MEASUREMENT OF THE SPREAD EFFECTS OF GROWTH CENTRES

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I

Few developments in regional economics have had the impact of the growth pole theory. This has occured on both a theoretical and a policy level. The basic concept and the policies stemming from it appear, once stated, to be obvious. Theoretically, parts of various theories of growth and concepts of regional economics can be fitted into the basic growth pole idea to provide a coherent acceptable explanation of why a growth center should serve as a fulcrum for the development of a geographical area larger than the space in which it itself is located [1]. The probable mechanisms of change which occur from the presence of a growth center to induce the development of peripheral areas can be derived from these additional theories and explanations of growth [2]. The literature is filled with the theoretical bases and ramifications of the growth pole and, to a lesser extent, with how to identify possible growth centers. A second group of writings details the application of growth center policies in various countries. However, about the most important aspect, from the viewpoint of policy, we know nothing.

Despite the importance of knowing whether mechanisms actually exist by which changes in growth centers are transmitted into the regions around them, few studies have used the existing data in order to assess their existence and strength. In order for a growth center strategy to be effective in inducing intra-regional development, it is necessary that they do, in fact, exist and, further, that they are capable of transmitting growth impulses of sufficient magnitude to bring about the desired changes in their regions. There are several possibilities concerning the existence and strength of these mechanisms. 1) They may exist and be sufficiently strong so as to be capable of achieving the desired policy objectives,

in the event that sufficient effort is concentrated in the growth center(s). 2) Linkage mechanisms between growth center and periphery may be absent entirely or may be so weak as to have little effect on the peripheral area, or the time lag between investment in the center and the desired result in the peripheral area may be unduly long. In any of these cases, serious reconsideration must be given to use of policies using growth centers. 3) Linkages of growth center and periphery may be stronger with the rest of the world than with each other, in which case policy emphasis must be given to national growth, with special attention to those industries and/or sectors which have the strongest ties with the target areas. Or, 4) it is possible that no indirect mechanisms exist for raising incomes and the standard of life in backward or stagnant areas, and that appropriate policy would involve transfers, in the form of money or services, to the people living in these areas. This would rule out the growth center policy also [3], [4].

The remainder of this paper will 1) examine briefly U.S. empirical studies of the linkage between growth centers and their peripheral areas, 2) look at the experience of the U.S. Economic Development Administration, and 3) comment on them briefly as a group.

II

Empirical studies testing the growth pole concept are few in number. These few are set out in the accompanying Table I, with a comparison of some of their characteristics. It is readily apparent from the table that the authors of these studies have very differing ideas on how to test the theory. Their varied studies have tended, however, to support the general conclusion that growth centers and their peripheral areas do not have linkage mechanisms of sufficient number and strength to justify the general use of a growth centers policy in the poorer areas of the United States.

The earliest study was that of Nichols [5]. According to Nichols, two sets of counteracting forces exist within a growth center hinderland area, one set causing growth to spread from growth center into its hinterland, the second causing growth within a center to be concentrated within the growth center itself, with little or no spillover into the peripheral areas. The first set, supporting the growth pole concept, include [6] :

1. As diminishing marginal returns to investment occur in the center itself, investment possibilities in the areas peripheral to the center should become relatively more attractive to potential investors and the resulting investment in the peripheral areas should be subject to the multiplier;

2. Innovation and their adoption in the center should spread into the peripheral areas in processes resembling those posited by Pederson, Berry and others [7];

TABLE I

EMPIRICAL STUDIES ON GROWTH POLES

Researcher(s)

	Nichols [1]	Lewis and Prescott [2]	Sears and Dymsza [3]	Yuchin [4]	Scewart and Benson [5]
Method of Analysis	Regression	Simultaneous Equations	Regression	Regression	Regression
Sample Composition, Centers	Cities of Georgia	86 SMSA's of 84 states	Urban areas 25,000 pop.	64 FDA centers	86 SMSA's of 50,000 - 250,000 pop.
Hinterland Definition	Counties of Georgia	Urban areas of FFA's labor market areas	County groups	FDA districts	Rand McNally trading areas
Sample Size	159 counties	86 SMSA's	200 county groups	64 districts	86 areas
Land Area of the U. S. Covered	State of Georgia	Parts of 34 states	Total U. S.	Total FDA districts	Sample from total
Time Period Covered	1948 - 1958	1958 - 1963	1950 - 1960	1959 - 1968	Variable 1940 - 1970
Dependent Variable	Increase in median income	—	Change in median family income	Rate of increase personal income	Variable
Number of Equations	1	8	1	1	8

1. Vida Nichols, «Growth Poles : An Evaluation of Their Propulsive Effect», Environment and Planning, Vol. 1 (1969), pp. 193 - 208; Vida Nichols, Growth Poles: An Investigation of Their Potential for Regional Development. RSRI Discussion Paper Series No. 30 (Phila. : May, 1969).

2. William C. Lewis and James R. Prescott, «Urban - Regional Development and Growth Centers : An Econometric Study», Journal of Regional Science, Vol. 12, No. 1 (1972), pp. 57 - 70.

3. David W. Sears and Richard B. Dymsza, Growth Pole Theory: A Test, Paper, Department of Agricultural Economics, Cornell University (Ithaca, New York : 1969).

4. Richard Yuchin, FDA study as reported in Niles Hansen, Location Preferences, Migration and Regional Growth: A Study of the South and Southwest United States. (New York : Praeger, 1973).

5. Charles T. Stewart and Virginia Bemson, Linkages Between Small Metropolitan Areas and Their Hinterlands with Implications for Regional Development Policies. Paper prepared under the FDA. (Washington, D. C. : The George Washington University, May, 1972).

3. Surplus labor in the peripheral areas should be drawn into the labor pool of the growth center according to the neoclassical model. This redistribution of labor within the growth center - peripheral area should lead to the reorganization of the labor remaining in the peripheral area, and, ultimately, to higher incomes in the peripheral area;

4. Income increases in the center should lead to an increased demand for products of the peripheral areas.

The second set of forces, causing Nichols to be somewhat skeptical of the growth center concept, includes [8] :

1. We have no evidence that there is some point at which diminishing marginal returns to investment set in even the largest centers. Congestion and high rents may be more than offset by other economic considerations or by subjective private returns. Therefore, investment in a center may occur past the point at which diseconomies occur.

2. Available investment opportunities within the peripheral areas are often overlooked in favor of opportunities in the center, or may not even be recognized. These opportunities in the center may be overestimated while the potential returns in the peripheral areas are underestimated. The equilibrating forces of neo-classical economic theory are distorted by imperfect knowledge or by a rationality aimed at some objective other than monetary profit. (Or, as stated by Richardson the determinant of where to invest may be a less risky location where average profit has been higher in the past rather than the less well known locations where marginal profits may be greater [9]). The neo-classical argument also disposed more lightly of the problem of interdependence than the practical business man may be inclined to dispose of it : the risk of losing the market to rivals who remain in the growth center may deter movement to potentially more profitable locations in the peripheral area;

3. Migration from peripheral area to growth center is age and education selective. The remaining population is likely to be made up of persons less capable of initiating or accepting changes which may be necessary to keep the peripheral area viable;

4. Central place theory supports the idea that the products of peripheral areas are typically of a lower order than those of urban areas and, as such, relatively income inelastic. This being the case, greater per capita income in the center is unlikely to be translated into increased demand for hinterland products. Additions to income in the center may be spent on the higher order goods of the center itself or those of still larger central places outside the region itself. The same is likely to be the case with any increases in peripheral area incomes generated by changes or growth in the growth center : demand is likely to increase outside the peripheral areas rather than within them.

Nichols feels that the latter consideration alone is sufficient to arouse doubts

as to the veracity of the growth pole phenomenon, and enlarges on its importance [10] :

....«One very important aspect of the spread of increasing prosperity through an area is the distribution of income multipliers, or more simply, the question of where those people who first get higher incomes spend their extra money. According to traditional Keynesian theory, the total addition to aggregate income, ΔY, resulting from an initial investment or income increase, ΔI, can be represented by the equation, $\Delta Y = [\ 1/(1 - C)\ ]/\Delta I$, where C represents the marginal propensity to consume or the proportion of one's income which is spent and which thus becomes someone else's income. At the national level particularly in fairly large, economically autonomous countries, this equation can be expected to provide moderately accurate predictions, provided that the marginal propensity to consume is fairly stable over short time periods. But if one wants to determine the addition to agregate income in a small area, one needs to know the marginal propensity to consume in that local area, or that proportion of an initial income increment that is spent within the local area.

If central place theory is correct in suggesting that higher order goods are purchased only from a few high order centers, then one would expect the marginal propensity to consume in rural countries or small towns to be generally small and possibly on occasions even zero. The actual proportion of total income spent locally could easily drop as the result of an increase in incomes of higher order goods, such as fashion clothes, are substituted for those previously bought locally, or/if the same low order goods are purchased in higher order centers as part of multiple purpose trips planned round a new demand for some higher order good. The assumption here is that higher order goods of central place parlance are virtually synonemous with goods that are highly income elastic».

Nichols' empirical analysis center around a simple regression of median income increases against population increases for the counties of Georgia from 1948 - 1960, with the geographic distribution of the residuals from the regression examined in order to find where income was increasing faster than employment. The conclusion reached was that growth in Georgia was occuring via the urban system with growth impulses entering the state by way of Atlanta and filtering down the urban hierarchy and, eventually, into the interurban areas. This, it must be objected, is a rather strong conclusion based on no actual evidence. In the first place, population growth cannot be assumed to be a good proxy for employment growth. Too many cases can be posited where the two are unrelated for this assumption to be made. It is uncertain at any rate, why a proxy was needed for employment increase, when employment increase, if that was the variable desired, could have been used itself. Secondly, Nichols gives no evidence of hierarchical

filtering processes. These appear to be assumed due to the concentration of large and positive residuals around major cities, with the largest concentration around Atlanta, but no linkages or linkage mechanisms are given or posited. Third, Nickols showed that historically, prior to 1940, growth in Georgia was strongly concentrated in the nothern portion of the state and the only evidence which Nichols has produced indicates that this pattern continues, that present growth trends have reinforced established growth patterns. However, the mechanism which lies behind this growth have not been uncovered. In total, Nichols' clear exposition of the implications of central place theory combined with Keynesian multiplier theory leave the reader unprepared for Nichols' conclusions, especially since the conclusions are accompanied by such a paucity of empirical support.

The second growth center study, also using central place theory as a basis, is that of Lewis and Prescott [11]. The results of their study tend to support Nichols theoretical analysis of the probable effects of income increases occurring in the areas peripheral to urban centers. The Lewis Prescott study is more general than that of Nichols in that it investigates relations between urban centers of 86 labor market areas and their peripheral areas and is more rigorous in that the model employed is an equation system with endogenous and exogenous variables for both centers and peripheral areas.

From 305 Functional Economic Areas mapped out by the Department of Commerce, Lewis and Prescott chose a sample of 86 in which 1) there was a 1960 population of 25,000 - 100,000, 2) there was a lack of economic or political domination by larger centers, and 3) employment was not concentrated in only a few activities. They estimated a set of equations in order to find 1) the determinants of population and employment in the retail trade, wholesale trade, and selected service sectors in the 86 labor market areas and 2) the subsequent impacts of the population and employment changes in the level and distribution of commercial sales in the F E A 's. Their primiry concern was with the relations among the various parts of the urban hierarchy and not with growth forces between urban and peripheral areas, but their findings indicate that a growth center strategy might be futile [12] :

> Though the growth center policy is designed to promote development at this regional level, our analysis indicates that growth patterns within the F E A are not highly complementary with this investment strategy... The strength of special spending patterns from the smallest rural town to the central cities of F E A suggest that policies promoting centralized urban growth alone will have severe impacts on commercial sales in peripheral communities. Though central city retail and service sales were substantially influenced by incomes earned in peripheral towns, the effects of increasing demand in the growth centers tend to be spatially self - contained.

They conclude that, based on their sample, decentralization of investment

within development areas would be preferable to centralized growth center investment. Their study, like that of Nichols, indicates greater support for the correctness of central place theory which emphasizes that the direction of support within an area is from periphery to center rather than in the opposite direction posited by growth pole theory. Based on their analysis, however, it is conjectural whether decentralization of investment within an FEA would achieve the desired objective of eventually self-sustaining growth within the peripheral areas, due to the large leakages of income through the marginal propensity to consume in the higher order centers, and the Nichols analysis supports this.

The Lewis Prescott sample was not random but was based on criteria which resulted in the omission of large and important segments of the universe, especially in the populous Northeast. We cannot ascertain from this analysis whether the same pattern of support from periphery to center holds for all areas or for those areas with centers of less than 25,000 or greater than 100,000 population. We might reasonably expect, based on the same type of theoretical analysis used by Nichols, that for places smaller than 25,000 the same phenomenon would hold but to an even stronger degree, while the greater variety of goods and services available at even larger centers than those used by Lewis and Prescott would make them even more self-sufficient than centers of 100,000 and less.

The Sears and Dymsza [13] study departs entirely from the central place theory concepts underlying the two preceding studies. The bases of their study are that : 1) the growth pole theory has a number of inherent ambiguities which must be cut through in order to create a workable, testable theory; 2) it is necessary to test the validity of the theory over a variety of areas; and 3) the standards of the Economic Development Administration must be used in testing because these standards govern the choice of actual growth centers [14]. Their own simple, unambiguous, but testable statement of the growth pole theory incorporates the following : firstly, a growth pole is an urban place of 25,000 population or less, a condition both necessary and sufficient for the existence of a growth center; secondly, growth may be measured by the percentage change in median family income occurring within five years of investment in the growth center; thirdly, growth effects will spread equally in all directions from the pole with their strength diminishing with increasing distance from the center [15].

The sample used in their study was obtained in a rather, tortuous manner. From all the non-metropolitan countries of the United States they formed 100 county groups on the basis of roughly equal populations. From these county groups they then chose two sets of counties, the first set containing those counties with the greatest increase in median family income over the period 1950 - 1960, and the second set, that group of counties having the smallest increase in median family income in the same period. Their reasoning is that : «Counties with extreme values on the dependent variable, change in median family income, were chosen

so as to ensure that if any bias is to be introduced into the regressions, it would be in support of the growth pole theory» [16].

Their most important independent variable is an interaction variable based on the gravity model of spacial influence. The gravity concept states simply that the attraction between two centers varies directly with their population sizes and inversely with the distance which separates them. Their variable, modified, is [17]

$$G_{ij} = \frac{P_i}{(D_{ij})^2}$$

where : i is the growth pole

j is the hinterland of the growth pole

G is the growth transmitted from i to j

P is the population of growth pole i

and D is the distance separating areas i and j.

Note that only one population mass — that the growth pole — is represented in the numerator of the variable. This is because the growth pole is assumed to be the active area, exerting growth forces on a passive peripheral area.

Variations of this interaction measure allow for

1) the influence of cities of various sizes and
2) the population potential of the growth center.

Several other independent variables were also used, «not because they were required to test the growth pole concept» [18], but in order to compare the explanatory power of the interaction variable with that of other variables.

The result of the regression analyses were disappointing. The growth pole interaction variable alone, in its original form or modified, explained less than 1 % the variation in the dependent variable. Inclusion of the non-growth pole based independent variables resulted in an R^2 of .26. Division of the total sample among the four large economic regions of the U.S. improved the explanatory power of the model; R^2's for various versions of the equation ranged from .30 to .63, with the growth pole variables explaining up to 16 percent of the variation of the dependent variable. Clearly, the growth pole effect, as measured by the interaction variable formulated by Sears and Dymsza, explained a relatively small amount of the variation in the increase in median family income in the counties peripheral to these growth poles, both regionally and nationwide.

The Sears Dymsza study has the merit of attempting to deal with the growth pole theory in terms of some useful concepts of spatial economics : the gravity and population potential concepts. It might have been better, and doubtless would have been done if the results of the regressions had been more promising, to have examined each element of the interaction variable separately in order to assess

their separate impacts on the growth indicator for the peripheral areas. A definite lack exists in the model, however, due to the fact that differing employment structures were not taken into account in the Sears - Dymsza equation in any way; this omits one of the more important elements of the growth pole theory. Finally, the study would be difficult to replicate due to the areas used in the analysis; there appears to be no good reason for Sears and Dymsza to have gone to so much trouble to form these areas when so many candidates exist among the numerous accepted areas and statistical divisions of the U.S.

The study made by Richard Yuchin[19] under the auspices of the Economic Development Administration examined the relationship between the rate of growth of personal income in the peripheral areas of 64 E.D.A. growth centers from 1959 - 1968, and the following income and population variables of the centers :

1) the rate of growth of personal income in the center, 1959 - 1968;
2) the rate of growth of personal income in the center, 1950 - 1959;
3) the size of the growth center population; and
4) the ratio of growth center population/to hinterland population.

Separate regressions were estimated using the total set of 64 growth centers, the 30 single - centered districts and the 34 districts with more than one centers. $\bar{R}^2$'s were 0.22, 0.26 and 0.20, respectively, for these three growth center sets. The population variables were not statistically significant in any regression. The rate of growth of personal income in the later time period was statistically significant in all three equations at the five percent level, while the lagged growth center income variable was significant at the five percent level in the cases of all 64 centers and of multiple - centered districts.

However, it is evident that this is only a beginning, a segment of a much broader study in which the mechanisms which underlie this correlation of the rate of growth of personal incomes in center and periphery are assessed.

The Stewart - Benson[20] study is a more thorough approach than the previously mentioned studies to the question of inter-areal relationships. They analyzed SMSA - hinterland county relationships for 85 SMSA's of the U.S. having 1960 populations between 50,000 and 250,000, with the objective of examining whether any factual basis exists for the prevalent expectation that structural changes in growth centers spread growth into their peripheral areas. The inter-relations between SMSA's and their peripheral areas were analyzed by means of three types of analysis : (1) A correlation analyses of 24 independent variables based on population, income, migration, commuting, wholesale and retail sales data, and manufacturing employment; (2) a set of seven equations which treat hinterland changes as a function of changes in SMSA variables, 3 equations dealing with migration and commuting, 3 dealing with the growth of sales and 1 dealing with the growth of manufacturing activity; and (3) a migration analysis for the period 1962 - 1967, based on the Social Security 1 % employment sample.

All three analyses reveal weak linkages between the variables used and hinterland welfare indicators. The authors conclude that «...the findings cast doubt on the entire growth center strategy, insofar at least as smaller metropolitan areas are concerned» [21]. Division of the entire growth center set according to relative rates of growth of SMSA population or hinterland per capita income do not affect their conclusions. However, they suggest that objectives other than the transmission of growth forces may make continuation of an EDA - type growth center policy useful [22].

Strengthening several weak points in the Stewart - Benson study would give greater force to the results. First, the study uses only a limited range of centers, those with populations of 50,000 - 250 000. This range corresponds reasonably well to E.D.A. centers, but the same inter - relationships may not exist between larger and/or smaller centers and their respective hinterlands. Second, the study leans heavily on data obtained from retail sales figures at several important points : in the definition of SMSA hinterlands; in the regression equations; and in the classification of cities by their economic structure. We are interested on a much wider variety of economic data than this, and greater variety does, in fact, exist. Third, this study fails to examine the economic structure of the SMSA, except, as mentioned above, for a gross categorization into six city types based on the percentage of employment in secondary and tertiary, sectors of the economy. Even this gross classification of cities indicated widely differing impacts on peripheral areas. However, further analysis of this variable is lacking; and it is just in this area that the original growth pole theory posited growth forces occurring.

It might seem that the best and most thorough test of the growth center idea has been the actual experience of EDA for over a decade in the large portion of the United States under its planning and programming jurisdiction [23]. The assumptions basic to EDA growth center strategy are as follows [24] :

1. The economic structure of the growth centers will be changed through the diversification of local economic bases as a direct result of the location or relocation of industry to the vicinity of the growth centers.
2. Expansion of local established businesses would result in new employment opportunities as an indirect effect of 1. above.
3. Suppliers and/or distributors would be induced to locate in the vicinity of their customers in the growth centers, creating additional jobs.
4. The newly created jobs, those created directly plus those created indirectly as a result of 2. and 3. above, would be filled primarily by previously unemployed or underemployed residents of the growth centers and/or migrants from the labor - shed areas of the growth centers.
5. Spillover effects would be created throughout the entire area of the hinterland of the growth center by way of additional spending on the part of individuals and businesses from their expanded incomes.

6. The growth centers would serve as migration centers for persons from their respective peripheral areas.

However, as of the 1972 E.D.A. evaluation of their own experience with growth centers, 32 completed projects in 12 growth centers had had no appreciable impact on the areal economies involved beyond that created directly by the projects themselves. More specifically, referring back to the preceding working assumptions of EDA policy, the evaluation team reached the following conclusions [25] :

1. There is no evidence that local economic bases have been diversified as a result of these projects.
2. 32 % of the positions created directly as a result of the EDA projects have been filled by previously unemployed or underemployed residents, and the remaining 2/3 have been filled by migrants or by residents who were employed before the projects were initiated.
3. There has been no secondary impact on the creation of new jobs by the relocation of suppliers and/or distributors to the areas arround the growth centers, and no new jobs were created by established local businesses or suppliers whose businesses expanded as a result of the EDA projects.
4. Indirect benefits to redevelopment areas from growth center jobs have been small. Only 8 % of the $ 16.6 million in annual wages created through growth center projects are spent in these redevelopment areas. Additionally, only $ 0.5 million is purchased annually in redevelopment areas by EDA - assisted firms.
5. The impact on out-migration has been negligible. Less than 1 % of the workers in the jobs created by EDA indicated that they would have migrated from the area in the event that their new jobs had not been created.
6. Migration to EDA growth centers has not been sufficient to stem the flow of net out-migrants from growth center counties. In addition, 31 % of the growth centers themselves had net out-migration rates greater than those of the areas in which they were located.

It may be unwise to generalize from the EDA evaluation given the multiplicity of EDA's development goals, the small size of the sample, and the short time which had elapsed between the completion of the projects and the evaluation. However, for the centers covered by the evaluation, there was no evidence that investment in growth centers has led to growth in their peripheral areas through the avenue of spread effects.

III

All of the above indicate that growth centers, variously defined, have little or no impact on their peripheral areas. This may be taken as highly suggestive evidence that the absence of spread effects from so many studies, using such a variety of centers, peripheral areas, variables, and approaches indicates that the

actual existence of spread effects is extremely doubtfull and that investigative efforts might be put to better use elsewhere. Alternatively, it might be concluded that lack of more favorable results may be due to defects in the studies and that efforts to establish the existence of spread effects should not be abandoned until the defects have been corrected.

Among the basic problems encountered by researchers are the following :

1. How to define a growth center or, what is more common, a potential growth center. Since the definition depends essentially on knowing in advance just that which the researcher is attempting to establish, the task is admittedly a difficult one. The growth pole literature offers no concrete guidelines, only suggestions based on industrial characteristics of growth poles, in the Perrouxian sense. Unfortunately we recognize from the outset that most of the geographic areas with which policy deals do not contain growth poles corresponding to those of Perroux, and the problem reduces to one of finding centers of lesser, but no less real, potential to transmit growth to their peripheral areas. However, the question of potential has too long tended to be associated with relative size of a center rather than with the industrial characteristics of that center. We suggest that a renewed emphasis on structure might reveal more than concentration on city size.

2. How to define the peripheral area of a growth center. Again the problem is accentuated by the fact that it is difficult to define the geographic peripheral area before the empirical investigation have been completed.

However we do tend to lean toward the idea that the best economic definition of peripheral area would be the labor catchment area of a center. Such areas are defined by the U.S. Department of Commerce and data for testing purposes is available either directly for these areas or it can be built up from county data. The Lewis and Prescott sample was, in fact, chosen from an early version of these areas.

3. How to measure the presence of spread effects from growth centers to peripheral areas. All researchers here appear to be in accord that welfare change in the peripheral area is the appropriate measure, and that welfare changes can be measured by income change, although no two researchers agree on what form of income variable to use.

4. Choice of independent variables. These tend to lean heavily towards sales data and population data. We feel that a well thought out model should lean instead toward variables descriptive of the economic structure of a growth center and of changes occurring in the growth center which could be expected to lead to changes in the peripheral areas. Models based predominantly on other types of variables, are not really tests of the growth pole theory with its central core of industrial growth and change leading to the creation of further growth and change elsewhere.

5. Time Lags. These must be considered to be very important. Choice of

the wrong lags, of course, would lead to lack of results from the model. However, the search for appropriate time lags is a part of the tests. We feel that each researcher should experience with lags of different lengths. This task is not made easier by the fact that much of the relevant data is available only by ten year periods.

These do not exaust the list of points to stress in formulating models to test the growth pole theory. However these would appear to be starting points. The theory is potentially valuable and should not be abandoned without some effort toward trying to create models which give us greater information than those to date.

NOTES

1. F. Perroux, «Economic Space : Theory and Applications», Vol. 64, Quarterly Journal of Economics (Feb., 1950); for an exposition of the transformation of the theory to the space economy, see D. Darwent, «Growth Poles and Growth Centers in Regional Planning - A Review», Envirnment and Planning, Vol. III (1969), pp. 5 - 31; for a contrast and possible synthesis of the growth pole theory and central place theory, see Tormad Hermansen, «Development Poles and Related Theories : A Synoptic View», pp. 160 - 203 in Hansen, Niles, ed., Growth Centers in Regional Economic Development. (New York : The Free Press, 1972).

2. For an exposition of those theories which fit in with the growth pole theory to form a coherent and reasonable theory of growth, see S. Xiarchos, Growth Centers and Their Spheres of Influence, Chapter II. Unpublished Ph. D. Dissertation. (The Pennsylvania State University, 1976) and the various references given therein.

3. There are several rationales for the use of a growth center policy, of which the harnessing of spread effects is only one. However, the argument from spread effects is the strongest, the one most often used to explain the desired results (see EDA writings), and the chief reason for the policy application, and if the phenomenon does not occur the basic foundation for this policy is destroyed. Other uses may then still exist which would make a growth centers policy reasonable. These include 1) offering alternative migration centers to large cities to the inhabitants of poor rural areas who would like to move from those areas, 2) providing a more adequate level of educational, health, and social services to poor rural areas than can be supported by the resources of the areas, and 3) a Hawthorne - type effect whereby the areas may create for themselves an environment which is more conducive to growth. It may, however, be cheaper and more expedient to provide these types of benefits more directly through some such avenue such as income transfers rather than the more indirect method of working through growth centers. It seems reasonable to assume that a «growth centers» policy has a somewhat hollow ring if the centers have no growth transmission potential.

4. However, it must be kept in mind that what is true of one time period may not necessarily hold true in another. The level of economic development of a region or nation or the general level of income or the overall economic situation of the national may effect the strength of linkage mechanisms between center and periphery and between each and the rest of the nation. Therefore, the appropriate policy may change over time.

5. Vida Nichols, «Growth Poles : An Evaluation of Their Propulsive Effect, «Environment and Planning, Vol I (1969), pp. 193 - 208; also, Vida Nichols, Growth Poles: An Investigation of Their Potential for Regional Development. RSRI Discussion Paper Series, No. 30 (Phila. : May, 1969).

6. Nichols, «Growth Poles ...», op. cit., p. 195.

7. For an exposition of where these innovation theories fit in with the growth center theory and central place theory, see Hermansen, op. cit., pp. 188 - 191 and Xiarchos, op. cit., pp. 83 - 87.

8. Nichols, «Growth Poles...», op. cit., p. 195.

9. Harry Richardson, Regional Economics: Location Theory, Urban Structure, and Regional Change (New York : Praeger Books, 1969), p. 305.

10. Nichols, «Growth Poles...», op. cit., p. 198.

11. William C. Lewis and James R. Prescott, «Urban - Regional Development and Growth Centers : An Econometric Study» Journal of Regional Science, Vol. 12, No. 1 (1972), pp. 57 - 70.

12. Ibid., pp. 68 - 69.

13. David W. Sears and Rechard B. Dymsza, Growth Pole Theory : A Test. Paper, Department of Agricultural Economics, Cornell University (Ithaca, New York : 1969).

14. Ibid., pp. 4 - 9.

15. Ibid., p. 9.

16. Ibid., p. 11.

17. Ibid., pp. 11, 13, 17.

18. Ibid., p. 17.

19. Richard Yuchin, Study reported in Niles Hansen, Location Preferences, Migration and Regional Growth: A Study of the South and Southwestern United States. (New York : Praeger Publishers, 1973).

20. Charles T. Stewart and Virginia B. Benson, Linkages Between Small Metropolitan Areas and Their Hinterlands with Implications for Regional Development Policies. Paper prepared under the EDA. (Washington, D. C. : The George Washington University, May, 1972).

21. Ibid., p. 16.

22. Ibid., p. 85.

23. U. S. Department of Commerce, Economic Development Administration, Program Evaluation: The Economic Development Administration Growth Center Strategy. (Washington : Feb., 1972).

24. Ibid., pp. A - 4 to A - 9.

25. Ibid., pp. 13 - 20.

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