PREFACE

This is one of several studies made to provide research approaches in different problem areas of rural poverty and economic development. These studies were initiated by the Economic Research Service to assist in program planning and guidance for future research. Generally, each one provides an outline of the problem of concern, a survey of research, evaluation of applicable research methods, and specific research proposals. Results are being used in expanding and reorienting the research program of the Economic Research Service. They should also be of value to other researchers in the areas covered.

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This report was prepared by the author under contract. The author's opinions do not necessarily reflect the views of the Economic Research Service, or the U. S. Department of Agriculture.

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STRATEGIES, MODELS, AND ECONOMIC THEORIES OF DEVELOPMENT IN RURAL REGIONS

by

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INTRODUCTION

The prosperity of the United States has reached an unprecedented level. The National Government has adopted policies to reduce the severity of cyclical disturbances in the economy and to maintain a high and rising level of production and wealth. Yet, one-fifth of the population is not sharing the national prosperity. Poverty continues to exist. It is concentrated most noticeably in the heart of big cities, and continues to be the normal lot of rural residents in many places.

Contradictions in the American society resulting from continuous poverty alongside increasing wealth have bred a sense of crisis in the last decade. After World War II, several public programs were initiated. First came broad new housing programs and related projects for cities. These were followed by regional development programs stemming from the Area Redevelopment Act of May 1961, which was designed to take care of what at that time were thought to be the few "pockets" of distress. The assumption apparently was that highly specific local programs would bring these isolated pockets back into the mainstream of the national economy.

But the assumption was wrong. Broad areas of the country qualified for redevelopment assistance under the terms of the Area Redevelopment Act, showing that rural and urban poverty were not confined to isolated pockets.

Poverty remains a broad regional phenomenon and permeates every major section of the country. Furthermore, it is not monolithic. There are several types of poverty affecting different segments of the rural population in different ways at different places. Broader views of regional situations and new kinds of policy are evidently needed in order to solve this problem.

The Appalachian Regional Development Act of 1965 represents one attempt to achieve a broad regional view. In its concern for regional disparities in social and economic well-being, and in its recognition of the need for a well-balanced regional approach to the problem, this act exemplifies a new sense of regionalism in national policy. Regional development programs are seen as means for providing all the people, wherever they live, an opportunity to participate fully and equally in the life of the Nation. Thus, the major objective of regional development is to maintain an employment base that will support the population of a region at a level of dignity and prosperity consistent with the affluence of the Nation. Links between the region and the

Nation must be strengthened to promote and sustain vigorous regional growth.1/

Questions of concept and strategy are immediately raised. What are the determinants of differential growth rates among regions? Indeed, what are these regions? How is overall economic development of the Nation and of its urban-industrial centers of activity related to the lag in the growth of rural regions and to differences in their growth? What techniques are available for studying growth determinants, and what are the findings of researchers using these techniques? What are the current major research problems and research priorities? These topics are examined in this report.

Also raised is a series of policy-related questions, approached in part at least, by reviewing techniques designed to address such queries as the following: What are viable and lagging areas and what is a meaningful growth matrix? What kind, amount, and location of investment should a policymaker be thinking of? What are the costs and the benefits of different investment patterns? What are the investment alternatives? Which of these lead to optimal use of funds? What are the welfare goals to be achieved, and are they accomplished by an economically optimum use of funds? There are no simple or complete answers to these questions. We simply indicate the nature of present understanding and a few of the more critical immediate steps that need to be undertaken.

RURAL ACTIVITIES WITHIN THE CONTEXT OF NATIONAL ACTIVITIES

No part of a modern nation can ever be separated from the other part. In their timely collection of readings on "Regional Development and Planning," John Friedmann and William Alonso wrote perceptively (15):

> Human activities are distributed over a national territory in certain rhythms and patterns that are neither arbitrary nor the workings of chance. They result rather from the interdependencies that give form to economic space.

Further, they argue that:

> Spatial patterns will shift with shifts in the structure of demand and production, in the level of technology, and in the social and political organization of the Nation. The economic and social development of the nation is reflected in its patterns of settlement; its systems of flow and exchange of commodities, money and information; its patterns of commuting and migration; and its reticulation of areas of urban influence. And if there is a spatial pattern corresponding to each "stage" of economic development, it may be further suggested that there is an optimal strategy for spatial transformation of one stage to the next. In the early period of development, marginal returns of the factors of production differ greatly among regions. With economic advancement, economic factors become more differentiated in space, and the relevant scale of many functions will increase. At an advanced stage of development, the national economy

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1/ Friedmann, John. Poor Regions and Poor Nations: Perspectives on the Problem of Appalachia. Paper presented at the 24th Ann. Mtg. Soc. Appl. Anthrop., Lexington, April 1-4, 1965. Also Menzies (29).

will appear as a fully integrated hierarchy of functional areas, with most of the population and activities polarized in metropolitan areas and, in effect, with national markets for labor, capital and commodities.

Friedmann and Alonso depict a highly articulated space economy in which the processes of economic development are leading to greater specialization and increased polarization of growth in a few urban-industrial complexes, each of which is functionally integrated with a surrounding economic region.

To what extent does the economic development of rural areas take place in such a matrix in the United States? Schlesinger has argued that since the Civil War, cities have had "supreme command" of the American growth process, with urbanization the controlling factor in national life (37, 38). But to answer such a question explicitly demands that the urban-industrial orientation of rural areas be spelled out and that the increased polarization be documented. The primary object of today's regional development policies is elimination of rural poverty through programs that make it possible to sustain increases in per capita incomes and products. Therefore, rural poverty needs to be appraised not as an isolated problem but one in the context of the entire matrix.

A first step in this direction is achieved in the second part of the book, "Metropolis and Region" by O. D. Duncan and others, which deals with the domination of hinterland activities by metropolitan centers (11). The authors of this book show that throughout the United States the proportion of land in farms and the proportion of farmland in crops are joint functions of the quality of the land resource used and of its accessibility to the national system of cities, as indexed by population potential. In contrast, the only substantial factor associated with per acre value of products and farmland values (which indicate the intensity of production) is proximity to a metropolitan center; the closer the regional market center, the greater the intensity of production. Density of farm population, like the proportion of land in farms and the proportion of farmland in crops, is a function of land quality and general accessibility rather than of distance to a metropolis. Yet, the simple correlation between density of farm population and land quality is negative; farm population densities are higher in the Northeast, where general access is higher, than they are in the naturally better land-endowed Midwest and South. Similarly, a negative relationship between land quality and the proportion of part-time and residential farms suggests other overriding elements. In this case, the lower natural endowments of some regions, combined with their superior location within the Nation, imply that farm residents can increase their incomes by working off the farm.

Other sections of "Metropolis and Region" show location of nonmetropolitan manufacturing activity to be a function of general accessibility to the urban system of the Nation and distance to the local metropolis, and to be associated with the degree of local urbanization. The relationship is stronger for fabricating than for processing industries. The association between level of activity and general accessibility to an urban center is weaker but significant for other resource-extracting activities such as coal mining, although the location of the activity obviously is determined by the location of the resource.

Findings consistent with those mentioned above abound. Findings of one study show how average value of land and buildings per acre decreases and average size of farms increases in the Northeast as the level of local urbanization decreases, distance from metropolitan centers increases, and size of related metropolitan centers decreases (16). Thus, the structuring effects of metropolitan centers and smaller urban places on agriculture are conditioned by their position in the hierarchy of urban places.

The urban-oriented rhythm of agricultural activity is thus clear. Yet, none of these findings should really be a surprise. They are accounted for logically by the classic theory of agricultural location in the tradition established by J. H. von Thünen, and since elaborated on by many location theorists and regional scientists.

The same rhythmic properties are characteristic of other facets of rural life. For example, in an excellent series of studies, John Borchert and Russell Adams have examined urbanization, population mobility, and urban dispersal in relation to the urban hierarchy of the upper Midwest (1, 6, 7, 8). They show a transformation of the pattern of settlement as part of a general urbanization process in which people are shifting from farm to nonfarm occupations, centralizing from farms and small trade centers to large urban areas in selective, age-specific migration, and dispersing from built-up city areas into neighboring suburbs and the countryside beyond as an ever-extending commuting rural nonfarm group. A compounding series of problems thus results: loss of business and eventual failure for the small town businessman; selective migration which leaves behind older and less able population groups in areas of slight opportunity; and an outward spilling of the urban labor market as improved accessibility permits long-distance commuters to select their residences farther away from urban centers. Centralization, differential migration, and a diffused extension of urbanization into former farming areas are all shaped by access of people to the central city. Yet, as Karl Fox points out, if improved access to the city creates problems, it also presents opportunities.2/ For if the city can grow, its entire functional economic area (laborshed) can benefit if workers commute. Fox thus makes a case for drawing major growth poles and their dependent areas into closer association, and for recognizing the resulting functional economic areas as viable planning units. We develop this argument in detail later.

Fox's view has been expressed most forcibly by T. W. Schultz in his locational hypothesis devised to explain spatial divergences in per capita incomes (39). Schultz argues that economic development occurs in a specific locational matrix that is primarily industrial-urban, near the center of which factor and product markets work best. Those agricultural activities with the most favorable locations in relation to industrial-urban centers enjoy more efficient factor and product markets than those located on the periphery of these urban systems.

2/ Fox, Karl A. The Major Problem of Rural Society. Paper presented at the Third Ann. Farm Policy Rev. Conf., Ames, Iowa, Dec. 18, 1962.

Nicholls shows that industrial-urban development contributes significantly to the efficiency of local factor and product markets, facilitating the transfer of excess labor out of agriculture and of needed capital into agriculture within the environs of growing industrial centers (32). Areas lacking the dynamic conditions of industrial-urban development experience high rates of outmigration and concomitantly realize declines in per capita income, even though labor migrations generally appear sufficient to overcome income differences attributable to differences in "original" resource endowments. The factors linking rural poverty to industrial-urban growth, polarized in urban centers and varying in amplitude according to the rank of these centers in an urban hierarchy, are thus clear.

HOW REGIONS GROW

If growth is stimulated from the center rather than the periphery of a region, how and why does it occur? In his masterful summary of a wealth of empirical evidence in "Regions, Resources and Economic Growth," Harvey S. Perloff makes the following generalizations about regional growth (33, 34):

1. Differential regional economic growth is an integral part of an open, highly dynamic economy. As long as demand and supply conditions change and regions have differing advantages for production, differences in regional growth must be seen as part of the total economic system, just as are economic specialization and division of labor.

2. All the elements essential to national economic growth are also essential to the economic growth of regions. Chief among these elements are development of natural resources, development of manpower skills, aggressive entrepreneurship, an elaborate infrastructure, and the associated external economies.

3. Basic to the growth of given regions is their capacity for attracting national industries, that is, industries that produce goods for export to other regions of the country. But substantial internal economic development is equally important. First, the direct and indirect impact of export industries on local income and employment varies greatly. Second, internal factors (for example, local income distribution) have much to do with expansion of the local market and the extent to which the market attracts industries producing for it. Growing market orientation of industries is thus important.

4. Growth industries--those whose rate of employment increase exceeds the average rate for all industries--have a favorable impact on the level of economic activity in a region through their effect on the industry mix. But a region may grow by gathering in a greater and greater proportion of slow-growing industries or by specializing in activities which, in general, are declining.

5. Competitive shifts in industry due to factors in the local economic environment may more than offset national industry trends. While certain industries are more conducive to local economic growth than others, not all regions can expect to have a comparative advantage in rapid growth sectors, and some can expect to grow only slowly on the basis of the industries for which they have comparative cost advantages. A realistic appraisal of a region's

relative advantages and disadvantages is an essential starting point for an understanding of its growth potential.

6. The clustering of economic activities into great urban regions and smaller urban centers has important implications for development efforts. Since efficiency and attractiveness of urban communities are significant ingredients in regional economic growth, city planning is a key weapon in area development even of rural regions.

7. Not all of the regions of a country can expect their economic activities and populations to increase at the same rate of speed. Yet, every region can hope to enjoy a high and rising per capita income if the Nation's output and productivity continue to increase, as long as its people are willing to face up to the need for a degree of outmigration when the overall situation calls for it. In most such instances, significantly higher income levels within a region can be achieved only by combining effective economic development with substantial outmigration.

8. An essential ingredient of a sound national program of economic development is encouragement of location of new industries and work force in the most advantageous regions. Efforts to develop economically and culturally poor areas may not produce long-term advantages for either the Nation or for more than a small proportion of the inhabitants of a region. On the other hand, regions in decline but possessing useful social overhead facilities and good location may be candidates for significant public action if this will at least stabilize the situation.

The conclusions that can be drawn from Perloff's eight points, given the knowledge that current economic growth of a region is industrial-urban in character and that rural poverty is localized in the lagging periphery are:

1. Industrial-urban polarization of growth is symptomatic of changes taking place in the total economic system.

2. The variety of manpower skills, the aggressive entrepreneurship, and the elaborate infrastructure of cities are related to this polarization.

3. The present pattern of growth has resulted because cities have amassed national growth industries while simultaneously developing local markets of increasing size that have fostered rapid internal economic development.

4. The growth of industrial-urban centers of activity is therefore of an industry-mix kind.

5. But rapid growth of cities due to their industry mix does not preclude competitive shifts in favor of other cities or, indeed, other regions.

6. Continuation of present growth trends is predicated upon continued efficiency and attractiveness of the urban nodes.

GROWTH COMPONENTS AND THE EMPLOYMENT STRUCTURE OF THE UNITED STATES, 1950-60

Multiple-factor analyses of the employment structure of 3,102 counties in the United States covering 32 employment categories for both 1950 and 1960 shed additional light on Perloff's generalizations (**see table** 1 for list of categories).3/ In both years, the shape of the economy was the same; both analyses revealed the same three aggregate structural dimensions underlying the employment mix of counties in the same order of importance: (1) urbanization of activity (communications, wholesaling, retailing, finance), (2) degree of dependence on agriculture, and (3) relative reliance upon recreational development for local employment. In addition, the analyses revealed a series of industry-specific locational patterns for mining, forestry, vehicles, textiles and apparel, and public administration and military activities, reflecting the importance of specialization in these sectors.

Table 1 shows the first five dimensions of this 32-industry analysis, with loadings lying between plus and minus 0.40 omitted to permit ease in reading. Factor scores for counties on each of the dimensions were computed and mapped. Figure 1 shows areas with the greatest and those with the least dependence of employment upon urbanization of activity. Similarly, figure 2 shows the areas with employment most dependent upon agriculture and those, largely in the manufacturing belt, with least agricultural dependence. Figure 3 shows areas whose employment structure had the greatest recreational orientation. The patterns shown on these maps forcefully point up variations in the character of the main components of employment among the regions.

Similar analyses were completed for the 3,102 counties using 2 variables for each of the 32 employment categories, representing the change in employment from 1950 to 1960 due to changes in industry mix (KIJ) and competitive shifts (CIJ). (See the discussion of shift analysis below.) These analyses revealed two significant kinds of changes that are working to reshape the spatial structure of the economy: (a) increasing polarization of a wide range of activity in existing urban centers as a result of industry-mix effects, and (b) a "tipping" of the regional economy into new sectors because of competitive shifts. Forestry, mining, vehicles, textiles, and apparel have individual patterns of change. The regions losing ground most rapidly because of their industry mix are also those in the worst competitive position with respect to industries upon which they place greatest reliance. Those areas most dependent upon agriculture are losing most because of the declining importance of agriculture in the national economy. But agricultural regions are accumulating an increasing proportion of the Nation's agricultural work force through competitive shifts.

3/ These analyses were undertaken by the author for Edgar S. Dunn, Jr., as part of Dunn's studies of changes in the nature of the American economy, 1940-60. For methods, see H. Harman, Modern Factor Analysis (17).

Table 1.--First 5 factors in normal varimax rotated principal axis factor analysis of 32 employment sectors, 1960

Employment sector	Communality	Factor				
		Urban orientation	Agricultural dependence	Recreational development	Factor four	Factor five
Agriculture	0.801		-0.604			
Forestry	0.621					
Mining	0.758					
Construction	0.580				0.676	
Food products	0.612					
Textile mfg.	0.867					
Apparel mfg.	0.684					
Wood products	0.521					
Printing	0.510		0.497			
Chemicals	0.766					
Electrical equipment	0.564		0.656			
Motor vehicles	0.865					
Other transportation	0.970					
Other mfg.	0.621		0.760			
Rail services	0.786					
Trucking services	0.555	0.429				
Other trucking services	0.539				0.646	
Communications	0.516	0.587				
Utilities	0.443					
Wholesale	0.637	0.783				
Food stores	0.629					-0.532
Eating places	0.647			-0.577		
Other retail	0.635	0.627				
Finance	0.695	0.698				
Personal services	0.621			-0.746		
Household services	0.697					-0.770
Business	0.488	0.471				
Recreation	0.595			-0.720		
Professional services	0.644					
Public administration	0.530				0.426	
Military	0.738					
Other types not reported	1.000					
Eigenvalue		3.017	1.939	1.772	1.632	1.455

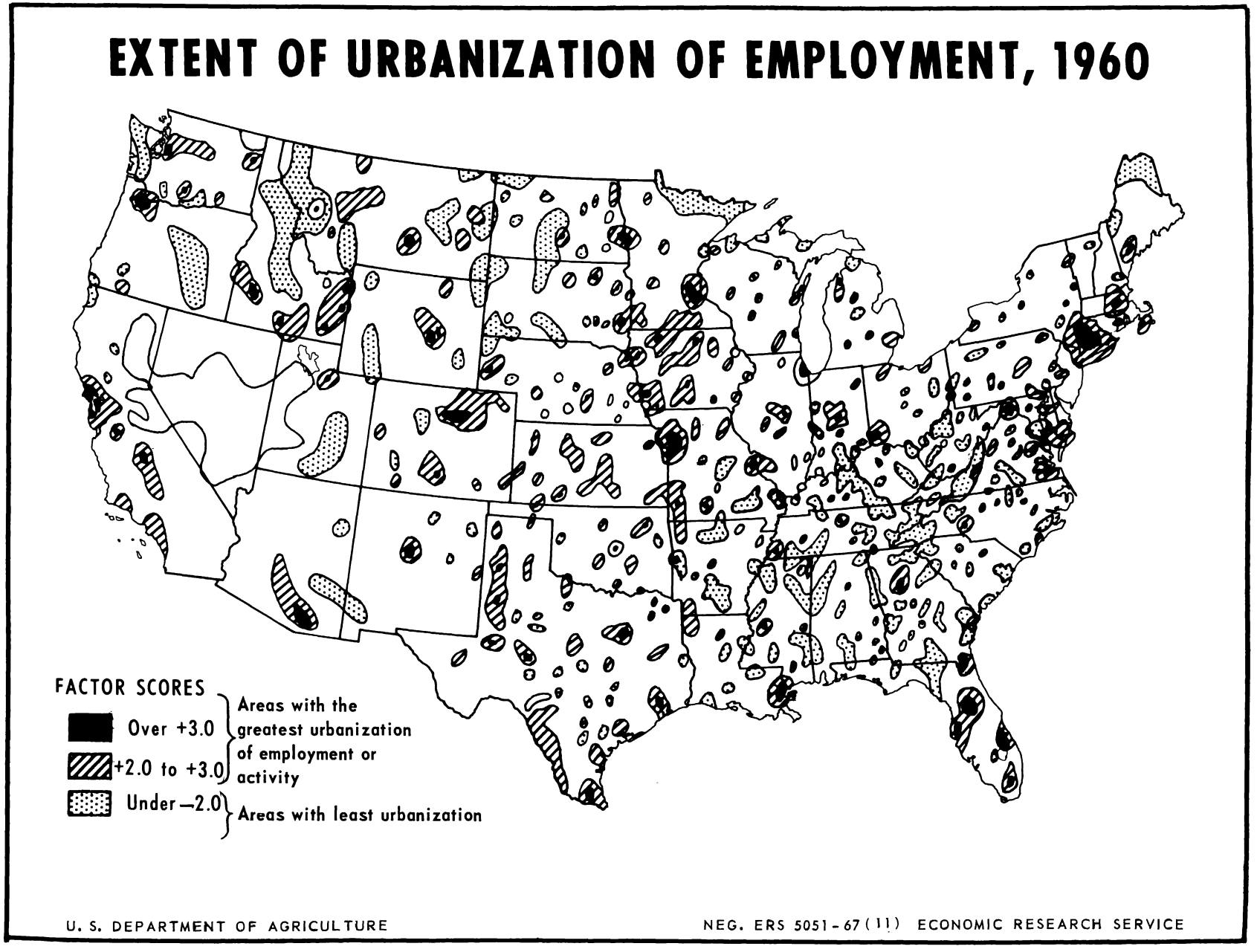
EXTENT OF URBANIZATION OF EMPLOYMENT, 1960
FACTOR SCORES
Over +3.0
+2.0 to +3.0
Areas with the greatest urbanization of employment or activity
Under −2.0
Areas with least urbanization
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 5051-67(11) ECONOMIC RESEARCH SERVICE

Figure 1

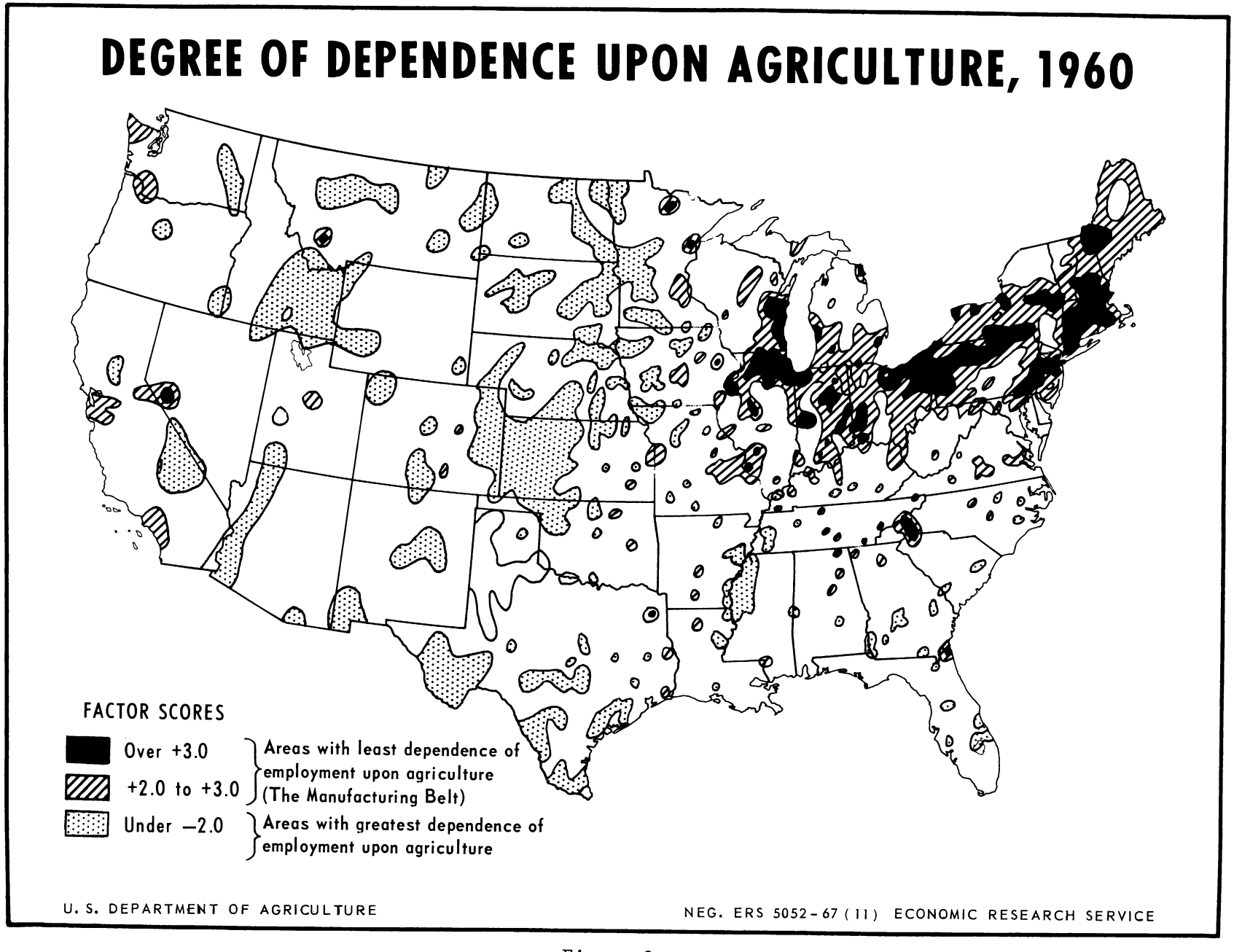
DEGREE OF DEPENDENCE UPON AGRICULTURE, 1960
FACTOR SCORES
Over +3.0
+2.0 to +3.0
Areas with least dependence of employment upon agriculture (The Manufacturing Belt)
Under −2.0
Areas with greatest dependence of employment upon agriculture
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 5052-67 (11) ECONOMIC RESEARCH SERVICE

Figure 2

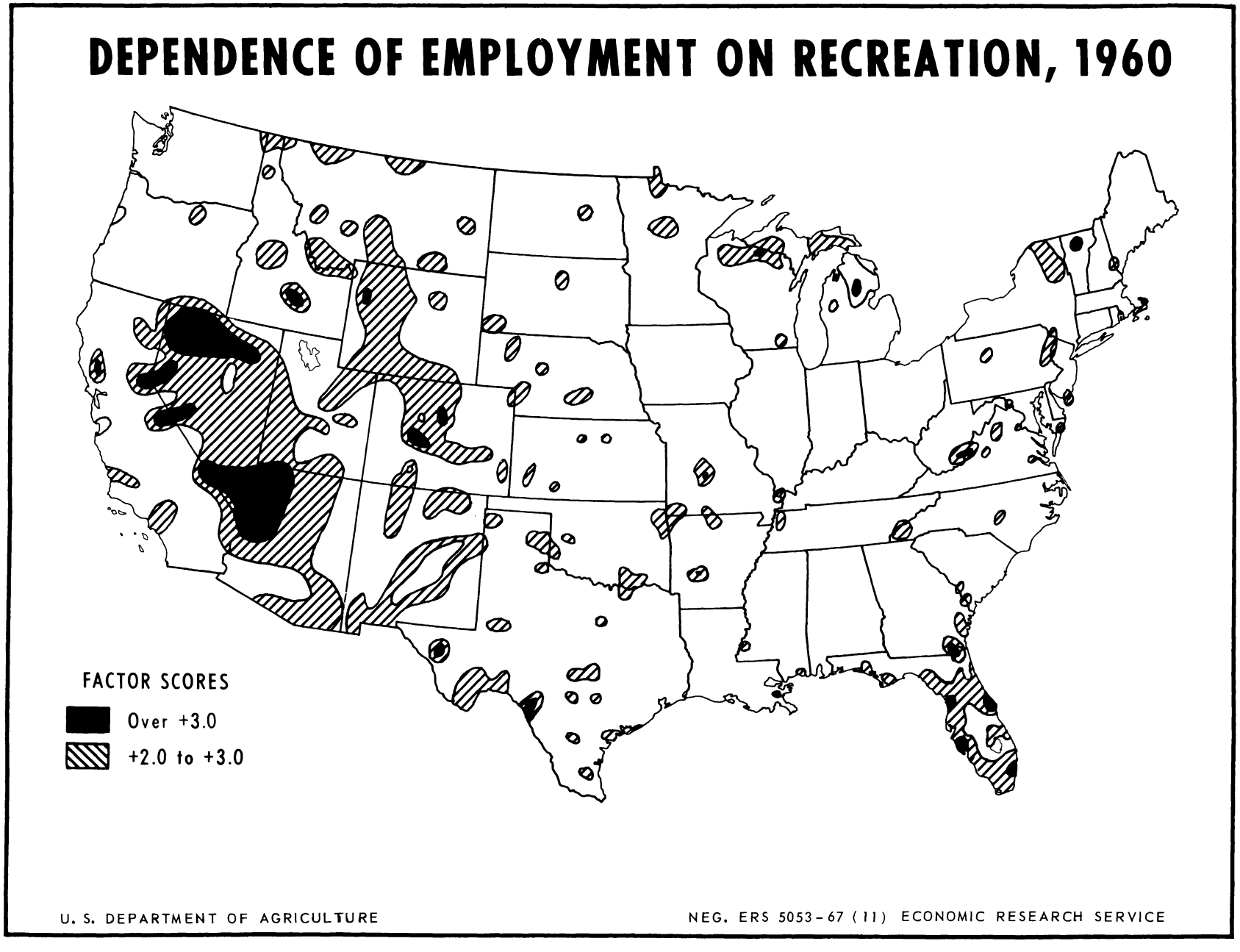
DEPENDENCE OF EMPLOYMENT ON RECREATION, 1960
FACTOR SCORES
Over +3.0
+2.0 to +3.0
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 5053-67 (11) ECONOMIC RESEARCH SERVICE

Figure 3

Table 2 presents factor analysis results again, with smaller loadings removed to ease inspection. Figure 4 shows the areas experiencing the greatest amount of change due to industry mix. The already existing concentration of the Nation's growth industries in urban centers was evidently the basic reason for the increased polarization of the economy during the 1950's. Figure 5 shows the areas gaining and those losing ground most because of competitive shifts. Note that the regional gains of the Southwest and of the suburbs in the Northeast were similar in character (4). Major central cities clearly had the greatest relative losses. Figure 6 shows the areas with greatest competitive shifts away from agriculture and those which, although less dependent upon agriculture, were nevertheless improving their agricultural position. Notable are the Southwest and Florida; the irrigated areas of the Pacific Northwest; the farm areas of Illinois, Wisconsin, Minnesota, and Iowa; the Mississippi Valley; and the Carolinas.

THEORIES OF REGIONAL GROWTH

For consistent explanations of patterns of regional growth within the context of national growth, we turn to economic theory. In his recent review of theories of regional development, Anthony Scott concluded that trade and location theories are suggestive in this context, but that they are not really helpful in understanding the dynamics of growth because the conclusions drawn from them have traditionally depended on the assumption that factor inputs are not mobile among regions.4/ A version of the staple theory is seen by Scott and others to be useful (3, 10). Whether or not this conclusion is valid in the context of growth of one or a sample of rural regions rather than national growth is debatable, however. Location theory is certainly relevant to examination of the strengths and weaknesses of particular regions as attempts are made to develop them.

Trade Theory

Trade theory was initially developed to deal with movements of goods and money among nations, but most of it also applies to similar movements among regions of a nation. In its classical or Ricardian form, this theory produces conclusions in terms of the "comparative advantage" of regions in specialization. Comparative advantage is based on relative productivity differentials. Modifications of the theory led to the prediction that higher incomes will accrue to that region with the greatest absolute advantage.

This classical theory does seem to account for trade flows and for spatial differences in wealth at any point in time, yet it fails to explain why regions have particular types of relative advantage in their productivity and why all regions produce a certain amount of most products.

4/ Scott, Anthony. Policy for Declining Regions: A Theoretical Approach. Paper presented at the Conf. on Areas of Econ. Stress, Queen's Univ., Kingston, Ontario, Jan. 22, 1965.

Table 2.--Normal varimax rotated factor loadings of principal axis factor analysis of industry mix and competitive shifts for industries, 1950-60

Employment sector and related changes		Communality	Factor								
			Industry mix	Competitive shifts	Vehicles	Forestry	Mining	Apparel	Textile	Military	Agriculture	Recreation
Agriculture	KIJ	0.653									0.739	
	CIJ	0.582									-0.647	
Forestry	KIJ	0.771				0.793						
	CIJ	0.754				0.846						
Mining	KIJ	0.823					0.891					
	CIJ	0.825					0.900					
Construction	KIJ	0.973										
	CIJ	0.786		0.610								
Food products	KIJ	0.928	-0.877									
	CIJ	0.857		0.612	-0.426							
Textiles	KIJ	0.686							0.756			
	CIJ	0.679							0.797			
Apparel	KIJ	0.652						-0.619				
	CIJ	0.817						-0.534				
Wood products	KIJ	0.719										
	CIJ	0.470			-0.375							
Printing	KIJ	0.951	-0.899									
	CIJ	0.863		0.744								
Chemicals	KIJ	0.623	-0.717									
	CIJ	0.485		0.587								
Elect. equip.	KIJ	0.850	-0.766		-0.635							
	CIJ	0.821		0.586								
Vehicles	KIJ	0.823			0.874							
	CIJ	0.791			0.879							
Transportation	KIJ	0.541	-0.593									
	CIJ	0.485										
Other mfg.	KIJ	0.584	-0.844									
	CIJ	0.755		0.731								
Rail serv.	KIJ	0.878	0.829									
	CIJ	0.565										
Trucking serv.	KIJ	0.973	-0.922									
	CIJ	0.817		0.854								
Other transp.	KIJ	0.876	0.796	0.363								
	CIJ	0.701		0.799								
Communications	KIJ	0.063										
	CIJ	0.884		0.833								
Utilities	KIJ	0.590	0.724									
	CIJ	0.860		0.723								
Wholesale	KIJ	0.907	0.897									
	CIJ	0.879		0.847								
Food stores	KIJ	0.981	0.925									
	CIJ	0.940		0.869								
Eating places	KIJ	0.978	0.927									
	CIJ	0.919		0.853								
Other retail	KIJ	0.988	-0.961									
	CIJ	0.971		0.877								

Table 2.--Normal varimax rotated factor loadings of principal axis factor analysis of industry mix and competitive shifts for industries, 1950-60--Continued

Employment sector and related changes		Communality	Factor										
			Industry mix	Competitive shifts	Vehicles	Forestry	Mining	Apparel	Textile	Military	Agriculture	Recreation
Finance	KIJ	0.963	-0.918									
	CIJ	0.914		0.869								
Personal serv.	KIJ	0.974	0.930									
	CIJ	0.867		0.833								
Household serv.	KIJ	0.914	-0.866									
	CIJ	0.907		0.667								
Business	KIJ	0.989	-0.964									
	CIJ	0.885	-0.597	0.520								
Recreation	KIJ	0.919	0.897									0.573
	CIJ	0.796		0.559								
Prof. serv.	KIJ	0.978	-0.946									
	CIJ	0.947		0.935								
Public admin.	KIJ	0.838	-0.789									
	CIJ	0.738		0.650								
Military	KIJ	0.733								-0.711		
	CIJ	0.741								0.831		
Other types not reported	KIJ	0.955	-0.887									
	CIJ	0.852	-0.895									
Eigenvalue			21.835	14.530	2.351	1.997	1.843	1.688	1.585	1.523	1.479	1.319	1.192

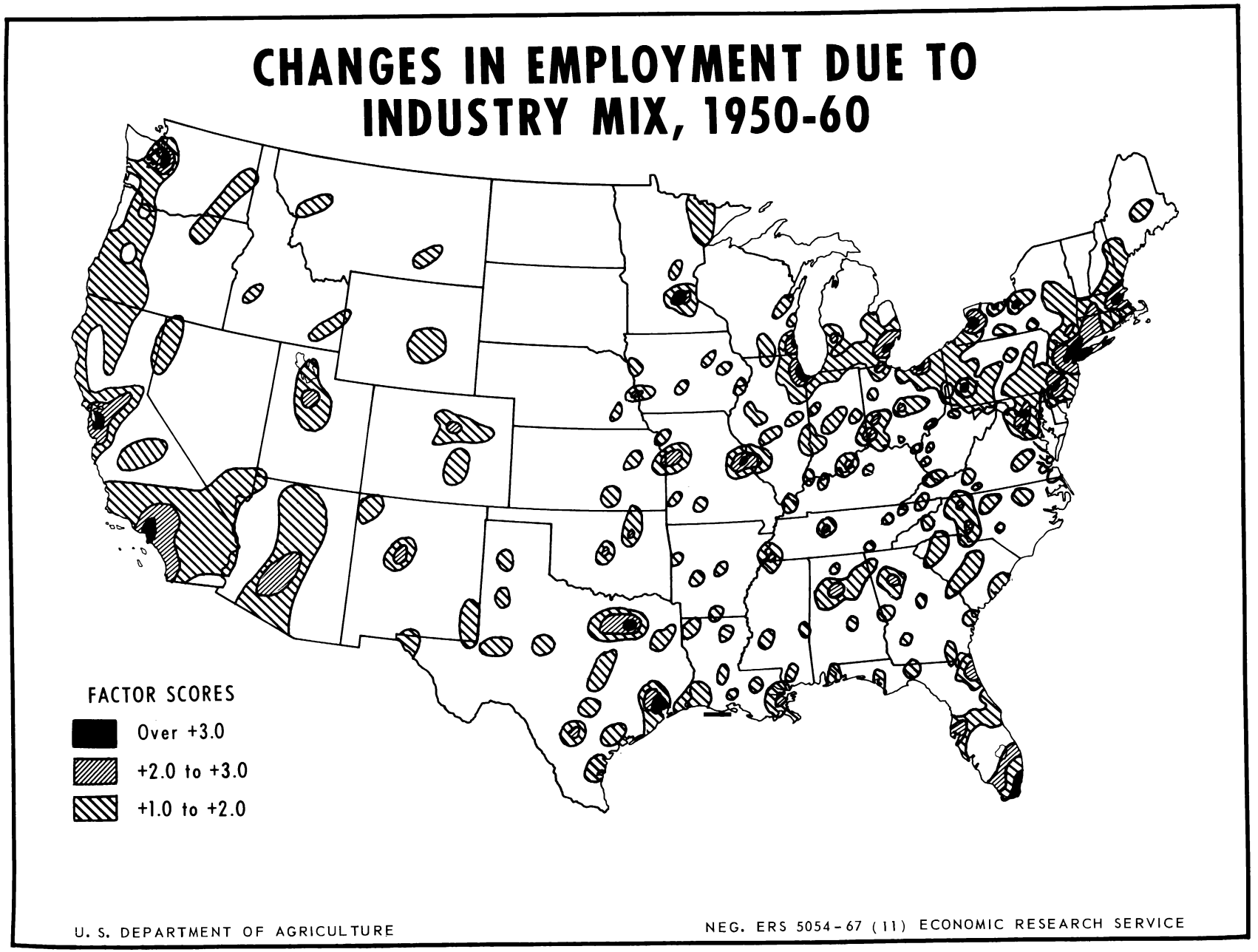
CHANGES IN EMPLOYMENT DUE TO INDUSTRY MIX, 1950-60
FACTOR SCORES
Over +3.0
+2.0 to +3.0
+1.0 to +2.0
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Figure 4

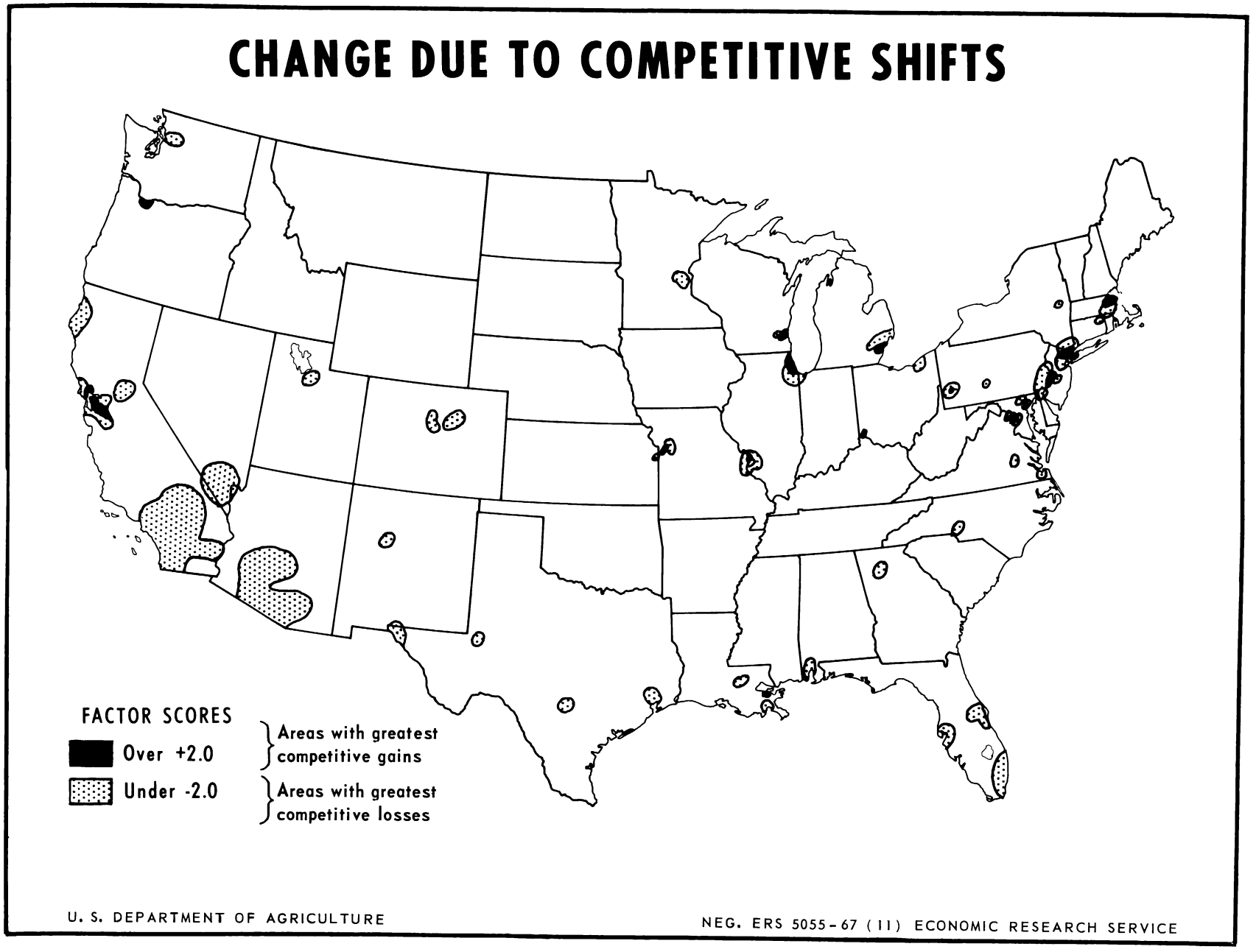
CHANGE DUE TO COMPETITIVE SHIFTS
FACTOR SCORES
Over +2.0
Under -2.0
Areas with greatest competitive gains
Areas with greatest competitive losses
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Figure 5

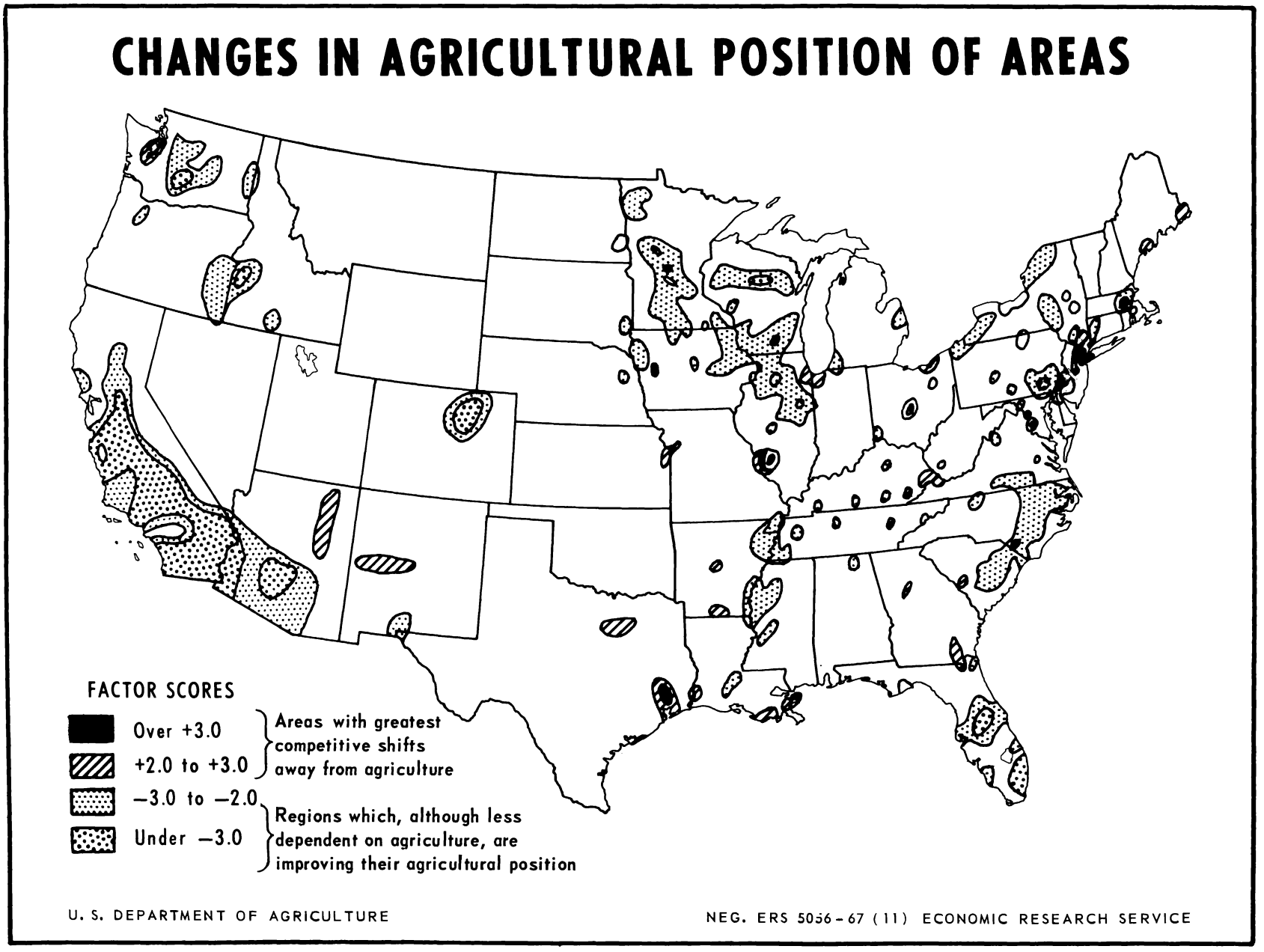
CHANGES IN AGRICULTURAL POSITION OF AREAS
FACTOR SCORES
Over +3.0
+2.0 to +3.0
Areas with greatest competitive shifts away from agriculture
−3.0 to −2.0
Under −3.0
Regions which, although less dependent on agriculture, are improving their agricultural position
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 5056-67 (11) ECONOMIC RESEARCH SERVICE

Figure 6

Attempts to apply the trade theory to regions were made by both Heckscher and Ohlin. Heckscher based his argument upon regional differences in production functions. Ohlin, on the other hand, assumed that from region to region production functions and the quality of resources were identical, attributing relative productivity advantages to differences in factor endowment. Refinements led to the explanation of differences in average incomes of regions in terms of differences in factor endowments. Yet, left unexplained by the theory are the observable facts that wage differentials tend to disappear and that factor inputs are mobile among regions. Neither fact is admitted by even a refined Ohlin theory. Ohlin provides a satisfactory basis for explaining cross-sectional differences among regions but is deficient in accounting for the effects of change. Other theories must be sought to provide the more general framework that is needed.

Location Theory

Location theory was developed out of a need to explain and predict the location of economic activities, and provides either the medium for ex-post-facto rationalization of survival of the fittest within an adoptive economic system or the basis for ex-ante planning whereby businessmen can analyze and comprehend the economic system and make rational choices concerning location of their firms.5/ This theory embraces three levels of observation: (a) location of a firm; (b) competitive locational equilibrium of sets of firms; and (c) the relative locations of sets of activities, such as land uses.

First, let us consider location of a single firm. Here, the location theory stems from Weber's theory of industrial location. In this theory, the locational problem is formulated as one of cost minimization. Cost schedules are examined to determine the proportion of total costs accounted for by different elements -- transportation of raw material, labor processing as affected by internal and external economies, and transportation of finished products to market. The spatial variability of each of these elements for each industry is studied, and the least-cost mix for industries of different kinds determined. Different cost mixes lead to different locational orientations of industries of different kinds: raw material orientation, market orientation, labor orientation, and so forth. In the tradition of Weberian theory, analysis of the various cost levels in a region in relation to those of other regions can provide valuable information on what industries are likely to be successful. However, the basic shape of economic space is taken as given; firms simply adjust to it. A dynamic theory of the location of the firm has yet to be constructed.

At the second level of observation, the theories of Christaller and Lösch apply. Examining the interactions of conditions of entry of business firms (thresholds) and drawing power (range in terms of maximum market areas), Christaller and Lösch provide a solution to the problem of a competitive locational equilibrium for a set of firms of the same type and scale. They then

5/ For a more detailed discussion, see Location and Space Economy and One Tenth of a Nation (21, 26).

show how firms of different types agglomerate into urban centers; a number of discrete types of agglomerations exist and agglomerations are organized into an urban hierarchy connected by patterns of dominance of the larger in a regular, nested arrangement. These assumptions lead to deductions about the increased polarization of activities in larger centers today. Structural changes in the economic environment, such as a technological advance in agriculture, may cause marginal firms at different levels in the hierarchy to fail. In this event, the market is likely to be captured by output of more efficient firms at higher levels in the hierarchy. In this way, the competitive process leads to further centralization.

At the third level of observation are Von Thünen's theories of location and land use, which were recently expanded and refined by Edgar S. Dunn and William Alonso. These theories deal with allocation of uses to the land in terms of rents in a competitive bidding process.

Export or Staple Theory 6/

To come closer to a theory of regional development that accounts for changes in the shape of the space economy, someone must explain why entrepreneurs and capital move from region to region. Some assert that owners of wealth shift quickly and readily to investments which, taking into account risks and taxes, yield the greatest net returns. Migration is explained by both the "pull" of greater expectations elsewhere and the "push" of displacement. Both are discounted by some function of distance. Furthermore, the value of land and other resource endowments of regions change through time because of changes in the population, the level of living, tastes, technology, and because exploitation of nonrenewable resources leads to progressive depletion. It is in the context of these changes that Scott writes: "Some general theory of regional fortunes must take into account not only ... factors, techniques, and demand, but also their growth over time, as in population growth, innovation and opulence and ... their change through space, as in labor and capital migration, the diffusion of new techniques, and the opening of new regional markets."

The export, or staple model, originally developed for application to the problem of the settlement of undeveloped regions, approaches this goal. The assumption is that growth in an unsettled region can be explained in terms of the region's main export commodity or staple.

Staple theory emphasizes migration of the factors of production, arguing that factor endowment can better be explained by factor migration than by local generation. Factors come to a region in response to the high returns offered by a staple export; growth comes when advancing technology reduces unit costs, or when expanding demand increases rates of return.

6/ For a more detailed discussion, see Innis on Canadian Economic Development (27).

The size of a region affected by a given industry, according to the traditional staple theory, depends upon the land-using characteristics of the industry. We must add, however, that this should be extended to cover the land-using characteristics of those activities affected by production and consumption of the staple. However, there is also a superstructure of "residentiary" activities which are secondary, but which depend on the staple. The location of residentiary activities is fundamental to a definition of the "impact region" of the staple.

If the staple industry continues to grow and, if along with it, the residentiary activities of the dependent region expand sufficiently, these secondary activities may, through internal and external economies, become export staples. It is at this point that the region "takes off" into self-sustained growth.

Whether or not a region has reached the point of self-sustained growth may not be apparent unless the original staple industry falters or dies. If this eventuality leads only to temporary disturbances and reallocations of factors, then regional growth has become self-sustaining. Unrefined staple theory would lead, of course, to a converse prediction of regional decline.

Regional development of staple industries is primarily a function of national economic growth, although the converse is often asserted by proponents of the export staple theory. The staple theory provides the mechanism by which the national endowment is allocated among industries in response to changing demands. Reallocation demands the abandonment of some resources and locations and the development of others, so that the development process embodies as integral parts both regional growth and regional decline. In each case, the region is that area affected by both the basic and residentiary components of staple activities.

Thompson's concept of the "urban size-ratchet" is relevant to staple theory in this context. Thompson (41) argues that growth rates for small regions are highly variable, but that the larger the region, (a) the more likely it is to have continuous, self-sustained growth, and (b) the more likely the growth rate is to approximate that of the Nation. Specifically, when the population of urban centers exceeds 250,000, these centers display all of the characteristics of self-sustained growth and carry forward their entire labor market--that region within effective commuting distance of the city's main employment centers.

Thompson continues his argument by stating that the export staples of these continually growing regions do not remain constant. They always display some changes in current industry mix; for, the essence of growth is continuous innovation. Urban nodes have satisfied the agglomerative conditions necessary for continuing development and exploitation of new kinds of staples, which subsequently "filter down" the urban hierarchy to smaller centers, and spread outward from the centers of change to the periphery.

Thus, according to staple theory, it is the continual introduction of new staple industries possible in large urban agglomerations, and the conjoint filtering down and diffusion outwards of older staple industries, that have led to the urban orientation of the Nation. Lagging segments of the rural periphery are those regions least able to benefit from filtering and diffusion.

GROWTH FORECASTING

The techniques currently available for forecasting regional growth make direct use of one or more facets of the trade, location, or staple theories (20, 23, 28, 30, 35). Each available method assumes that the regions for which forecasts are required be already defined, that good historical data be already available, and that historical relationships will continue to hold in the future. Most forecasting methods link regional fortunes to those of the Nation and are predicated upon the hypothesis that a solution to the basic economic problem of optimal area development requires public and private investment at levels high enough to at least maintain the competitive position of the area's export industries and to provide for the growth of export and local markets at a rate equal to or greater than the rate of increase in regional labor productivity.

Shift Analysis (The Spatial Allocation Approach) 7/

One of the simplest analytical approaches is based on a study of three main components of regional growth: that part attributable to national growth, that part attributable to rates of growth of the mix of industries in the region that are greater or less than the national rates of growth of all industries, and that part due to differences between rates of growth of industries within a single region and rates of growth of the same industries in other regions. Symbolically, this may be expressed as:

(1) $$d_{ij} = g_{ij} + k_{ij} + c_{ij}$$

where: g_{ij} = the national growth element for industry i in region j

k_{ij} = the industry-mix effect for industry i in region j

c_{ij} = the regional competitive effect for industry i in region j

d_{ij} = the absolute change in employment between two points in time for industry i in region j (that is, $E_{1960} - E_{1950}$).

For example, considering industry i in region j between 1950 and 1960, the following might apply:

Year	April 1 employment (thousands)
1950	42.8
1960	59.0
Absolute change..	16.2

7/ Ashby, Lowell D. Regional Change in a National Setting. U.S. Dept. Com. Off. Bus. Econ. Staff Working Paper No. 7, 1964; and Matilla, John M. A Methodology of Comparative Analysis of Regional Growth: Some Technical Notes. U.S. Dept. of Com. Off. Bus. Econ. Staff Working Paper No. 8, 1964.

Now, the national overall rate of growth between 1950 and 1960 was 0.1548. For industry i it was 0.3112. And for industry i in region j it was 0.3787.

Letting: r = the national overall rate of growth (0.1548)

r_i = the national rate of growth in industry i (0.3112)

r_{ij} = the rate of growth of industry i in region j (0.3787)

with: E_{1950} being employment in 1950

E_{1960} being employment in 1960

Then:

$$g_{ij} = E_{1950} \times r$$
$$= 42.8 \times 0.1548 = 6.6 \text{ thousands}$$

$$k_{ij} = E_{1950} \times (r_i - r)$$
$$= 42.8 \times (0.3112 - 0.1548) = 6.7 \text{ thousands}$$

$$c_{ij} = E_{1950} \times (r_{ij} - r_i)$$
$$= 42.8 \times (0.3787 - 0.3112) = 2.9 \text{ thousands}$$

$$d_{ij} = E_{1960} - E_{1950}$$
$$= 59.0 - 42.8 = 16.2 \text{ thousands}$$

Finally, we have:

$$d_{ij} = g_{ij} + k_{ij} + c_{ij}$$

$$16.2 = 6.6 + 6.7 + 2.9$$

This example was worked out in terms of employment. However, the same method could have been used to analyze many other kinds of shifts--for example, a change in the sources of regional income.

If it is assumed that the shift coefficients will be the same in the future, they can be used to make direct employment forecasts. Alternatively, the industry-mix and competitive shift coefficients can be used as independent variables in econometric models, as in Matilla's regional interaction unemployment-migration model.8/ Inclusion of additional information will permit more refined regional forecasting. For example, the effect of national growth may be obtained from forecasts of growth in national employment. Similarly, the effect of industry mix can be obtained from industry-specific forecasts. Careful comparative cost analysis based on Weber's location theory will indicate the probable competitive position of a region. By combining these three, forecasts of aggregate growth may be made.

8/ Matilla, John. A Regional Interaction Unemployment-Migration Model. Draft copy, Off. Bus. Econ., U.S. Dept. Com., 1965.

Economic Base Analysis

Theoretical and empirical findings to date stress the importance of export activity as a determining factor in regional economic growth. Any region within a specialized economy must import to survive. To pay for its imports, it must in turn export to other regions. Thus, a basic sector of regional activity will be the production of goods and services for export. Another sector consists of output activity that, because of convenience and comparative cost, will always be local (for example, retail or repair services). If the region is in equilibrium, with imports equaling exports and with local (residentiary) output just equaling demand, the question is which sector will be most influential in disrupting the equilibrium. Export activity will be the most important, especially in the short run, according to staple or export theory. Regional export activities essentially limit residentiary activities, unless these too become a part of the region's exporting base. Fluctuation in the level of regional exports is a prime cause of changes in regional economic activity. Consequently forecasts of regional economic activity may be based on multipliers which relate residentiary activities to exports.

In economic base analysis, certain activities are classified as exogenous. These comprise the export industries whose fortunes are determined by forces outside the region. All other industries are classified as endogenous or residentiary. The fortunes of these industries are determined by internal forces represented by a multiplier linking the export sector to total regional activity. This multiplier is estimated by observing historical relationships between export activity and total regional activity. Then, given estimates of the future magnitude of export activity, application of the multiplier yields forecasts of total regional activity.

In terms of a simple economic model, we have:

(2)
$$Y_r = f(Y_t) \text{ and}$$
$$Y_t = Y_r + E$$

where: Y_t = total regional employment or income

Y_r = employment or income in the residentiary sector

E = employment or income in the export sector

In its most elementary form, economic base analysis hypothesizes simple homogeneous relationships of the form as:

$$Y_r = kY_t$$

so that:

$$Y_t = \left(\frac{1}{1-k}\right) E = mE$$

and the multiplier:

$$m = \frac{1}{1-k} = \frac{1}{1-(Y_r/Y_t)} = \frac{Y_t}{E} = \frac{Y_r + E}{E} = 1 + \frac{Y_r}{E}$$

The weaknesses of this type of analysis are many and are well known. There are difficulties in allocating activities to the export and residentiary sectors. External money flows into a region are generally unaccounted for. The handling of indirect effects is unclear. The basic/nonbasic multiplier mixes economic concepts and thereby cuts across the conventional Keynesian multipliers. Sensitivity of fluctuations in an export base will be greater, the smaller the area. For relatively large areas, the multiplier will approximate that of the Nation. This suggests a priority on finding the appropriate scale of region for base analysis. There is some contradiction in the logic of base analysis and shift analysis. Base analysis projects the base and then applies the resulting rate to residentiary sectors. Shift analysis develops separate rates of change for both base and residentiary functions. Following Thompson's "ratchet effect," once a given size has been reached, continued growth may be assured apart from the original base through innovation of new bases.

Intersectoral Input-Output Analysis (Area Accounts and Multipliers)

A logical extension of economic base analysis is input-output analysis, which provides a complete structural description of the transactions taking place within a region during some period and which links each intermediate flow among sectors of the regional economy to exogenous demand.

Consider the economic system to be made up of n sectors. The sectors may be arrayed in a double-entry table with each sector appearing on the column side as a purchaser of goods and services from the other sectors and on the row side as a supplier of products to other sectors. The conventional ordering is to put the n sectors in the first rows and columns of the matrix and then to reserve the last columns for the so-called "final sectors": household expenditures, government purchases, private capital formation, and exports. These final sectors are often treated as exogenous parts of the model.

The array appears as follows:

Supplying sectors	Purchasing sectors 1	2	3	...n	Final sectors Y_i (i=1,2,....m);	Total
1	X_{11}	X_{12}	X_{13}	X_{1n}	Y_1	$X_{1.}$
2	X_{21}	X_{22}	X_{23}	X_{2n}	Y_2	$X_{2.}$
3	X_{31}	X_{32}	X_{33}	X_{3n}	Y_3	$X_{3.}$
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
n	X_{n1}	X_{n2}	X_{n3}	X_{nn}	Y_n	$X_{n.}$
V_j	V_1	V_2	V_3	V_n	V=Y	---
Total	$X_{.1}$	$X_{.2}$	$X_{.3}$	$X_{.n}$	---	S

This accounting system displays consistency because of the following balance conditions:

(a) Row balances. Total output measured in physical terms, X_i, or operationally in value terms, $X_i p_i$ (where p_i is price per unit), of any productive sector, i, and the sum total of the amounts and values of its products purchased by other sectors (x_{ij}, $x_{ij}p_i$) and/or by the final sectors (y_i, $y_i p_i$) where i = 1,2... n and j = 1,2... n, displays the following relationships:

$$X_{i.} = \sum_{j=1}^{n} x_{ij} + y_i$$

$$X_{i.}p_i = \sum_{j=1}^{n} x_{ij}p_i + y_i p_i$$

(b) Column balances (similar to row balances).

$$X_{.i}p_i = \sum_{i=1}^{n} x_{ij}p_i + v_i$$

(c) Overall balance.

$$\sum_{i=1}^{n} y_i p_i = \sum_{j=1}^{n} V_j$$

As in economic base analysis, it is then assumed that the amount of goods and services delivered by any sector, i, to the other sectors is a linear and homogeneous function of the output levels of the purchasing sectors, j.

$$x_{ij}p_i = a_{ij}X_{.j}$$

where the coefficients a_{ij}, calculated in same time period t as

$$a_{ij} = (x_{ij}p_i) / X_{.j}$$

represent the direct requirement of the products of any sector, i, per unit of output of any other purchasing sector, j.

Assuming that the entire n x n system A of technical coefficients a_{ij} remains constant through time, then one can write for the n x n intersectoral portion of the input-output array, X, plus the vectors representing the final sectors, Y:

$$X = AX + Y$$

which becomes:

$$Y = (I-A)\ X$$

where I is an n x n identity matrix. Furthermore,

$$X = (I-A)^{-1}Y$$

The coefficients in the matrix $(I-A)^{-1}Y$ represent the direct plus indirect requirements of the products of any sector, i, per unit of final demand for the products of any other sector, j. Thus, the output level of each productive

sector is related to the final demand for finished products supplied by all other sectors, and the elements of $(I - A)^{-1}$ are multipliers in the intersectoral case analogous to the multiplier $m = \frac{1}{1 - k}$ in the two-sector case of economic base analysis described earlier.

Input-output analysis is usually applied by forecasting exogenously the levels of final demand. Application of the multiplier matrix $(I - A)^{-1}$ to these levels yields estimates of the gross output of each producing sector required to meet the direct (export) and derived (endogenous, including residentiary) demand originating with the initial increase in each final demand specified.

The problems of this kind of analysis are many. Some are similar to those of economic base analysis. Data on interindustry flows are scarce. Linear homogeneous relationships do not necessarily obtain, and technical coefficients may well be unstable through time. Production functions may be irregular and stepped or "lumpy" rather than continuous over time. On the other hand, the input-output method of analysis is more general than the economic base method. It spells out specific multipliers for each industry. Hence, when used in the correct context, it may provide findings of considerable value.

Interregional Intersectoral Input-Output Analysis

Intersectoral input-output analysis may be extended to interregional models. Where there are R regions for which regional detail is needed in the forecasts, the matrix of technical coefficients is Rn x Rn, with cells $x_{si,tj}$ representing the direct requirements of the products of sector i in region s per unit of output of purchasing sector j in region t. Final demand vectors are thus disaggregated by sector and region (they might represent an area divided into subregions, or a nation into regions). However, one may still write:

$$X = (I - a_{si,tj})^{-1} Y$$

so that exogenous forecasts of final demands produce estimates of the required production levels of every industry i in all regions s.

In general, because of the unavailability of data on interregional intersectoral flows, this method of analysis is seldom likely to be operational. It has all of the problems associated with the simpler single-region intersectoral models, which, of course, represent nothing more for the large area or nation studied than the "collapse" over all regions of the Rn x Rn matrix $(x_{si,tj})$ to the n x n matrix (x_{ij}), plus additional problems resulting from regional detail. At the national level, arguments for short-run stability of technical coefficients can be made because they are tied to the current technology and prices. But at the regional level, stability also implies that the proportion of regionally produced intermediate flows to imported flows remains stable for different levels of demand. Technical coefficients and multipliers of an interregional model are blends of conventional technical coefficients and interregional trade coefficients. The stability of trade coefficients in particular is open to question. On the other hand, compared with simple economic

base analysis and the intersectoral model, interregional input-output analysis has the advantage of making it possible to estimate not only total impact of a given change (as in economic base analysis) and the industrial composition of that impact (achieved by intersectoral input-output for a single region) but also the required regional location of the impact. A capability is thus provided for estimating regional impacts within the context of national growth forecasts or goals.

Regional intersectoral input-output models have been prepared for single cities such as St. Louis and Philadelphia, or for States such as California and Iowa. Little attention has been paid to developing a consistent set of models to blanket all regions of the United States simultaneously. Additional information needed to reflect regional variations includes (35):

(a) Differences in production techniques.

(b) Differences in regional consumption functions.

(c) Differences in estimates of regional sales to final demand sectors.

(d) Variations in sources of supply, by sector, for each region.

But the formulation of the model implies a questionable assumption: inputs for a given sector in one region require fixed proportions of output from other sectors in other regions. Dynamic changes in the shape of the space economy and the changes in regional flows might constrain the use of the model to short-run applications. Leontief and Isard have attempted to solve this problem. In their balanced models, the solution involves three steps (22, 24, 25):

(a) Solving a national input-output table for all sectors exogenous to regions into which the Nation is to be divided.

(b) Allocating national output among regions (Leontief assumed this to be in the same proportions as in the past).

(c) Given estimates of regional final demand, solving for each region to obtain total regional production, including residentiary output.

Isard has proposed gravity models as a means of allocating output among regions.

A variant is provided by Chenery's model for the Italian economy (9). Input-output matrices are provided for the Nation and for each region. A region's supply coefficients for each commodity are the fraction of total input furnished by each of the other regions, so that there is a single trade coefficient for each region by particular type of commodity imported. The assumption is that if imports of a commodity are needed as inputs by regional industries, the proportion of imports of the commodity will be the same for all industries in the region.

Each of these may be subjected to the same general order of criticism. However, it is worth noting John Meyer's general conclusions about the utility of this form of analysis:

The fact still remains that with all its problems and difficulties input-output does have the advantage of being an empirically workable model that provides an organizational framework and set of consistency checks that are difficult to achieve with less formal techniques. The danger does exist ... that preoccupation with the empirical detail involved in establishing these models may lead to an oversight of importance ... that ... leads to grossly inaccurate results ... Still this is not an intrinsic shortcoming of the model as such ... (but) a question of what constitutes a proper allocation of research resources in regional analysis ... Finally, it must be recognized that input-output and economic base analyses, with all their short-comings and deficiencies, are the tools most invariably relied upon at the present time when actual empirical work in regional economics must be performed (30).

Econometric Models

The central ideas of input-output social accounting tables can be incorporated into models comprising sets of equations that can be used to study the evolution of the regional economy through time.

One example was developed for the Iowa economy by Wilbur Maki (28). It comprises 50 major equations showing the chain of events from capital consumption and labor utilization to the disposition of business income among households, government, and business. Of the 50 main equations, 20 are disaggregated into as many as 7 subequations (1 for each of 7 sectors in an abbreviated interindustry transactions table), so that the complete model consists of some 170 equations. These equations are connected sequentially. Some constituent variables are affected by current conditions, whereas others are predetermined for any given year either on the basis of the previous year's activity or by forecasting from national or regional phenomena that lie entirely outside the influence of State policies and programs. Running this model on a computer, Maki produced a yearly series of estimates for variables of interest, constructed a 1974 social accounts table, estimated year-to-year effects of changes in labor productivity and market demand, and explored the regional implications of changes in government expenditures and receipts in relation to changes in the distribution of business incomes, resource productivity, and market shares of export industries.

Econometric models of the kind developed by Maki to study the economy of Iowa will play an increasing role in regional analysis for several reasons. They draw on and use the essential ideas and methods of the simpler forecasting procedures. Yet, they order these methods sequentially so that the regional growth process may be seen as it takes place through time, and as growth itself modifies the parameters of subequations and accounting schemes.

Simulation Models

The models discussed so far are deterministic. No allowance was made for a range of possible outcomes and for random disturbances of the growth process. Sometimes complicated models which contain probability distributions are called simulation models. The geologist who uses a sandpile to show how fluvial

erosion works is in a sense using a simulation model. An econometric model, since it replicates a growth process, is also a simulation model. We frequently reserve the term simulation for models which admit to the high "noise" level of social and economic life. Simulation models, then, may incorporate time-dependent probability processes in which the distributions of probable outcomes are specified. Solutions may be achieved in a Monte Carlo fashion: a random number is selected which prescribes an outcome from among the possible outcomes as arrayed in a probability distribution. A sequence of such choices, with later decisions in part a function of earlier choices, simulates the process being considered.

Urban economists are turning to the development of simulation models more rapidly than are economists concerned with regional problems. However, several significant applications of simulation model analysis to regional studies could be cited.9/

DEVELOPMENTAL PROGRAMMING

Forecasting procedures can be used to predict probable regional growth, and, in a larger spatial framework, to indicate viable and lagging areas and to reveal meaningful growth matrices. With these procedures, the research worker can replicate growth processes. Forecasts made on the basis of different sets of assumptions about investment patterns, for example, can facilitate study of the costs and benefits of the alternatives. Yet, they cannot tell the research worker what investment patterns meet given sets of goals and lead to optimal use of funds, or whether welfare aims are realized in the achievement of some economic optimum.

For optimizing the level of relevant decision variables, we turn to programming procedures. According to Meyer, "mathematical programming is without question the best of the tools employed in modern regional analysis from a strictly conceptual point of view if one believes in a reasonably pervasive economic rationality (30)." Two illustrative examples are the Heady-Skold spatial programming of agricultural locations showing how optimal interregional allocations may be achieved, and the Spiegelman-Baum-Talbot activity analysis of a small rural region, which exemplifies the evaluation of multiple policy objectives (18, 40).

Spatial Programming

Heady and Skold studied five agricultural systems that compete for use of the land of the United States--wheat, feedgrain rotations, feedgrain-soybean rotations, soybeans, and cotton. For each of 144 producing areas, they calculated the production costs of each system, the yields of each, and the land

9/ See the May 1965 issue of the Jour. Amer. Inst. Planners for examples of the use of both econometric and simulation models in forecasting the growth of urban regions.

available for each kind of production. They then looked at the year 1975, and, using a projected population of the United States of 230 million and assuming real incomes would be 50 percent higher than they are now, computed consumption requirements at that time in 31 consuming areas of the United States (each of which is a group of 4 or 5 producing areas). Transport costs for each crop to each consuming area from each producing area were also calculated.

They then sought to determine the production and interregional trade pattern of each of the five activities that would meet 1975 demands, while simultaneously minimizing joint costs of agricultural production, processing, and transportation. Relatively straightforward application of linear programming to the spatial allocation and trading problem which had been posed provided the answers. Maps of production patterns and trade flows were created. Required withdrawals of land from production were specified.

The overall model comprises 401 equations and 1,925 variables, excluding "slack" vectors. The equations include 144 total land area restraints, 105 soybean area land restraints, 58 cotton area land restraints, and 94 area demand restraints. The 1,925 column vectors in the coefficient matrix include 134 for wheat production, 144 for feedgrain production, 105 for feedgrain-soybean production, 105 for soybean production, 58 for cotton production, 31 for transforming wheat to feed grain, 459 each for wheat and feedgrain transportation, and 430 for oilmeal production.

Major problems encountered by the authors included data accumulation, computer capacity, and, conceptually, the fact that regional demands are given rather than determined endogenously in terms of prescribed consumption functions. The analysis specified optimum production patterns and trade flows of the various crops and total and regional land requirements and surpluses.

Activity Analysis

In the study by Spiegelman, Baum, and Talbot, a highly disaggregated form of linear programming was used to determine, for a five-county area incorporating a small trade center and its tributary region, the following:

(1) The amount of outside financing needed to achieve the planned increase in income and consumption.

(2) The mix of new manufacturing and agricultural activities that would achieve these increases with the least cost in outside financing.

(3) The best techniques of production to employ where alternative techniques are available.

(4) The amount of technological change required in existing economic sectors, especially agriculture.

(5) The amount of labor, by level of skill, required for the plan, and any shortage or surplus in the local labor force.

(6) The amount of local capital formation required.

(7) The variations in the costs and content of the plan that would result from varying the assumptions concerning outmigration.

A 10-year time span was selected for the development analysis, and the model was stated in terms of planning increases in production above existing levels to meet targets of increased income and consumption, with the assumption of equilibrium at full use of capital.

The core of the model is an input-output matrix for alternative economic activities. The authors use alternative technologies, alternative scales, and joint products to enrich the model.

To run the model, targets for population, income, and local consumption in the 10th year were given, together with size and composition of the local labor force, constraints on natural resource use, and export demand. The model estimates income generated by the development program, activities to be included, net foreign balance on capital and current accounts, fixed investment required by industry and government, and the labor surplus and deficit by type.

The model has 586 columns (activities) and 239 rows (balance equations). Of the 586 columns, 339 represent real activities (manufacturing, 62; agricultural production, 32; agricultural conversion, 13; other production, 15; export activities, 129; and import activities, 88. The remaining 247 columns represent "slack" variables. In the 239 rows, 115 are equations showing flows of commodities, and 124 are "dummy" equations for exports. The solution obtained minimized total foreign funds required for the program, while achieving targets subject to the constraining goals and targets for population and income. This emphasized what the authors believed to be the scarcest resource in a depressed area: capital. To the extent that this is not the relevant criterion for a region seeking to grow, this may be the major limitation in applying the resulting estimates. The solution was forced into the competitive range by assigning appropriate prices to import and export activities.

In their evaluation of the results, the authors found many important implications for public policy formulation in the five-county study area. The results provided the basis for determining the magnitude of capital requirements for the proposed plan; suggested the need for shifting developmental goals; and indicated a scarcity of skilled labor and managerial personnel. The authors considered the activity analysis planning model to be extremely useful, and pointed out the need for obtaining solutions under varying economic conditions and resource structures to learn more about the sensitivity of the planning requirements. They saw that, in the long run, the very high costs of preparing matrices of technical coefficients could be spread over many studies, because technological requirements are liable to be constant over many areas for industries of similar scale. Further, they pointed out the flexibility provided by the method in evaluating requirements for alternative goals.

With such programming techniques, it is clear that one can come closer to satisfying the requirements of regional policymakers for information than is possible with other techniques. Furthermore, these techniques can be used either in an interregional context, as was done by Heady and Skold, or to provide detailed estimates of capital requirements and the like for small regions properly defined, as was done by Spiegelman, Baum, and Talbot.

DETERMINING A PROPER DEVELOPMENT REGION

The techniques so far described are technically independent of the kind of area to which they are applied; neither the theories of regional growth nor the methods of regional analysis are regionally specific. But not so the meaning and utility of the results--they are inseparable from the regionalization within whose framework the technical manipulations are performed. It is through regionalization that links to the Nation are defined. Regionalization provides the base for connecting the area of interest to economic space and to the processes that are changing that space. Defining regional boundaries also defines the factors that are exogenous and those that are endogenous. Thus, if our focus of interest is rural regions, and the fortunes of rural areas are inseparable from industrial-urban growth matrices, to forecast or program effectively for rural areas demands regional definition that exploits the inseparability of the industrial-urban growth poles and the dependent rural regions.

Concepts of a Region 10/

Traditionally, three approaches have been used to define regions. The first stresses uniformity or homogeneity of specified attributes. The second emphasizes nodality or polarization, and is associated with concepts of functional organization. According to the third, a policy-oriented definition, a region may be defined in two ways: (1) in terms of the political or other machinery through which programs are to be implemented, and (2) with respect to similarity of purposes or goals of regional programs.

The uniformity or homogeneity criterion is illustrated by the Area Redevelopment Act (Public Law 87-27) in its definition of areas eligible for assistance on the basis of the amount of substantial and persistent unemployment or because of low average income.

The administrative convenience criterion is reflected in most organizations of counties, and some aggregations of States, into program areas. To the extent that regionalization under the Area Redevelopment Act results in groups of counties within a State working together, the Act combines elements of two approaches to regional delineation.

The nodality or polarization criterion for regionalization is a logical outgrowth of efforts to apply the theories and research techniques discussed earlier in this report to regional problems. What this approach gains in logical consistency is partly offset by the difficulties of becoming operational because of incomplete data on which to base a functional delineation and the difficulties of administrative control over areas defined along other than administrative lines.

10/ The early classic to be consulted is the National Resource Committee's Regional Factors in National Planning and Development (31).

Fox persuasively argues for making the functional economic area operational. He begins by asserting,"The major problem of rural society in the United States is our institutionalized belief that a rural society exists and can be manipulated successfully apart from society as a whole." 11/ We are trapped, he says, by our conventional dichotomies -- agricultural and non-agricultural, rural and urban -- and we persist in using them despite the fact that the people we call rural consist of a variety of full and part-time farmers, retired folk, and commuters, plus a coterie of businessmen providing needed services to them, and despite all the evidence of the dependence of these people upon industrial-urban nodes. What in fact, he asks, are the broader ecological patterns of the human species? What, Friedmann and Alonso might similarly ask, are the interdependencies that give form to economic space?

At the macro level, Fox argues, one can get a more meaningful picture of the socio-economy by dividing the United States into functional economic areas (FEA's). Each of these areas contains one residentiary cluster and comprises a zone oriented to some major urban center by virtue of commuting and shopping patterns. FEA's are relatively self-contained labor markets in the short run, and are also the retail service and wholesale market areas of their urban centers. The essence of an FEA is its orientation to a major urban focus and its closure with respect to residentiary activities--people work and shop within it. There are, Fox says, some 400 or 500 such FEA's into which the United States can be divided, and they completely partition the space of the Nation without residual areas. In short, they sum to the Nation.

What moves between the FEA's is the product of their nonresidentiary activities--the specialized exports or staples that link the FEA's together into a national economy. Thus, he argues, the national economy in fact comprises a set of interacting, interdependent city-states, with each city core providing a viable growth pole. Further, there are two distinct levels of planning suggested: one for each FEA concerned with residentiary activities and exogenously determined levels and trends of staple activity, and one at the Federal level concerned with influencing stability and growth in the economy as a whole and therefore the staples of its various specialized regions. Rural problems accessible on an FEA basis include the education of farm youth, problems of low-income farms and underemployed farm people, and problems of land use allocation.

The Central Place Concept 12/

In his FEA scheme, Fox has identified one level (perhaps the most important one) in a complete hierarchy of functional regions centering on urban nodes. The set of FEA's described by Fox is a set of similar cells. Each is a labor market defined by commuting patterns. Each is the short-distance area to which people from the urban center migrate (1, 6, 7, 8). Proceeding downward, each FEA can be subdivided into a set of smaller cells--the market areas

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11/ See footnote 2, p.4 for citation.

12/ For a more detailed discussion, see Central Place Studies (5).

of smaller cities (roughly county seats in Iowa). These can be still further subdivided into the market areas of small towns. Yet another division can be made because there is a smaller village level of centers and market areas.

Each of these levels is defined by the travel behavior of the consumers in obtaining the different sets of goods and services demanded on a daily or weekly basis and supplied by stores with low conditions of entry into the market. Additional activities are performed at the town level, and yet others are obtainable at the level of small cities (approximately the county seats of Fox's Iowa). At each level, then, there is a set of areas displaying some degree of closure and focusing on some central urban place. Lower level areas "nest" neatly within higher level areas. Only when the level of the FEA is reached, however, is there complete closure for the entire set of residentiary activities. FEA's with their central cities, in their turn, may be grouped into at least one or two more cells, focusing on the regional and national metropoli of the country and, parenthetically, on the main centers of innovation. The entire hierarchical system may be explained by central place theory. Within regions at every level, residentiary and other activities display decay with distance from the center, so that every locality in the county is simultaneously affected by many gradients. Together, hierarchies and gradients provide an organized body of concepts concerning the functional organization of the U. S. economy.

Methods of Regionalization 13/

Until recently, objective methods were not available for deriving either a uniform or a functional regionalization that incorporated many variables and optimized in some sense. Simple forms of mapping and map comparison were generally used, and there was never assurance that the regionalization derived was the best possible for the purposes of the analysis for which it had been designed.

With the removal of computational constraints by the coming of the modern computer, and the development of systems of numerical taxonomy embodying multivariate analysis, it is now possible to seek optimal regionalizations.

The concept underlying the analysis is as follows. A socio-economy can be considered a field comprising locations, properties of these locations, and interactions among locations. The set of all properties is a system, and because many of the properties simply index the same underlying concepts, such as urban-regional gradients characterizing each of the levels of the central place hierarachy, the basic set of concepts describes the state of the system. Similarly, the many kinds of interactions are composed of a smaller finite number of underlying patterns, such as the different levels in the central place hierarchy. Changes by the analyst in the kind and number of properties and interactions lead to changes in the descriptive states and patterns.

13/ Berry, Brian J. L. The Mathematics of Economic Regionalization. paper presented at the Conf. on Meth. of Econ. Regionalization, Brno, Czechoslavakia, Sept. 1965.

If the locations and their properties, and the pairs of locations (dyads) and their interactions relevant to a particular piece of analysis are assembled, they can be arrayed in two matrices, one of properties and locations and the other of dyads and interactions. Application of multiple-factor analysis to each of these matrices will enable identification of the underlying concepts in the first and the underlying patterns in the second. Further, both concepts and patterns are scaled in the multiple-factor analysis by creation of factor scores, so that the relevance of each concept to each location is known numerically, as is the relevance of each pattern to each dyad.

Locations can be plotted as points in a multi-dimensional graph, using the concepts as axes. Distances between points index the degree of multifactor similarity of pairs of locations: the shorter the distance, the greater the similarity. A stepwise grouping of all interpoint distances will produce an optimal uniform regionalization into that number of groups desired. The optimality, which in this case involves a criterion for minimum within-group variance, can be checked by use of multiple discriminant functions; for, the concepts are independent underlying variates. A contiguity constraint may be required to produce compact contiguous regions rather than regional "types" (such as type of farming areas in land use studies).

Similar distance scaling and clustering is probably unnecessary to produce a functional regionalization; for, the patterns identified in the factor analysis are fundamental kinds of interaction whose relevance to each dyad has already been indicated as an outcome of the factor analysis. The dyads to which the pattern is relevant define the functional organization of an area with respect to that pattern. A specific application of this procedure involves the identification of growth poles and their functional regions. Dyadic analysis identifies functional regions and the individual analysis identifies uniform regions. Field theory equations can be developed to show interrelations between distance separating pairs in the analysis and locations of dyads in the behavior space. However, this has never been done for the United States.

Determining Which Regions are Relevant

Having a method for deriving optimal sets of regions does not, however, enable us to answer the initial question. We still need to know what a proper development region is. The question cannot be answered apart from the goals to be achieved, and additional factors, such as administrative coherence for effectuating policy decisions, must be taken into account. The discussion above points to the priority of functional regions that are closed with respect to residentiary activities and which focus on industrial-urban growth poles. Thompson's work would suggest a minimum size criterion for sustained growth.14/ Yet, a small area unified by common problems may, if seeking a local solution to these problems (as in the case reported in Spiegelman's and Baum's activity analysis), be equally appropriate, especially if national funds are redistributed from growth regions to other regions. Similarly, a large area such as

14/ Southern, John H. Regional Growth and Development and Rural Areas. Talk given to the 42nd Ann. Agr. Outlook Conf., Washington, D.C., Nov. 17,1964 and Glasgow, Robert H., and Baum, E.L. Considerations for Planning Economic Development of Rural Areas. Paper delivered to the Amer. Farm Econ. Assoc. Ann. Mtg., Minneapolis, Aug. 28, 1963. See also (14).

Appalachia is undoubtedly a proper object of public policy. Ideas of regionalization may be relevant in such a case in (a) defining Appalachia initially, and (b) in specifying ways in which Appalachia may be disaggregated or subregionalized internally (and/or connected externally) to achieve the goals of the development plan, as indicated in a growth pole analysis. Thus, the specific circumstances dictate which methods and concepts are relevant. It is appropriate to consider a rural region, for purposes of economic development planning, as an area comprising "the rural people, and the geographic segments in which they live, taken in conjunction with those urban areas and people with whom they share close economic and social interdependence." 15/

POLICIES AND STRATEGIES 16/

Identification of current and emerging problems, and priorities for research specifically oriented to policy on economic development of lagging rural regions, follow logically from contributions, theory, and methods of analysis that we have surveyed. This is done within the framework of a Tinbergen policy model in which exogenous and policy variables are combined in a series of structural relationships so that the consequences of changes induced by policy variables can be divided into those that produce the desired policy objectives or goals and those that produce other effects.

Structural relationships describe the space economy and the way it is changing: agglomerations of activity organized into an urban hierarchy; an urban size-ratchet that permits innovations to occur at the top, filter down, and diffuse outwards; gradients reflecting the industrial-urban orientation of rural life; sustained growth at the center; and rural poverty at the periphery.

The goals of regional policy involve the spatial organization of the national economy. Relevant regional policy objectives appear to be (1) economic development, with an economically efficient spatial allocation of growth that conforms to national growth objectives; 17/ (2) equity in the distribution of incomes among regions; (3) social welfare, incorporating provision of all necessities at minimum acceptable levels; and possibly (4) political balance, the maintenance of political power through appropriate regional distribution of investment resources.

15/ Glasgow, Robert H., and Baum, E.L. See footnote 14.

16/ See especially (12).

17/ We hasten to add that such national growth objectives remain to be formulated. We suspect that Pareto optimization is relevant, however: growth such that at least some segments of the Nation become better off while none become worse off.

Policy-oriented research involves determining the ways specific subsets of such general goals can be achieved by manipulating policy variables within the framework of the given economic structure and the predetermined levels of exogenous inputs over which the policymaker has no control. As Henderson and Krueger so succinctly put it (19):

> Policy-making requires information about the economic development process that it is designed to alter. The following are among the range of questions relevant for policy decisions: Why is economic growth taking its current course? Which aspects of the growth process are subject to alteration? Which are not? What activities are available for the implementation of policy? Will these succeed in meeting desired goals? Will they have undesirable effects?

Viable research can be directed toward clarification of goals, elaboration of policy instruments, estimation of structural relationships, definition and identification of relevant exogenous variables, further refinement of forecasting models for exploring effects of exogenous and policy inputs, and refinements of programming models linking policy inputs to the achievement of specified goals.

Empirical evidence in each of these areas of inquiry is necessary but not sufficient for thorough understanding. For example, no one has yet identified and described the system of functional economic areas into which the United States is organized, their disaggregation via central place principles, and their aggregation into higher order units of the Nation's urban size-ratchet; nor has there been a systematic investigation of the gradients found at each level of the functional order. Such empirical information is essential to proper formulation of structural relationships among regional programs, and will be needed to develop a unified, systematic national effort in regional development.

In addition to further accumulation of empirical evidence, extensions of existing theory are needed; partial elements of a dynamic theory of regional development and growth have been assembled. And technique is manifestly inadequate; for example, forecasts using shift analysis techniques are different from those using the techniques of economic base analysis.

Yet, technique has outrun data. The Waybill statistics, published by the Interstate Commerce Commission, are organized by States, and are insufficient in themselves for exploring interregional dependencies. To use either input-output or econometric forecasting techniques, it will be necessary to explore differences in production techniques, regional consumption functions, regional sales to final demand sectors, and variations, by sector, in regional sources of supply. It will also be essential to prepare regional time series for those variables not currently available which are essential for relevant regional models.

Essential variables depend, in part, upon the goals of regional policy, and vary as the goals vary. In the absence of universal agreement on explicit regional policy objectives, we can only surmise what some might be. Essential variables depend, in part, upon the regions for which policy is to be made.

Essential variables also depend in part upon the philosophy regarding growth processes and the strategy to be pursued in promoting growth of rural regions. Authors agree that if regional growth processes are to be manipulated to achieve goals of regional policy, aggregate demand must be sustained at high and rising levels, so that the prime policy instrument is the national growth rate. It bears reemphasizing that growth of the national economy equals net growth of the regions within it. Greater growth in one place is sometimes at the expense of growth somewhere else.

If national growth is rapid and sustained, innovation, filtering down the urban size-ratchet and diffusing outwards from center to periphery, will probably stimulate growth in lagging areas. Thus, a proposed strategy is to promote activity at the center in hopes that it will spread to the rural periphery.

Eugene Smolensky, for example, extends Reder's argument, in this vein, of the relevance of "trickle-down" to regional income inequality as follows: 18/

> The higher the capital-labor ratio in a region the higher the employment level at any wage rate of the unskilled and at any given social minimum; therefore, the smaller the number of involuntarily unemployed. The implication of this is that in any general expansion the high income region will reach a rising floor to the wage-rate first. As a consequence, some industries will be priced out of the high income labor market and there will be a shift of that industry to low-income regions. The significance of this shift of industry lies not so much in its direct, but in its indirect effects. If the boom originated in the high income regions, as is highly likely, then the multiplier effects will be larger in the initiating region although the relative rise in income may be greater in the underdeveloped region. But, more interestingly, the induced effects on real income and employment may be considerably greater in the low-income region, if prices are likely to rise less in the low-income region and/or if the rise in output per worker would be greater. Both are likely from the same source--decreasing cost due to external economics. The external economies that are especially relevant are associated with urbanization of the labor force. If the boom can be maintained, industries of higher labor productivity will shift into the low income region and some industries will be driven out of the county.

Smolensky further points out Anderson's arguments concerning the reduced role that "trickle-down" can play today (2):

> In the first place, the proportion of the poor in the labor force is now something less than 60 per cent. Secondly, for all groups classified by socio-economic characteristics other than income and education, the poor are a small proportion of all family heads with the other socio-economic characteristic. For each income distribution formed on a particular socio-economic characteristic, the poor constitute a small left tail. If each

18/ Smolensky, Eugene. Poverty Policy and Pennsylvania. Paper presented at the meeting of the Pa. Assoc. Econ., June 1965. See also Reder (36).

of these distributions is conceived of as fixed in shape, an empirically acceptable hypothesis, but variable in its position on the income axis, then the trickle-down thesis can be conceived of as reliance upon moving those distributions with a larger proportion of frequencies to the left of the poverty line along the income axis more rapidly over time than the poverty line. In earlier times any given movement of the distribution faster than the poverty line would drop a larger proportion of families across the poverty line than is the case now, for only a small tail of each distribution now lies to the left of the poverty line.

Smolensky concludes by noting the unappetizing political aspects of the "trickle-down" thesis, involving inflation and balance of payment problems, as opposed to an alternative "de-tailing" position which involves "educating-up" the labor force. The latter is represented, for example, by area redevelopment policies intended to link the poor rural peripheries with the Nation and to pull them into the mainstream of national life.

If one assumes the priority of national growth and "trickle-down" processes, then policy-oriented research in regional development becomes a matter of developing a precise understanding of how national growth impulses, responding to stimuli at the Federal level, translate themselves into regional growth; how to determine the national growth objectives required to meet given regional goals; and of how to enable regions to take the fullest advantage of exogenous national forces.

On the other hand, if one argues that unemployment and low incomes in peripheral rural regions are fundamentally structural in character, policy instruments can be analyzed in terms of their influence on the structural relationship between the region's inputs and outputs (29). More attention would then be paid to the autonomous components of services and government, and to the region's potentially developable resources, including the unconventional forms of capital that might be transformed into new staples--human capital; social overhead capital, including the existing infrastructure; new resource discoveries; technology; and relative location changes to take advantage of growth elsewhere. These matters imply the priority of special surveys of the regions to be developed.

Here again, the definition of region makes a difference. Does the area span a varied set of problems and potentialities? Is it a functional region having a single growth pole and ranging out as far as people are willing to commute? Does it span a series of alternative nodes--urban growth poles, areas where resources are exploited, recreational regions exploited on weekends or during certain seasons etc.,--in what Friedmann calls an "urban realm?"

The "trickle-down" philosophy points to functional economic areas as regions for analysis, while the "de-tailing" view places priority upon problem areas delineated according to uniformity and administrative criteria. In either case, it is essential that regions that have reasonable prospects for economic development be defined. There have been many objections to the development of any single set of national planning regions patterned after the French model (12). Even so, we find Fox's arguments pursuasive within a "trickle-down" framework: functional economic areas are laborsheds of urban growth poles; national growth accrues at these central poles; and the functional

interdependence of center and periphery means that national growth affects the whole. Also, FEA's appear to satisfy Thompson's criterion for areas of self-sustained growth on the urban size-ratchet, although the relationship between size of region, size of central agglomeration, and growth behavior is imperfectly understood and should have the same priority for research.

FEA's also can be used within the framework of a "de-tailing" philosophy; any problem area, no matter how defined, may be viewed within a spatial framework of regions that have reasonable prospects for economic growth. FEA's approximate these regions.

Technical research is resulting in a broad range of analytical methods. Many are scarcely operational because of data limitations. The situation can be improved by keeping available data in mind as modifications are made in analytical methods, and by increasing efforts to make needed data available. Data on regional interdependencies, that is, commodity flow statistics by sector for regions are needed. Similarly, data need to be developed to disaggregate functional economic areas into subregions on central place principles and to aggregate them into major metropolitan regions so that a variety of information is available for any geographic area in the Nation. In addition, for each level of regionalization, estimates of gradients of densities, intensities, and values linking periphery to center need to be available. A set of regional accounts that sums to national accounts is essential.

Currently available data do not meet these needs. Census statistics on small area commuting provide enough information to estimate FEA's for the country.19/ However, commodity flow statistics are inadequate to effectively describe the space economy suggested earlier in this report.

A set of national goals for rural development needs to be explicitly formulated; a national strategy must be stated. Is a strategy to be centered on growth poles, is it to be focused specifically on distressed rural areas or is it to be some combination of these? If so, what is the combination? Only when these policy issues are clarified can priorities for research be determined.

19/ This task has been completed by the author since the first draft of the present manuscript was submitted on November 7, 1965.

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