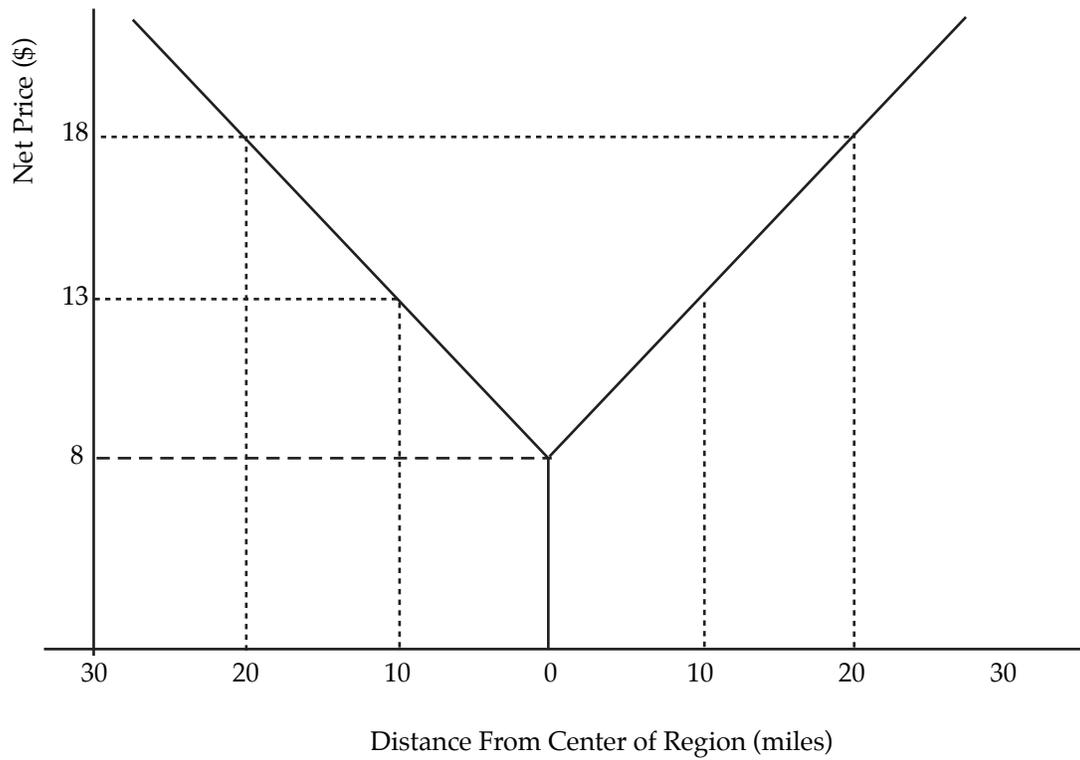
Suppose that there is a single music store (owned by Bob) at the center of the region. The net price per CD is the sum of the store price and the consumer's travel cost. Figure 1 shows the net price of CDs for consumers living in different parts of the region. If Bob charges \$8 per CD, the net price rises from \$8 for a household living next to the music store, to \$13 for a household living 10 miles from the music store, to \$23 for a household 30 miles from the store.

Figure 2 shows how the monopolist chooses the profit-maximizing output. The monopolist's demand curve is negatively sloped; as the store price increases, people buy fewer CDs. The negatively sloped demand curve generates a negatively sloped marginal-revenue curve. Profit is maximized where marginal revenue equals marginal cost, so the monopolist produces q_m units of output. If the monopolist sells q_m CDs, the market-clearing price is P_m (the point on the demand curve above q_m). Total profit (revenue less cost) is indicated by the shaded area.

Entry and Competition

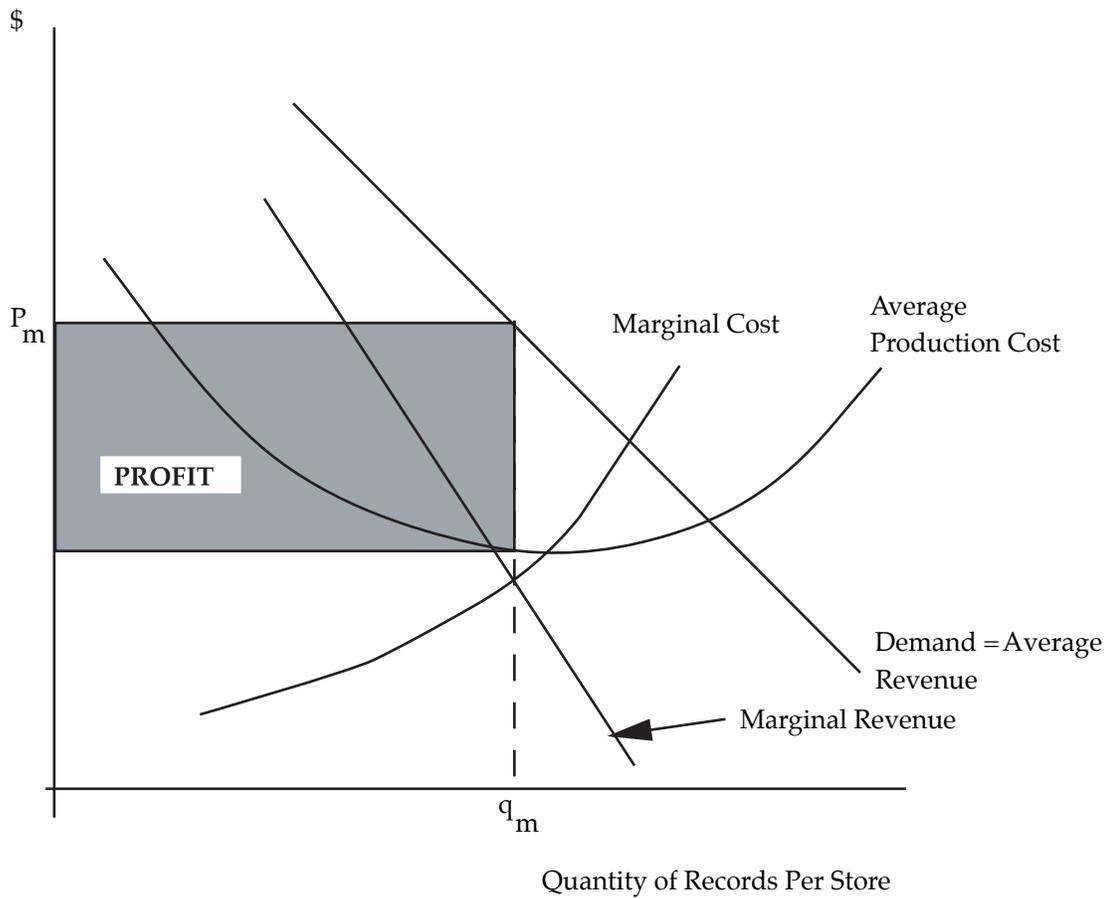
Since Bob the monopolist is making positive economic profit, other entrepreneurs will set up new music stores. Some consumers (those who live near the new music stores) will patronize them, so Bob's demand curve shifts to the left: at every price, he will have fewer customers. As his demand curve and marginal-revenue curve shift to the left, his sales volume decreases and his profits fall. In other words, entry causes competition, which decreases sales volume and profit per firm.

Figure 1: Net Price of CDs under a Monopoly



The net price of CDs is the sum of the store price (\$8) and the cost of traveling to the record store (50¢ per round-trip mile per CD).

Figure 2: Price and Quantity with Single Music Store



The profit-maximizing output (q_m) is the quantity at which marginal revenue equals marginal cost. The monopoly price is P_m , generating profit equal to the shaded area.

How long will entry and the associated decreases in profit continue? Equilibrium occurs when two conditions are satisfied. First, every firm is maximizing its profit, producing the output at which marginal revenue equals marginal cost. Second, economic profit is zero: The store price equals the average total cost of production.

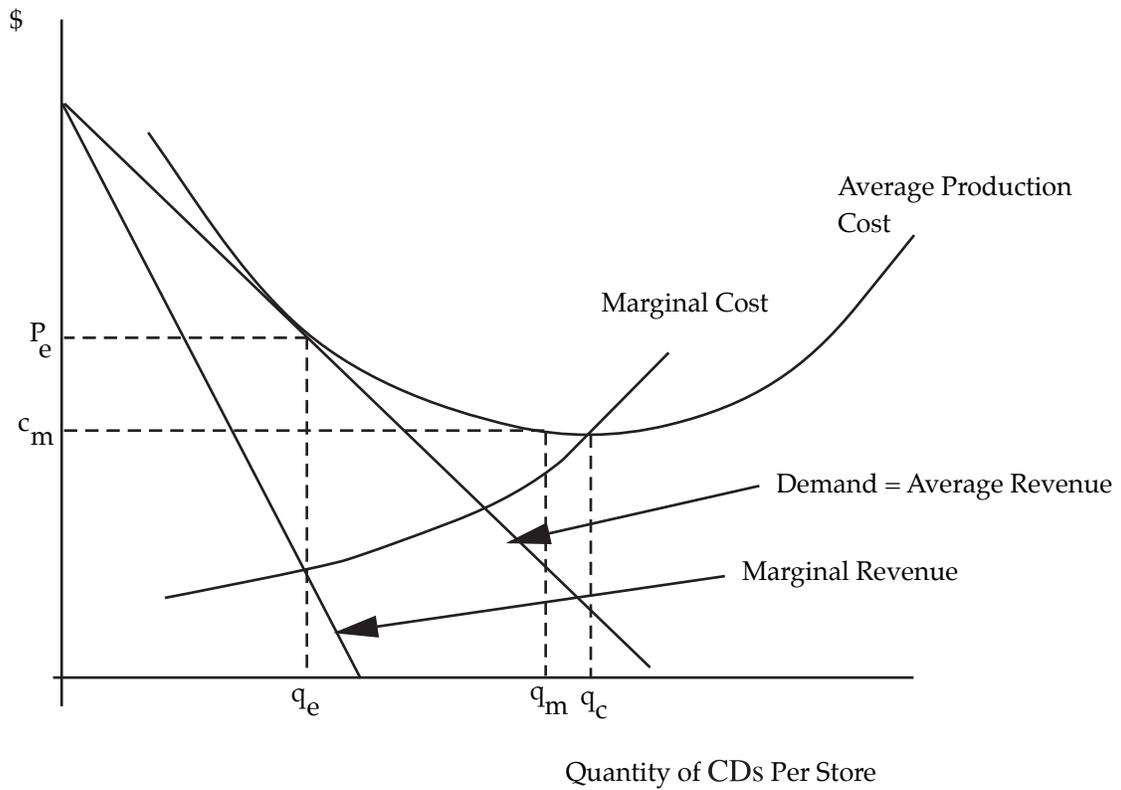
Figure 3 shows the equilibrium situation. At an output w_e , marginal revenue equals marginal cost (firms are maximizing profit), and the store price P_e equals the average production cost (profits are zero). At the equilibrium output, the marginal revenue curve intersects the marginal-cost curve, and the demand curve is tangent to the average production-cost curve.

This is the theory of monopolistic competition (covered in most intermediate microeconomics textbooks). Each music store is a monopolist within its own territory, but its monopoly power is limited by entry and competition. Each store faces a negatively sloped demand curve, and entry shifts the demand curve to the point at which profits are zero. Like a perfectly competitive firm, a firm with a local monopoly earns zero economic profit.

Efficiency Trade-Offs

There are some efficiency trade-offs associated with entry and competition. On the one hand, entry decreases output per firm, so individual firms move upward along their average cost curves. Scale economies are lost because output is divided among a larger number of firms, each of which produces at a higher average cost. On the other hand, the increase in the number of stores decreases travel distances for consumers, decreasing travel costs.

Figure 3: Equilibrium Price and Quantity of CDs with Entry



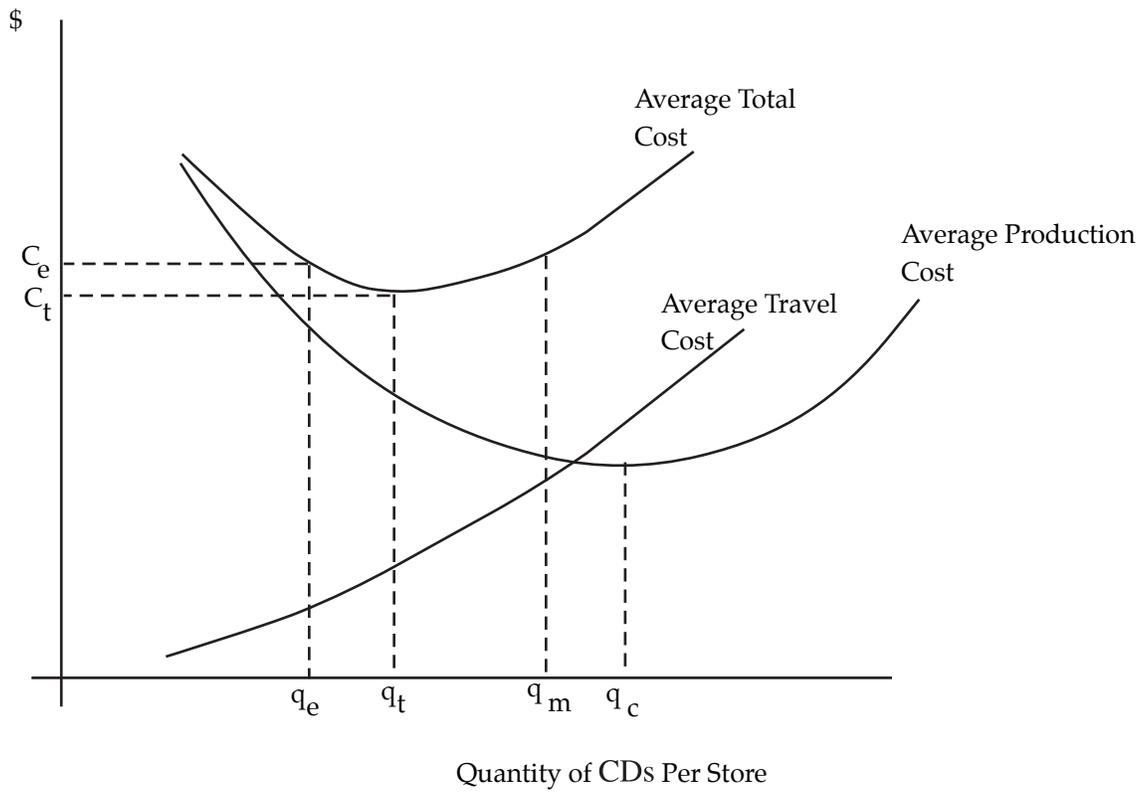
Entry shifts the demand curve of the individual store to the left, decreasing price and profit. Entry continues until profit is zero. The equilibrium output is q_e because $MR = MC$ (firms are maximizing profit) and $P = AC$ (profit equals zero).

Figure 4 shows the trade-offs between production and travel costs. The average total cost of CDs is defined as the sum of average production cost (from Figure 3) and average travel cost. Average travel cost is the travel cost incurred by the typical CD consumer. As the output of the music store increases, the market area increases and the typical consumer travels a longer distance to buy CDs. Therefore, the average travel cost increases with the output of the store. Average total cost (production cost plus travel cost) reaches its minimum point at q_t , far below the output that minimizes average production cost (q_c).

Entry decreases output per firm, generating bad news and good news. The bad news is that average production cost increases as firms move up the average production-cost curve. The good news is that average travel costs decrease as firms move down the average travel-cost curve. Starting from q_m in Figure 4, the good news dominates the bad news until output per firm reaches q_t . From that point on, further entry increases production costs by more than it decreases travel costs, so average total cost increases. In equilibrium, the output per firm drops to q_e , meaning that the entry process goes “too far” in the sense that average total cost is higher than the feasible minimum.

Figure 4 shows only one possible equilibrium outcome. For different sets of cost and demand curves, the equilibrium output per firm might be greater than q_t or equal to q_t . In other words, unless one knows something about the demand and cost curves, it's impossible to predict exactly where on the average total-cost curve the firm ends up. However, we do know that (1) entry decreases output per firm and (2) in equilibrium, the

Figure 4 Tradeoffs with Entry: Production Cost versus Travel Costs



Entry increases the number of firms and decreases output per firm. As output falls, average production cost increases and average travel cost decreases. In this case, entry goes "too far" in the sense that average total cost is higher than the feasible minimum (C_t).

firm does *not* produce at the minimum point of its average production-cost curve, but at some point to the left of the minimum point.

DETERMINANTS OF MARKET AREAS

Figure 5 shows the market areas for music stores under the assumption that there are three stores in equilibrium. Tammy and Dick set up music stores 20 miles from Bob and charge the same price for CDs (\$6). Compared to Bob, Tammy has a lower net price in the western third of the region, and Dick has a lower net price in the eastern third of the region. The three music stores split the region into three equal market areas, so every store has a circular market area with a 10-mile radius.

The market arrangement in Figure 5 has two implications for CD consumers. First, if the spaces between the circular market areas are ignored, the maximum net price is \$11, the sum of the price charged by music stores (\$6) and the maximum travel cost (\$5). Second, every household patronizes the music store closest to its home. All stores charge the same price for the same product, so a household will buy from the store with the lowest travel costs.

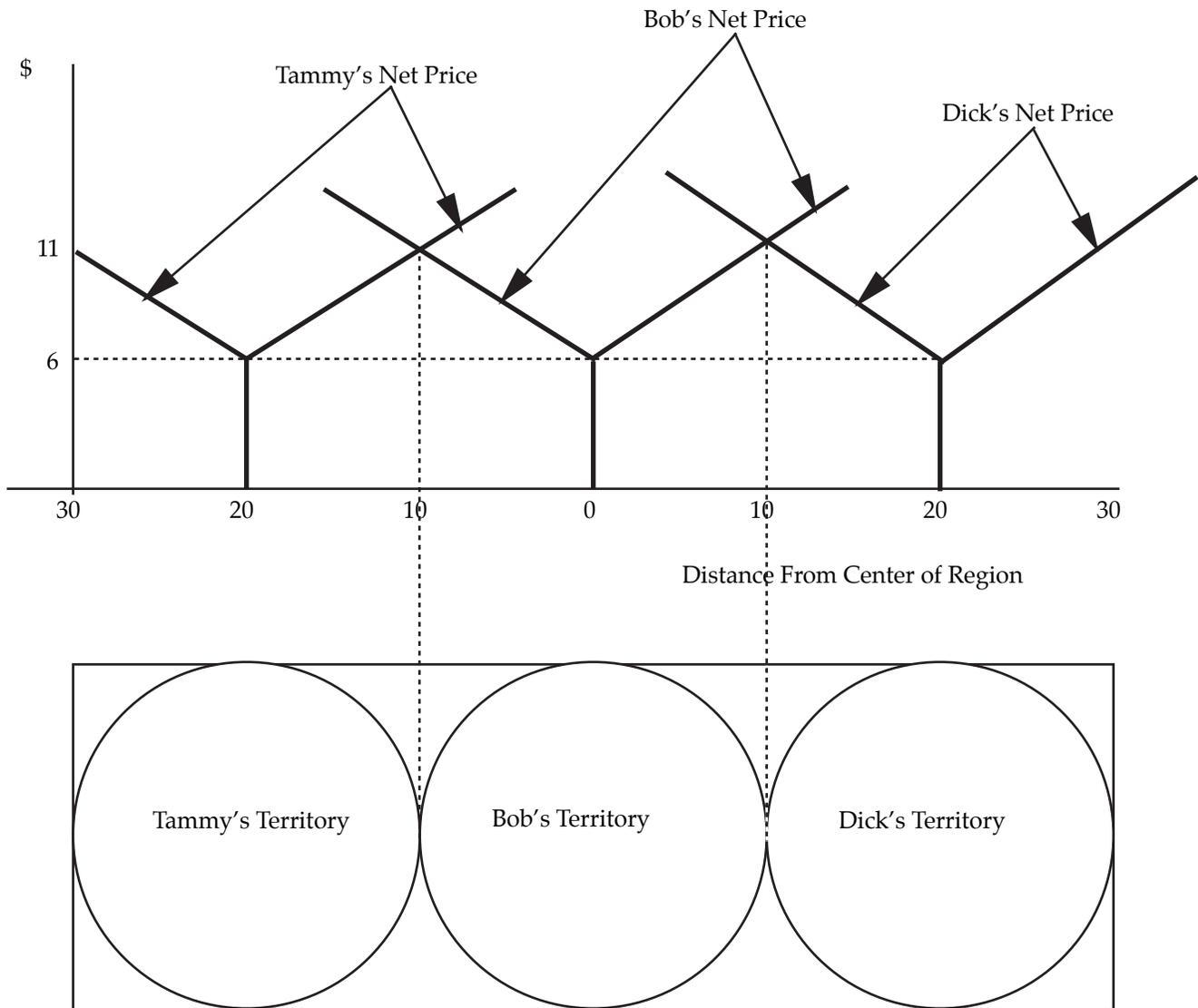
An Algebraic Model of Market Areas

What factors determine the market areas of market-oriented firms? We can derive an expression for the size of the market area with some simple algebra. The following symbols represent the market for CDs in a region:

d = Per capita demand (number of CDs)

e = Population density (people per square mile)

Figure 5 Equilibrium Market Areas



Each store's market area is the area over which its net price is less than the net prices of other stores. Each store has a circular territory with a 10-mile radius.

q = Output of the typical music store (CDs sold per month)

The market area of the firm (in square miles) is the territory required for the firm to sell its target quantity (q). In other words, the market area is

$$M = q / (d \cdot e)$$

The denominator is the demand for CDs per square mile (also known as demand density), equal to the quantity demanded per person (d) times the number of people per square mile (e). In Table 2, the demand density is 200 CDs, equal to 4 CDs per person times 50 people per square mile. The market area equals the target output (q) divided by the demand density. For example, if $q = 1,000$ CDs, the firm needs 5 square miles (each of which has a demand of 200 CDs) to sell its target output.

TABLE 2 Numerical Example of Number of Stores and Market Area

<i>Variable</i>	<i>Symbol</i>	<i>Numerical Example</i>
Per capita demand (number of CDs)	d	4
Population density (people per square mile)	e	50
Demand density (CDs per square mile)	$d \cdot e$	200
Output per store (CDs sold per month)	q	1,000
Market area (square miles)	$M = q / (d \cdot e)$	5.0

Changes in Demand and Population Density

How does an increase in the demand for CDs affect the market area of the typical firm? An increase in per capita demand increases the volume of CDs sold per square mile, so each firm needs a smaller market area to exploit its scale economies. For example, if per capita demand doubles to 8 CDs per person, the market area shrinks from 5 miles (1,000/200) to 2.5 miles (1,000/400).

How does an increase in population density affect the market area? Like an increase in per capita demand, an increase in density increases the volume of CDs sold per square mile, so each firm needs a smaller territory to exhaust its scale economies. For example, if population density increases to 125 people per square mile, the market area shrinks from 5 miles (1,000/200) to 2 miles (1,000/500).

Market Area and Scale Economies

How does an increase in scale economies affect the market area? An increase in scale economies means that average production costs continue to fall over a larger range of output, and this causes the typical firm to produce more output. There are greater scale economies to exploit, so the firm produces more output.

Assume for the moment that the demand for CDs is perfectly inelastic with respect to price. In other words, consumers don't obey the law of demand. Because an increase in scale economies increases the output of the typical firm, it increases the market area. Each firm needs a larger territory to exploit its now greater scale economies. Using the numbers in Table 2, if output per store increases from 1,000 to 1,200 and the demand density doesn't change, the market area will increase from 5 square miles

(1,000/200) to 6 square miles (1,200/200). This is the output effect of an increase in scale economies.

If consumers obey the law of demand, an increase in scale economies will have an ambiguous effect on the size of the market area. The increase in scale economies will decrease production costs and the store price, pulling down the net price of CDs to consumers. As a result, the per capita demand for CDs will increase, and this will tend to provide downward pressure on the firm's market area; the firm needs a smaller territory to sell a given output. This price effect at least partly offsets the increase in market area caused by the increase in output per firm, so we cannot predict whether the market area will increase or decrease. If the demand for the good is relatively inelastic, an increase in scale economies will increase the market area.

Market Area and Travel Costs

How does a decrease in travel costs affect the output per store? Suppose the development of a faster, cheaper travel mode decreases the monetary and time costs of travel. Recall that travel costs prevent a firm from moving all the way down its average production cost curve to the minimum point of the curve. The higher the travel cost, the further a firm is from the minimum point, that is, the smaller the quantity produced. A decrease in travel costs will reduce the strength of the force pulling the firm away from the minimum point, so the firm will move further down the curve and produce more output.

Assume for the moment that demand is perfectly inelastic. A decrease in travel costs increases the quantity of product produced per firm and increases the market area

because each firm needs a larger territory to sell its now larger quantity. Using the numbers in Table 2, if output per store increases from 1,000 to 1,400, the market area will increase from 5 square miles ($1,000/200$) to 7 square miles ($1,400/200$). This is the output effect of a decrease in travel costs.

If consumers obey the law of demand, a decrease in travel costs has an ambiguous effect on the size of the market area. A decrease in travel costs decreases the net price of CDs, increasing demand per capita (d). The increase in demand tends to reduce the firm's market area because the firm needs a smaller territory to sell a given quantity of output. The price effect at least partly offsets the increase in market area caused by the increase in output per firm, so we cannot predict whether the market area will increase or decrease.

Parcel Post and General Stores

For an example of the effects of changes in travel costs on market areas, consider the effects of parcel post on farm communities. Before the introduction of parcel post in 1913, farmers purchased most of their goods, including clothing and tools, in general stores in small farm communities. The introduction of parcel post decreased the cost of shipping goods from big-city merchants to farmers. Mail-order houses (e.g., Sears Roebuck, Montgomery Ward) underpriced the local stores, and farmers started buying clothing and tools from the mail-order houses. In the year following the introduction of parcel post, the sales of Sears and Montgomery Ward quintupled, and many general stores disappeared.

The introduction of parcel post decreased the cost of transporting clothes and tools, increasing the market area of the typical firm. The general store with its small market area was replaced by Sears and Wards, with their large market areas. In this case, the output effect was stronger than the price effect, so the market area grew. Although farmers consumed more trousers and shovels as the net prices fell, the increases in per capita demands were not large enough to offset the output effect.

Market Area and Income

How do differences in income affect the size of market areas? Consider a region with the following characteristics:

1. There are two cities, a poor one and a wealthy one.
2. A CD is a “normal” good (positive income elasticity of demand).
3. Land is a normal good (positive income elasticity).

Recalling the expression for market areas ($M = q/(d \cdot e)$), we expect a common output per firm in the two cities (q is the same), so the city with the larger demand per square mile ($d \cdot e$) will have the smaller market area for music stores. This is sensible because a larger demand per square mile means a firm needs a smaller territory to exploit its scale economies.

Which city will have a larger demand per square mile? Since a CD is a normal good, the wealthy city will have a higher per capita demand for CDs. Since land is a normal good, population density will be lower in the wealthy city. For example, the wealthy may live in single-family homes and the poor may live in apartment buildings. Because the wealthy city has a higher per capita demand and lower population density,

we can't predict whether it will have larger or smaller market areas for music stores. The relationship between income and market area is ambiguous because income affects per capita demand and population density in opposite directions.

Under what circumstances will the wealthy community have a larger market area? Suppose that the income elasticity of demand for land is large relative to the income elasticity of demand for CDs. If so, the density effect (increased income decreases population density) will dominate the demand effect (increased income increases per capita demand), and the wealthy city will have a lower demand density and a larger market area. Music stores will need a larger market area because although each household consumes more CDs, there are many fewer households per square mile.

Table 3 shows a simple example of how differences in income affect market areas. The income elasticity of demand for CDs is 0.50. In the wealthy city, where per capita income is 20 percent higher, the per capita demand for CDs is 10 percent higher. In the middle column, the income elasticity of demand for land is assumed to be 1.0. Therefore, the wealthy city has a 20 percent higher demand for land and a 20 percent lower population density (40 instead of 50). Given these assumptions, the wealthy city has a lower demand density, so music stores need a larger market area to exploit their scale economies (5.68 square miles instead of 5 square miles).

TABLE 3 Market Area with Different Income Elasticities of Demand for Land

	Poor City	Wealthy City	
		High Income Elasticity	Low Income Elasticity
Income elasticity for land	1.0	1.0	0.25
Per capita income	\$1,000	\$1,200	\$1,200
Per capita demand for CDs (d)	4	4.4	4.4
Population density (e)	50	40	47.5
Demand density ($d \cdot e$)	200	176	209
Output per store (q)	1,000	1,000	1,000
Market area in square miles ($q/d \cdot e$)	5	5.68	4.78

This result depends, of course, on numerical assumptions. If the demand for land were relatively income-inelastic, the difference in population density would be relatively small. The demand effect would dominate the density effect, so the wealthy city would have a smaller market area. In the third column of Table 3, the income elasticity of demand for land is assumed to be 0.25: population density in the wealthy city is 47.5 (a 5 percent difference) instead of 40; demand density is 209 instead of 176; and the market area is 4.78 instead of 5.68. In general, if the income elasticity for land is small relative to the income elasticity for CDs, the wealthier city will have a smaller market area.

The Demise of Small Stores

The demise of small stores illustrates the effects of changes in population density and transportation costs on market areas. Before the late 1800s, most goods in the United States were purchased in small stores. People bought food in small “mom and pop” grocery stores and purchased other goods in small general stores. The traditional merchant was involved in every transaction, playing two roles:

1. **Huckster.** The merchant assisted customers in their choice of goods, providing information on alternative products and persuading reluctant customers to buy the goods. The merchant was an effective huckster because he knew the features of every good in his store and was a trusted source of information about the products.
2. **Haggler.** The merchant negotiated with each customer over the price of a good. The merchant was an effective haggler because she knew the cost of every good in her store, and could quickly compute her profit margin as she negotiated with the customer. In addition, the merchant was skillful in assessing her customers’ willingness to pay for various goods.

Since huckster and haggler skills were not easily transferred to low-skilled employees, the merchant was involved in every transaction, and the traditional store was small.

The replacement of the small general store with larger stores suggests that the optimum store size increased. This occurred for a number of reasons, two of which are related to transportation costs. First, in the late 1800s and early 1900s, innovations in urban transit increased the speed and decreased the monetary costs of intracity travel. Second, rapid urbanization during this same period increased population density,

decreasing average travel distances (from home to store). As travel costs decreased, merchants expanded to exploit scale economies in marketing.

As merchants developed larger stores, they adopted new marketing techniques. New advertising and display techniques made the goods “sell themselves.” Some stores, such as Macy’s and Marshall Field’s, used newspaper advertising to inform and persuade consumers. Woolworth’s used plate-glass windows to display goods and attract customers. Grocery stores displayed their goods in such a way that consumers could do their own comparison shopping. A grocery store named Piggly Wiggly developed a floor plan that forced customers to walk through a maze from the entrance to the exit. By following the prescribed path from the entrance to the exit, customers were exposed to every commodity in the store, allowing them to make their own choices. These marketing techniques freed the merchant from acting as a huckster. Another new feature was the single-price policy, under which the merchant charged each customer the same price and was freed from haggling.

These two new marketing techniques freed the merchant from being involved in every transaction, allowing an increase in the size of the store. The merchant hired low-skilled laborers to perform the simple tasks of stocking shelves, wrapping goods, and collecting money. A single merchant could run a self-service store with dozens of low-wage employees, and this store could underprice the small traditional store.

Market Areas of Different Industries

Market areas vary from industry to industry, reflecting differences in travel costs, per capita demand, and scale economies. If scale economies are large relative to per

capita demand, the industry will have a small number of firms, each of which has a large market area. In contrast, if scale economies are small relative to per capita demand, there will be a large number of firms with small market areas.

Consider the market areas of pizza parlors and Tibetan restaurants. Suppose that both activities are subject to the same sort of scale economies, so the optimum output for both types of restaurants is 200 meals per day. If the total demand for pizza is 10,000 meals per day, the region will have 50 pizza parlors ($10,000/200$). If the total demand for Tibetan food is 200 meals per day, a single Tibetan restaurant will serve the entire region. The market area is not determined by scale economies per se, but by scale economies relative to per capita demand.

CENTRAL PLACE THEORY

Central place theory, which was developed by Christaller (translated in 1966) and refined by Losch (translated in 1954), is used to predict the number, size, and scope of cities in a region. The theory is based on a simple extension of market-area analysis. Market areas vary from industry to industry, depending on scale economies and per capita demand, so every industry has a different location pattern. Central place theory shows how the location patterns of different industries are merged to form a regional system of cities. The theory answers two questions about cities in a regional economy:

1. How many cities will develop?
2. Why are some cities larger than others?

A Simple Central Place Model

Consider a region with three consumer products: CDs, pizzas, and jewelry. The region has the following characteristics:

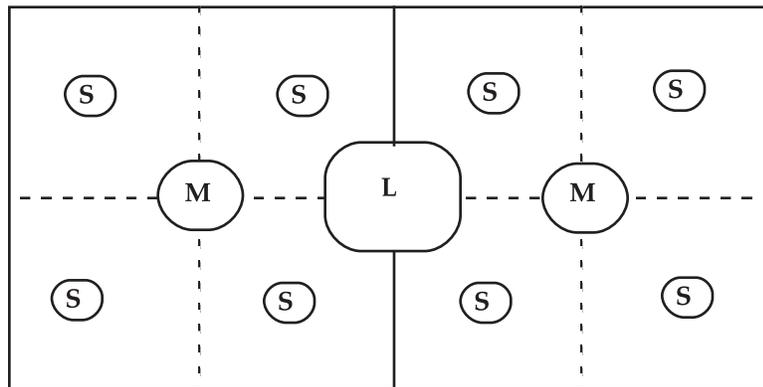
1. **Population density.** The initial distribution of population is uniform. The total population of the region is 80,000.
2. **No shopping externalities.** As discussed in Chapter 2, shopping externalities normally occur with complementary goods (one-stop shopping) and imperfect substitutes (comparison shopping). The simple central place model assumes that there are no shopping externalities.
3. **Ubiquitous inputs.** All inputs are available at all locations at the same prices.
4. **Uniform demand.** For each product, per capita demand is the same throughout the region.
5. **Number of stores.** The three goods have different per capita demands and scale economies:
 - a. **Jewelry.** Scale economies are large relative to per capita demand. Every jewelry store requires a population of 80,000, so a single jeweler will serve the entire region.
 - b. **Compact discs.** Scale economies are moderate relative to per capita demand. Every music store requires a population of 20,000, so there will be four music stores in the region.
 - c. **Pizza.** Scale economies are small relative to per capita demand. Every pizza parlor requires a population of 5,000, so there will be 16 pizza parlors in the region.

The central place model is a model of market-oriented firms, defined earlier in the book as firms that base their location decisions exclusively on access to their consumers. Because all inputs are ubiquitous, the firms ignore input costs in their location decisions. The single jeweler will locate at the center of the region. Because production costs are the same at all locations (all inputs are ubiquitous), the jeweler will minimize its total costs by minimizing its travel costs. According to the principle of median location (discussed earlier in the book), travel costs are minimized at the median location. Because population density is uniform, the median location is the center of the region and the jeweler will locate there. A city will develop around the jewelry store. Jewelry workers will locate near the store to economize on commuting costs. The population density near the jeweler will increase, generating a city (a place of relatively high density) at the center of the region. In Figure 6, a city develops at point L.

The music stores will carve up the region into market areas, causing the development of additional cities. If the region's population density were uniform, music firms would carve out four equal market areas. However, because there is a city surrounding the jeweler in the center of the region, there will be enough demand to support more than one music store in city L. If city L along with the surrounding area has enough people to support two music stores, the two other music stores will split the rest of the region into two market areas. In Figure 6, two more cities develop at the locations marked with an M.

The pizza parlors will also carve up the region into market areas, causing the development of more cities. Because the population density is higher in the cities that develop around the jewelry store and the music stores, there will be more than one pizza

Figure 6 The Central Place Hierarchy



City L

- 1 Jeweler
- 2 Music Stores
- 4 Pizza Parlors

M Cities

- 1 Music Store
- 2 Pizza Parlors

S Cities

- 1 Pizza Parlor

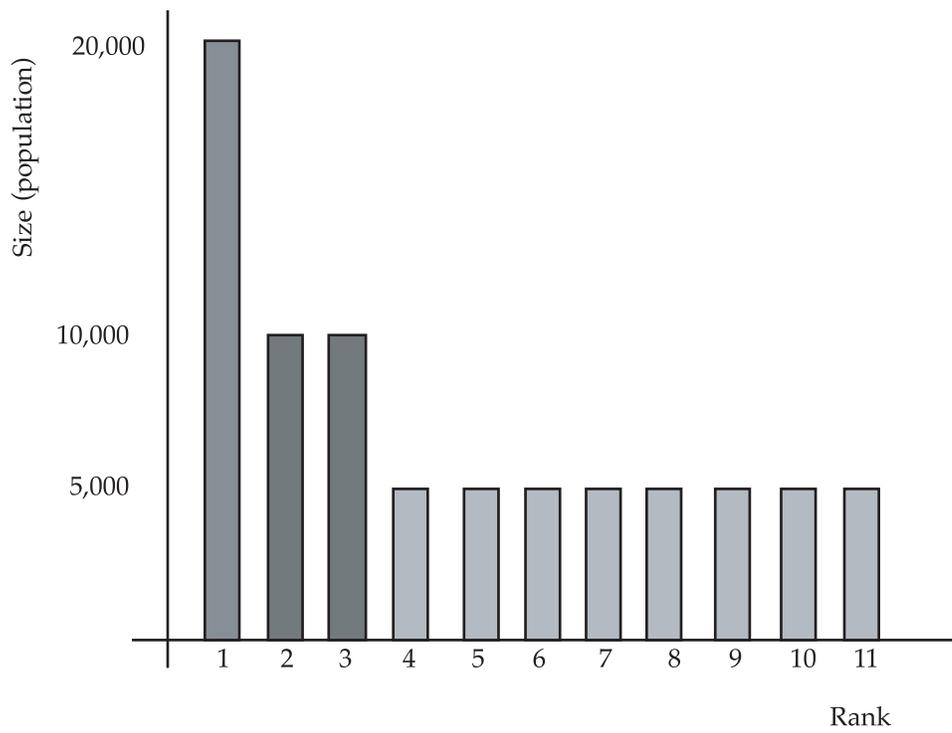
There are 11 cities in the region: one large city (L), two medium-sized cities (M), and 8 small cities (S). The larger the city, the greater variety of goods sold.

parlor in L and the two M cities. Suppose that L will support four pizza parlors, and each of the M cities will support two pizza parlors. If so, a total of eight pizza parlors will locate in cities L and M. The remaining eight pizza parlors will divide the rest of the region into eight market areas, causing the development of eight additional cities (the places marked with an S in Figure 6).

The rectangular region has a total of 11 cities. The large city at the center of the region sells jewelry, CDs, and pizza. City L has a population of 20,000, meaning that it is large enough to support four pizza parlors (5,000 people per pizza parlor). The city sells CDs to consumers from the four surrounding S cities, so the total number of CD consumers is 40,000 (20,000 from L and 5,000 each from four S cities), enough to support two music stores. The two medium-sized cities sell CDs and pizza. Each of the M cities has a population of 10,000, meaning that each city is large enough to support two pizza parlors. Each city sells CDs to consumers from two nearby S cities, so the total number of CD consumers in each M city is 20,000 (10,000 from M and 5,000 each from two S cities), enough to support one music store per M city. The eight small cities sell only pizza. Each of the S cities has a population of 5,000, meaning that each city can support one pizza parlor.

Figure 7 shows the size distribution of cities in the region. The vertical axis measures city size (population), and the horizontal axis measures the rank of the city. The largest city (L) has a population of 20,000; the second and third largest cities (M cities) have populations of 10,000; and the fourth through the eleventh largest cities have populations of 5,000.

Figure 7 Size Distribution of Cities with Simple Central Place Model



The simple central-place model generates one large city (L) with a population of 20,000, two medium-sized cities (M) each of which has a population of 10,000, and eight small cities (S), each of which has a population of 5,000.

The simple central place model generates a hierarchical system of cities. There are three distinct types of cities: L (high order), M (medium order), and S (low order). The larger the city, the greater the variety of goods sold. Each city imports goods from higher-order cities and exports goods to lower-order cities. Cities of the same order do not interact. For example, an M city imports jewelry from L and exports CDs to S cities, but does not interact with the other M city. Similarly, an S city imports jewelry from L and CDs from either L or an M city, but does not trade with other S cities. The system of cities is hierarchical in the sense that there are distinct types of cities and distinct patterns of trade dominance.

The simple central place model provides some important insights into how the market-area decisions of firms combine to generate the urban hierarchy. Here are some lessons from central place theory.

1. **Diversity and scale economies.** The region's cities differ in size and scope. This diversity occurs because the three consumer products have different scale economies relative to per capita demand, so they have different market areas. To explain the importance of differences in relative scale economies, suppose that the three goods have the same scale economies relative to per capita demand, so the region has 16 jewelers, 16 music stores, and 16 pizza parlors. The market areas of the three goods would coincide, so the region would have 16 identical cities, each of which would provide all three goods. In other words, if there are no differences in scale economies relative to per capita demand, the region's cities will be identical.
2. **Large means few.** The region has a small number of large cities and a large number of small cities. Why isn't there a large number of large cities and a small number of

small cities? A city is relatively large if it provides more goods than a smaller city.

The extra goods provided by a large city are those goods that are subject to relatively large scale economies. Since there are few stores selling the goods subject to relatively large scale economies, few cities can be large. In the simple central place model, the L city is larger than an M city because L sells CDs, pizza, and jewelry. Since there is only one jewelry store in the region, there is only one city larger than the M cities.

3. **Shopping paths.** Consumers travel to bigger cities, not to smaller cities or cities of the same size. For example, consumers from an M city travel to L to buy jewelry, but do not travel to the other M city or an S city to consume CDs or pizza. Instead, they buy CDs and pizza in their own city. Similarly, consumers in S cities travel to larger cities for jewelry and CDs, but do not shop in other S cities.

Relaxing the Assumptions

Several of the assumptions of the simple central place model are unrealistic. This section relaxes some of the assumptions, addressing two questions. First, does a more realistic model generate the same hierarchical pattern of cities? Second, does a more realistic model have more or fewer cities? The simple model assumes that the CDs from different music stores are perfect substitutes. There is no need for comparison shopping, and thus no tendency for music stores to cluster. Suppose that CDs and music stores are replaced by clothing and clothing stores. People shopping for clothes like to compare the clothes from different firms, and this will encourage the clothing stores to cluster rather than disperse like the music stores. If the optimum cluster is four clothing stores, the

stores will cluster at the center of the region. The region will have only two types of cities, large ones (with jewelers, clothing stores, and pizza parlors) and small ones (with pizza parlors). The presence of imperfect substitutes reduces the equilibrium number of cities from 11 to 9 because clothing stores compromise on their “ideal” (central place) locations to exploit the shopping externalities. Although comparison shopping decreases the number of cities, it does not disrupt the hierarchical pattern of cities.

Another assumption of the simple model is that the three products are not complementary goods. Suppose instead that pizza and CDs are complementary, so that the typical consumer purchases a CD and a pizza on the same shopping trip. If so, music stores and pizza parlors will pair up to facilitate one-stop shopping. If pizza parlors cannot survive without a companion music store, there will be only two types of cities in the region: large (with jewelry, CDs, and pizza) and medium (with CDs and pizza). Pizza parlors compromise on their ideal (central place) locations to exploit the shopping externalities associated with one-stop shopping, so the equilibrium number of cities decreases from 11 to 3. The presence of complementary goods does not, however, disrupt the urban hierarchy.

One of the assumptions of the simple central place model is that per capita demand does not vary with city size. Systematic variation in per capita demand may disrupt the urban hierarchy. Suppose we replace pizzas with grits, a good for which per capita demand is high in smaller cities and zero in large cities. Since there will be no grits restaurants in the large city, the urban hierarchy will be disrupted: the medium-size and the small cities supply goods that are not available in the large city. Of course, if per capita demands increase with city size (for example, theater or opera), goods will be more

concentrated in larger cities and this sort of variation in demand will not disrupt the hierarchy, but will increase the variety of goods more rapidly as we move up the hierarchy.

Other Types of Industry

Central place theory is applicable to market-oriented firms. The objective of a market-oriented firm is to minimize the travel costs of its consumers. The market-oriented firm is not concerned about (1) the cost of transporting its inputs or (2) the costs of local inputs. Central place theory predicts the pattern of cities that would result if all firms were market-oriented.

As explained in Chapter 2 of *Urban Economics* (Sixth Edition), there are two other types of firms, resource-oriented firms and input-oriented firms. For the resource-oriented firm (e.g., the producer of baseball bats), the cost of transporting raw materials is relatively high, so the firm locates near its input sources. For the input-oriented firm, the costs of local inputs vary across space, and the firm locates near sources of inexpensive labor, energy, or intermediate goods.

The location decisions of resource-oriented firms may disrupt the central place hierarchy. Suppose that a bat factory is located near the coastal forests of the region. Once the coastal city is established it may attract some market-oriented firms (e.g., pizza parlors). In addition to the three types of cities described above (large, medium, and small) there will be a coastal city, with a bat factory and pizza parlors. The urban hierarchy is disrupted because the coastal city has one activity (bat production) not available in the largest city.

It is possible that the bat factory will not disrupt the region's urban hierarchy. Suppose that the coastal city becomes large enough that it becomes the median location for the jeweler. If so, the coastal city will have all four types of activities (jewelry, bats, CDs, and pizza). The medium-size cities will have two activities (pizza and CDs), and the small cities will have only one activity (pizzas). In this case, the hierarchy is preserved because the coastal city takes the place of city L.

The same arguments apply to input-oriented activities such as textile firms (labor-oriented), aluminum producers (energy-oriented), corporate headquarters (oriented to intermediate inputs), and firms engaging in research and development (oriented to amenities valued by engineers and scientists). If the input-oriented firm locates near its input source, the resulting city will have some goods that are not available in the largest city. If, however, the resulting city becomes the median location in the region, it may replace city L as the largest city in the region.

CENTRAL PLACE THEORY AND THE REALWORLD

While central place theory is not literally true for many regions, it provides a useful way of thinking about a regional system of cities. The theory identifies the market forces that generate a hierarchical system of cities. It explains why some cities are larger than others, and why the set of goods sold in a particular city is typically a subset of the goods sold in a larger city. Exceptions to the hierarchical pattern result from (1) systematic variation in per capita demand and (2) the location decisions of firms oriented toward raw materials and local inputs.

Empirical Studies of Central Place Systems

Table 4 shows the results of an empirical study of central place theory. Berry and Garrison (1958) examined the economic activities of urban places in Snohomish County, Washington. They concluded that the dozens of communities in the area could be divided into three distinct types of urban places: towns (high order), villages (medium order), and hamlets (low order). The largest urban place, a town, was about twice as large as a village, which was in turn about twice as large as a hamlet. There were about half as many towns as villages, and about half as many villages as hamlets. As one moves down the hierarchy, the number of establishments and the number of functions decrease, which is exactly what is predicted by central place theory. Berry and Garrison concluded that the system of urban places was indeed hierarchical, with individual communities exporting to lower-order places and importing from higher-order places.

TABLE 4 The Urban Hierarchy in Snohomish County, Washington

	Type of Place		
	Town	Village	Hamlet
Number of places	4	9	20
Average population	2,433	948	417
Average number of establishments per place	149	54.4	6.9
Average number of functions per place	59.8	32.1	5.9
Average number of establishments per function	2.5	1.7	1.2

Source: Brian J. L. Berry and William Garrison, “The Functional Bases of the Central Place Hierarchy,” *Economic Geography* 34, pp. 145-54, 1958, Clark University.

Most of the empirical studies of central place theory examine systems of small towns in agricultural regions. Such regions have little industrial activity, so most firms are oriented toward the local market, not toward natural resources or local inputs. What about the national economy? As explained earlier, the central place hierarchy is disrupted by the location choices of resource-oriented firms and input-oriented firms. Since a large fraction of national employment comes from resource-oriented and input-oriented activities, it would be quite surprising if a study of the national economy provided much support for the simple central place model.

SUMMARY

- 1.** Market-oriented firms are involved in monopolistic competition or spatial competition. Each has a local monopoly, but its monopoly power is limited by entry and competition from other firms. In equilibrium, every firm produces the quantity such that marginal revenue equals marginal cost and each firm makes zero economic profit.
- 2.** The market area of an industry depends on the quantity produced per firm, per capita demand, and population density.
- 3.** Central place theory, which is based on market-area analysis, predicts that the regional system of cities will be hierarchical, with a small number of large cities and a large number of small cities. The set of goods sold in smaller cities will be a subset of the goods sold in larger cities.
- 4.** If the assumptions of the simple central place theory are relaxed to allow imperfect substitutes (comparison shopping) and complements (one-stop shopping), the equilibrium number of cities may decrease, but the urban hierarchy will not be disrupted.
- 5.** Central place theory is not applicable to resource-oriented firms and firms oriented toward local inputs. The introduction of such firms into the central place model may disrupt the urban hierarchy.

EXERCISES AND DISCUSSION QUESTIONS

- 1.** The discussion of the market area of music stores assumed that store owners Bob, Tammy, and Dick had the same production costs. As a result, households patronized the

store nearest their homes. Suppose that Bob discovers a new way of marketing CDs that cuts his production cost (and store price) in half, from \$6 to \$3. Tammy and Dick continue to sell CDs for \$6.

- a. How does the decrease in production cost affect Bob's market area?
- b. What is the net price at the border between Bob's and Tammy's market area?
- c. Will each household still patronize the firm closest to its residence?

2. Consider the market area of food stores in a region described by the following assumptions: (i) The per capita demand for food is 30 units; (ii) Population density is 40 people per square mile; (iii) The land area of the region is 100 square miles; (iv) The output of the typical food store is 6,000 units.

- a. How many food stores will there be in the region?
- b. How large is the market area of the typical food store?

3. Consider the market areas of hardware stores in two independent regions, Low and High. The average production-cost (APC) curves of the two regions reach their minimum points at the same level of output (1,000 units), but because Low has lower input costs, the minimum point of its APC curve has a lower average cost (its average cost of 1,000 units is \$1 instead of \$2). Will the market area in Low be larger, smaller, or the same as the market area in High? If you don't have enough information to answer the question, indicate what additional information you need and how you would use it.

4. Consider a regional economy with two cities. The two cities have the same population, but the average household income in city H exceeds that in city L. The residents of H and L consume Y. The characteristics of Y are as follows: The average production-cost (APC) curve is U-shaped; The APC curve is the same at all locations; Y is a standardized

product, with no close substitutes or complements; all households have the same tastes for Y; Y is inferior (negative income elasticity).

a. How will the size of the average market area of Y in city H compare to the size of the average market area in city L?

b. How would your response to (a) differ if the APC curve were a horizontal line?

5. Suppose that you intend to purchase the franchise rights for a pizza parlor. The franchiser has divided your region into two areas of equal size: H is a high-income area, and L is a low-income area. Suppose that the income elasticity of demand for pizza is zero: the consumption of pizza is independent of income. The income elasticity of demand for land is 1.0. Your objective is to maximize the quantity of pizzas sold.

a. Which of the two franchises will you choose?

b. How would your response to (a) change if the income elasticity of demand for pizza is 1.5?

6. In the example based on the data in Table 3, the implicit assumption is that travel costs were the same in the two cities. Suppose that the opportunity cost of travel is higher in the wealthy city. How might this change the market areas in the wealthy city?

7. Consider the city of Vaudeville, where initially all video consumers travel to video outlets to rent videos. Suppose that when the video outlets offer home delivery, all video consumers switch to home delivery.

a. Under what circumstances is the switch to home delivery rational?

b. In what type of cities would you expect home delivery to be efficient?

8. In 1930, most rural children walked to school. By 1980, most of them rode school buses. Would you expect the average “market area” of rural schools to increase or decrease as a result of the school bus?

9. The introduction of parcel post decreased transportation costs and increased the market area of the typical firm. Can you think of any good for which a decrease in transportation costs is likely to decrease the market area?

10. In the city of Metro, retail firms locate either in the central area of the city or in one of the suburban subcenters. There are two retail goods sold in the city, A and B. The per capita demands for the two goods are equal. The scale economies associated with the production and sale of A are large relative to the scale economies associated with B. Where in the city will the firms selling A and B locate?

11. Consider a city with a uniform distribution of population where every household consumes the same number of video rentals. The city is two miles long and two miles wide. The mayor recently stated her policy for the location of video rental outlets: “A video outlet reaches the minimum point of its average production-cost curve at an output of 1,000 units. Since the total demand for video rentals is 4,000 units, we should have four video outlets. Since the distribution of population is uniform, the video outlets should be distributed uniformly throughout the city, with every outlet at the center of a one-square-mile market area.” Comment on the mayor’s policy. Will it lead to an efficient distribution of video outlets?

12. In the city of Zone, the actual number of grocery stores is less than the number that would occur in the absence of zoning. A recent survey of grocery prices suggests that

Zone consumers pay less for groceries than people in a similar city without zoning. For example, the prices of Spam and Velveeta are 5 percent lower in Zone.

- a. Is there any reason to doubt the validity of the survey?
- b. Suppose that the survey is valid. Does the zoning policy make the residents of Zone better or worse off?

13. A developer has requested a permit to build a drugstore in a rapidly growing part of your city. Your mission is to figure out whether the new drugstore is appropriate. What information do you need, and how would you use it?

14. Explain why poor areas of cities typically are served by small grocery stores, not by large grocery-store chains.

15. Consider a region in which all firms are market-oriented (all employment is in retail outlets). There are no shopping externalities, and all retail activities are subject to the same degree of internal scale economies. In the last 10 years, the region's rank-size curve (with city rank on the horizontal axis and city size on the vertical axis) has become flatter.

- a. What changes in market areas are lurking behind the flattening of the rank-size curve?
- b. Provide an explanation for the changes in the market areas lurking behind the flattening of the rank-size curve.

16. Mr. Wizard, a regional planner, recently made the following statement: "If my assumptions are correct, all cities in this region will eventually be identical. They will be the same size and will sell the same set of goods."

- a. Assuming that Mr. Wizard's reasoning is correct, what are his assumptions?

b. Are Mr. Wizard's assumptions realistic?

17. Some people claim that state capitals (e.g., Sacramento, California; Salem, Oregon; Olympia, Washington) are boring cities. Specifically, it is claimed that these cities have fewer goods than one finds in other cities of equal size. After checking a map to see where each of these capital cities is located, use central place theory to explain why they might be considered boring.

REFERENCES

1. Berry, Brian J. L., and William L. Garrison. "The Functional Bases of the Central Place Hierarchy." *Economic Geography* 34 (1958), pp. 145_54. An empirical analysis of central place theory.
2. Christaller, Walter. *Central Places in Southern Germany*, trans. C.W. Baskin. Englewood, NJ: Prentice Hall, 1966.
3. Losch, August. *The Economics of Location*. New Haven, CT: Yale University Press, 1954.