Course: Rural Economic Development and Growth (AAE 4710/6710)
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LOCATION THEORY (reading: Shaffer, et al., Ch. 3)

Introduction. A body of literature in economics, regional planning and geography is concerned with explaining the location of economic activity. The literature examines many different aspects of location such as: (a) how a multi-facility firm can maximize profits over space, (b) how a spatial monopoly affects local economic welfare, or (c) what a community can do to attract a new employer.

A. PROFIT MAXIMIZATION APPROACH – a firm considers both costs and revenues it can make at alternative locations. If the company has better exposure to its market (i.e. higher revenues) at one site, it may choose that site even if the costs of operating there are higher.

Revenue factors are things like population of a location, income and family composition.

Cost factors include transportation and processing costs, i.e. labor, machinery, agglomeration factors, etc.

The firm chooses a location that maximizes profit, defined as:

$$\prod = \sum_{i=1}^{m} P_i D_i(P_i) - f - vq(x_i) - \sum_{i=1}^{m} t(s,s^i) D_i(P_i) - \sum_{i=1}^{n} d(s,s^i) x_i$$

$\prod$ = profit
P_i = price charged at market i
$D_i(P_i)$ = demand for firm's product at market i
$t(s,s^i)$ = per unit transport cost of product from factory s to market s^i
f = fixed production costs
v = marginal production costs
x_i = inputs purchased from point i
$d(s,s^i)$ = per unit transportation costs of input from point s^i to factory s
$q(x^i)$ = firm's production level

This is an expansion of the basic idea of profit maximization, but now both total revenue and total costs are affected by locational considerations. Product demand will be different at various locations, and there will be many choices of input suppliers.

There are two distinct cases that provide a good understanding of location theory.

These approaches are summarized below.

1. LEAST COST LOCATION

It views the firm's location decision as a two-stage process.

Stage 1: firm picks a general region where access to input and output markets is optimized.

Stage 2: within that region, it picks the most advantageous site.

Points to consider:

1. In stage 1, the size of the optimal region varies with the type of firm. A bottling plant may consider a multi-county region, and General Motors may consider the entire southeast U.S. There are consulting firms that employ large programming models to determine a region.

2. At the second stage, the community can arrange the set of location factors under its control and thereby increase its chances of attracting a new employer.

An Example

A. The firm chooses the location that minimizes costs of production and transportation. This is most applicable to a company that produces the good and sells it to a distributor at a single point. To give this some substance, think about a wood preserving company that wishes to build a new factory, and the distributor is Home Depot in Atlanta.

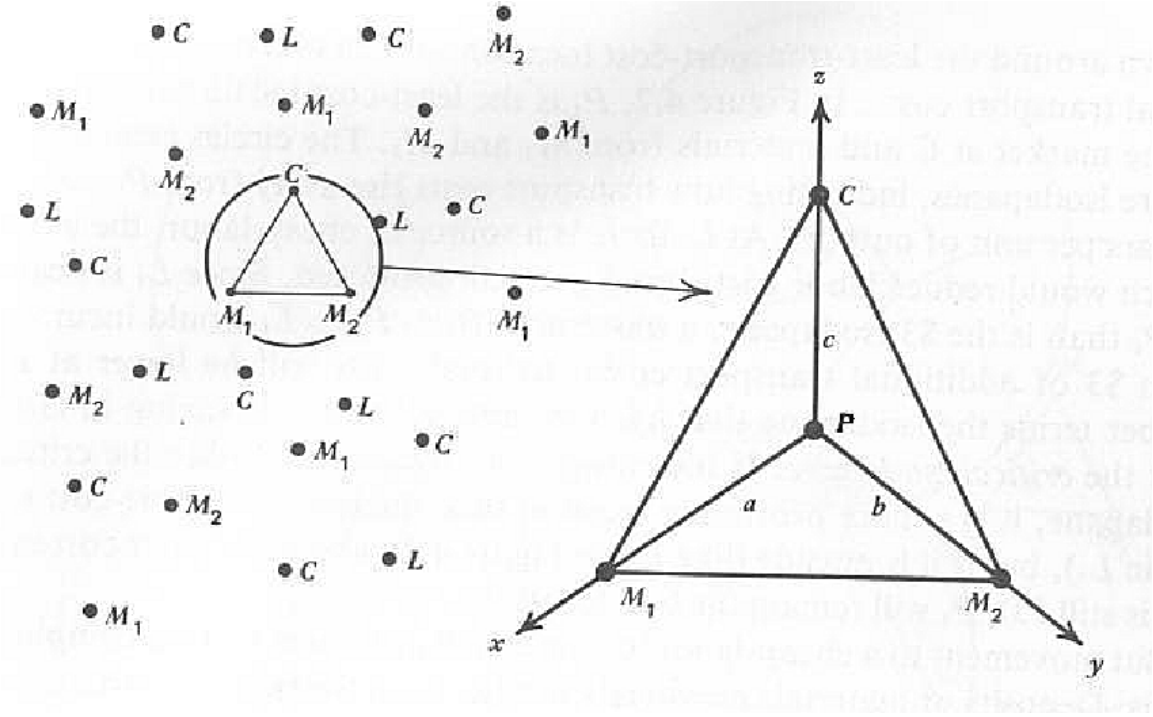
B. Assumes perfect competition. A firm cannot gain a monopolistic advantage by positioning itself close to its market.

C. Total costs relevant to the location decision can be broken down into:

a. Transport costs
b. Labor costs
c. Agglomeration advantages

1. Transport costs can be analyzed in a location triangle. Across an economic landscape there are market locations (for example, Atlanta at point C) and sources of raw materials. To keep things simple, consider just two raw materials: the raw wood (at point M1) and the treatment chemicals (at point M2).

The wood preserving company's problem is to determine the location for its plant (point P) that will minimize transportation costs. Each corner of the location triangle exerts a pull on where point P will be, according to how much weight is to be transported to or from that point. For example, if the raw wood weighs more than the chemicals do (a real possibility), then point P would move closer to point M1.

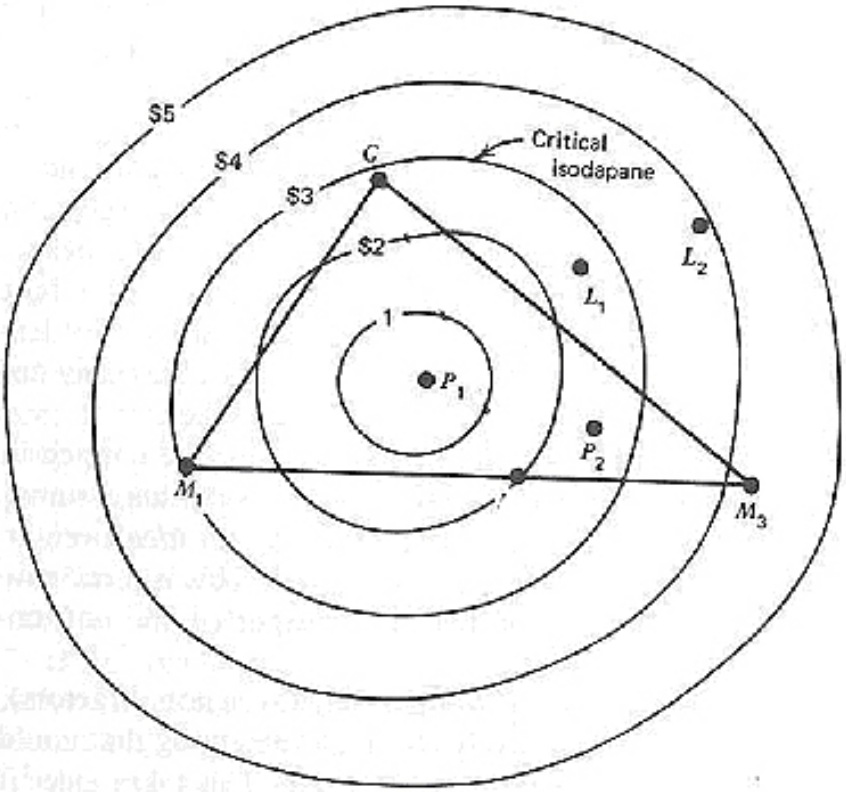


a, b and c are the distances that the materials have to be hauled, and x, y and z are their weights. The plant location (P) will be where the transportation cost = ax + by + cz is minimized. In this simple location triangle, the solution can be found by the theorem of the parallelogram of forces. If there are more 2 inputs, it is better to use a computer routine.

2. Labor costs

In the first stage of the location decision above, the firm minimized transport cost at point P1. More realistically, the company will have to consider other location factors that shift its location from P1. This deicision is made in the second stage of the location process. In this example the firm needs to consider labor costs in choosing a location, but other location factors like land and machinery costs can be considered as well.

Graph: Effect of Labor Costs on Least Cost Transportation Site



The concentric circles are isodapanes. Each isodapane connects points of equal additional transport costs from P1, the minimum transport cost site. The label on top of the isodapane shows how much it costs to transport a ton from P1.

Suppose the cost of labor is $10 per ton of outut at P1, the minimum transport cost site. Suppose, further, that there are two other potential sites, L1 and L2, where the cost of labor is only $7 per ton of output.

To determine whether there is a lower cost location than P1, make the following comparisons:

(1) Area L2: Reduction in labor costs/ton of output: $3
Increase in transport costs/ton of output: $3-4

Thus, L2 does not offer a lower cost site than P1.

(2) Area L1: Reduction in labor costs/ton of output: $3
Increase in transport costs/ton of output: $2-$3

Thus, area L1 offers a lower cost site than P1. This is shown as P2 in the diagram above.

This process can be repeated for other factors of production like land, capital, etc.

AN APPLICATION TO GEORGIA COUNTIES (reading: Kriesel and McNamara, copy available online)

In rural development, especially for the practitioner, locational questions are asked from the community's point of view, that is, what can the community do to attract new employers? The approach outlined above is well-suited to answer this question.

Location Factors

A fairly standard set of location factors has emerged in the literature. Below are summarized the location factors from the Georgia industrial location research by Kriesel and McNamara. The goals of the research were to (a) estimate the probability of Georgia counties attracting a manufacturing plant, and (b) discover which location factors are important.

This list represents location factors that should apply to nearly all types of industries. Of course, specific industry types will have special considerations. In some cases the location factor is a broad concept, and workable proxy variables are provided as examples of how the concepts can be operationalized. In all cases the variables are measured at the county level.

1. AGGLOMERATION: the firm's economic advantage that comes from locating close to other economic activity, such as: (a) specialized industries and producer services, (b) social amenities and (c) a diversified labor force. Measured by 'miles to a metro area' or 'number of manufacturing plants'.

2. LABOR QUANTITY: The available labor force in an area. Measured by 'the size of the local labor force' or the unemployment rate.

3. LABOR COST: This directly affects the cost of doing business. If the productivity of labor is accounted for then this factor should be a negative effect. Measured by the county's average weekly manufacturing wage.

4. ACCESS TO TRANSPORTATION: This directly affects cost of doing business. In Georgia this can be measured by 'presence of an interstate highway'. In Georgia a development tool has been the construction of 'developmental highways'

5. COMMUNITY ATTITUDE TO INDUSTRY: "industry locates where it feels welcome". Ideally, this would be measured by a county's effort to attract industry, but this is not available. A proxy variable was used: FREEPORT (whether or not the inventory tax exemption referendum was passed).

6. INDUSTRIAL SITE QUALITY: counties have developed industrial parks with improvements such as water and sewer service, access roads and shell buildings. These can be a direct reduction of firms' set-up costs. Measured by the predicted per-acre price of the county's best industrial site.

7. HUMAN CAPITAL: investments made in human resources which improves its productivity. If the cost of labor is held constant then firms should prefer locations with more productive labor forces. Measured by the % of students who completed high school.

8. LOCAL INFRASTUCTURE: water works, bridges and types of public services. Measured by the fire protection rating, a determinant of insurance cost, ranging from 1 (best) to 10 (worst).

9. QUALITY OF LIFE: local cultural and natural amenities. Measured by distance to the nearest 4-year college..

10. TAXES AND SUBSIDIES: The outcome of tax effects depends on how business views what this revenue is spent on. If firms perceive that additional taxes are spent on items that benefit them (i.e. better public services like utilities) then they should not be repelled by taxes. If they think that taxes don't benefit them, then they will avoid high tax areas. Measured by the county's effective tax rate per $1,000 of property

11. RACIAL COMPOSITION: Previous research in the south has indicated that firms may avoid counties that are predominately black. This was measured with the county's percentage of black residents.

The extension bulletin by Kriesel and McNamara explains the results of the Georgia research. It is important to note that the county has direct control over some of these location factors, and counties face the choice of where to put their money to the best use. For Georgia counties, the research shows that bigger improvements in location success come from public service investments rather than the traditional investment in industrial sites. The research also emphasizes how a place can overcome disadvantages. For

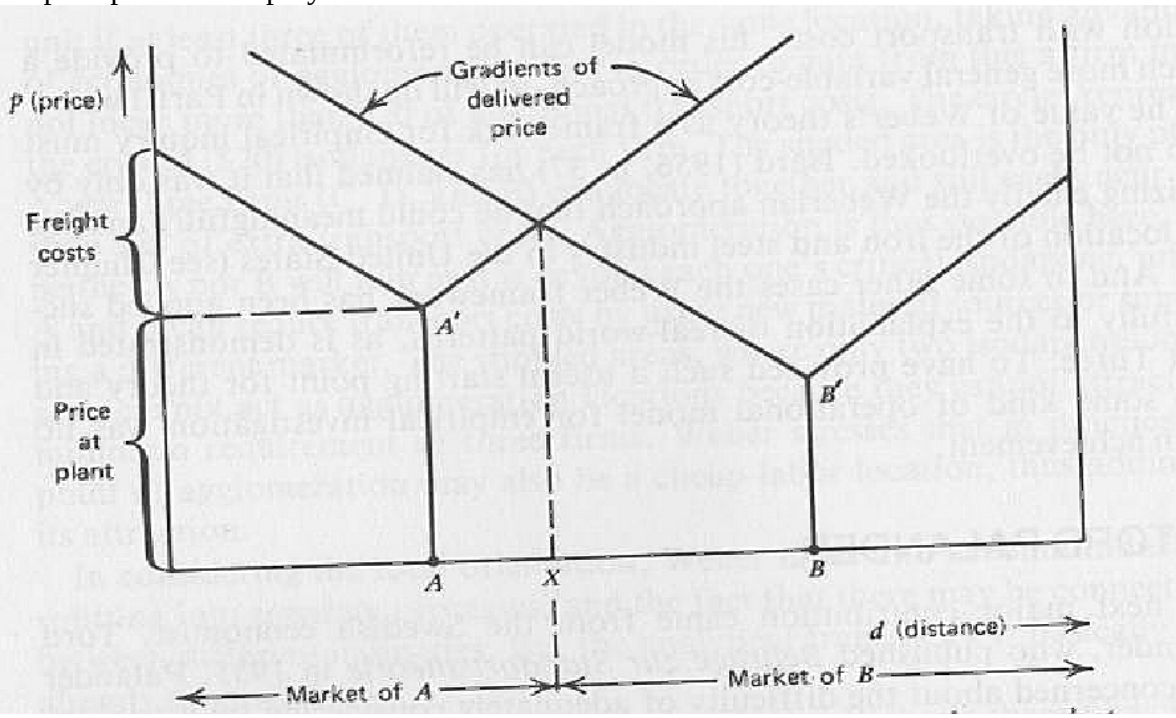
example, a county that is remote can overcome this disadvantage by developing an educated work force.

2. DEMAND MAXIMIZATION APPROACH: this is the second case that comes out of profit maximization.

1. Ignores production costs. The analysis is appropriate for the retail sector, in which production costs are low (as compared to, say, manufacturing). Rather than selling to a specific point, as in cost minimization, here the firm sells to customers in a geographical market area. Therefore, the approach is used in locating retail stores and food processors such as bakeries, bottling plants, etc.

2. The firm attempts to locate where it can control as large a market area as possible. Within this area it can exert some monopolistic control over its market.

Graph: Spatial Monopoly



Consider two companies, A and B, that make an identical product like bread and they service a linear market of groceries, convenience stores, etc. as pictured in the horizontal axis above. The production cost is the distance AA' for company A. Company B's cost structure is lower, given by BB' The price paid by retailer, the delivered price, is the sum of the freight cost plus price at the bakery. At the intersection of the two "Gradients of Delivered Price" the prices charged by the two companies will be identical. On the right side of point X, company B can underprice his competition, so all of the customers in this area will patronize him. Same goes for company A and the market area to the left of point X. Therefore, within a market area, each company has a

"spatial monopoly". This is a fairly weak form of monopoly for the following reason. Suppose that company B tries to raise its price. Then, the market boundary would shift from point X to the right. B would lose customers to company A, and this may also open the door for a rival company to locate around point X.

3. Market boundaries are affected by both production and transport costs

Graph: Market Boundaries

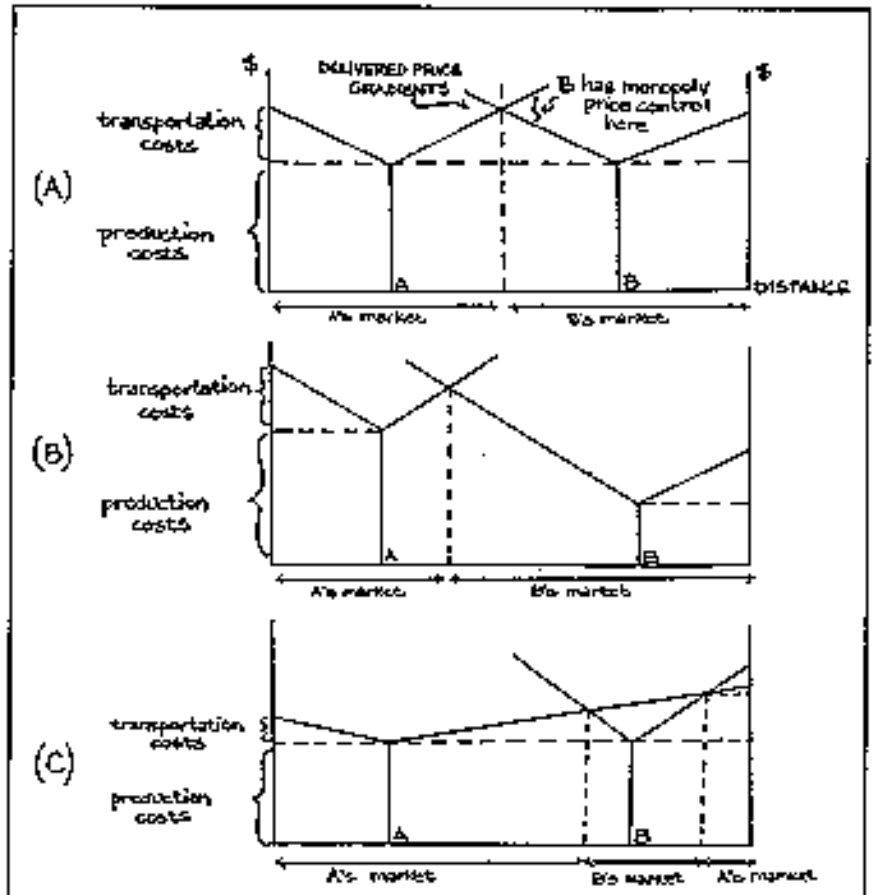


Fig. 3.11. Delineation of market boundaries. (After Palander 1935, Fig. 39, p. 224.)

In panel A, company A and B have identical cost structures, so they split the market 50-50. In panel B, company B has lower production costs, and this increases its market area. In panel C, company A has lower transportation costs, and this increases its market area.

Demand maximization has also been applied to political science, where rival politicians try to match the tastes of the median voter.

B. BEHAVIORIAL APPROACH

Rather than assuming that the firm only wishes to maximize profits, this approach permits other types of objective functions such as

1. Maximize the owner's utility. This allows an explanation of why factories are located in odd places. Eg, the owners might have an emotional attachment to a place.

2. Maximizing behavior in the presence of bounded rationality. This allows for shortcomings in management's ability to use all relevant information.

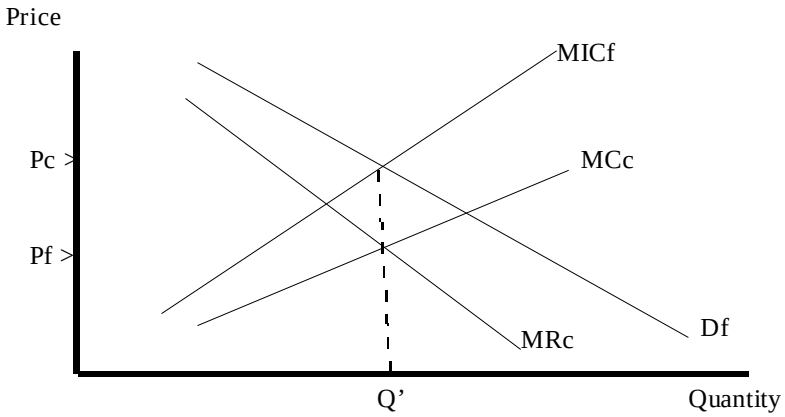
3. Maximizing behavior in the presence of uncertainty about future conditions.

This approach draws heavily upon the sociology and regional planning literature, and is seldom used by economists.

C. INSTITUTIONAL APPROACH

This approach focuses upon the interaction between firms, government, labor unions, and other institutions. It says that firms can play different communities against each other. It also recognizes that communities see themselves as competing with other for the benefits associated with a new employer. The approach uses game theory (invented by John Nash) to explore different outcomes. A frequent outcome is that communities can get into a bidding war for a new factory, but the "winner" will actually bargain away potential benefits.

To see why this is so, consider the situation of a single firm negotiating with a single community over the terms of a location incentive package. For simplicity, suppose the firms uses mass amounts of water in its production, so negotiations are about the price and quantity of water that the community will supply. This situation can be analyzed as a bilateral monopoly, where the firm is a single buyer in the market for water (i.e. it's a monopsonist) and the community is the single seller (i.e. it's a monopolist). As a monopolist, the community will produce water at Marginal Cost = Marginal Revenue, (MCc=MRc) but it charge what the market will bear, given by the firms demand for water at Pc. As a monopsonist, the firm will buy water at Demand = Marginal Input Cost (Df=MICf), but it will only pay what the market will bear, given by the community's marginal cost of production at Pf. Both parties will try to pay (or charge) what the market will bear, and this leads to an indeterminant outcome for price - the firm will want to pay a low price and the community will want to charge a high price. Then the two parties begin bargaining over what the price of water should be, and the advantage goes to whoever has bargaining power.



Now consider a more realistic situation where a firm has expressed interest to 3 communities. These can be analyzed as three separate bilateral monopolies, and the firm conducts separate negotiations with each community. When there is no collusion between the communities about what price they are offering to the firm, the firm will have bargaining power. This is because the firm can set the stage for a bidding war among the communities. A community that doesn't engage in the bidding war can be persuaded to because the firm can use a *threat of noncooperation*, i.e. the firm threatens to end negotiations with that community and concentrate on the remaining bidders. This is a powerful bargaining tool. If a community is desperate enough for the jobs that the firm would bring, it will bargain down to where its net benefits for location are zero.

This simple model can be expanded to consider the usual items that go into a location incentive package - tax breaks, free utilities, housing assistance, etc. This analysis and the result also applies to counties and states. As an example, consider bidding wars between the southern states over new, foreign car factories as described in the reading from the *Economist* magazine. The states have probably obtained no net gains from the new factories because of generous location incentive packages.

D. FOUR ISSUES ABOUT INDUSTRIAL RECRUITMENT AS A RURAL DEVELOPMENT STRATEGY

Issue 1. The Role of Agglomeration in Firm Location

This is one of the primary industrial location factors considered in the profit maximization approach. The story starts with the concept of *regional comparative advantage*. This is where a region might very conducive to development because it has abundant high-quality inputs, a productive labor force, etc. These physical characteristics mean that the region will have a low-cost advantage that will probably attract specialized industries. These industries will spawn the creation of highly specialized business service providers. The existence of these services gives the area an additional cost

advantage. Agglomeration is a powerful explanation of industrial location. For a rural area, overcoming the lack of agglomeration is a major problem.

A specialized type of agglomeration is seen in *industry clusters*. This is where an industry is concentrated in an area, be it a multi-county area of a state, a metropolitan area, or a single county. The key is that firms in the area will be interlinked through their use of specialized inputs such as an educated work force, shared local infrastructure such as a research park, and shared business knowledge through networks.

Industry clusters can give a comparative advantage to an area in three ways.

1. They increase the productivity of the area's firms.

2. They can provide a basis for innovations and discoveries.

3. They can spawn the formation of new businesses.

That concept of industry clusters is similar to agglomeration, only it stresses the dynamic nature of how innovations can fuel further growth.

Issue 2. The Product Cycle

This explains how a new product, such as the personal computer, evolves from a high-priced specialty item whose manufacture involves high skilled, high paid labor to a mass-market commodity with standardized production techniques involving unskilled, low wage labor. The product cycle suggests that low skill areas will be manufacturing mature products. Even though the product may seem a high technology one, workers in it will be paid low wages. Thus, when a rural county attracts a high technology industry it is doubtful that the workers' wages will be very much above the county's average.

Stage 1. Research and Development characterized by:
- requires high skills, pays high wages
- test marketing to specialized consumers
- high product price
- most activity is in urban areas (Corporate HQ)

Stage 2. Product Refinement characterized by:
- firm has monopoly on production
- high price
- high income market
- production requires high skills, pays high wages
- production is in urban areas

Stage 3. Product maturation characterized by:
- standardized production techniques
- requires low skills, pays low wages
- many firms in the market
- mass marketing
- low product price, low income market

So, production is eventually farmed out to branch plants in areas with low skills, low labor cost. The branch plants are usually in rural areas, but increasingly they are overseas.

Issue 3: How Has Industrial Recruitment Changed Over Time?

Industrial recruitment has become more expensive for communities to do. This is because communities have no choice but to "keep up with the Jones'". That is, communities know that they are in competition with other communities for a very small number of industrial prospects. Starting from a situation where all communities have a corn field designated as their industrial park, a community can make itself more noticeable to industry if it develops the corn field and erects an industrial shell building. Neighboring communities will notice this and they will want to keep their competitive position by buying shell buildings. Thus, the stakes of the game are raised and soon all communities feel they have to make these costly investments. This leads to a spiraling cycle of increased expenditures.

Unfortunately, the benefits to a community have not changed much over time. When a plant locates in a community, there is increased employment and increased income, and there may be spinoff employment in supporting industries. Therefore, there is downward pressure on net benefits that a community can expect.

Issue 4: Is Industrial Recruitment a zero sum game?

Definition: a zero sum game occurs when increased economic activity in a community comes at the expense of another community.

Zero sum outcomes can occur because within a region there is a very limited number of new employers considering locating there during any period of time. Thus, within Georgia, increased employment from a new plant locating in Macon directly detracts from the new jobs available to Augusta. Therefore, the state government should concentrate on attempting to lure new plants away from surrounding states, and it should try to limit the incentive packages that individual communities offer.

There is an important exception when industrial recruitment is not zero sum. This is when a firm locates in a place where it becomes more productive that it would otherwise have located. When the firm experiences this increased efficiency, there can be real gains

from industrial recruitment. The best tool for encouraging these good matches between a firm and a community is the site information service provided by state government, Georgia Power, etc.