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Scale Economies, Agglomeration Economies and the "Cumulative Causation Hypothesis" Implications for U.S. Rural Development

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During periods of economic history when regions are converging economically, economic theories that emphasize equilibrating mechanisms (factor mobility, relative price differentials) tend to dominate economic thinking. The existence of pockets of economic disadvantage in such theories is explained by imperfections of various kinds, which are seen as progressively disappearing as these imperfections are reduced through government policy and technological change. The regional economic experience of the United States in the half-century preceding the late 1970s was one of convergence. Per capita incomes of states (Coughlin and Mandelbaum, 1988), regions and metropolitan and non-metropolitan counties became more equal during the period from 1929 to about 1978. (See Table 1)

This half century trend of convergence of regional per capita incomes ended in the late 1970s. "Since 1978," according to Coughlin and Mandelbaum, "this trend toward greater income equality across states has been sharply reversed; by 1987, state per capita income inequality had risen back to its 1966 level" (1988, p. 24). Table 1 shows the spread among regional per capita incomes and between metro and nonmetro per capita incomes has increased as well. This decade-long reversal of a 50 year trend has persisted long enough to challenge the continued uncritical use of the neoclassical model in explaining regional growth patterns.

Table 1. U.S. Regional Per Capita Incomes as Percent of National Average: 1929-87

Regions	1929	1939[b]	1949[c]	1959	1969	1979	1987[d]
New England	125	127	105	109	110	104	120
Middle Atlantic	139	132	115	114	113	106	114
E.N. Central	114	111	109	107	105	104	98
W.N. Central	82	82	95	92	93	99	96
S. Atlantic	65	77	82	84	90	91	97
E.S. Central	50	49	63	69	73	79	77
W.S. Central	62	66	85	83	83	93	85
Mountain	83	88	98	94	89	95	89
Pacific	129	130	122	118	115	114	111
Spread[a]	89	83	59	49	42	35	43
Metro/Nonmetro Counties							
Metropolitan	127	124	114	111	108	106	107
Nonmetropolitan	56	58	71	73	78	81	77
Spread[a]	71	66	43	38	30	25	30

[a]/Percentage point spread between highest and lowest (metro/nonmetro) region
[b]/1940 for metro/nonmetro
[c]/1950 for metro/nonmetro
[d]/1986 for metro/nonmetro

Source: Bureau of Economic Analysis, 1988a, 1988b; Strong and Weber, 1986.

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There are two basic alternatives to the neoclassical paradigm that can generate a divergent trend in interregional per capita incomes: the first of these is the dependency paradigm, which is most often used in analyzing growth differentials between first and third world countries (see Seligson 1984, for a review of these theories). Lovejoy and Krannich (1982) have used this framework to examine metro and non-metro development patterns in the U.S.

In our judgment, a potentially more fruitful alternative is that of the "cumulative causation" paradigm. This paradigm is most often associated with the work of Gunnar Myrdal (1957) and Nicholas Kaldor (1970). In this context, it is the basis for an active intellectual exchange among European economists. (Dixon and Thirwall, 1975, 1978; Guccione and Gillen, 1977; Swales, 1983; Dow, 1986).

The purposes of this paper are: (1) to outline the "cumulative causation" paradigm; and (2) to discuss the ways induced scale economies and agglomeration economies may operate within a "cumulative causation" framework to explain rural-urban growth differentials. The paper concludes with a research agenda for testing the efficacy of the hypothesized mechanisms in explaining rural-urban growth differentials in the United States.

The Basic "Cumulative Causation" Model[2]

Myrdal argued that market forces normally tend to increase inequalities between regions. Clustering of increasing returns activities in certain areas of the economy generates self-sustaining growth because of increasing internal and external economies at these centers of agglomeration. The main influence on the rates of growth of lagging regions is the induced effects of growth in the prosperous areas. The spread (favorable) effects are due to the creation of growing markets for the primary products of the lagging regions, and the diffusion of innovation from the center to the periphery. On the other hand, backwash (unfavorable) effects result from the disequilibrating flows of labor, capital, goods and services from poor to rich regions.

Nicholas Kaldor emphasized how increasing returns to scale, including external and agglomeration economies in manufacturing, favor the rich regions and inhibit development in the poor.

The Kaldorian "cumulative causation" model is formalized by Dixon and Thirwall (1975) as follows:

$$y = \lambda x \quad (1)$$

$$x = \eta p_d + \sigma p_f + \epsilon z \quad (2)$$

$$P_d = w - t + u \quad (3)$$

$$t = t_a + \delta y \quad (4)$$

where

- y = rate of growth of output
- x = rate of growth of exports
- p_d = rate of growth of 'domestic' prices
- p_f = rate of growth of 'foreign' prices
- z = rate of growth of 'world' income
- w = rate of growth of money wages
- t = rate of growth of average product of labor (export sector)
- u = rate of growth of 1 + % markup on unit labor costs
- t_a = rate of growth of autonomous productivity growth
- λ = constant elasticity of output growth with respect to exports

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[2] This section draws from Weber and Deaton (1984)

η = price elasticity of demand for exports
σ = cross elasticity of demand for exports
ϵ = income elasticity of demand for exports
δ = elasticity of productivity growth with respect to output growth (Verdoorn coefficient)

The growth rate of output in this model is a multiplicative function of the rate of growth of exports (Equation 1). A region will grow to the extent that its exports grow. The rate at which exports will grow depends on how fast domestic and foreign prices and world incomes grow, and on the price and income elasticities of demand for the region's exports (Equation 2). The characteristics of the region's resource base and its industrial structure thus become critical determinants of the region's growth rate.

The growth rate of domestic prices, however, is also critical (Equation 3) and this depends on the growth rates of money wages, labor productivity in the export sector, and the markup on unit labor cost. To the extent that wages and markups grow at similar rates in different regions, differences in the rates of growth of prices among regions will depend importantly on differences in the rates of growth of productivity. Hence, productivity differentials alone may significantly alter the level of regional exports.

The Kaldor model introduces the Verdoorn relationship to allow regions to grow indefinitely at different rates or even at diverging growth rates. The growth rate of productivity stems partly from an autonomous element which can depend on exogenous technological forces and the rate of capital accumulation and partly from an endogenous element captured in the Verdoorn coefficient in which productivity growth depends on the growth rate of output (Equation 4). Rapidly growing regions may generate an environment in which productivity gains can be maintained and enhanced, enabling a region which gains an initial advantage to cumulatively build on that advantage in a way that cannot be duplicated in slower growing regions. "The essence of the argument," according to Dixon and Thirwall and consistent with Myrdal and Kaldor, "is that once a region gains a growth advantage it will tend to sustain that advantage through the process of increasing returns that growth itself induces..." (1975, p. 201).

Some Mechanisms of Cumulative Causation

What is the process by which increasing returns are induced in a growing economy? Economists have emphasized several mechanisms through which increasing returns can come about: scale economies (generated by induced specialization and the division of labor and by induced technical innovation) and agglomeration economies.

Scale Economies

Beginning with Adam Smith's observation that specialization and the division of labor are limited by the extent of the market, Young (1928) emphasizes that larger markets permit the break-up of complex processes into a series of simple ones, allowing for use of machines in the simple ones. (The capital/labor ratio in production is thus a function of the extent of the market rather than of relative factor prices.) Technical change in this model is embodied in the capital put into service to do the simple tasks. The division of labor is enhanced and productivity increases, which gives rise to increasing returns to scale.

Kaldor (1972) emphasized the Smithian mechanism of induced innovation: that inventions and innovations are induced by experience--what has later on been termed as "learning-by-doing" or "dynamic economies of scale". He further indicates that, "The gain in design through experience is even more important in the making of plant and equipment; hence the annual gain of productivity due to "embodied technical progress" will tend to be all the greater the larger the number of plants constructed per year".

In Kaldor's growth model, the forces for making continuous technical changes that generate increasing returns to scale are endogenous--that is, they are generated from within the economic system. The embodied technical progress phenomenon implies that the higher the rate of growth, the higher the rate of capital accumulation and higher the embodied technical change (which is necessarily labor saving). This means the productivity grows along with output growth, i.e., Verdoorn's Law. This makes Kaldor's model circular and cumulative.

Service growth may reduce the Verdoorn coefficient: income growth may have a reduced effect on productivity growth. Increases in growth from the service sectors will usually reduce capital formation and increase labor intensity. "Learning by doing" in the service sector will tend to generate "labor-embodied technical change" (e.g., an engineer with a computer), which is likely to generate a smaller Verdoorn relationship. This could partially explain Vaciago's (1975) finding that the Verdoorn coefficient is diminishing over time.

It is worth noting that the idea of induced innovation is not dependent on the Kaldorian mechanisms. Schumpeter (1934) and Hicks (1932), coming from quite different theoretical perspectives, developed induced innovation hypotheses. Schumpeter's innovations were induced by the response to disturbances in equilibrium: entrepreneurs built new plants in expectation of profits, making old plants obsolete.[3] Hicks' innovation was induced by responses of producers to relative factor prices: expensive labor induces labor saving technology.

Agglomeration Economies

Up to this point, the discussion has emphasized economies of size internal to the firm. External economies, and particularly external economies of agglomeration, have been relatively neglected in cumulative causation models. The concept of agglomeration economies, however, is critical to the explanation of rural-urban growth differentials.

As an industry grows, specialized firms will enter the market making components on a large scale that are costly to produce in small quantities. According to Stigler, this progressive specialization is a major source of agglomeration economies: "Many of the functions which an industry can delegate to auxiliary and complementary industries must be performed in fairly close proximity, and this is a powerful factor making for the geographic concentration of industries". (Stigler, 1952, quoted in Heilbrun 1981 p. 16)

Heilbrun describes the cumulative effect of agglomeration economies on urban growth: "within the national market sector one industry attracted other, related activities to its locality; this increased agglomeration produced external economies that attracted still more firms and produced still more external economies. As employment and income rose, local market industries also expanded, and this expansion too was potent for the creation of further economies of agglomeration and further urban growth." (Heilbrun, 1981, p. 18)

Scale Economies and Agglomeration Economies in Urban and Rural Development

The different industrial structures of urban and rural areas and the differences among industries on the extent to which scale economies and agglomeration economies are operative provide a basis for speculating about the prospects for urban and rural development within a cumulative causation framework.

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[3] We are indebted to Jim Barron for bringing Schumpeter's contribuiton to our attention.

Table 2 summarizes the characteristics of the major industrial groupings with respect to internal scale economies, agglomeration economies, growth rates and the extent to which metropolitan and non-metropolitan countries specialize in these industries.

Agriculture has often been characterized as a constant or increasing cost industry. Castle has challenged this notion in a recent reexamination of research on economies of size in agriculture (1989). He argues that agriculture exhibits increasing returns. Given the competitive market within which farmers operate, the slowly growing inelastic demand for agricultural products insures that increasing returns in agriculture are translated into lower product prices, lower operator returns and fewer operators. The extent of the market for agricultural products limits the potential of this sector to provide cumulative growth impulses to the rest of the economy. As a widely geographically dispersed sector dependent on the location of natural resources (soil, water, climate), agriculture exhibits relatively weak agglomeration economies.

Table 2

Conceptual Framework for Hypotheses About Rural and Urban Development

	Extent to which Industry Exhibits		U.S. Employment Growth Rate[a/]	Industry Structure [a/] (Percent of Employment in each sector in 1986)	
	Scale Economies	Agglomeration Economies	1982-86 (Annual % Change)	Metropolitan	Nonmetroplitan
Agriculture	X		-1.7	1.1	9.0
Mining	X		-5.1	0.6	1.9
Manufacturing	X	X[b]	0.3	15.0	
17.3					
Service-Producing		X	3.6	77.2	65.1

[a/] Source: Majchrowicz and Ghelfi. (1988) [b/] "top of product cycle" sectors

The natural resource sectors of forestry, mining and energy also exhibit, (1) increasing returns, (2) a slowly growing inelastic demand, and (3) relatively weak agglomeration economies. (Weber, Castle, Shriver 1987)

The existence of increasing returns in manufacturing is widely accepted and indeed forms the basis of Kaldor's model (1970). Mills (1987, p. 10) concludes that scale economies are still important in manufacturing but that "technological change that increases processing per unit of output" and improvements in transportation have made proximity of processing activities less important than it used to be in manufacturing. Many manufacturing activities seem also to benefit from geographic proximity to various suppliers and customers. The decentralization of manufacturing during the 1960s and 1970s may signal a weakening of the agglomeration economies in manufacturing. This has continued into the 1980s: manufacturing employment and earnings grew 50 percent faster during the 1982-86 period in non-metropolitan counties than in metro counties. (Majchrowicz and Ghelfi, 1988) Many of the decentralized activities however, have been low-wage routine assembly activities at the bottom of the "product cycle". (Bloomquist,

1988) Such industries do not have much potential for inducing major productivity advances.

Agglomeration economies seem to be much more in evidence in the "top of the product-cycle" high technology industries, given the preponderance of these industries in metropolitan areas (Barkley et al 1988).

Service producing industries, taken as a whole, do not exhibit scale economics, and have limited potential for productivity advances that would release labor to other sectors (Baumol, 1967). Service sectors do, however, exhibit strong agglomeration economies and, because services are highly income elastic, can be expected to have good growth potential. Miller and Bluestone's data support the hypothesis that services are urban-oriented:

> "Employment shares in most service industries increased with urbanization. Except for...consumer services...and a few service industries linked to the traditional economic base, most service industries were not oriented to non-metro areas. Thus far there is little evidence that services have loosened their ties to big cities and have begun to decentralize to rural sites." (1988, p. 154)

Implications for Rural Development

Services and "top of the product cycle" manufacturing are the industries that are most rapidly growing. They are also the industries in which agglomeration economies are strongest. The fact that the rapid growth sectors experience agglomeration economies represents a significant growth advantage for urban areas. To the extent that they are also industries in which innovations are strongly induced by growth, urban areas would appear to have an economic base strongly suited to cumulative growth in an expanding economy.

Industries that produce income-inelastic export goods (agriculture, mining and low-wage manufacturing) are not growing rapidly. They also exhibit weak agglomeration economies. The absence of strong agglomeration economies in these industries encourages their location in rural areas. Slow export growth implies, in Kaldor's terms, slow income growth and limited induced innovation/productivity growth. Scale economies in these industries may go unrealized.

Because of the highly competitive market environment in these sectors and inelastic demands for output, the benefits of productivity gains resulting from scale economies or induced innovation accrue to consumers of the product outside the region through lower prices rather than to proprietors and labor in the region through higher income.

Rural regions appear to suffer some serious disadvantages in a world of industrial restructuring toward "top of cycle" manufacturing and service producing industries, since these industries appear to have strong agglomeration economies and (under the Kaldorian hypothesis) are expected to strongly induce productivity gains. The sectors in which rural areas have specialized and in which they seem to have a comparative advantage are slow growing or declining and (by hypothesis) will not generate induced productivity gains. To the extent that such gains are induced, they tend to be transmitted to consumers outside the region.

A Research Agenda

The per capita income divergence of rural and urban counties in the United States during the last decade would appear at first blush to be better explained by cumulative causation models with increasing returns and agglomeration economies than by neoclassical "equilibrium" models.

The income convergence of the prior half century is, of course, consistent with the neoclassical model. Perhaps the movement from convergence to divergence of the two periods can be explained by a movement from resource-constrained growth in the early period (that would be consistent with a neoclassical framework) to demand-constrained growth in the last decade (in a Kaldorian world). To the extent that this is true, the dim prospects for continued growth of industries found in rural areas does not bode well for rural areas.

Dixon and Thirwall (1975) have shown that, depending on the values of the parameters in their Kaldorian model, growth rates of output may converge, diverge or persist indefinitely at different levels. The recent release of time series data on gross state product by the Bureau of Economic Analysis makes possible the estimation of a Kaldorian model for U.S. states and regions. Such a test could provide insight into the plausibility of the mechanisms embodied in the Kaldorian cumulative causation hypothesis and some guidance with respect to the value of further research in disequilibrium paradigms.

REFERENCES

Barkley, David L., Dahlgran, Roger A. and Smith, Stephen M. "High-Technology Manufacturing in Nonmetropolitan West: Gold or Just Glitter," American Journal of Agricultural Economics, Vol. 70, No. 3, August, 1988, pp. 560-71

Baumol, W. J. "Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis," American Economic Review, 47:415-26, 1967

Bloomquist, Leonard E. "Performance of the Rural Manufacturinig Sector," Rural Economic Development in the 1980s: Prospects for the Future, United States Department of Agriculture. Rural Development Research Report No. 69, September, 1988. 3:49-75

Bureau of Economic Analysis. "Personal Income for Counties and Metropolitan Areas" April, 1988, unpublished data. (1988a)

Bureau of Economic Analysis. Per Capita Personal Income, for States and Regions, Table S A 2.1, August 1988, unpublished data (1988b)

Castle, Emery N. "Is Farming a Constant Cost Industry?", American Journal of Agricultural Economics, 1989 (forthcoming).

Coughlin, Cletus C., and Mandelbaum, Thomas B. "Why Have State Per Capita Incomes diverged Recently?", The Federal Reserve Bank of St. Louis Review, Vol. 70, No. 5, September/October, 1988. pp. 24-36

Dixon, R. and Thirlwall, A. P. "A Model of Regional Growth-Rate Differences on Kaldorian lines," Oxford Economic Papers, July 1975, pp. 201-14

Dixon, R.J. and A.P. Thirwall. "Growth Rate Stability in the Kaldorian Regional Model" Scottish Journal of Political Economy 25(1): 97-99, February 1978

Dow, Sheila C. "The Capital Account and Regional Balance of Payments Problems," Urban Studies, 1986. 23, No. 3 pp. 173-184

Guccione, A. and W.J. Gillen. "Growth Rate Stability in the Kaldorian Regional Model", Scottish Journal of Political Economy 24(2): 175-176, June, 1977

Heilbrun, James. Urban Economics and Public Policy, St. Martin's Press, Inc., 1981

Hicks, J.R. The Theory of Wages, London: Macmillan, 1932

Kaldor, Nicholas. "The Case for Regional Policies," Scottish Journal of Political Economy, November 1970, pp. 337-48

Kaldor, Nicholas. "The Irrelevance of Equilibrium Economics," Economic Journal, 1972 (82: December) pp.

Lovejoy, Stephen B. and Richard S. Krannich. "Rural Industrial Development and Domestic Dependency Relations: Toward an Integrated Perspective," Rural Sociology, 47 (3): 475-495, 1982

Majchrowicz, T. Alexander and Linda M. Ghelfi. "Employment and Earnings in Nonmetro Industry, 1979-86," United States Department of Agriculture, Agriculture Information Bulletin No. 552, November 1988

Miller, James P. and Herman Bluestone. "Prospects for Service Sector Employment Growth in Nonmetro America," United States Department of Agriculture, Rural Development Research Report, No. 69, Rural Economic Development in the 1908's: Prospects for the Future, pp. 135-158 September 1988

Mills, Edwin S. "The Determinants of Small Area Growth," University Graduate Faculty of Economics, Lecture Series #1, Oregon State University, October 1987

Myrdal, Gunner. Economic Theory and Under-Developed Regions, Gerald Duckworth & Co. Ltd., London, 1957

Schumpeter, J.A. The Theory of Economic Development, Cambridge: Harvard University Press, 1934

Seligson, Mitchell A., ed., The Gap Between Rich and Poor: Contending Perspectives on the Political Economy of Development, Boulder: Westview Press, 1984

Stigler, George. The Theory of Price, revised edition, New York: Macmillan, 1952

Strong, Elizabeth J. and Bruce A. Weber. "Explaining Development in Rural America: The Nonmetro Dependency Hypothesis Reexamined," Selected Paper presented at annual meetings of the American Agricultural Economics Association, Reno NV. 1986.

Swales, J. K. "A Kaldorian Model of Cumulative Causation: Regional Growth With Induced Technical Change," Technical Change and Regional Development, ed. A. Gillespie. London: Pion Ltd. 1983

Weber, Bruce A., Castle, Emery N. and Ann L. Shriver. "Performance of Natural Resource Industries," Rural Economic Development in the 1980's: Prospects for the Future, David L. Brown, J. Norman Reid, Herman Bluestone, David A. McGranahan, and Sara M. Mazie, editors. Agriculture and Rural Economy Division, Economic Research Service, U.S. Department of Agriculture. Rural Development Research Report No. 69, September 1988

Weber, Bruce A. and Brady J. Deaton. "U.S. Regional and Rural-Urban Growth Differentials: An Examination of the Cumulative Causation Hypothesis" Agricultural Economies Staff Paper SB-85-1, Blacksburg: Virginia Polytechnic Institute and State University, 1984

Vaciago, G. "Increasing Returns and Growth in Advanced Economies: A Re-evaluation, Oxford Economic Papers, 27:232-230 1975

Young, Allyn. "Increasing Returns and Economic Progress," Economic Journal, 35:December pp. 527-542, 1928