Nonmetropolitan Manufacturing in the United States and Product Cycle Theory: A Review of the Literature

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During the 1950s and 1960s, rural counties in the United States gained manufacturing employment at a significantly higher rate than did metropolitan counties. From a theoretical perspective, this was unexpected and appeared to contradict existing manufacturing location theory. The product cycle theory was proposed as an explanation, and it quickly gained acceptance. The product cycle model as applied in regional analysis predicts that manufacturing plants will locate in urban areas in early stages of product development to take advantage of highly skilled labor, external economies of subcontractors, and close ties to management. As production becomes standardized, manufacturing will shift to rural areas to take advantage of lower labor costs. There now exists a substantial literature, mostly empirical in nature, concerned with the product cycle theory. This article presents a review and evaluation of this literature in hopes of achieving two goals: the first is to provide a coherent summary of the literature for use by economic development planners. The second is to evaluate the strengths and weaknesses of the product cycle theory and to point out unresolved issues.

The rural United States is not predominately agricultural. In only about a quarter of the 2,443 nonmetropolitan U.S. counties does farm income account for more than 20 percent of total labor and proprietor income. Of rural employment, 40 percent is in manufacturing, in contrast to only 18 percent across the entire nation (Swanson 1989). Rural areas have experienced a pattern of decline, resurgence, and decline in economic circumstances over the last thirty years, and much of the debate about the cause of this pattern has focused on the nature and magnitude of manufacturing activity. The product cycle theory is among the most frequently cited of a number of explanations for the variability in rural manufacturing employment. In the product cycle model, manufacturing location is determined by the extent of product development. Manufacturers are expected to locate in urban areas in the early stages of product development when skilled labor, contracted inputs, and specialized services are required. As cost minimization becomes more important in the later stages of product development, manufacturers are expected to relocate to rural locations because of their low labor costs.

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Shifts in U.S. manufacturing growth patterns toward nonmetropolitan places were noted in the early 1960s and well documented by the early 1970s. Explanation of this change was particularly controversial among regional scientists, because the shift represented patterns that countered the continued urban dominance indicated by the Christaller-Lösch[1] theory of industrial location. International development theorists experienced a similar challenge over the need to explain the location of capital-intensive industries in low-wage countries; this controversy was exemplified by Leontief's (1954) contrary factor intensities paradox, which challenged the Heckscher-Ohlin theory of trade.[2] In a similar vein, the product cycle theory was developed by Vernon (1966) to explain the conflict between international development theory and actual patterns of change. Within a few years, the theory was used as the basis for intracountry empirical studies of the United States and European countries. Product cycle theory later became intertwined with elements of core-periphery and headquarter location analysis. Over the last twenty-five years, a considerable literature of application, policy derivation, and criticism has developed around the theory. The many controversies generated within this literature prompt this review.

The changing economic fortunes of nonmetropolitan areas pose a challenge to planners and policymakers: what kind of policies can they help develop to promote healthy economies? Good intentions do not guarantee success. Policies must be based on an understanding of the forces that effect change. Although the focus here is the nonmetropolitan economy, the literature has many implications for the urban economy as well. The product cycle theory suggests that in some ways, employment gains in rural manufacturing come at the expense of employment in urban regions.

This review of the product cycle theory and associated rural U.S. manufacturing issues is organized on a functional basis. We first present background definitions and detail the record of manufacturing decentralization. The development of the product cycle theory in both its international and regional forms is then described. Critiques of the theory are reviewed, followed by a review of some related theories and elaborations of the product cycle theory. Finally, we assess both the evidence that directly tests the product cycle theory and the empirical measurement of the theory's applications.

THE RECORD OF MANUFACTURING DECONCENTRATION

Within the context of rural/urban differences, "decentralization" or "deconcentration" refers to a movement down the central place hierarchy—from places of greater urbanization to places of lesser urbanization (Menchik 1981). Much of the literature relies on the U.S. Bureau of the Census metropolitan statistical area (MSA) designations to distinguish between urbanized and rural areas, and defines decentralization and deconcentration more specifically as a movement of economic activity from out of counties within MSAs and into non-MSA counties. Because the urban or metro areas are defined as MSA counties, the terms *rural* and *nonmetropolitan* are used interchangeably in this review. Confusion arises because the terms can be used with reference to any geographical scale; that is, decentralization can take place in a national, interregional, regional, or intraregional context. Decentralization of an economic activity at one scale may result in centralization at another. For example, a shift of employment from smaller metropolitan areas in a highly developed region to the larger metro areas of a less developed region is decentralizing in the interregional sense, and centralizing within the national context because of the movement to a higher-ordered city.

Nonmetropolitan counties have relatively small populations and low population densities, but beyond these similarities, the counties are diverse. Research results and policy recommendations must be qualified, therefore, because they may hold only for certain regions or types of counties.[3]

Considerable professional controversy persisted through the mid-1960s as to whether a turnaround had begun with respect to the previously superior economic performance of metropolitan over rural areas. At issue were a number of explanations for the higher growth rates of urban areas: agglomeration economies, better business services, abundance of skilled labor and other advantages. The empirical work of the early 1970s confirmed that manufacturing activities were moving from metro to rural locations. A number of explanations for these shifts arose (see Miller 1979), most of which were variations of the product cycle theory.

On average, rural counties performed better than their metropolitan counterparts from the mid- to late 1960s until about 1980. The nonmetropolitan population increased at a faster pace than the population of metropolitan counties (McCarthy and Morrison 1977; Vining and Strauss 1977; Vining and Kontuly 1978). "During the 1960s and 1970s, non-metro areas competed successfully with metro areas in attracting or creating new job opportunities in manufacturing" (Brown and Deavers 1988, 5).[4]

The trends in the 1980s clearly contrasted those of the late 1960s and the 1970s. Rural counties once again lagged behind metropolitan counties in population growth and economic recovery (e.g., Brown and Deavers 1988; Champion 1988). Rural areas were especially hard hit by the 1981 recession (Murdock et al. 1987; Daniels and Lapping 1988; Reich 1988a, 1988b). Manufacturing moved out of rural areas throughout the

immediate recovery period, as well as the remainder of the decade. One explanation for this difference in performance is that nonmetropolitan counties do not, in fact, compete directly with metropolitan areas for manufacturing activities but depend on different segments of the industry that display greater sensitivity to business cycles.

Bechter and Chmura (1990) investigated changes in rural manufacturing during a period of dollar appreciation. They found that the greatest percentage of losses in manufacturing employment occurred in rural counties adjacent to large metropolitan areas rather than in more rural counties. Conversely, Gilmer and Pulsipher (1989) found that improvement in rural economic conditions was based in part on the effect of a strong dollar on rural manufacturing employment. They found little evidence that structural damage to the manufacturing base of the Tennessee Valley was caused by a strong dollar.

Bloomquist (1987) analyzed performance of the rural manufacturing sector in terms of regional differentials. He found that the states in the South and West have had the highest rates of rural manufacturing growth, in contrast to the states in the Northeast and Midwest. Although the expansion of manufacturing employment in the West was associated with increases in high-quality jobs, growth in the southern region was associated with jobs of low quality and wages.

During the 1980s, growth in rural employment lagged behind growth in metropolitan areas in all regions except New England. Manufacturing employment growth, however, did better in rural areas. But this does not permit the conclusion that rural areas were doing well; average annual growth in real earnings per worker for rural manufacturing was negative during the 1980s, whereas large metropolitan counties had the largest increases (Drabenstott and Smith 1991). Thomas A. Clark (1991) noted that capital movements have recentered in the urban circuit since the early 1980s, paralleling the urban employment turnaround.

PRODUCT CYCLE THEORY

Although this review is focused on the development of product cycle theory in its domestic applications, the theory had origins in the sphere of international development. Kuznets (1930) and Burns (1933) published the seminal works in product cycle theory; both noted that industries pass through a series of phases with differing growth rates. The spatial element was added in Vernon's (1960, 1966) revival of the concept. Vernon used the theory to explain the growth of capital-intensive industries in low-wage countries. He argued that specific kinds of products go through a cycle characterized by three stages: (1) new product, (2) maturing product, and (3) standardized product. As a product goes through these stages of development, the location of production shifts from the technologically most sophisticated countries to places of lesser sophistication.

With the introduction of a new product, producers face a number of transitory conditions: there is a need for flexibility in altering the input mix; price elasticity of demand is comparatively low; and communication with customers, suppliers, and even competition is crucial (Vernon 1966, 195). This new product stage of the cycle manifests rapid change in both product and production technology. Accordingly, there is an intensive use of skilled labor and the external economies of subcontractors and a need for close ties to management. According to Vernon, then, new product output locates in the most technically advanced nations. Application of this theory in domestic regional analysis draws the parallel that first-stage activities are centered in metropolitan areas where skilled labor, scientific skills, and external subcontractors are available; for these and other reasons, headquarters are also located in metropolitan areas (Erickson and Leinbach 1979).

The second stage of the product cycle, the maturing product stage, is characterized by movement toward increasing economies of scale and standardization of production methods. These are justified by increases in world demand. Vernon (1966) maintained that market expansion into relatively advanced economies occurs at this stage. In this stage, producers in the country of origin consider the advantages of setting up production in those countries (e.g., Vernon and Wells 1976). Once economies of scale can be fully exploited in overseas units, the decision to relocate production activities depends on the traditional locational factors of shipment costs and labor costs.

Applications of the product cycle theory to domestic regional economies depict similar locational shifts in the maturing product stage. As routinization sets in, the production unit may locate closer to the final demand. But because the crucial inputs at this stage are management, finance, and engineering skills, the production facility will still locate in a metropolitan area—usually with the firm's headquarters. This tendency to maintain initial location during the second stage differentiates domestic applications of the product cycle theory from Vernon's (1966) original international applications.

The standardized product stage marks the end of significant innovation in either product design or production techniques. Stability is noted both in the industrial organization and in the production process. There is considerable price competition, and unskilled labor and the capital equipment of a standardized process are the critical inputs. Accordingly, production of goods that require significant quantities of labor and do not rely on external economies is moved to less developed

countries or regions in search of low labor costs. The advanced regions then import the commodities from the less developed economies.

Vernon (1966) briefly drew a parallel of this international shift analysis to interregional shifts in the United States. Industries that no longer needed a sophisticated industrial environment and that produced standardized products moved to the low-wage South. In the textile industry, for example, the production of gray goods, sheetings, and men's shirts shifted to the South, whereas high-styled fashions and other unstandardized or research-oriented products continued to be produced in the major industrial complexes of the North and Northeast.

Later writers expanded on this point by noting that the managerial elements of these branch plants concentrated on production management, with little need for financial, marketing, purchasing, and research and design (R&D) inputs (Thompson 1969; Pred 1974; Kale and Lonsdale 1979). In these later applications, the primary locational implications of the filtering-down process depended on the tendency of first- and second-stage production to take place in headquarter locations where scientific, managerial, and externally contracted inputs are available. Because of the availability of these inputs, headquarters tend to maintain metropolitan locations. Similarly, the external support services and producers of intermediate goods for the first two stages also maintain metropolitan locations.

In a related manner, Norton and Rees (1979) viewed "innovative capacity" as the determinant of the core-periphery relationship. They ascribed the loss of manufacturing jobs in the U.S. heartland to the "gradual dispersal of innovative capacity to the south and west" (142), a reversal of the historical location of rapid growth industries. In terms of spatial locations and the managerial function, secondary implications were posited by Krumme (1971) and Steed (1971a). They asserted that those branch plants farthest from the headquarters tend to be in the final phase of the product life cycle and also are the most managerially independent. Branch plants in earlier stages of the cycle are located closer to a firm's headquarters and are accordingly more dependent on the direction of headquarters.

A strict interpretation of the filtering-down process should be limited to the study of branch and relocated plants only. New plants joining an industry have not yet accumulated the institutional experience that permits routine production with unskilled labor. This argument ignores the possibility that some experience can be transferred by hiring managers, engineers, and technicians from other plants, however. Nevertheless, there are some tests of the filter-down theory that look at branch plants only.

METHODOLOGICAL CRITIQUE

Since the inception of product cycle theory in the mid-1960s, critics have challenged it on methodological grounds. Additional criticism was generated when application of the theory shifted from international uses to intranational uses. Much of this criticism focused on the regional application of the product cycle theory; in its international configuration, the theory was designed to be applied to closed systems, but it was being applied to the opened systems of regional economies. At that juncture, Vernon (1979) expressed his concerns over the appropriateness of the domestic application.

Taylor (1986) and Storper (1985) both presented excellent critiques of the application of product cycle theory. Each approached the product cycle from a different perspective, and together they covered practically all major criticisms of the method in the literature.[5]

Taylor (1986) asserted that, in the transition from international to domestic application, many of Vernon's (1966) original caveats were "conveniently forgotten" (751). At the core of Taylor's criticism, however, was concern over the "disembodied, unilinear, technological determinism" (751) of the model. He viewed the basis for the model as a sequence in which changes in technology cause changes in investment decisions and spatial adjustment. The model therefore subordinated all other aspects of the economic system—supply and demand in both labor and product markets, as well as the entire panoply of investment decision making. Taylor noted that Vernon's (1966) original assumptions addressed the absence of many of these economic system variables but that these assumptions were lost in the later applications.

Taylor (1986) identified six specific shortcomings of the model. First, there is an ambiguity of ownership in the industrial organization of industries; that is, the model treats all filtering down as if all plants are owned by the same firm. Thus it avoids all questions of franchising, joint ventures, and sectoral competition—both foreign and domestic. Second, invention and innovation are assumed to be discrete, with movement to the final product and production forms without allowance for incremental development. Third, products are treated as homogeneous; the economics of product differentiation would change locational outcomes, but these are not incorporated into the model. Fourth, large-scale production is not necessarily labor intensive, and high-volume outputs are not the only means of attaining cost reductions. Such a broadening of the model to include matters of capital mobility would remove much of the determinism of the model. Fifth, the model does not incorporate any location-specific advantages other than that of low-cost labor; thus most of the external relations of the firm are not incorporated. Sixth, there is

an assumption that the market cycle and the production cycle mature synchronously. Taylor suggested the possibility that these cycles are, instead, independent of each other.

Storper (1985) found the product cycle model to be too generalized: it takes a set of empirical observations of one sector, period, and set of places and assumes them to apply to a broad array of industries, times, and places. He referred to this practice of finding mechanical relationships among variables, while ignoring the more complex interrelationships among the same variables, as "essentialism," and objected to the raising of a "transitory empirical phenomena to the status of a development logic" (267). Like Taylor (1986), Storper noted that the determinism of the model is based on questionable logical and empirical assumptions. First, the logic of the cycle is too narrow, because there is no necessity that all sectors undergo these exact processes of change. Second, there is a historical contingency to many of the occurrences that is assumed to be empirically constant. Third, the model has a narrow concept of division of labor that does not allow for practices such as subcontracting or other economies of scope. Fourth, the empirical factors of the model are not constant; the model, therefore, is too dependent on the relationship between the extent of the market and a Smithian form of economies of scale. Fifth, there is no incorporation into the model of how the outcome is affected by the firm's coping with uncertainties and instabilities. Sixth, the sinusoidal pattern of output of new products is highly dependent on macroeconomic variables that are not consistent over time and place. Seventh, the spatial logic and the use of the hierarchical concept of succession is crude, and industries may differ significantly from each other in actual experience. Finally, the specifics of the innovational processes are not incorporated in the model.

Other analysts have also criticized the product cycle theory. Gordon Clark (1986) focused his critique on the spatial segmentation of production as the result of spatial differentiation in employment. He suggested that the product cycle is a spatial result of the organization of production rather than an explanation of spatial order, and he looked instead to the interaction of employment contract relationships to explain the location of production. Norcliffe (1984) recommended coupling the costs of labor, fixed capital, and circulating capital as an explanation for urban, suburban, and nonmetropolitan location.

Finally, Vernon (1979) himself has become more critical of the model over time. Although he did not find fault in the construct itself, he claimed that two changes in the climate of international production have rendered the model less useful: the increases in the activities of multinational corporations and the number of countries of origin of multinationals.

RELATED THEORIES OF SPATIAL DEVELOPMENT

Because space will not permit comparison of product cycle theory to the mainline development theories and their many variants, it is perhaps more useful to consider two theories as examples of such possible contrasts. The first is Markusen's (1985) book, *Profit Cycles, Oligopoly, and Regional Development*—selected as an example of an extension of product cycle theory, developed for purposes of incorporating both changes in the structure of the economic base and behavioral variables. The second group of theories comes from the "new industrial division of labor" (NIDL) literature. Its comparison to the product cycle is of interest because a similar developmental outcome is reached, although the driving variables of the structuralist approach are significantly different.

Markusen (1985) added further behavioral components to the product cycle theory with her incorporation of a five-stage profit cycle; spatial changes in production are associated with each stage. Corporate strategies taken as responses to the sequence in profit cycle are determinants of locational change. In the zero-profit stage, production is customized and confined to one or several places. The second stage, the superprofit stage, is based on innovative monopoly and represents the creation of a new industrial sector. The need for a skilled labor pool and professional services makes the original location attractive to entering firms. The third stage incorporates both product cycle and neoclassical theory, with normal profits resulting from entry of new firms and expanded production of existing firms arising from the final mechanization of production. As in product cycle theory, this stage emphasizes services and focuses on the production process. Accordingly, this stage is marked by dispersal of production to low-wage areas. The fourth stage, normal-plus and normal-minus profits, is characterized by two alternatives: either the industry responds to reduced growth by concentrating into an oligopoly, or there will be a decline of the industry because of competition from substitutes or imports. If oligopolization occurs, geographic dispersion is truncated; if there is no oligopolization, dispersion is mandated. The final stage is called negative profits, and is characterized by disinvestment and plant retirement.

Markusen's incorporation of oligopolist strategies does add behavioral elements to the product cycle theory, yet it does not rescue the original formulation from its primary criticism that causal ties between stages are not developed. For this reason, her case studies for eighteen industrial sectors fail to show deterministic links and often reflect exceptions to posited behavior.

Over the past two decades, literature on the NIDL has focused on the international core-periphery theme. Although the work is driven by a structuralist approach, the results are the same as those predicted by the product cycle model.

Fröbel et al. (1980) developed a well-integrated study of the NIDL. Their findings confirmed product cycle expectations, although the explanatory logic differed considerably. According to Fröbel et al., changes in the international structure of production are based on a set of conditions that are necessary for the continuation of capitalism. These are (a) the development of a worldwide supply of productive and inexpensive labor; (b) the continued refinement of job organization to allow for short training periods; and (c) the development of transport and communication technology, which allows for production to be located with little regard to distance from markets. An international business superstructure has evolved from these structural preconditions, resulting in the expansion and deepening of transnational production. Other elements that further the process are tax agreements to avoid double taxation, investment protection treaties, and cooperative trade policies.

In their empirical analysis, Fröbel et al. (1980) found a number of trends in the international economy associated with the shift of manufacturing employment out of western countries and into peripheral areas. They documented increased investment in overseas operations, increasingly specialized and fragmented operations in peripheral areas, and unemployment and failing labor relationships in western countries. Other core-periphery literature has also affirmed the shift of specialized production activities to peripheral regions (Keeble et al. 1988).

Similarly, much of the literature on multinationals, intrafirm trade, and transfer pricing has projected results compatible with product cycle theory, in that profit switching provides another explanation for the increase of standardized production in peripheral areas (Greenaway 1987; Lall 1973; Steward 1988).

EMPIRICAL WORKS

The body of empirical studies on rural manufacturing can be classified into six topics: product cycle, industry mix, employment stability, agricultural and service linkages, locational choice, and job skill requirements. Analyses in some of these areas—product cycle, industry mix, and locational choice—take the form of direct tests of product cycle hypotheses. The other research themes—employment stability, job skill requirements, and linkages—serve policy analysis by identifying and measuring the attributes of branch plant employment.

Product Cycle: Branch Plants and Headquarters

Initial empirical testing of the product cycle theory centered on the international shifts posited by Vernon (1966). Later applications of the theory to domestic shifts in manufacturing activities developed around the mechanisms of interregional dominance of headquarters and the spatial decentralization of production.

The existence of two dimensions of dominance creates a potential for confusion in the literature. In one sense, dominance is manifested when the majority of economic activity occurs in one region or urban delineation compared to the economic activity of other places. A more exact definition of dominance refers to the organizational dimension: the controlling level of an organization is located at one place and exerts dominance over the economic activity of another. The literature that maps headquarters/branch location is based on this latter definition. Unfortunately, in descriptive works, the two dimensions of dominance are often confused or are treated as if they map the same hierarchy of places. Similar potential for confusion arises from the use of different geographical scales—both between and within studies. That is, headquarters control can be increasing at the metro-nonmetro level or scale but simultaneously decreasing or deconcentrating at the scale that compares interregional performance. The existence of a variety of subregional scales makes cross-study comparisons even more difficult.

Wells (1969), one of Vernon's colleagues, tested the variables crucial to the product cycle theory. At the second stage, foreign market size is dependent on income elasticity of demand for the product. If the product is of high income elasticity, then foreign market size will sooner justify overseas production. Income elasticity is, therefore, the testable variable with respect to the types of product. Because production costs are a function of plant size and transportation costs, Wells also examined these variables. He found that U.S. exports of consumer durables for the period between 1952 and 1963 were consistent with the predictions of the model. Product cost studies showed that the United States did better as an exporter of the more sophisticated versions of several products. As for economies of scale, an index of dispersion was calculated and a relationship between scale and export performance was found. Similarly, a value per weight index was constructed, showing that transportation costs did appear to be significant in determining the volume of exports.

Empirical studies lend support to the filtering-down theory (e.g., Cromley and Leinbach 1981; Erickson 1976; Erickson and Leinbach 1979; Leinbach 1978; Park and Wheeler 1983). Erickson and Leinbach (1979) studied branch plants established in Illinois, Kentucky, New York, and Ohio between 1967 and 1976. They found that

the headquarters of branch plants in Kentucky were concentrated in New York and the traditional manufacturing states of Ohio and Illinois. The average distances from headquarters to branch plants were relatively short. Similar results were obtained for Wisconsin. Most of its branch plant headquarters were located in Illinois, Minnesota, Ohio, and Wisconsin. In contrast, branch plants in New Mexico were located at a much greater average distance from their headquarters; most of them were in Illinois, California, and New York.

Cromley and Leinbach (1981) intensively examined the patterns and implications of the filter-down process in nonmetropolitan Kentucky. Using data gathered from annual industrial directories published by the Kentucky Department of Commerce and covering the years 1960 to 1980, they found increasing impacts of branch plant employment. In 1960, 60 percent of total manufacturing employment stemmed from branch plants; by 1980, this figure was 79 percent. Examination of the general pattern of branch employment pointed to three explanatory factors: labor competition, access to the transportation network, and community infrastructure. They also found an oscillation in the relationship of employment growth rates and town size—that is, the lowest levels of employment were associated with the largest and smallest nonmetro town sizes. The rate of employment turnover was an inverse function of town size, as was the negative impact of economic recessions.

Cromley and Leinbach (1981) found that the labor intensity of branch plants in various industry groups tended to confirm the product cycle theory. Labor-intensive industries accounted for nearly 60 percent of the rural firms, and these were all mature, low-technology, slow-growth industries.

Another study also found differences between branch plants and newly established independent manufacturing firms (Erickson 1976). Branch plants that located in nonmetropolitan Wisconsin between 1969 and 1974 were larger on average than independent firms. Objectives leading to the choice of a nonmetropolitan location also differed between branch plants and independent operations. Branch plants were more likely to be motivated by avoidance of competition for labor than independent new firms. The latter independent new firms were most interested in a less urbanized location with more land for operation and expansion.

A related study by Park and Wheeler (1983) looked at the filtering-down process in Georgia. The authors distinguished between branch and local single plants among firms established between 1970 and 1979 that were still operating in 1980. New branch plants accounted for more than 61 percent of additional employment. They noted that their findings were consistent with those of a previous study in the southwestern United States by Hansen (1979) but that they appeared to contradict the job generation studies of Allaman and Birch (1975) and Birch (1979), "which concluded that new businesses are especially important in the job generation process" (Park and Wheeler 1983, 21). Branch plants accounted for more than 50 percent of all new nonmetropolitan plants in Erickson's (1976) study of Wisconsin, but not in Leinbach's (1978) study of Vermont.

Industry Mix

Other studies have analyzed industry mix of branch plants versus independent operations. In their Georgia study, Park and Wheeler (1983) found that high-technology industries constituted about 26 percent of new branch plants, versus only 19 percent for local single plants. Within the group of high-technology plants, the location patterns of new firms varied significantly between branch and local plants. Of the branch plants, 83 percent were located in nonmetropolitan areas, compared with only 52 percent for local single-plant additions. Consistent with the results of other studies, Park and Wheeler also found that the average size of new branch plants (125 employees) far exceeded that of new single plants (37 employees). Another study found significant differences in average size when branch plants were further subdivided into U.S. owned and foreign owned (McNamara and Barkley 1990). Using data for Georgia and South Carolina, McNamara and Barkley also showed that foreign-owned plants in nonmetropolitan areas were larger than U.S.-owned branch plants. Park and Wheeler (1983) looked at differences between branch plants in Georgia with headquarters in Atlanta and New York (see also Cromley and Leinbach [1986] and Wheeler [1988] for related studies). Branch plants with headquarters in New York were located in nonmetropolitan areas in 68 percent of all observed cases, compared with only 40 percent of branch plants with headquarters in Atlanta. Only 18 percent of the employment of nonmetropolitan New York branch plants was classified as high-tech. New York branch plants were located at a greater average distance from Atlanta than branch plants with headquarters in Atlanta. The New York branch plants were "pioneers" in moving farther away from the city, which suggests that those plants had more to gain from moving into nonindustrialized areas with low-cost labor than did the Atlanta-based branch plants. The marginal cost of communication was probably higher for branch plants with their headquarters in Atlanta. For New York branch operations, the marginal cost of the additional travel time was probably close to zero. For both groups of branch plants, the average distance from

Atlanta increased significantly between 1930 and 1979. This conformed to the predictions of the filtering-down theory.

In a study of firms that formed between 1960 and 1975 in nonmetropolitan Vermont, Leinbach (1978) found that traditional explanations of location decisions lost credibility over the study period. Population size and industry concentration were major predictors of locational choices, but their influence decreased between the years 1960 and 1975.

In Norton and Rees's (1979) work, the product cycle was a conceptual framework used to explain the loss of hegemony by core U.S. regions. They employed a shift-share analysis to test two hypotheses about the loss of employment in the core manufacturing-belt regions: first, that the innovative capacity—and hence the rapid-growth industries—had spread to the hinterlands; and second, that the flight of standardized production to the hinterlands had increased. They used value-added data to examine the dispersal of manufacturing to rapid growth regions, and found that a transition had taken place between 1963 and 1976. In the early part of the period (1963 to 1972) a decline in the magnitude of core hegemony measures was evident; a reversal of these measures appeared in the later period (1972 to 1976), indicating that high-technology industries were locating away from the core. Norton and Rees also found significance in their second hypothesis, that movement of standardized fabricating activities also accounted for part of the core's loss. Their analysis showed that the core's losses reached "floodtide proportions during the 1960s" (149).

As the study by Park and Wheeler (1983) demonstrated, the number of plants classified as high-tech that were locating in nonmetropolitan areas increased, at least in the southeastern United States. This could have indicated a shift away from low-skill and unskilled jobs that characterized rural manufacturing in the past. There are some researchers who argued that this would have been a logical development (Till 1974).[6] The initial industrialization by low-wage, low-skill plants was seen as a necessary condition to make a region an attractive location for more sophisticated plants requiring an experienced labor force.

Product cycle theory maintains that research and development (R&D) facilities will be established in metropolitan (or developed country) locations, because this type of activity is associated with the earliest segment of the first stage of the product life cycle. Several writers have addressed this linkage conceptually. Some tied the availability of highly educated manpower to the location of early phases of production, whereas Gordon Clark (1986) suggested that the existence of research and development in a region is a major factor in projections of economic growth. Similarly, Roberts (1979) tied R&D activities to headquarter locations because of closer linkages with overall corporate activities.

Malecki (1985) considered R&D location decisions in terms of the metro-nonmetro split.[7] Based on data from the 1965 and 1977 directories of Industrial Research Laboratories of the United States, his findings indicated a slight trend toward deconcentration of R&D from major urban areas to lesser metro areas. Despite this trend, the R&D activities of the 330 largest corporations remained concentrated in the twenty largest urban areas. The share of R&D activity in nonmetropolitan areas remained constant over the study period. As for organizational considerations, Malecki found no change in the linkage between corporate R&D facilities and headquarters. He therefore implied a parallel slight tendency for headquarters to move from major to lesser urban areas.

Barkley et al. (1988) used tobit analysis to examine differences in employment, occupational linkages, and market linkages between nonmetropolitan high- and low-tech firms. Data on manufacturer characteristics in eleven contiguous western states were collected by survey. After controlling for firm and community size, they found that nonmetropolitan high- and low-technology employment sizes were similar. The high-technology manufacturers were more rapidly growing, export oriented, and skill intensive. Stronger backward linkages with local economies were maintained by the low-technology manufacturers.

Rural Manufacturing and Locational Choice

Many studies of locational choice were conducted to determine whether the product cycle theory's locational determinism on grounds of labor cost held up under statistical scrutiny. Other analyses reviewed in this section may have been conducted for other purposes, but their results also have bearing on this same question.

Johnson (1991) examined the relationship between those activities in the southern United States that reflected late-stage production and its labor environment. Using data derived from a questionnaire of branch plant managers, Johnson found that labor factors were important to branch plant location. He indicated, however, that labor costs may have been considered too narrowly in empirical studies of the product cycle theory. He found that employers looked at "work ethic" and "labor climate," which included such factors as unionization and right-to-work laws (Johnson 1991, 405).[8] But Johnson stressed the importance of factors other than labor in decisions to locate: "low-cost labor alone will not necessarily attract investment, even of assembly oriented branch plants" (406). He found, for example, that good trucking connections were more important in location decisions than proximity to an interstate highway.

Johnson further found differences between labor-intensive and high-technology branches. The latter, for example, were more sensitive to the tax environment. Whereas Johnson provided no information about possible locational differences between these two types of plants, Barkley et al. (1991) showed that in the western United States, high-technology firms in small towns located in larger towns near urban areas, near universities, or in areas high in natural amenities (see also Haug 1991).

These findings are consistent with those of Johnson's (1989) previous study, in which plants with a strong orientation toward assembly showed a clear indication that factors influencing production cost were most important to the choice of location. His study area included all counties in North Carolina, South Carolina, and Georgia. Only plants with at least twenty employees were considered, and 116 usable responses were gathered via survey. The five most important factors were labor cost, a supply of people who could work as assemblers, the availability of land, the presence of workers with little or no factory experience, and a favorable tax environment. Johnson found, however, that more recently established branch plants were much more likely to have an experienced labor force. This suggests that some high-technology plants perform pioneer roles in industrializing a town or region, in accordance with the predictions of filtering-down theory. The location of other more sophisticated plants, however, may signal the beginning of a new industrial era in the rural United States.

Leinbach's (1978) finding of the decreasing importance of traditional locational variables in Vermont may be at odds with the conclusions of a study of the north-central United States by Dorf and Emerson (1978). They looked at the changes between 1960 and 1970 in the number of plants with more than one hundred employees and at changes in total employment in plants with more than one hundred employees in a sample of nonmetropolitan communities (between 2,500 and 50,000 population) throughout North Dakota, South Dakota, Nebraska, Kansas, Missouri, Iowa, and Minnesota. Factor analysis was used to identify differences between communities related to differences in changes in manufacturing employment. Sixteen variables were identified by this process, of which community size, county size, and distance to the closest metropolitan area were found to be particularly important. Regression analyses were performed with the net number of new plants and net change in employment as dependent variables, respectively. Only community size, distance to a metropolitan area, and the size of the labor force were statistically significant in both regressions. These results seem to be contradicted by the findings of Carlino and Mills (1987). Their research led them to conclude that manufacturing employment density in 1979 was positively correlated with a dummy variable for nonadjacent nonmetropolitan counties. The two studies are not directly comparable, however. Dorf and Emerson looked at communities and changes in the number of plants; Carlino and Mills studied manufacturing employment levels in counties.

The results of the previously mentioned study of rural Kentucky by Cromley and Leinbach (1981) also suggest that town size is an important variable in explaining total employment in rural branch plants. Town size may be a "composite index" because it is a proxy for the size of the labor force and the capacity of the infrastructure. Employment changes in branch plants from 1970 to 1975 were strongly related to town size and the presence of a limited-access highway. The presence of an industrial park was another important explanatory variable. Transportation was not found to be statistically significant in explaining employment change between 1975 and 1980.[9]

Location theory tells us that transportation should play a major role in location decisions and employment growth. The results obtained by Miller (1979) and Isserman et al. (1989) do not strongly support that expectation (see also Rephann 1990, 1991). Miller compared job growth in nonmetropolitan counties served by an interstate highway and other nonmetropolitan counties. He found that interstate highways played an important role during the late 1960s but that their importance diminished in the early 1970s. This result seems to echo the findings of Leinbach (1978) that the importance of traditional locational factors had declined.

Miller (1979) compared manufacturing growth among the four U.S. census regions: the Midwest, the South, the West, and the Northwest. In three of the four regions, noninterstate counties experienced faster employment growth between 1971 and 1975 than those served by an interstate highway. Only manufacturing in the West and trade and services in the Northeast persistently grew faster in interstate counties. Miller offered two explanations for the findings. First, as secondary roads were improved, access to interstate highways became available to many counties outside the interstate corridor. Second, the interstate highway system may have been planned to serve those nonmetropolitan counties where substantial growth had already occurred.

> Nonmetropolitan counties off the corridor, therefore, grew more rapidly in the late 1960s and early 1970s because industry and jobs were "filtering out" from the corridor areas, taking advantage of the availability of low-wage labor and new markets provided by the growth of retirement population, the development of recreational and mining areas, the expansion of colleges and universities, and other nonhighway related amenities. (P. 81)

Isserman et al. (1989) compared growth rates of small cities (between 15,000 and 35,000 population) on interstates with those not on interstates for 213 cities from all but eight of the most densely populated states in the continental United States. They examined several time periods between 1969 and 1984. The authors distinguished between manufacturing, services, retail trade, and wholesale trade, and used growth rates of income by sector as a measure of growth. Because the information was not available for the cities themselves, the counties were used instead. Isserman et al. found that total income grew significantly faster in rural counties with a small city located on an interstate than in other rural counties. Manufacturing income growth did not differ significantly, however. To find out if there were temporal differences in these results, the period between 1969 and 1984 was divided into five- and ten-year segments. Services and retail experienced more significant growth in counties with a small city served by an interstate highway in five of the six time periods. The differences were statistically significant only twice—for manufacturing and wholesale trade. This result provided additional support for the finding of other researchers that traditional variables may have become less powerful in explaining manufacturing location decisions.

For further analysis, the cities were divided into five groups: (1) located at the intersection of two interstates, (2) located at the intersection of an interstate and another four-lane highway, (3) served by one interstate highway, (4) served by a four-lane highway, and (5) served only by a two-lane highway. Isserman et al. (1989) found that

> the growth rates of the five groups do not nest nicely into hierarchical order with monotonically increasing growth rates at higher service levels. For instance, counties with cities at the intersection of interstate highways grew on average 28% in total income between 1969 and 1984—the same average growth rate as the counties with only two-lane roads—and counties with only a single interstate highway grew 42% and counties with only a four-lane highway grew 35%. (P. 3)

Nonetheless, the authors concluded that cities with better links to the national transportation network had a competitive advantage. Their result is somewhat contradictory to the findings of Miller (1979). The data in the two studies are not the same, however: the first part of the Isserman et al. (1989) study excluded rural counties served by an interstate highway without a city in the population range of 15,000 to 35,000.

Isserman et al. (1989) also studied counties without such cities. The study area for this part of their research consisted of six counties in Appalachia—four of them in West Virginia, one in New York, and one in Ohio. The county populations ranged from 11,400 to 51,700, and the largest towns in these counties had populations between 1,200 and 6,700. Income growth rates before and after highway construction were compared for these counties, and the results were similar to those of Miller (1979). "The most optimistic assessment of these results is that there are some stirrings of economic development within the first ten years after highway construction. Major highways do not constitute a quick fix for relatively remote rural areas" (Isserman et al. 1989, 7).

Further evidence for the decreased importance of highways on the growth of rural communities and towns comes from a study of rural areas in Illinois (Sofranko et al. 1985). Of the forty-one rural communities in Illinois located on an interstate highway between 1950 to 1960, 88 percent grew, compared to growth in only 57 percent of communities not on an interstate. Between 1960 and 1970, 168 rural communities were located on an interstate highway, and by 1980, this figure increased to 238. By 1980, 27 percent of rural Illinois communities were located on an interstate highway. Without any doubt, many other rural communities had easy access to interstate highways via improved state highways. Hence the decreased statistical importance of interstate highways did not reflect a decreased role for transportation but, rather, the ubiquitous access to the interstate highway network.

Haynes and Machunda (1987) showed that nonmetropolitan counties in Indiana adjacent to a metropolitan county experienced faster employment growth from 1950 to 1980 than did other nonmetro counties. From 1970 to 1980, metropolitan counties lost manufacturing employment at the rate of 2.2 percent, and nonadjacent nonmetropolitan counties were practically stagnant (–0.2 percent). From 1960 to 1970, however, manufacturing in nonadjacent counties grew faster (29.2 percent) than in adjacent (16.8 percent) or metropolitan counties (14.4 percent). These results support the finding of Dorf and Emerson (1978) that distance to a metropolitan area was a significant explanatory variable in location decisions of manufacturing plants. Distance can be regarded in these studies as a measure of competition for labor.

Haynes and Machunda (1987) grouped the nonmetropolitan counties according to degree of urbanization. The authors distinguished three types of nonmetropolitan counties: urban, less urban, and rural. The most rural counties did consistently well in attracting manufacturing employment. Between 1970 and 1980, in particular, manufacturing employment in these counties grew at a rate more than thirty times that of the less urban nonmetropolitan counties. Employment increased by only 0.2 percent in the group of the urban

nonmetropolitan counties. In accordance with the assumption of filtering theory, the most rural counties had the lowest manufacturing wage rates.

Employment Stability and Rural Manufacturing

As for the dynamics of branch employment in nonmetropolitan areas, studies by Pred (1974) showed that branch plants had a sharply limited life span because of the short duration of markets for many products. This limitation was also attributed to the tendency of corporations to exploit tax benefits and other locational incentives and then leave when the facilities are fully depreciated (Steed 1971b). Erickson and Leinbach (1979) found branch plants to be particularly susceptible to downturns in the business cycle and noted that expansions of existing plants and the creation of indigenous establishments were more important to long-run employment. Birch (1979) also found a great deal of instability over the business cycle in relatively new branches, but not as much instability as with small, new, independent firms.

Cromley and Leinbach (1981) provided data on the stability of branch plants in nonmetropolitan Kentucky by community size. Net employment increased between 1970 and 1980 in all towns. The percentage change was highest in towns with a population between 10,000 and 19,999 (+59.3 percent) and 2,500 and 4,999 (+47.2 percent). These net increases masked much activity, however. All classes of towns lost firms between 1970 and 1980. By 1980, towns with a population below 2,500 had lost nearly half of the 144 manufacturing plants that were in business in 1970. The job loss associated with these closures was 4,948—or 25.1 percent of the jobs in existence in 1970. The next largest group of towns were those with populations between 2,500 and 4,999. These towns lost thirty of sixty-nine plants over the same time period, with 2,216 jobs (–22.8 percent of all jobs in 1970). Towns with 5,000 to 9,999, 10,000 to 19,999, and more than 20,000 inhabitants also lost a large percentage of their manufacturing plants in operation in 1970; but the associated job losses were only –8.9 percent, –9.7 percent, and –6.7 percent, respectively. This showed a negative relationship between town size and manufacturing employment stability.

Smaller towns did not fall behind because new branch plants created jobs. From 1970 to 1975, new branch plants contributed more new jobs than did existing branch plants in all six town size groups, and existing branch plants also added new jobs in all groups. The situation was different between 1975 and 1980. Old branch plants in towns with 5,000 to 9,999 inhabitants had a net employment loss. New branch plants were still more important in the job creation process than were existing plants, but their relative role decreased, except in towns with 5,000 to 9,999 inhabitants.

A related study of rural Iowa manufacturers was undertaken by Barkley (1978). He investigated the locational stability of branch plants compared to independent (single) plants between 1965-66 and 1975-76. Barkley found that single plants were more likely to fail (8.73 percent) than were branch plants (5.43 percent). The branch plants' locational instability rate was 50 percent greater than that of single plants because they were more likely to move. Branch plant locational stability was not significantly different for branches with headquarters outside or inside Iowa. Locational instability rates decreased with employment size for branch plants with up to 500 employees. For larger branch plants (more than 500 employees), instability rates increased 25 percent. Only branch plants with 51 to 100 employees had a higher locational instability rate (26.19 percent). The locational instability rate for local plants ranged from 10 percent for plants with 101 to 250 employees to 12.93 percent for the smallest plants (21 to 50 employees). Measured in terms of the plants' outputs, local plants were consistently more stable, with the differences between them and branch plants statistically significant at the 10 percent level of significance or above for all sectors except nondurable goods.

Brown and Pheasant (1987) examined cyclical employment instability in Indiana at the county and state levels. They found that rural areas suffered more cyclical employment instability than did urban counties. At the state level, a high percentage of employment in manufacturing was associated with greater employment instability. At the county level, however, most manufacturing sectors appeared to stabilize counties over the business cycle. Killian and Hady (1988) found a similar rural-urban unemployment bias; Yetley (1989) showed that underemployment was also a more serious problem in rural labor markets.

Linkages to Service Activities

Services are often ignored as a location factor in the study of rural manufacturing. Goode's (1989a, 1989b) research showed a positive relationship between the location of industries in nonmetropolitan communities and the service sectors in those communities. The relationship traced out a threshold effect: communities with a "moderately complex" service sector were as likely to attract new manufacturing firms as were communities with a "complex" service sector. Using data from the early 1970s, Goode (1989a) also showed that the factors for growth through expansion differed from those for the location of new plants. Growth through expansion was more likely to occur in larger towns with better services.[10]

MacPherson (1988) looked at the role of technical service linkages in new product development by small manufacturing firms. He conducted a survey among

Canadian-owned single-plant manufacturing firms with no more than two hundred employees in the Toronto metropolitan region. Of the firms, 73 percent obtained technical support from external experts, although the annual expenditures for such services were low. Of those firms that introduced new or substantially changed products over the study period, 87 percent contracted outside technical support services. Similar results were obtained for firms with a strong export orientation. Only 56 percent of noninnovating firms contracted such services.

Location and Job Skill Requirements

Like those in the previous section, the studies of location and job skills requirements are not direct analyses of the product cycle; yet they serve to identify the nature of branch plant employment and, in doing so, add one more dimension for policy analysis.

Smith and Barkley (1988) used data obtained through a survey in nonmetropolitan counties in ten western states and found that high-tech branch plants were similar to other branch plants, offering a relatively large share of low-skill jobs. An argument that high-technology firms generated a significant share of low-skill jobs was given persuasively by Sassen (1988). Glasmeier (1991) is also pessimistic about the prospect of increased nonmetro manufacturing job growth by high-tech firms.

Bloomquist (1987) noted that the quality of manufacturing jobs was highest in the western states, followed by those in the Northeast, the Midwest, and the South. He found that gender differences were also significant—earnings for women were markedly lower than those of men. More men were employed in "top of the cycle" industries and tended to have higher-quality occupations; women tended to be employed in skilled blue-collar occupations rather than as technicians.

Single plants and headquarter establishments were found to provide a much higher percentage of professional, technical, and skilled jobs. Branch plants had better access to capital, technical expertise (through headquarters located in metropolitan areas), and markets.[11]

Glasmeier (1988, 1991) examined the extent to which rural areas can expect to attract high-tech manufacturing plants during the early product cycle. She concluded that, because of fewer employment and advancement opportunities, nonmetro regions could find it difficult to attract and retain highly qualified labor (e.g., Teixeira and Mishel 1991). Even employers in smaller metropolitan areas have had such problems. In the words of one Champaign-Urbana, Illinois, company president who decided to relocate the firm's manufacturing plant elsewhere, "executives may be reluctant to come to Champaign-Urbana because the community lacks similar job opportunities in the event they'd want to change employers" (Anderson 1983, A3). A new microelectronics firm in the same metropolitan area experienced difficulties recruiting qualified workers for its clean room and had to train them itself before the local community college started to provide such training (see also Redwood et al. 1989). If a metropolitan area of some 130 thousand inhabitants has had such problems, they are also likely to exist in nonmetropolitan cities and counties.[12]

Another problem that may prevent "true" high-technology plants (those providing a large share of technical and high-skill jobs) from locating in nonmetropolitan areas was explained and projected by Mincer (1978). As more and more families consist of two-wage earners, and as women pursue more ambitious careers, areas with small and narrow job markets will be at a disadvantage in recruiting. This problem will be more severe for plants trying to hire highly trained managers, scientists, and engineers. Well-educated individuals tend to have educated spouses, and large metropolitan areas provide more opportunities acceptable to both spouses.

In the short run, at least, the "communication revolution" is not sufficient to counteract such trends. First, some of the most optimistic claims regarding the impact of improved means of communication underestimate the importance of regular face-to-face contact. Second, at present, the major communication firms consider many nonmetropolitan towns too small and the costs too high to connect them to the new sophisticated fiber-optics network, or to equip their exchanges with digital switches (Fulton 1989; Parker et al. 1989). This may not be a problem for firms with modest communication needs, but firms cannot assume that rural communication systems will be able to handle a very large volume of business.

In recent years, education has been linked to success in economic development. Empirical results generally support the existence of such a link for metropolitan areas, but rural counties do not seem to benefit from increased educational expenditures (e.g., Schaeffer and Sander 1988). This is probably because the relatively small rural labor markets provide few advancement opportunities to highly educated labor (Mincer 1978).

SUMMARY AND CONCLUSIONS

We have reviewed the formulation and results of twenty-five years of application of product cycle theory to the evaluation of rural manufacturing in the United States. The record of manufacturing deconcentration in the 1960s and 1970s was a significant turnaround from the previous long-run tendency toward manufacturing concentration. Along with this recorded change came the realization that existing models of domestic regional economic development contained no means of satisfactorily explaining this

phenomenon. In the area of international economics, a somewhat similar observation was made a decade earlier, with the need to explain the location of capital-intensive industries in low-wage countries—a development that ran counter to the predictions of the Heckscher-Ohlin theory (see note 1). The product cycle theory was accordingly developed by Vernon (1966) to explain the actual development of change. Several years later, the theory was adopted by regional scientists to explain the resurgence in rural manufacturing.

The product cycle model is dependent on invention, innovation, and the search for lower costs through economies of scale. In the first stage—the new product stage—the inputs and conditions of invention and production mandate location in major metropolitan areas. The second stage—maturity—is associated with product standardization and the search for economies of scale. Production may relocate in this phase. In the final stage—standardized production—the search for lower costs shifts production to low-wage locations. Corollaries to the theory associate a shortfall of linkages, vicissitudes of production, and lesser-skilled employment associated with branch plants.

As for the methodological consistency of the product cycle models, studies from the mid-1980s to present have increasingly questioned its validity. Storper (1985) claimed that the models falsely elevated temporal empirical regularities to the status of theories. He implied that the use of technological change as the primary basis for modeling location subordinates the realities of supply and demand in both the product and factor markets. Similarly, Taylor (1986) found the model to be an oversimplification, not accounting for the complexities of relationship between the enterprise and its external environment. He found that the model overemphasized labor and had an unrealistically simplified view of the changeability of goods. Even Vernon (1979) found that the model was a less viable explanation of the behavior of firms since the 1970s than it had been in previous decades.

Initial empirical analyses tended to confirm the original international hypotheses. These works were followed by studies with less robust results. Domestic studies showed increasing importance of the branch plant hypothesis in explaining the growth of rural manufacturing. Analysis of headquarter location was used to explain the lack of growth of the service sector in states that had experienced significant growth in manufacturing output via branch plants. Studies of industry characteristics also showed that R&D operations tended to be located near headquarters as did manufacturing classified as high-tech.

Hypotheses constructed to test the role of labor costs in branch plant location showed that labor costs ranked high, but not significantly above other factors such as adjacency to markets and transportation networks, quality of labor force, and absence of unions. Analysis of branch plant employment showed that plants further down the product cycle were significantly more susceptible to economic downturns and were more likely to feature jobs of lower quality.

The methodological criticisms of product cycle theory are made on valid bases. The theory is too simplistic and too technologically deterministic to predict location adequately, given the microeconomic and macroeconomic complexities of location decision making. Despite the simple elegance of the model, in application it failed to predict the final turnaround in the fate of the rural areas in the mid- to late 1980s. The intuitive logic of the model could be used, however, to infer that the turnaround was caused by rural areas losing low-skill jobs to locations in developing countries with even lower labor costs. On the other hand, the U.S. economy has experienced considerable structural change over the decade, and perhaps those industries that traditionally located in rural areas were also those most affected by industrial restructuring. Given the number of economic variables that are not accounted for in product cycle theory, we likely need to look to other microanalyses for the glimmer of an answer. Meanwhile, it is unlikely that rural areas will soon manifest the same rates of growth in manufacturing that they did in the 1960s and 1970s.

Recent extensions of product cycle theory, such as the work of Markusen (1985), provide very useful new theoretical insights. As explained above, they are no more capable of predicting turning points than the original theory was, however; the possibility to build new policies based on them is therefore limited. The more recent theories are more complex and incorporate more variables. Although this makes them more interesting and more relevant in some respects, the greater complexity makes empirical testing less reliable. Thus some of the case studies in Markusen's book are ambiguous. To overcome this problem, it would be very useful to conduct more empirical studies of nonmetropolitan manufacturing. For example, we still do not know enough about linkages between rural manufacturing and the service sector. We also have incomplete knowledge about the entrepreneurs of independent plants; product cycle theory focused attention on branch plants. Detailed studies of manufacturing plants—and other enterprises—should be complemented with more research into the economic and social environments in which they operate. Examples of research that has moved in this direction include Hansen (1991, 1992), Rosenfeld (1992), and Tödtling (1992). Also of great potential is the emerging literature on barriers to communication in a spatial setting. This literature is reviewed in Button and Rossera (1990).

The economic environment for rural manufacturing has changed. It is not clear what insights from the past remain valid. If rural manufacturing develops primarily because of low labor cost as implied by product cycle theory, then the future is bleak. With much improved transportation and communication capabilities, even the lowest labor costs in industrialized nations are very high compared to those of developing nations. Fortunately, there are many indications that labor costs, although important, are only one factor in locating manufacturing plants. New research should focus on these other factors to inform us how to adjust to the new economic realities.

We express our appreciation for the excellent comments we received from the editor of this journal and the anonymous referees.

NOTES

1. Christaller (1966) and Lösch (1954) provided the theoretical foundations for what is now known under the name "central place theory." This theory explains the division of economic and administrative functions among a system of cities and towns. For a succinct summary of the theory and its history and developments, see King (1984).

2. Heckscher and Ohlin were two Swedish economists who developed the theory of comparative advantage in international trade. One implication of the theory is that low-wage countries should produce labor-intensive goods for exports because of their labor cost advantage, and they should import capital-intensive goods. The establishment of capital-intensive factories in low-wage countries clearly contradicts the predictions based on this theory.

3. Ilvento et al. (1988) presented a useful discussion of the meaning of rurality in a policy context.

4. See also Whiting (1974) for a detailed discussion of rural manufacturing growth in the late 1950s and during the 1960s.

5. A very succinct discussion of the criticisms of product cycle theory can also be found in chapter 1 of Malecki (1991).

6. See Johnson (1985) for an empirical study for the southeast United States.

7. See also Malecki and Bradbury (1992); and Malecki (1991) for a more general discussion of technology, research, and regional economic growth and decline.

8. See also the similar findings of Leistritz (1991) for the Upper Great Plains.

9. Other useful studies dealing with new manufacturing are Greenstreet and Walker (1989); Walker and Calzonetti (1987); and Walker, Greenstreet, and Calzonetti (1989). Walker and Greenstreet (1989) provided an empirical analysis of the impact of incentives on the location and growth of manufacturing employment.

10. For other studies of the rural service sector see Cocheba et al. (1985), Gilmer et al. (1987, 1989), Mack (1984), and Pulver and Lien (1989).

11. For a discussion of capital availability in rural areas see Markley (1988) and Gustafson and Beauclair (1991).

12. A useful study, although not focused on nonmetropolitan regions, is Malecki (1985). For a more optimistic view in a European setting, see Hansen's (1991) description of factories in nonmetropolitan Jutland, Denmark. A related article by Hansen (1992) deals with the development of an innovative regional milieu. Although it does not limit itself to nonmetropolitan regions, it fits into this general literature, as does a recent book by Suarez-Villa (1989).

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