THE URBAN TO RURAL SHIFT IN MANUFACTURING EMPLOYMENT: A TEST OF ALTERNATIVE THEORIES

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The University of Arizona M.S. 1986

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THE URBAN TO RURAL SHIFT IN MANUFACTURING EMPLOYMENT: A TEST OF ALTERNATIVE THEORIES

by

Bradley John Werth

A Thesis Submitted to the Faculty of the

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In Partial Fulfillment of the Requirements
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THE UNIVERSITY OF ARIZONA

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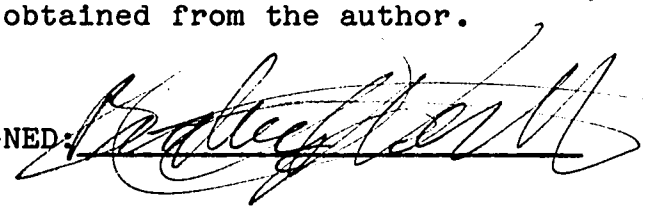
SIGNED: 

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ABSTRACT

The plight of American agriculture has caused widespread economic difficulties in the nation's rural areas and small towns. As a result, these communities have sought, and are seeking, to develop their industrial sectors by attracting urban manufacturers. Manufacturing firms can often find a comparative advantage in rural areas due to the availability of low cost labor or inexpensive real estate for plant expansion. To determine which manufacturers, and the characteristics of manufacturers, that have decentralized employment an ordinary least squares regression analysis was used. It was found that manufacturing had decentralized employment for reasons of both labor cost minization and for reasons of plant expansion. Therefore, rural communities having a comparative advantage in either land or labor will be able to attract manufacturing industries.

CHAPTER 1

INTRODUCTION

Agriculture has fallen on hard times in the United States in recent years. Prices have been depressed while input costs have been rising. As a result, farm income is down and many farms have gone bankrupt. In many of the nation's rural areas and small towns, agriculture has been the mainstay of economic activity. In light of agriculture's misfortunes, many towns and rural communities have sought, and are seeking, to attract industrial firms to reduce the economic slack caused by agriculture. Often the only choice for a rural community is to industrialize or decline.

Rural areas have been able to attract industrial firms for several reasons. Often, firms are attracted to rural areas in search of low cost labor.[1] Other times, firms desire room to expand their operations and they relocate to nonmetropolitan areas where land is less expensive and

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1. Throughout this paper rural and nonmetropolitan refer to non-Standard Metropolitan Statistical areas (non-SMSAs). Conversely, urban and Metropolitan refer to Standard Metropolitan Statistical Areas (SMSAs).

more plentiful. The pupose of this research is to study the urban-to-rural shift of manufacturing industry. Specifically, to identify manufacturers, and characteristics of manufacturers, that have shifted employment from urban to rural areas during the period 1974 to 1979. The analysis of manufacturing decentralization is organized as follows.

Chapter two introduces the theories that have been used to explain the migration of manufacturing. Three principle theories will be addressed. The filtering down and capital restructuring theories propose that manufacturing industries shift employment from metropolitan to nonmetropolitan areas primarily to cut labor costs. The constrained location theory argues that industries move to nonmetrpolitan areas in order to permit plant expansion not possible in cities. Both theories are based on the product life cycle theory which identifies life cycle phases of a product and suggests optimal locations for each life cycle phase. Chapter two continues by reviewing past theoretical and empirical research concerning the urban-to-rural shift. The chapter concludes by introducing implications for rural development that each of the theories proposes.

In chapter three the United States urban-to-rural shift is documented using 1974 and 1979 metropolitan and nonmetropolitan employment data. Urban and rural employment growth rates are given on both a national level, and on a

more detailed industry level by two digit SIC.[2] The shift in employment is further documented by use of shift-share analysis. Shift-share analysis provides a better indication of the types of industries located in a region and can identify employment change caused by migration. Chapter three also introduces two regression models used to test the theories of industrial migration. The first model identifies characteristics of industries having a large proportion of nonmetropolitan employment. The second model identifies characteristics of industries redistributing employment from metropolitan to nonmetropolitan areas. The industry characteristics (explanatory variables) were selected to identify industries that may have decentralized employment according to the filtering down and constrained location theories. Also, the variables selected can be used to infer information concerning the life cycle phase of an industry. Each variable is explained in detail and hypothesized coefficients are given.

The fourth chapter presents the results of the regression models. The discussion of the results corresponds to the specification of the models in chapter three. The variables and their coefficients are then

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2. SIC is the abbreviation for Standard Industrial Classification. Manufacturing industires are disaggregated according to two, three, and four digit classification. A list of manufacturing industries by 3 digit SIC is provided in Appendix C.

analyzed to determine if the filtering down or the constrained location theory are helpful in explaining the employment in, and the employment shifting to, nonmetropolitan areas. Chapter four also examines the residuals of the regressions to determine if further information can be deciphered concerning the types of industries participating in the urban-to-rural shift.

The final chapter of the thesis considers policy implications suggested by the research. The filtering down and constrained location theories have differing implications for rural development. The results of the research will be drawn upon and considered in the context of rural development. Specific procedures and prescriptions for development will not be stated. What the research does, is identify industries and characteristics of industries decentralizing employment. Therefore, the information in the thesis will help rural communities to be better able to attract, and be prepared for, the industries they desire.

CHAPTER 2

THEURBAN-TO-RURAL SHIFT: THEORETICAL EXPLANATIONS AND EMPIRICAL ANALYSIS

The recent migration of manufacturing employment from urban to rural areas is almost universal with respect to Western Europe and North America. As a result, economists and geographers have sought to formulate theories that can be used to explain the manufacturing migration phenomenon. Three principle theories have been offered as explanations for the urban-to-rural shift: the filtering down theory, the constrained location theory, and the capital restructuring theory. All three theories are based on the concept of a product life cycle, however they differ with respect to the resource and locational requirements that evolve during phases of the cycle. In this chapter, theories of industrial migration are reviewed, and supporting theoretical and empirical research is presented. The review begins with a discussion of the product life cycle concept and concludes with comments on similarities, differences, and implications for rural development that the theories present.

Product Life Cycle

The product life cycle concept divides the life of a product into phases based on corporate strategies, production techniques, labor and capital inputs, and market conditions.[3] Suarez-Villa identified six phases of the product life cycle for agglomeration orientated industries (Table 1.). In this paper, the cycle is condensed into four phases: 1.) infant phase, 2.) growth phase, 3.) mature phase, 4.) declining phase. A description of the four phasesas well as the resource and spatial preferences of industries ineach phase is presented below.

Infant Phase

In the infant stage of the product, (Suarez-Villa's phases A and B), research and development are the principle activities of the firm. Production levels are low with highly skilled and professional labor being the principle human inputs. Components of the product are usually purchased from local subcontractors. The firm will often enjoy very high profit margins and significant pricing power because demand generally exceeds production and few suppliers serve the market. A firm will find it advantageous to locate in an urban area in order to employ the services of research institutions and subcontractors.

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3. For the original discussion of the product life cycle theory see Vernon (1966).

Table 1. The Manufacturing Process Cycle for Agglomeration Oriented Industries

	Phase A	Phase B
I. Strategic Corporate Priorities	1. R & D productivity maximization 2. Development of potentially productive applications with highest value	1. Market outreach maximization 2. Maximization of productive applications
II. Corporate Organization		
1. Management	--Creative and risky scheming	--Rising employment of professional/managerial personnel
	--Partnership or small proprietorship No profits	--Formation and rapid growth of corporate unit Revenue-side profit satisficing
2. Production		
a. Overall Organization	--Limited to R&D activities --Very customized or subcontracted out	--Substantial investment in new capacity
	Product Innovation Phase	Process Innovation Phase-Start
b. Labor	--Non-existent	--Grows rapidly, especially in technical professional occupations
c. Capital Equipment	--Non-existent	--Substantial capacity installation and expansion
d. Scale of Operation	--Limited to R & D activities --Very small (except in large corps. pioneering entirely new product lines)	--Overall scale gro rapidly --Very rapid output increase
3. Research & Development	--Intensive experimentation and prototype modelling	--Development of productive applications and value potential
4. Marketing	--Non-existent, or subcontracted out	--Relatively undeveloped but experiencing rapid build-up of sales/service networks
5. Spatial Preference	--Initial location close to major research institutions/centers	--One major location serving regional and eventually national markets (may/may not be original location)
6. Spatial Development Impact	--Insignificant	--Creation and growth of complementary industries --Rapid expansion of multiplier effects

Table 1. (cont.)

	Phase A	Phase B
III. Product Markets		
1. Pricing	--Non-existent (non-productive phase)	--Semi-monopolistic (Demand-led pricing predominates) --High when initial product is floated, due to high value and unit costs --Bears little relation to marginal costs --Capacity expansion may slowly moderate high prices
2. Competitive Conditions		
a. Firm Entry and exit	--Entry open --Very high concentration	--Very high concentration --Entry frequency very possible/exit non-existent
b. Firm Survival Period	--Very limited without short-term productive applications	--Permanent throughout, unless merged
c. Product Differentiation Possibilities	--None	--Undeveloped
IV. Factor Markets		
1. Capital	--Very inaccessible--cannot gather large sums, unless attached to diversified parent firm	--Very accessible
2. Labor	--Demand for uniquely (and highly) skilled technicians and professionals	--High demand for specialized professional/technical categories
3. Transport	--No demand	--Rapidly increasing demand
4. Unique natural resources	--No demand in significant quantities	--Rapidly increasing demand

Table 1. (cont.)

	Phase C	Phase D
I. Strategic Corporate Priorities	1. Market share maximization (domestic) 2. Horizontal Integration	1. Mass production efficiency and scale economies maximization 2. International market share development/ expansion 3. Vertical integration
II. Corporate Organization		
1. Management	--Rapid growth of corporate organization	--More efficient, managerial operations --Profits nearly equal to price of capital
	Revenue-side profit satisficing	Cost-side profit maximization
2. Production		
a. Overall Organization	--Average unit costs decrease --Vertical integration starts --Less subcontracting, more inhouse fabrication	--Less subcontracting --Output growing at decreasing rates --Very limited capacity investment
	Process Innovation Phase-Mid-life	Process innovation Phase-End
b. Labor	--Growing, with more balance between professional technical and blue-collar occupations	--Deskilling begins through task division --Widespread unionization --Blue-collar workforce relatively most important
c. Capital Equipment	--Moderate-high capacity expansion	
d. Scale of Operation	--High output increases and capacity expansion	--Rapidly increasing automation becoming widespread --Large scale
3. Research & Development	--Improvement of productive applications	--Less important
4. Marketing	--Well-developed sales/ service networks --Large marketing staff	--Marketing/sales relatively less important
5. Spatial Preference	--Several locations in/close to major population centers	--Multiple branch plant creation/location in suburban areas of growing regions
6. Spatial Development Impact	--Creation of professional and blue-collar employment opportunities for selected locations --Backward and forward linkages strengthened	--Decentralized--location close to markets --Partial shift of operations abroad (subsidiaries) --Reduction of operations in original locations --Employment relatively stable, but increasingly blue-collar

Table 1. (cont.)

	Phase C	Phase D
III. Product Markets		
1. Pricing	--Oligopolistic --Relatively stable pricing arrangements	Competitive --High price competition --Near-saturation of domestic regional markets and possible expansion into international markets
2. Competitive Conditions		
a. Firm Entry and exit	--Minimal decrease in concentration --Entry frequency high/ exit non-existent --Permanent throughout, mergers less likely	--Low concentration --Entry moderate-low --Mergers common
b. Firm Survival Period	--Permanent throughout, mergers less likely	--Reduced to medium-term
c. Product Differentiation Possibilities	--Unlikely	--More likely
IV. Factor Markets		
1. Capital	--Extremely accessible	--Accessible
2. Labor	--Demand for professional/ technical categories	--Demand for blue-collar personnel
3. Transport	--High demand	--Demand growing at decreasing rates
4. Unique natural resources	--High demand	--Demand growing at decreasing rates

Table 1. (cont.)

	Phase E	Phase F
I. Strategic Corporate Priorities	1. Labor cost minimization 2. Product differentiation maximization	1. Overall cost minimization 2. Inefficient/obsolete capacity minimization
II. Corporate Organization		
1. Management	--Less likely that profits will be re-invested in this industry --Profits very low or negative	--Management trimmed to the essentials --Substantial losses
	Cost-side profit maximization	Cost-side profit maximization
2. Production		
a. Overall organization	--More subcontracting possible, to discipline labor and take advantage of scale economies	--Limited to day-to-day operations --Disinvestment
b. Labor	--Mostly blue-collar --Deskilling continues	--Low-skilled blue-collar
c. Capital Equipment	--Automation continues	--Obsolete --Capacity reduction --Automation restricted by low profits
d. Scale of operation	--Non-existent or very modest investment in capacity expansion --Relatively large scale but decreasing	--Rapid decrease
3. Research & Development	--Very limited, if present	--Non-existent
4. Marketing	--No extensive efforts - saturated markets	--Non-existent
5. Spatial Preferences	--Relocation to low labor cost areas and offshore production zones	--Plant closings liquidation at original locations --Relocation to low-cost offshore production zones
6. Spatial Development Impact	--Unemployment layoffs noticeable in former locations --Employment generated in new locations with limited short-term multiplier effects	--Plant closings relocation, widespread unemployment in former locations --Employment generated in new locations with limited short-term multiplier effects

Table 1. (cont.)

	Phase E	Phase F
III. Product Markets		
1. Pricing	Very competitive --Intense price competition --Price levels approach production costs --Domestic market saturation	Extremely competitive --Very intense competition --Price levels generally below production costs
2. Competitive Conditions		
a. Firm Entry and exist	--Tendency towards high concentration --Entry virtually non-existent --Product substitution may accelerate exist	--Very high exit frequency --Decreasing concentration possible (smaller operators
b. Firm Survival Period	--Medium to short-term	--Generally short-term --Plant closings widespread
c. Product Differentiation Possibilities	--Very likely, if feasible, may imply regression to Phase C	--Very limited
IV. Factor Markets		
1. Capital	--Less accessible	--Not accessible
2. Labor	--Demand for lowly-skilled labor	--Very low demand
3. Transport	--Decreasing demand as market area shrinks, some unemployment	--Relatively low demand unemployment
4. Unique natural resources	--Decreasing demand	--Relative low demand

Growth Phase

As new firms enter the market and production levels increase the product enters its growth phase (phase C and early phase D of Suarez-Villa). Now a larger proportion of the product's components are produced at the production site. Production becomes more routinized and skilled labor begins to displace technical and professional labor as the most important human element. More firms enter the industry and production levels increase; however, profit levels remain high as demand continues to increase. In the growth phase, the locational preference of the firm begins to shift to suburbs or even rural areas. More room is needed to permit the plant expansion which is needed to meet the products increasing demand.

Mature Phase

The mature phase (Suarez-Villa's late phase D and early phase E) is the third stage in the product life cycle of a manufacturing industry. In the mature phase demand has become constant. Facing stagnant demand, firms search for ways to cut costs in order to halt the decline in profit margins. Production becomes highly routinized, and can be capital or labor intensive. In either case low wage unskilled labor is the main human input. Significant economies of scale often exist and small firms may not be able to compete. In order to employ low wage labor, or to

establish large plants with significant economies of scale the firm may relocate in a rural area.

Declining Phase

Depending on demand conditions the product may reach a declining phase or even become extinct. In the declining phase the industry fights to remain solvent. As demand continues on a downward trend costs are cut further by closing plants. Depending on the strength of labor unions, workers will face layoffs or wage reductions. If demand drops further the product will cease to exist.

The remainder of this chapter will present the filtering down theory, the constrained location theory, and the capital restructuring theory. Special attention is given to the relationship of these theories to the product life cycle. Past empirical research that is related to, or supports, the three theories will also be examined.

Filtering Down Theory

Theory

The leading proponent and author of the filtering down theory is Wilber Thompson. (1968,1969). Thompson hypothesized that as an industry evolves through its product life cycle the industry will find it advantageous to "filter down" from large cities to rural locations. In the infant phase of a product an urban production site is desirable

because of the relative abundance of professional, technical, and highly skilled workers who are needed to carry out the research and development process. Also, the urban areas offer proximity to subcontractors who often produce components of the product.

As the product enters its growth phase, professional and technical labor are replaced by lower skilled labor. Expanding demand forces the firm to increase production or risk losing its market share. If competition is strong enough, and profit margins begin to decline, a production site in an outlying area is chosen because semi-skilled labor is more plentiful and less expensive. The proximity to subcontractors becomes a less important locational factor because a larger proportion of the components are produced at the production site.

When the product enters the mature phase of its life cycle demand becomes stagnant and increased competition reduces profits. The firm realizes it must cut costs in order to remain competitive. Standardization of the production process allows the firm to employ low wage, unskilled labor and hence, reduce costs. To permit the reduction of labor costs the firm will locate in rural areas where unskilled labor is least expensive and most plentiful. The attractiveness of rural areas is further supported by a mature firm's lack of dependence on urban subcontractors as nearly all components can be fabricated in-house.

In summary, Thompson hypothesized that rural areas will attract primarily industries seeking to minimize labor cost. Examples of the filtering theory often include the textile industry, apparel, electronics assembly, and other labor intensive slow growth industries. Empirical research supporting filtering theory has been done on the decentralization of both United States and international manufacturing industries. A survey of recent research follows.[4]

Empirical Tests

Erickson (1976) tested the filtering process in his study of industrialization in nonmetropolitan Wisconsin. He conducted a survey of 112 plant representitives from 65 branch plants, 43 new indigenous firms, and four relocations. The survey included 52 nonmetropolitan counties for the years 1969-1974. Erickson's results provide strong support for the filtering down theory. He stated that: "The most frequently cited primary locational objective of branch plants was to minimize the competition from other plants for the labor force."[p.258]

Fisher (1979) studied the locational characteristics of new manufacturing additions in Georgia. His research

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4. Research on the filtering down theory is not limited to the articles reviewed here. Further studies are provided by Newman (1983), Kuehn and Braschler (1985), and Browne, Mieskowski, and Syron (1980).

used metropolitan and nonmetropolitan employment data from 1961 to 1975. A factor analysis was utilized to group regions with similar manufacturing additions. Fisher discovered that Georgia experienced rapid employment gains in the textile, food processing, and apparel industries. Of these labor intensive industries, nonmetropolitan areas have realized a 52 percent increase, while the gain to metropolitan regions was 32 percent. Fisher pointed out that the manufacturing additions have tended to follow the filtering process. He concluded that:

> While the nonmetropolitan regions have attracted new manufacturing disproportionate to the population found in such areas, the new additions clearly remain dominated by low-wage and slow growth industries. The only exception to this pattern is in the nonmetropolitan areas near Atlanta suggesting that these areas were able to attract industries somewhat earlier in their product life cycle.[p.14].

Rees (1979) used employment and value added data to demonstrate industry filtered from developed to less developed regions. He divided the U.S. into a core Northeast - Northcentral region and a periphery which encompasses the remaining regions. Rees found that for the years 1963-1972 the periphery gained 1,348,000 production workers while the core actually lost 51,500 production workers. The discrepancy in nonproduction workers was not as significant. The core gained 296,000 nonproduction workers to the periphery's 479,000. These findings suggest that while production has shifted to lower

wage areas, corporate administration and research and development shifts were not nearly as strong. Rees also applied a shift-share analysis to determine regional growth differentials due to industrial mix. Specifically, he calculated mix coefficients of value added by industry respective of region. During the period 1963-1972, the core experienced a 4559 million dollar value added increase due to mix while the periphery suffered a 1541 million dollar loss. The trend reverses from 1972 to 1976 with the core losing 127 million and the periphery gaining 96 million. Rees suggested that government has helped the periphery gain high growth industries for 1972 to 1976. As examples he noted that new military bases, and large defense contracts to firms in the Southwest have helped to launch high growth industries such as electronics.

Research on the filter down theory outside the United States has focused primarily on international decentralization, i.e., firms from industrial countries establishing branch plants in developing countries in order to take advantage of low wage surplus labor. For example, the Mexican Border Industry Program has attracted many branch plants from the United States. The program allows inputs to enter Mexico from the U.S. duty free and the U.S. in turn levies a small tariff on only the value added of the product. Although these factors have helped to attract U.S. industries, wages and labor availability are the main

attractions to the border zones. Ayer and Layton (1974) noted that in 1971 the average border area minimum wage, including fringe benefits, was approximately 55(U.S.) cents. Border area labor is generally of a low skilled variety as pointed out by Hanson (1981). He noted that young females make up four fifths of the labor force. In addition to low wages, unemployment levels are typically higher in the Mexican border areas as compared to U.S levels. Because firms establishing plants in the Northern border areas of Mexico seek to employ low skilled, low cost, surplus labor their migration patterns follow the filtering down theory.

Storper (1984) found that labor availability has been a contributing factor in the industrial migration experienced by Brazil. Storper's particular focus was on the decentralization from the industrial center of Sao Paulo, and his findings again support filtering theory. Through the use of wage and employment data he discovered that Sao Paulo demonstrated some of the same decentralization characteristics as American cities. Prior to the 1970s Brazil, and in particular Sao Paulo, experienced large increases in industrial output. Demands for labor in Sao Paulo were met by a huge in-migration that helped to suppress wages. However, during the 1970s the labor market began to tighten and firms from Sao Paulo moved to the suburbs and countryside in search of low cost labor, a consequence that almost parallels the discoveries

of research done on United States manufacturing.

Evidence supporting filtering theory seems to be quite strong. It is intuitively logical that an industry facing increasing competition and declining profit margins would seek to cut costs by employing low wage labor, and historically, wage rates have been lower in nonmetropolitan areas. However, labor is not the only input for a manufacturing firm. The cost and availability of land, plant, and equipment may also affect a firm's location decision. The constrained location theory considers land, plant, and equipment and their role in the urban-to-rural manufacturing shift.

The Constrained Location Theory

Theory

The constrained location theory, like the filter down theory, uses the product life cycle concept as its basis. However, Fothergill and Gudgin (1982) asserted that industry decentralizes not to employ low wage labor but rather to permit expansion. More specifically, the degree that the industry faces locational constraints is given by its phase in the product life cycle. In the infant stage of a product's life cycle an urban location is acceptable because research and development are the main activities of the firm and production levels are typically low. As the firm enters the growth phase of its product life cycle it finds

itself physically constrained and not able to expand in an urban area. In order to increase output and maintain market share, capital intensive production processes may be introduced. These techniques require extensive layouts not available in the cities. Specifically, production floorspace is insufficient to meet increasing demand. As a result, a suburban or even rural production site is chosen.

Depending on the degree of capitalization in the industry, further migration to more rural areas may be necessary as the product enters its mature phase. With demand now constant production costs need to be cut. The constrained location theory states that further capitalization to reduce costs will require more extensive layouts than are available in urban areas. In conclusion, proponents of the constrained location theory state that industries needing, or wishing to expand will experience space constraints in cities and thus, will migrate to rural areas.

Past research with respect to the constrained location theory has been undertaken mainly in Europe, and in the United Kingdom in particular. In the United States research supporting the constrained location thoery has dealt with intra-metro or urban to suburban firm migration. A summary of specific studies follows.

Empirical Tests

In the United Kingdom, Fothergill and Gudgin (1982) have found that plant expansion, not plant relocation, in rural areas is the primary cause of rural employment growth. For example, in the East Midlands region the 1968 to 1975 percentage employment change due to plant expansion was 24.9 % in rural areas compared to 11.9 % in the cities. The disparity in urban/rural employment change due to closures or contraction was not nearly as significant as the employment change due to expansion. The authors also pointed out that migration in the form of relocations or branch plants has contributed to rural employment growth to an extent much less than existing plant expansion. They concluded that: "The problem with cities is not simply that firms are diverting growth to other areas, but rather that city-based firms are growing more slowly than their rivals elsewhere." [p.81]. Given the fact that slow growing firms remain in the cities, and that firm closure rather than relocation is the main cause of urban job loss,it can be deduced that older firms do not move to cut labor costs as in the case of filtering theory. In fact, in an examination of British labor markets, Fothergill and Gudgin assert that labor has always been available in the cities and furthermore wages and work-stoppages show no significant disparities between urban and rural areas. Thus, the authors conclude that it has been the industries which are

most constrained, the high growth, high investment industries that exhibit the greatest employment growth in the rural areas.

Fothergill and Gudgin further support their theory by a general study of seven characteristics of the British industrial sector: 1.) The larger the city,the greater the industrial decline. Since the larger the city, the greater the constraint will be on manufacturing; 2.) Increasing capital intensity requires additional floorspace that is not available in the cities; 3.) The locations of new and expanding plants are more important in explaining employment shifts than are the locations of closures as closures are nearly equal in urban and rural areas; 4.) The smaller the firm, the less problem it will have with an urban location. (The authors pointed out that when a small firm needs to expand it is able to do so on a scale that still permits an urban location); 5.) The older, slow growing, low investment firms can maintain their urban locations because they face little problem with expansion; 6.) Because any urban expansion is on a small scale, and the relatively large proportion of older, slow growing firms in urban areas, cities are troubled with slow growth caused by lack of room for expansion; 7.) Lower profitability in the cities stems from the inability to adopt new production processes in cramped quaters. The study by Fothergill and Gudgin gives strong support to the constrained location

theory in the case of British manufacturing decentralization.

Fothergill et. al. (1984) have looked at the question of the relative profitability of urban and rural locations and discovered that constrained urban locations prohibit maximum profitability. They have found that profitability, measured by the ratio of profits to assets, profits to sales, and sales to assets is significantly higher in rural areas. The authors cite several reasons for the lower profitability in the cities including: 1.) older plants with little room for expansion, 2.) inefficient multistory buildings, 3.) more work in progress due to inefficient layouts, and 4.)urban plants need to buy more finished materials because of inability to expand and produce them. The authors have also found that there were no significant differences in the price of labor between urban and rural locations. Therefore, firms will not move to rural areas to lower labor costs. Moreover, the results suggest that if urban plants were not constrained these plants would have been as profitable as their rural counterparts.

The application of the constrained location theory is not unique to the United Kingdom. Keeble, Owens, and Thompson (1983) examined the urban-to-rural shift in the European Community to determine whether the filtering down or the constrained location theory best describes industrial migration. They measured 1970-1980 manufacturing

output and employment change for urban and rural areas. The results of their research give tentative support to the constrained location theory. Manufacturing employment showed a strong urban-to-rural shift, but the shift in output was even stronger. This result suggests that more capital intensive production has shifted to rural areas and that firms did not move solely for labor reasons. Moreover, high technology as well as labor intensive industries demonstrated considerable shift, thus further supporting the constrained location theory.

Keeble (1980) identified a continuum of U.K. urban to rural locations and sought to discover if, and why, manufacturing has migrated to rural areas. His results showed that for the period 1971 to 1976, employment exhibited a pronounced shift from the most urbanized to the most rural areas. Keeble regressed differential employment shift against manufacturing employment densitiy, investment incentives per 1000 pounds of investment, residential space preference, and the female labor force participation rate. The results again tend to give support to the constrained location theory. Residential preference was insignificant, as was the investment incentive variable. The female participation rate can be used as a measure of the attractiveness of low cost, nonunionized labor. The female participation variable was negative, suggesting that firms move to areas where female labor is available. However, the

correlation coefficient between the female activity rate and employment density was .575. Employment density had a negative relationship with differential shift and alone accounted for 45 percent of the shift. Thus, employment density was the leading factor in attracting firms to nonmetropolitan areas. The female participation rate is only a secondary factor that occurs as a consequence of its correlation with employment density. Keeble's results suggest that firms move to rural areas for reasons such as expansion rather than the attractiveness of low cost labor.

In the United States, the constrained location theory has been applied to the city center - suburban manufacturing shift. Swan (1973) asserted that the capitalization of the production process has necessitated a decentralization of manufacturing. Decentralization is further encouraged by improved truck transport and better telecommunication facilities. To test his hypothesis, Swan analyzed 1954 to 1967 city to suburban employment shifts in the 35 largest SMSAs for the United States. His methodology consisted of a regression analysis that was used to predict changes in central city employment concentration. The dependent variable, percentage change in the concentration of central city manufacturing employment was measured by:

$$\text{employment in } \frac{\text{1967 city center}}{\text{1967 metro area}} \Big/ \frac{\text{1954 city center}}{\text{1954 metro area}} .$$

Central city employment concentration was then regressed on:

1.) central city population density, 2.) central city wage rate (1954), 3.) age of the central city (1950), 4.) nonwhite central city population percentage. All of the variables were significant at the 5 percent level with the exception of the central city wage level. Population density showed a negative relationship with concentration change. Central city age was related positively to the dependent variable but Swan did not offer an explanation as to this occurrence. An interesting result of the analysis was a negative coefficient on percentage nonwhite population. Swan suggested that the lack of skilled labor among the nonwhite population may cause firms to locate elsewhere. Given that wages were insignificant and Swan's suggestion that employers seek skilled or semiskilled workers, the constrained location theory tends to fit his analysis. Although Swan's study was confined to 35 greater metropolitan areas he concluded by stating that the decentralization process will continue into more rural locations.

Schmidt (1979) sought to discover factors that have influenced a Denver city core to suburb shift. He surveyed 106 firms that relocated during the period 1974 to 1976, 28 of which were under the heading of mining, manufacturing, and construction. The cost and availability of land and buildings was the single most important factor in 12 of the 28 cases. Market centrality and the proximity

to previous location accounted for five responses each. No other factor had more than two responses. An "other" category included proximity to labor force, proximity to owners residence, personal preference for the area and parking availability. This category drew only one response. Schmidt concluded that because land and building supply was the dominant response and labor supply drew almost no response, the constrained location theory fits the Denver metropolitan relocation experience.

Cromly and Leinbach (1981) sought to discover locational factors that enticed branch plants to nonmetropolitan Kentucky. Branch plant establishment from 1960 to 1980 in 103 nonmetropolitan counties served as the data base for their research. In 1960, 60 percent of total manufacturing employment was in branch plants, by 1980 the percentage had grown to 79. To help determine significant locational factors the authors employed a "best subset" regression technique. Independent variables selected were: 1.) town size, 2.) binary variables for the accessibility to rail, water and highway transportation, 3.) a binary variable for the presence or absence of an industrial park. Three regressions were run. First, 1980 branch plant employment was regressed on the above variables. Town size and the presence of an industrial park were selected as the best subset. Both had positive coefficients with significance levels of .10 and .13 respectively. The second

and third regressions used the change in branch plant employment for 1970-1975 and 1975-1980 as dependent variables. Civilian labor force and the unemployment level by county were added as independent variables. Again town size was the dominant variable for each regression with significance levels of .01 and .02. The binary variable for highway accessibility was also significant at a level of .08 for the 1970-1975 regression. The absence of the labor force and unemployment variables discredits filtering theory as far as rural Kentucky is concerned. At the same time the strength of the town size variable does not support the constrained location theory. The positive coefficient on the town size variable suggests that firms will need to compete for available land.

In a Canadian study, Scott (1982) asserted that tecnological change is the prime reason for firm movement. He further suggested that labor costs are lower in the cities due to higher ethnic and minority populations. He tested his hypothesis by estimating correlation coefficients for:

$$\frac{\text{city output}}{\text{metro output}} \quad \text{verses} \quad \frac{\%\ \text{change capital}}{\%\ \text{change labor}} \ .$$

Scott's sample consisted of metropolitan Toronto, Montreal, and Vancouver for the time periods 1956-1959, 1961-1964, 1971-1974. In eight of the nine cases the correlation was negative. Scott's results illustrate that innovative

production processes need space for extensive layouts that are not available in the cities, and hence support the constrained location theory.

The Capital Restructuring Theory

The two previous decentralization theories are founded on Neoclassical principles of mobile factors of production according to comparative advantage. The capital restructuring theory provides a Marxist response. Peet (1983) asserted that firm migration is a function of class struggle.[5] He argued that:

> In an era of intense worldwide corporate competition, and declining profit rates, capital is forced to move between regions within and outside the country,... Competitive advantage is increasingly linked to the super-exploitation of unemployed females and the workers of the underdeveloped regions and countries of the periphery.[p.118]

Peet tested his assertions by examining labor and firm activity in the United States during the 20th century. Using wage rates, unionization, work stoppages and business climate rankings,he divided the United States into high and low class struggle states. Manufacturing employment data show that the low class struggle states of the periphery (mainly those outside the Northeast and West coast regions) have added employment faster, and lost employment slower,

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5. Other research concerning the capital restructuring theory is provided by Dunford (1979), and Massy (1978). Also, the article reviewed under the filtering theory by Storper (1984) has somewhat of a Marxist overtone.

than the high class struggle states. Throughout the period 1939-1982 the ten highest class struggle states had employment gains of 56 percent verses 228 percent for the ten lowest class struggle states. Peet has argued his point well, however the similarities between his analysis and those supporting the filtering down theory are striking. Both assert that industries move to lower labor costs when faced with increased competition. The difference lies in ideology, whether the term is profit maximization or labor exploitation, the result is the same, firms move to reduce labor costs and remain competitive.

Conclusion

The three theories reviewed have certain similarities, differences, and implications for rural development. They all are based on the product life cycle concept and assert that firms migrate for reasons of cost minimization. The filtering down and capital restructuring theories state that a firm will migrate to minimize costsby employing or exploiting low wage rural labor. The constrained location theory states that a firm can minimize its rent or mortage costs by expanding in rural rather than urban locations. Concerning implications for rural development, if filtering theory best predicts migration then rural communities will be able to attract firms by establishing methods to develop their human resources, such

as trade or vocational schools. If the constrained location theory best describes firm movement then establishment of industrial parks, utility services, and real estate subsidies will attract new industry. The forthcoming empirical analysis will seek to discover which and for what reasons, American industries migrate from urban-to- rural areas.

CHAPTER 3

DATA AND METHODOLOGY

Previous research has established that manufacturing employment decentralized from urban to rural areas. In this chapter the 1974 to 1979 shift in employment will be analyzed in detail, at the national level. This research will examine U.S. manufacturing employment decentralization to determine if the filtering down theory or the constrained location theory are helpful in explaining the industries participating in the urban-to-rural shift. The chapter begins with an overview of the data used. Next, evidence of the urban-to-rural shift is presented. Lastly, the methodology used for testing the two theories and the variables involved in the industrial migration are introduced.

Data

U.S. Department of Agriculture cross-section employment data for 441 four digit SIC manufacturing industries were used as the data base for calculating the 1974-1979 urban-to-rural employment shift. The sample is sufficiently large to reduce problems of aggregating different industries found in smaller samples. Moreover,

the sample is also large enough to capture the effects of industries operating in all phases of the product life cycle.

Evidence of the Urban to Rural Shift

Evidence of the urban- to -rural shift of manufacturing employment is provided by an analysis of 1974 and 1979 metropolitan and nonmetropolitan employment data. Regional growth rates (Table 2.) reveal that manufacturing employment decentralized from urban to rural areas during the second half of the 1970s. U.S. manufacturing employment growth was 5.2% from 1974 to 1979. This increase in manufacturing employment was not distributed equally between metropolitan and nonmetropolitan counties, nonmetropolitan areas gained 6.4% while metropolitan areas experienced an increase of only 4.8%. Thus, rural areas share of manufacturing employment increased during this period.

A second technique used to measure employment decentralization was shift-share analysis (Table 3.) Shift-share analysis divides regional employment change into two categories, a shift and a share component. The components of growth are illustrated in equation 1. and discussed below.

Table 2. U.S Manufacturing Employment, 1974-1979.

Region	Employment 1974	Employment 1979	% Change
United States	19,032,932	20,027,094	5.2%
Metropolitan	14,161,005	14,841,621	4.8%
Nonmetropolitan	4,871,927	5,185,473	6.4%

Table 3. Aggregate Shift-Share Analysis of Metropolitan and Nonmetropolitan Employment Change, 1974-1979.

Component of Change	Nonmetropolitan	Metropolitan
Total Change	313,546	680,616
Industry Mix or Share Component	100,891	893,271
Competitive or Shift Component	212,655	-212,655

Source: National Data Planning Corp. (NPDC), Enhanced County Business Patterns (ECBP).

Equation 1. The Components of Growth

$$(1.)\ \Sigma S_i = \Sigma\left[N_i 79 - N_i 74\right] - \Sigma\left[N_i 74\left(\frac{US_i 79}{US_i 74}\right) - N_i 74\right]$$

shift component — actual growth — share component

where: S_i = shift in industry i

$N_i 79$ = 1979 regional employment in industry i

$N_i 74$ = 1974 regional employment in industry i

$\frac{US_i 79}{US_i 74}$ = 1974 to 1979 U.S. growth rate in industry i

$N\ 74\left(\frac{US_i 79}{US_i 74}\right)$ = predicted 1979 regional employment in industry i

The mix or share component predicts regional employment growth based on a region's industrial composition. Predicted nonmetropolitan employment for each industry is equal to the base year nonmetropolitan employment (1974), multiplied by U.S. growth for that particular industry. Table 3 reveals that the share component would predict aggregate nonmetropolitan growth to be 100,891 jobs or 2.1% - substantially less than the 5.2% U.S. aggregate rate. Therefore, nonmetropolitan regions contain a large share of relatively slow growing industries. Conversely, metropolitan areas contain a larger proportion of rapidly growing industries. The industry predicted growth was 893,271 jobs, or 6.1% - somewhat higher than the 5.2 % U.S. aggregate rate.

The nonmetropolitan competitive component, or shift measure, is equal to the employment growth not predicted or explained by the national industry growth rates. The nonmetropolitan competitive figure of 212,655 illustrates a net in-migration of jobs not predicted by a region's industry mix. Thus, a comparitive advantage must have been present in rural areas that attracted manufacturing industries. Alternatively, although metropolitan areas had a higher proportion of fast growing industries, the negative shift measure reveals that these regions suffered a net out-migration of 212,655 jobs.

The relative growth of manufacturing employment in rural areas has occured across a broad spectrum of industries, both labor and capital intensive (Table 4). Two digit industry growth rates show that on average, rural areas added employment faster, and lost employment slower, than urban areas. Two digit industries that experienced rural growth greater than urban growth include: publishing (SIC 27), chemicals (SIC 28), petroleum (SIC 29), rubber (SIC 30), fabricated metals (SIC 34), nonelectrical machinery (SIC 35), transportation equipment (SIC 37), and instruments (SIC 38). Generally these industries tend to be characterized by recent and continuing technological advancements, both in their products and their production processes. Industries that lost urban employment but gained

Table 4. SIC Two Digit Growth Rates, 1974-1979.

SIC	Industry	U.S	Metro.	Nonmetro.
20	Food products	.14	-1.9	5.0
21	Tobacco	-13.7	-14.4	-9.7
22	Textiles	-10.8	-16.0	-6.5
23	Apparel	-3.2	-4.2	-1.5
24	Lumber	8.1	8.8	7.8
25	Furniture	2.9	4.4	0.6
26	Paper	1.1	-0.6	4.8
27	Publishing	11.6	9.9	21.3
28	Chemicals	4.3	3.3	7.6
29	Petroleum	6.7	6.5	7.2
30	Rubber	16.3	13.0	25.5
31	Leather	-4.8	2.2	-14.0
32	Stone, Clay	-2.0	-4.1	2.7
33	Primary Metals	-2.9	-4.7	5.5
34	Fabricated Metals	7.4	5.9	14.6
35	Non-electrical Mach.	11.4	10.2	16.1
36	Electrical Mach.	7.8	8.8	3.9
37	Transportation Equip.	14.9	13.4	25.8
38	Instruments	18.4	18.1	20.5
39	Miscellaneous	-2.9	-3.0	-2.4

Source: NPDC, ECBP

rural employment were: food and kindred products (SIC 20), paper (SIC 26), stone and clay (SIC 32), and primary metals (SIC 33). These industries tend to fit the product life cycle theory. They are mature industries characterized by a standardized production process and relatively low levels of capital expansion. Industries that lost employment slower in rural, relative to urban areas, include industries that are traditionally categorized as following filtering theory: tobacco (SIC 21), textiles (SIC 22), and apparel (SIC 23). Increased foreign competition has, no doubt, led to overall employment declines but lower rural wages probably has saved some jobs in nonmetropolitan areas. Industries that added employment faster or lost employment slower in urban areas include: lumber (SIC 24), furniture (SIC 25), electrical machinery (SIC 36), and leather (SIC 31). These industries are more difficult to classify as following a particular theory. The following regression analysis will provide a more indepth analysis of the urban-to-rural shift and characteristics of those industries participating in the shift.

Model Specification

Two specific linear regression models were developed to identify characteristics of 1.) industries located in rural areas in 1974, and 2.) industries participating in the 1974-1979 urban-to-rural shift. The two models were

constructed to determine if information could be inferred concerning the types of industries with employment in, and shifting employment to, rural areas. Fifteen characteristics were selected as potential predictors of industrial location. These industry characteristics were grouped into four categories: general industry, mature industry, filtering down, and constrained location. A set of "general" industry characteristics considers an industry's factor shares, plant size, and market or resource orientation. A second set of variables identify characteristics that are common to industries in the mature phase of their product life cycle. Variable sets three and four isolate characteristics of industries migrating for reasons of filtering and constrained location respectively.

Characteristics of Industries Located in Nonmetropolitan Areas, 1974.

In order to identify characteristics common to industries located in rural areas the following ordinary least squares regression model was constructed.

$$(2.)\quad NMUS = a_0 + a_1\,KLR + a_2\,APS + a_3\,FL + a_4\,PROF + a_5\,LI + a_6\,GRN + a_7\,CONT + a_8\,WAGE + a_9\,WWS + a_{10}\,PPC + a_{11}\,RGA$$

A list of the specific variables and their descriptions is provided in Table 5. The data source for each variable is provided in Appendix A. An outline of the model follows.

Table 5. Explanatory Variables in the Regression Models.

Variable	Definition	Form
KLR	capital to labor ratio	$\frac{\text{capital assets, 1977}}{\text{payroll, 1977}}$
APS	average plant size	$\frac{\#\text{plants having >20 employees}}{\text{total \#plants}}$
FL	footloose industries	1 for 2 digit footloose industries, 0 otherwise
PROF	% professional emp.	$\frac{\text{emp. in professional and technical occupations}}{\text{1977 industry emp.}}$
LI	labor intensity	$\frac{\text{wages, 1972}}{\text{value added, 1972}}$
RWVA	ratio of value added to wages	$\frac{\text{VA 77}}{\text{wages 77}} \Big/ \frac{\text{VA 72}}{\text{wages, 72}}$
GRN	growth rate in emp.	$\frac{\text{total emp., 1977}}{\text{total emp., 1972}}$
CONT	industry concentration	1977 four firm industry concentration level
COMP	change in industry concentration	1977 minus 1974 four firm industry concentration
WAGE	hourly wage	1977 average industry wage rate
WWS	weighted work stopages	$\frac{\text{days lost to work stoppages 1974+1976+1977+1979}}{\text{industry emp., 1977}}$
RGA	growth in assets	$\frac{\text{gross assets, 1977}}{\text{gross assets, 1972}}$
PPC	preferred plant capacity	1974 to 1978 average of actual to preferred plant capacity
WRGA	weighted RGA	RGA • proportion of metro to total emp., 1974
WPPC	weighted PPC	PPC • proportion of metro to total emp., 1974

Dependent Variable. The ratio of an industry's 1974 nonmetropolitan-to-total U.S. employment (NMUS) was selected as the measure of industry concentration in rural areas. The average proportion of employment in nonmetropolitan areas was .28 and ranged from a low of .004 (industry 3996, floor coverings) to a high of .861 (industry 2492, particleboard). A summary of nonmetropolitan employment concentration by two digit SIC is provided in Table 6.

Independent Variables. (1. General Industry Variables.) Variables under this heading are termed "general" because, although they may be significant in explaining the proportion of nonmetropolitan employment, they bear no direct inference to the current life cycle phase of an industry nor are the variables unique to the filtering down or constrained location theory. An industry's capital - to - labor ratio (KLR) represents the relative importance of these two inputs in the production process. The KLR variable was calculated as the ratio of gross assets to payroll. If the coefficient on KLR is negative then it can be deduced that labor intensive industries are located in rural areas. Conversely if the coefficient on KLR is positive then it primarily capital intensive industries that are located in rural areas.

Table 6. The Proportion of Employment in Nonmetropolitan Areas by Two Digit SIC (NMUS).

SIC	Industry	NMUS
20	Food products	.306
21	Tobacco	.221
22	Textiles	.472
23	Apparel	.321
24	Lumber	.588
25	Furniture	.319
26	Paper	.222
27	Publishing	.118
28	Chemicals	.264
29	Petroleum	.222
30	Rubber	.284
31	Leather	.366
32	Stone, Clay	.345
33	Primary Metals	.255
34	Fabricated Metals	.210
35	Non-electrical Mach.	.204
36	Electrical Mach.	.258
37	Transportation Equip.	.173
38	Instruments	.146
39	Miscellaneous	.186

Source: NPDC, ECBP.

The average plant size of an industry (APS) is also a factor that may influence industrial location. APS is measured by the proportion of plants in an industry with twenty or more employees. Swan (1973) hypothesized that an industry with numerous large plants will tend to locate in rural areas because of space constraints in cities. Therefore, the expected sign on APS is positive.

The final general industry variable (FL) is a dummy variable that assigns a value of one to each industry that is classified as "footloose" and a value of zero to all the others. An industry is said to be "footloose" if it does not have strong orientations to locate near input or product markets. FL industries are aggregated by two digit SIC and include industries: 22,23,32,34,35,36,37,38,39.[6] The expected coefficient on FL is positive since a footloose industry is easily able to locate in rural areas if economic conditions so dictate.

(2. Mature Industry Variables). The product life cycle concept suggests that mature, slow growing industries will find it advantageous to locate in rural areas. Typically, a mature industry is characterized by a standardized production process, that is, the production process has

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6. The criterion for the selection of the "footloose" industries can be found in Latham (1978).

been routinized to the extent that low skilled labor may be used. To measure labor intensity (LI) the 1972 ratio of production worker wages to dollar value added is used. As the production process becomes more labor intensive a larger proportion of industry value added can be attributed to production workers. Thus, if mature industries with labor intensive production processes tend to be located in rural areas the coefficient on LI will be positive.

A characteristic also common to industries in the mature phase of the product life cycle is the relatively low number of professional, technical, and managerial employees. Percentage professional employment (PROF) is a measure of the importance of skill level in an industry. Typically a mature industry is characterized by a low requirement for skilled labor, and therefore, rural production sites are not prohibitive from a labor skill standpoint. Thus, if mature industries, employing low skilled labor, are located in rural areas, the coefficient on PROF will be negative.

A third characteristic of mature industries is slow or stagnant employment growth due to decreasing demand for the mature industry's product, which leads to decreasing demand for labor needed to produce the product. The growth rate in employment (GRN) is calculated as the 1979 to 1972 ratio of industry employment. If mature, slow growing industries are located in rural areas then the relationship between NMUS and GRN will be negative.

(3. Filtering Down Variables). The variables CONT, WAGE, and WWS were selected to represent characteristics of industries located in rural areas because of the filtering process. CONT is a measure of the competitiveness of an industry and is calculated as the 1977 four firm industry concentration level. Suarez-Villa (1984) noted that industry concentration increases as a product matures and the industry becomes more competitive. Therefore, as an industry faces increased competition, both domestic and foreign, it may be able to better minimize costs in rural areas. Thus, the correlation between NMUS and CONT is hypothesized to be positive.

The strength of labor unions is a critical factor to an industry with significant labor inputs. Traditionally, labor solidarity is stronger in urban areas, therefore industries seeking to minimize labor conflict may locate in rural areas. Weighted work stoppages (WWS) was used as a proxy for labor problems. WWS is the sum of 1974, 76, 77, 79 work stoppages divided by 1977 employment in each industry. If industries in rural areas seek to minimize labor conflict, and employees in rural areas are less prone to strike, the relationship between NMUS and WWS should be negative.

The final, and perhaps most important, variable in the filtering category is the industry average hourly wage

rate (WAGE).[7] Historically, wage rates are lower in rural, relative to urban areas. Because mature industries are forced to cut labor costs, they may elect to locate in rural areas. Therefore, the correlation between NMUS and WAGE should be negative.

(4. Constrained Location Variables.) The constrained location theory argues that manufacturing industries are forced to move in order to permit plant expansion. The required expansion may be necessary because industry growth has forced existing plants to full capacity, or because the introduction of capital intensive production processes are not feasible at the current plant site. Two variables, PPC and RGA were included to capture the effects of industries that are located in rural areas because of constrained urban locations. Preferred plant capacity (PPC) is the percentage of preferred plant capacity that an industry is actually using. Preferred utilization represents the optimal use of the plant rather than "full tilt" operation. Industries near the physical constraint of their plant size may seek to expand, often times in rural areas. Thus, the expected coefficient on PPC is positive. RGA is

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7. Because production worker wages are such a large proportion of employee payroll (average 60 %) this variable is perhaps the most important as far as identifying the industries following filtering theory is concerned.

the 1977 to 1972 ratio of gross assets for each industry. To the degree that assets are added in an industry, abundant low cost space is needed for their location. Therefore, the coefficient on RGA is expected to be positive.

Characteristics of Industries Participating in the 1974-1979 Urban-to-Rural Shift.

Two regression equations were developed to help identify characteristics of industries that had decentralized employment from 1974 to 1979. The two equations were constructed to isolate characteristics of industries that may have decentralized employment for reasons of filtering or constrained loaction. The model for the filtering theory is:

$$(3.)\quad GMVN = a_0 + a_1\,KLR + a_2\,APS + a_3\,FL + a_4\,PROF + a_5\,RWVA + a_6\,GRN + a_7\,COMP + a_8\,WAGE + a_9\,WWS$$

The equation for the constrained location theory is:

$$(4.)\quad GMVM = a_0 + a_1\,KLR + a_2\,APS + a_3\,FL + a_4\,PROF + a_5\,RWVA + a_6\,GRN + a_7\,WRGA + a_8\,WPPC$$

The above variables are listed in Table 5 and in Appendix A along with the variables for the NMUS model. A discussion of the dependent variable, the independent variables, and their hypothesized relationships follows.

Dependent Variable. The difference in 1974 to 1979 industry employment growth rates for metropolitan and nonmetroploitan areas (GMVN) was the measure of employment decentralization. Specifically:

$$GMVN = \frac{N_i 79}{N_i 74} - \frac{M_i 79}{M_i 74}$$

where: $N_i 74,79$ is nonmetropolitan industry employment for 1974,79 in industry i

$M_i 74,79$ is metropolitan industry employment for 1974,79 in industry i

If GMVN > 0 then there was a redistribution of industry employment from urban - to - rural areas. Conversely, if GMVN < 0 then employment shifted from rural to urban areas. The larger the absolute value of GMVN the greater was the employment redistribution.

Independent Variables. (1. General Industry Variables. An industry's capital to labor ratio (KLR), and average plant size (APS) are characteristics that may affect an industry's propensity for employment decentralization. The expected coefficients on both variables are indeterminate. The coefficient on KLR may be positive or negative depending on whether it was capital or labor intensive industries that had a tendency to decentralize.[8] The relationship between APS and GMVN is also indeterminate. It is possible that an industry with a greater proportion of large plants will be less susceptible

to decentralization because of the greater expense involved in closing an urban plant and establishing a rural plant. Swan (1973), however, hypothesized that an industry with numerous large plants would tend to locate in rural areas because of space constraints in cities. The final variable in the "general" category is the dummy variable for footloose industries (FL). Footloose industries have little market or resource orientation and therefore may move to rural areas if economic conditions so dictate. Thus, the expected sign on FL is postitve.

(2. Mature Industry Variables). Mature industry variables used in the two regressions were RWVA, PROF, and GRN. The 1977 to 1972 ratio of value added to wages (RWVA) is a measure of standardization of the production process. As an industry matures, and the production process becomes more standardized, it is expected that the affected industry will decentralize to rural areas. Thus, the coefficient on RWVA should be positive. The measure of an industry's labor force skill level (PROF) is also a factor that may help explain decentralization. As an industry matures, skill requirements decline and rural production

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8. A positive coefficient on KLR may also indicate a standardized production process. The standardized production process may use large amounts of labor input or may be almost totally capital intensive, eg. heavy use of robotics.

sites become more attractive. Therefore, the expected sign on PROF is negative. Mature industries are often typified by slow employment growth. If mature, slow growing industries do decentralize then the coefficient on the employment growth rate proxy variable (GRN) will be negative.

(3. Filtering Down Variables). Variables used to identify characteristics of industries susceptible to filtering theory include:COMP,WAGE,and WWS. COMP is the 1977-1972 difference in the four firm concentration level. Increasing concentration often symbolizes increased industry competition. As competition increases it is expected that the industry will migrate to rural areas to lower labor costs. Thus, a positive coefficient on COMP is expected. If an industry follows filtering theory increasing wage rates (represented by the industry average hourly wage: WAGE) may force relocation to rural areas where wage rates are typically lower. Therefore, WAGE should be related positively with GMVN. Weighted work stoppages (WWS) is also expected to be related positively with GMVN. As the incidence of work stoppages increases in an industry, the affected industry is expected to decentralize to rural areas where labor is less powerful, and strikes less common.

(4. Constrained Location Variables). The two variables unique to the constrained location equation are the weighted growth in assets (WRGA), and weighted

preferred plant capacity (WPPC). Both variables are weighted by the proportion of metropolitan industry employment - or the degree that the industry may be constrained in metropolitan areas. By weighting PPC and RGA by constrained employment the effects of industries reaching their plant capacity or adding assets is further accentuated. An industry with a large proportion of metropolitan employment, and near its plant capacity, should show a strong tendency to decentralize. Likewise, an industry adding large amounts of assets, with significant constrained empolyment, is also likely to decentralize to rural areas in search of low cost expansion sites. Thus, the coefficients on both variables are expected to be related positively with GMVN.

Conclusion

Evidence presented in this chapter illustrates that manufacturing employment has indeed been decentralizing. Rural areas have added over 200,000 jobs due solely to migration from urban areas. In order to explain the factors involved in the employment shift ordinary least squares regression models were developed. Dependent variables in these models are the proportion of nonmetropolitan employment, and the urban-to-rural shift in employment. Explanatory variables are grouped according to their explanatory purpose and are classified as general, mature,

filtering, and constrained location industry vairables. The following chapter will present the results of the models and conclude whether the filtering theory, the constrained location theory, both, or neither best predict urban to rural industrial migration.

CHAPTER 4

RESULTS OF THE OLS MODELS

The regression models outlined in the previous chapter were designed to identify characteristics of industries that had 1.) a large proportion of nonmetropolitan employment in 1974, and 2.) industries that had shifted employment to nonmetropolitan areas during the 1974 to 1979 period. In this chapter, it will be determined which of the characteristics are statistically significant predictors of nonmetropolitan employment concentration, and the urban-to-rural shift in employment. The organization of the results corresponds to the specification of the models in chapter three. First, the results of the static model (dependent variable NMUS) are presented. Second, the decentralization model (dependent variable GMVN) is presented with respect to the filtering down and constrained location theory equations. Third, the residuals of the two equations are examined to identify the industries depicted by the theories.

The Proportion of Nonmetropolitan Employment (NMUS)

The results of the static model identifying characteristics common to industries located in rural areas (in

1974) are shown in equation 5. The results are discussed below according to independent variable headings.

$$
\begin{aligned}
(5)\quad NMUS = {} & .208 + .041\,KLR + .198\,APS - .014\,FL \\
& \quad (2.62)^{**} \quad (7.86)^{**} \quad (5.18)^{**} \quad (-.86) \\
& - .003\,PROF + .516\,LI - .008\,GRN - .066\,WAGE \\
& \quad (-1.97)^{*} \quad (6.36)^{**} \quad (-.31) \quad (-10.38)^{**} \\
& + .001\,WWS + .001\,CONT - .0001\,PPC + .075\,RGA \\
& \quad (.89) \quad (2.11)^{*} \quad (-.06) \quad (2.84)^{**}
\end{aligned}
$$

$R^2 = .410$ $\qquad F_{(441,429)} = 27.155^{**}$

t statistics appear in parentheses

* significant at the 10% level
** significant at the 1% level

General Industry Variables

An industry's capital to labor ratio (KLR) and average plant size (APS) are characteristics useful in identifying the types of industries located in rural areas. Both variables were positive and significant predictors of the proportion of nonmetropolitan employment (NMUS). The positive coefficient on KLR suggests that capital intensive industries (those with a high proportion of assets to payroll) tend to be located in rural areas. The positive sign on APS indicates that industries with numerous large plants have found rural production sites suitable for their more expansive operations. The two positive signs for KLR and APS together suggest that industries using large amounts of capital input need large plants, and that they have found room for these types of

facilities in rural areas. The third variable in the category "general industry variables" was the dummy variable for "footloose" industries (FL). FL was found to be an insignificant predictor of NMUS indicating that the specified industries have not found a significant comparative advantage in rural areas.

Mature Industy Variables

Significant variables in the "mature industry" category were an industry's percentage of professional employment (PROF) and the labor intensity of an industry (LI). PROF was negatively related to NMUS supporting the product life cycle hypothesis that mature industries have lower labor skill requirements and therefore have found rural areas "acceptable" production sites. The variable for labor intensity (LI) had a positive and significant coefficient. This positive relationship supports the hypothesis that rural areas attract labor intensive manufacturing. The positive coefficients on KLR and LI are not necessarily in conflict. Rural industries may be using large amounts of labor to complement heavy capital use. There may also be a combination of labor and capital intensive industries operating in nonmetropolitan areas. The third variable under the "mature industry" heading was the growth rate in employment (GRN). Mature industries tend to characterized by slow employment growth

and the negative sign supports this hypothesis. However, the coefficient on GRN was not significantly different from zero as evidenced by the low t-ratio.

Filtering Down Variables

Two of the three variables in the "filtering" category, hourly wage (WAGE), and industry concentration (CONT) had their anticipated, and also significant signs. As expected, the coefficient on WAGE was negative supporting the hypothesis that industries seeking to employ low wage labor tend to be located in rural areas. The positive coefficient on CONT suggests that industries experiencing high competition levels must cut costs, and therefore seek to locate in rural areas where they can employ low wage labor. This result is in agreement with the product life cycle hypothesis that increased competition leads to higher concentration. Industry work stoppages (WWS) failed to show a significant relationship with NMUS. The insignificance probably results from the fact that WAGE and WWS are somewhat collinear.[9]

Constrained Location Variables

The two variables used to represent the constrained location theory were preferred plant capacity (PPC) and the

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9. The correlation coefficients of the independent variables are provided in Appendix B.

growth rate in industry gross assets (RGA). The coefficient on PPC was negative but insignificant in the model. However, the sign on RGA was positive and significant. This result does give some support to the constrained location theory. Industries that added large amounts of assets from 1972 to 1977 tend to be located in rural areas due in large part to the fact that urban areas may have constrained the addition of the new assets.

The overall results of the model do not lend strong support to either the filtering down or the constrained location theory. The results do, however, support the product life cycle theory quite well. The results appear to show that the older, well established industries with large amounts of capital input and a routinized production process tend to be located in rural areas. There also appear to be economies of scale involved in the rural industries, evidenced by the positive coefficients on industry plant size and the four firm concentration level. Furthermore, the product life cycle theory fits the results concerning the labor force found in rural areas. The negative signs on PROF and WAGE indicate that those industries which employ lesser skilled, and hence lower priced labor, have a tendency to locate in nonmetropolitan areas.

The Urban to Rural Shift (GMVN)

Filtering Down Theory

General Industry Variables. The results of the filtering down equation for the urban to rural shift model are shown in Table 7. Significant independent variables are found under all variable headings. The category "general industry characteristics" yielded three variables significant at a ten percent confidence level. The negative coefficient on the KLR variable reveals that labor, rather than capital intensive industries decentralized during the 1974-1979 period. Industries operating with relatively small plants had a greater tendency to decentralize as illustrated by the negative coefficient on the APS variable. The final variable in the "general" category is the dummy variable for footloose industries (FL). The coefficient on FL was positive and significant, indicating that industries without strong market or resource orientations are more likley to decentralize.

Mature IndustryVariables. Percentage professional employment (PROF) was significant at the ten percent level and had a negative coefficient. The negative coefficient suggests that industries with low labor skill requirements are likely to decentralize. Also the proxy variable for standardization of the production process (RWVA) and the industry employment growth rate (GRN) were significant at a

Table 7. Results of the Regression Model for Filtering Theory.

Explanatory Variables	Equation A	Equation B	Equation C
CONSTANT	-.246 (-1.53)*	.026 (.18)	-.261 (-1.63)*
KLR	-.030 (-1.64)*	-.007 (-.39)	-.029 (-1.58)*
APS	-.204 (-1.58)*	-.172 (-1.32)*	-.198 (-1.54)*
FL	.132 (2.24)*	.112 (1.88)*	.135 (2.29)*
PROF	-.007 (-1.47)*	-.002 (-.37)	-.006 (-1.37)*
RWVA	.302 (6.38)**	.315 (6.58)**	.299 (6.31)**
GRN	-.306 (-3.15)**	-.263 (-2.70)**	-.310 (-3.20)**
COMP	.007 (1.59)*	.009 (1.90)**	.007 (1.54)*
WAGE	.081 (3.51)**		.088 (4.04)*
WWS	.006 (1.15)	.012 (2.27)*	
R^2	.148	.124	.145
$F_{(441,431)}$	8.326**	7.632**	9.192**

t statistics appear in parentheses

* significant at the 10% level
** significant at the 1% level

one percent level. The positive coefficient on RWVA supports the product life cycle hypothesis that mature industries with a standardized production process are susceptible to decentralization. The negative coefficient on the GRN variable also supports the product life cycle hypothesis that slow growing, mature industries tend to decentralize to nonmetropolitan areas.

Filtering Down Variables. The independent variables used to represent the filtering down theory were significantly related to employment decentralization. Industry competition as measured by the 1972 to 1977 change in the four firm concentration level (COMP) had a positive relationship with GMVN. Industries decentralizing in the face of increased competition supports the filtering down theory. A firm in a competitive industry will seek to relocate to rural areas where production costs can be cut, thus preventing further reduction in profit margins. Variables for labor costs (WAGE and WWS) also demonstrated their anticipated positive signs. However, the coefficient on WWS was insignificant. The insignificance probably results from the multicollinearity between WWS and WAGE. The two additional regressions in Table 7 (equations B and C) were run with WWS and WAGE entered separately. This procedure yielded significant results for both WWS and WAGE. The positive relationship between both labor cost

variables and employment shift give strong support to the filtering theory. The combined effects of the variables COMP, WWS, and WAGE reveal that industries wishing to cut costs had a strong tendency to decentralize, and hence follow the filtering down theory.

Constrained Location Theory

General Industry Variables. The results of the regression model for the constrained location equation are presented in Table 8. As was the case in the filtering equation, significant coefficients were present in all variable categories. However, the only significant "general" industry variable was the dummy variable for footloose industries (FL). The positive coefficient on FL reveals that industries with little market or resource orientation had a greater tendency to decentralize than industries classified otherwise. In the constrained location equation the variables for factor shares (KLR) and plant size (APS) proved to be insignificant. The insignificance may be caused by multicollinearity between the two "general" industry variables (KLR and APS) and the variables entered to exemplify the constrained location theory (WPPC and WRGA).

Mature Industry Variables. All three variables under the heading "mature industry characteristics" (PROF,

Table 8. Results of the Regression Model for the Constrained Location Theory.

Explanatory Variables	Equation A	Equation B	Equation C
CONSTANT	-.587 (-3.50)**	-.270 (-1.83)*	-.617 (-3.68)**
KLR	.004 (.24)	-.004 (-.23)	.007 (.43)
APS	.096 (.75)	.053 (.41)	.068 (.54)
FL	.126 (2.23)*	.115 (2.01)*	.127 (2.25)*
PROF	-.009 (-1.99)*	-.008 (-1.85)*	-.007 (-1.64)*
RWVA	.294 (6.28)**	.265 (5.66)**	.315 (6.89)**
GRN	-.399 (-4.33)**	-.443 (-4.78)**	-.355 (-3.96)**
WRGA	.240 (1.95)*	.562 (6.22)**	
WPPC	.009 (3.76)**		.012 (7.06)**
R^2	.205	.179	.198
$F_{(441,432)}$	13.954**	13.516**	15.306**

t statistics appear in parentheses

* significant at the 10% level
** significant at the 1% level

RWVA and GRN) demonstrated significant coefficients. Also, the three coefficients had the same signs as in the filtering down equation. The negative coefficients on PROF and GRN suggest that slow growing industries and those with relatively low labor skill requirements had a tendency to decentralize during the second half of the 1970s. The positive coefficient on RWVA shows that industries that increased the standardization of their production process also had a tendency to migrate to rural areas. The three variables in the "mature" category offer strong support for the product life cycle hypothesis that mature, slow growing industries, with low labor skill requirements tend to decentralize employment.

Constrained Location Variables. The two variables used to test the constrained location theory (WPPC and WRGA) were both significant and had their anticipated signs. The variables were entered together (equation A) and separately (equations B and C) because of their collinearity. The positive coefficient on WPPC shows that industries experiencing the physical constraints of their production tend to relocate to rural areas. The positive sign on WRGA suggests that industries which added relatively large amounts of capital assets from 1972 to 1977 tended to locate those new assets in nonmetropolitan areas. These results are consistent with the constrained location theory which states

that industries needing or wishing to expand will face space constraints in cities, causing them to relocate to rural areas. Moreover, the fact that the variables are weighted by constrained employment further illustrates that the affected industries are moving to nonmetropolitan areas.

Comparison of the Theories

The results of the employment shift models lend support to both the filtering down, and the constrained location theory. However, neither theory was superior in explaining the urban-to- rural shift. The principle result appears to be that it is the product life cycle theory which is being supported. Both models indicated that industries with a standardized production process tended to shift employment to nonmetropolitan areas. The product life cycle theory was further supported by the results of the coefficients on PROF and GRN. Both variables showed negative relationships with employment shift, indicating that slow growth industries with low labor skill requirements have tended to decentralize.

The filtering down and constrained location theories have found some support in the results of the models by the strength of their respective variables. However, these results appear to occur as a consequence secondary to the product life cycle concept. Thus, it can be deduced that manufacturing employment is decentralizing not only

because of filtering and constrained location but primarily because of the product life cycle. To determine if specific industries tended to decentralize because of one particular theory the residuals of the filtering and constrained location equations were analyzed. As an arbitrary measure, it was determined that an industry's decentralization was "well explained" by the models if the difference between the actual and predicted employment shift (residual) was relatively small. Specifically, an industry's decentralization was "well explained" if the absolute value of the residual was within $\pm$.25 standard deviations of the regression's residual.[10]

Altogether, 134 SIC 4 digit industries were identified as being "well explained" by the examination of the residuals. The industries whose residuals were within $\pm$.25 standard deviations of the regressions residual are shown in Table 9. Included in the 134 industries are 68 industries which were well explained by both the filtering down and constrained location theories. Table 9 also shows that 39 industries were well predicted solely by the filtering down equation and 27 industries were well explained solely by the constrained location equation.

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10. The measure of $\pm$.25 standard deviations was chosen to identify an "adequate number of industries. In a standard normal distribution approximately 20% of the random values are within $\pm$.25 standard deviations of the variables mean.

Table 9. Industries Well Predicted by the Regression Models. [1]

A. Both Filtering and Constrained Location (68)				B. Filtering Down Only (39)			C. Constrained Location Only (27)	
2011	2646	3321	3621	2021	2651*	3643*	2046	3431
2013		3325	3631	2034	2653	3691		3462*
2033	2711	3353	3641	2048			2514*	3479
2065	2721	3361	3646	2051	2731	3721		
2077		3369	3651	2066		3732	2642	3523
2084	2812		3661	2083*	2819	3751	2652	3537
2091	2822	3411	3699			3764		3541
	2869	3421		2211	2911		2794	3544*
2257	2875	3423	3825	2272		3952*		3565
2283		3429	3861	2282	3011*	3993*	2821	3576*
2291	3069	3441			3031	3995*	2833	
2295			3931	2311				3612*
	3111	3452	3962	2323	3255		2952	3635
2329	3142	3469		2394	3261			3674
2341		3471					3079	
2392	3221	3494		2421	3334			3714*
2399	3271	3496		2431	3398*		3259	
	3272	3535		2492			3292	3842
2441	3273	3573		2517	3443			
	3275	3552			3451		3331	3914
2541	3291	3561			3482			
	3296	3566						
	3297	3585						

1. An industry was determined to be well explained if its residual (the difference between the actual and predicted shift) was within $\pm$.25 standard deviations of the regression's residual.

* Industries where the differnce between the two models regression residuals were within $\pm$.25 standard deveiations.

The examination of the residuals has given support for the deduction presented earlier - that manufacturing has decentralized for reasons of both filtering and constrained location but primarily because of product life cycle. 50.7 percent of the industries were well predicted by both models, a result that occurs for two reasons: 1.) both equations shared six variables, and 2.) industries that decentralized tended to be in the mature phase of their product life cycle.

An examination of industries "well explained" solely by the filtering or constrained location models does provide some interesting insight as to the types of industries that decentralized employment. Industries that were well predicted by the filtering model include those that are traditionally classified as being labor intensive industries. Table 9 shows that industries "well predicted" solely by the filtering equation showed strong concentration (46.1%) in industries 20 (food and kindred products), 22 and 23 (textiles and apparel), 24 and 25 (lumber and furniture) and industries 26 and 27 (paper and publishing). These industries tend to be quite competitive and operate on slim profit margins, therefore their decentralization patterns tend to follow filtering theory. Industries well predicted solely by the constrained location theory include those that tend to be characterized as more capital

intensive and technologically advanced. These industries are machinery and equipment (SIC 35), electronic and transportation equipment (SIC 36 and 37), and instruments (SIC 38). Altogether, the above industries made up 40.7% of those well explained by the constrained location theory. Relatively few of the industries (14.8%) in SIC groups 20-26 were well explained by the constrained location equation. Accordingly, only 15.3% of the industries in SIC groups 35-38 were well predicted by the filtering down equation. Thus, it appears that labor intensive, low wage industries decentralized according to the filtering down theory. Additionally, industries experiencing more rapid growth and capital expansion are better explained by the constrained location theory.

CHAPTER 5

CONCLUSION AND IMPLICATIONS

The purpose of this paper was to identify characteristics of manufacturing industries having employment in, and shifting employment to, nonmetropolitan areas. Specifically, this research has sought to determine if the filtering down theory, the constrained location theory, both, or neither were helpful in explaining the urban-to-rural migration phenomenon. Previous research has found support for both theories. Research, principally in the United Kingdom, has found that manufacturing has decentralized primarily to permit plant expansion not possible in cramped urban areas. In the United States, and internationally, research has found that industries have decentralized to rural areas, and the Third World, in search of low cost, abundant labor. Some research has been done in the United States concerning the constrained location theory but these earlier studies dealt only with an intra-metro or city core-to-suburb migration.

The research in this text has found support for both the filtering down and constrained location theories. However, the results of the research were inconclusive with regard to the determination of a superior theory. The main

conclusion drawn from the research supports other studies concerning the product life cycle theory. The product life cycle hypothesis that mature, slow growing industries have migrated to rural areas is in congruence with the results of the regression results presented in this paper. It was found that mature, slow growing industries, with a standardized production process, employing lesser skilled and lower priced labor had a tendency to decentralize.

Some support was found for both the filtering and constrained location theories. The variables used to represent filtering theory, WAGE, WWS, and COMP were positively and significantly related to employment decentralization. The constrained location theory was also supported by the positive and significant coefficients on WPPC and WRGA. Further support for the filtering and constrained location theories was found by examining the regression's residuals. Of the 134 industries "well explained" by the regression equations, 39 were well explained solely by the filtering down equation. These industries tend to be the older, well established, labor intensive industries - or those seeking to minimize labor costs. The 27 industries well explained by the constrained location equation tended to be more technologically advanced and characterized by increases in capital assets - or those that may have been constrained in urban locations. The

largest group of well explained industries were those explained by both the filtering and constrained location equations. This fact gives support to the conclusion that manufacturing is decentralizing principally because of the product life cycle theory, and secondly because of the filtering and constrained location theories.

The results of this research have certain implications with respect to rural development policy. Historically, rural areas have considered themselves "dumping grounds" for old, worn out industries. In the past industries have moved to rural areas in the last leg of their product life cycle only to die. New evidence, brought forth by this research has found that some industries may also be decentralizing in search of adequate, low cost, space for plant expansion. This new evidence offers a rural community several options in their efforts to industrialize. Previously, rural communities have concentrated their development efforts on the skill enhancement of their labor force. Education was seen as a method to attract somewhat younger industries paying higher wages. These labor training programs may help to attract industries by speeding up the filtering process of decentralization. A second development option for a rural community is brought forth by the constrained location theory. If industries are decentralizing because of constrained urban locations, then

the development of industrial parks and property tax subsidies will be cost effective measures to attract industry.

Because manufacturing industries decentralize for reasons of both land and labor, rural communities are afforded the privilege of tailoring their development efforts. A rural community needs to recognize, or develop, a particular comparative advantage that will allow it to attract desired industries. The rural community must recognize not only its particular comparative advantage but also the needs of industries that decentralize employment. Any long range development plan should include provisions to attract a variety of industries so that the risk of concentration in one or few industries is reduced.

The results of this research are not conclusive. The relatively low R^2s reveal that the research has not been able to explain entirely the decentalization process. Further research is needed to determine other factors that influence plant location decisions. Suggestions for future research include: 1.) disaggregation of community classifications to identify a spectrum of urban and rural locations; 2.) better data concerning the "quality" of labor in nonmetropolitan areas; 3.) better data on the age and type of capital that is used in rural areas; 4.) a study of the multiplier effects that a new industry has in a community; 5.) use of data concerning industry

profitability and floorspace requierments. Because the decentralization process has not been fully explained further research on this topic should prove to be a worth-while endeavor.

APPENDIX A

VARIABLE DATA SOURCES

Variable	SIC Level	Source
KLR	4	U.S. Department of Commerce, 1977 Census of Manufacturers
APS	4	U.S. Department of Commerce, 1977 Census of Manufacturers
FL	2	
PROF	3	U.S. Department of Commerce, Current Industry Reports
LI	4	U.S. Department of Commerce, 1977 Census of Manufacturers
RWVA	4	U.S. Department of Commerce, 1977 Census of Manufacturers
GRN	4	U.S. Department of Agriculture
CONT	4	U.S. Department of Commerce, 1977 Census of Manufacturers
COMP	4	U.S. Department of Commerce, 1977 Census of Manufacturers
WAGE	4	U.S. Department of Commerce, 1977 Census of Manufacturers
WWS	3	U.S. Bureau of Labor Statistics
RGA	4	U.S. Department of Commerce, 1977 Census of Manufacturers
PPC	4	U.S. Department of Commerce, Current Industry Reports

APPENDIX B

CORRELATION COEFFICIENTS OF THE EXPLANATORY VARIABLES

	KLR	APS	FL	PROF	LI	RWVA	GRN
KLR	1.000						
APS	.306	1.000					
FL	-.386	-.059	1.00				
PROF	.305	-.028	.194	1.000			
LI	-.332	.092	.205	-.320	1.000		
RWVA	.053	.016	-.120	.204	.099	1.000	
GRN	-.071	-.105	.009	.151	-.063	.115	1.000
CONT	.284	.388	.001	.220	-.195	-.011	-.097
COMP	-.016	.078	.075	-.151	.097	.008	-.292
WAGE	.464	.188	-.186	.334	-.249	.101	.099
WWS	.219	.166	-.017	.218	-.096	-.034	.003
RGA	.183	-.013	-.076	.125	-.183	.189	.296
PPC	.121	.091	-.067	-.143	.082	-.061	.025
WRGA	-.040	-.250	.018	.312	-.319	.180	.286
WPPC	-.132	-.270	.034	.224	-.229	.007	.123

APPENDIX B (cont.)

	CONT	COMP	WAGE	WWS	RGA	PPC	WRGA	WPPC
CONT	1.000							
COMP	.115	1.000						
WAGE	.385	.001	1.000					
WWS	.204	-.042	.395	1.000				
RGA	.071	-.045	.231	.166	1.000			
PPC	-.068	.062	.043	.027	.116	1.000		
WRGA	.011	-.019	.377	.136	.631	.015	1.000	
WPPC	-.059	.045	.307	.070	.036	.322	.715	1.00

APPENDIX C

SIC THREE DIGIT INDUSTRIES

SIC	Industry
201	Meat Products
202	Dairy Products
203	Preserved Fruits and Vegtables
204	Grain Mill Products
205	Bakery Products
206	Sugar and Confectionery Products
207	Fats and Oils
208	Beverages
209	Miscellaneous Food and Kindred Products
211	Cigarettes
212	Cigars
213	Chewing and Smoking Tobacco
214	Tobacco Steaming and Redrying
221	Weaving Mills, Cotton
222	Weaving Mills, Synthetics
223	Weaving and Finishing Mills, Wool
224	Narrow Fabric Mills
225	Knitting Mills
226	Textile Finishing, except Wool
227	Floor Covering Mills
228	Yarn and Thread Mills
229	Miscellaneous Textile Goods
231	Men's and Boy's suits and Coats
232	Men's and Boy's Furnishings
233	Women's and Misses' Outerwear
234	Women's and Children's Undergarments
235	Hats, Caps, and Millinery
236	Childern's Outerwear
237	Fur Goods
238	Miscellaneous Apparel and Accessories

SIC	Industry
239	Miscellaneous Fabricated Textile Products
241	Logging Camps and Logging Contractors
242	Sawmills and Planing Mills
243	Millwork, Plywood, and Structural Members
244	Wood Cabinets
245	Wood Buildings and Mobile Homes
249	Miscellaneous Wood Products
251	Household Furniture
252	Office Furniture
253	Public Building and Related Furniture
254	Partitions and Fixtures
259	Miscellaneous Furniture and Fixtures
261	Pulp Mills
262	Paper Mills, except building paper
263	Paperboard Mills
264	Miscellaneous Converted Paper Products
265	Paperboard Containers and Boxes
266	Building Paper and Board Mills
271	Newspapers
272	Periodicals
273	Books
274	Miscellaneous Publishing
275	Commercial Printing
276	Manifold Business Forms
277	Greeting Card Publishing
278	Blankbooks and Bookbinding
279	Printing Trade Services
281	Industrial Inorganic Chemicals
282	Plastics Materials and Synthetics
283	Drugs
284	Soap, Cleaners and Toilet Goods

SIC	Industry
285	Paints and Allied Products
286	Industrial Organic Chemicals
287	Agricultural Chemicals
289	Miscellaneous Chemical Products
291	Petroleum Refining
295	Paving and Roofing Materials
299	Miscellaneous Petroleum and Coal Products
311	Leather Tanning and Finishing
313	Boot and Shoe Cut Stock and Findings
314	Footwear, except Rubber
315	Leather Gloves and Mittens
316	Luggage
317	Handbags and Personal Leather Goods
319	Miscellaneous Leather Goods
321	Flat Glass
322	Glass and Glassware, Pressed or Blown
323	Products of Purchased Glass
324	Cement, Hydraulic
325	Structural Clay Products
326	Pottery and Related Products
327	Concrete, Gypsum, and Plaster Products
328	Cut Stone and Stone Products
329	Miscellaneous Nonmetalic Mineral Products
331	Blast Furnace and Basic Steel Products
332	Iron and Steel Foundries
333	Primary Nonferrous Metals
334	Secondary Nonferrous Metals
335	Nonferrous Rolling and Drawing
336	Nonferrous Foundries
339	Miscellaneous Primay Metal Products
341	Metal Can and Shipping Containers
342	Cutlery, Handtools, and Hardware
343	PlumbingandHeating, except Electric

SIC	Industry
344	Fabricated Structural Metal Products
345	Screw Machine Products, Bolts, etc.
346	Metal Forgings and Stampings
347	Miscellaneous Metal Services
348	Ordnance and Accessories
349	Miscellaneous Fabricted Metal Products
351	Engines and Turbines
352	Farm and Garden Machinery
353	Construction and Related Machinery
354	Metalworking Machinery
355	Special Industry Machinery
356	General Industry Machinery
357	Office and Computing Machines
358	Refrigeration and Service Machinery
359	Miscellaneous Machinery, Except Electrical
361	Electric Distributing Equipment
362	Electric Indusrial Apparatus
363	Household Appliances
364	Electric Lighting and Wiring Equipment
365	Radio and TV Receiving Equipment
366	Communication Equipment
367	Electronic Components and Accessories
369	Miscellaneous Electrical Equipment and Supplies
371	Motor Vehicles and Equipment
372	Aircraft and Parts
373	Ship and Boat Building and Repairing
374	Railroad Equipment
375	Motorcycles, Bicycles, and Parts
376	Guided Missiles, Space Vehicles and Parts
379	Miscellaneous Transportation Equipment

SIC	Industry
381	Engineering and Scientific Instruments
382	Measuring and Controlling Devices
383	Optical Instruments and Lenses
384	Medical Instruments and Supplies
385	Opthalmic Goods
386	Photographic Equipment and Supplies
387	Watches, Clocks, and Watchcases
391	Jewelry, Silverware, and Plated Ware
393	Musical Instruments
394	Toys and Sporting
395	Pens, Pencils, Office and Art Supplies
396	Costume Jewelry and Notions
399	Miscellaneous Manufacturers

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