AN EMPIRICAL TEST OF THE DOMINANT INDUSTRY HYPOTHESIS: SOME PRELIMINARY EVIDENCE

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Introduction

Two issues which are quite perennial in economics are slow growth of some regions and growth variation among regions. This paper uses a dominant industry/industry region approach for observing and analyzing slow regional growth and regional growth variation. The purpose of this paper is to provide a theoretical framework to explain the disparities among regions' manufacturing growth rates. Regional manufacturing economic growth is explored using two concepts: (1) a dominant industry and (2) an industry region.

The paper is divided into five parts: (a) Theoretical Framework and Research Problem; (b) Hypothesis and Methodology; (c) Manufacturing Growth; (d) Relevant Tests of the Hypothesis; (e) Significant Findings and Conclusion.

THEORETICAL FRAMEWORK AND RESEARCH PROBLEM

Theoretical Framework. The dominant industry hypothesis rests upon the following assumptions:

(1) Productive activities of the economy can be divided into: (a) agricultural; (b) industry; and (c) service.

(2) The *industry* sector of the economy consists of m industries, which is defined by the finite set F.

$$F = \{f/f_1, f_c, \dots, fm\}$$

The m industries are dispersed over k regions; but f_1 (and every f) is dispersed over n regions, where $n<k$.

(3) The demand for the output of f_1 (as well as f_2, ... fm) is not evenly distributed among the k regions. The intensity of demand for final and intermediate consumption of the m industries differ among the k regions.

(4) The transportation requirement of the m industries differ, and the transportation networks differ amont the k regions. The transportation networks create overlapping concentric zones, thereby influencing transportation-dependent industry location.[1] These concentric zones are

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[1] According to Alperovich and Katz [2], uncertainty of transportation cost on

comprised of a few contiguous regions.

(5) The availability of money capital differs among the m industries and among the k regions. This condition produces what can be called an industry capital investment preference, with significant regional impact.[2] Regional investment in capital goods is a function of the availability of money capital.

Given these basic assumptions, the demand and supply determinants of regional economic expansion can be brought together in the concept of the *dominant industry.*

The *dominant industry* (DI) emerges in a region when: (a) there is a sustained increase in regional demand (D) for an industry's output, (b) the region's capital investment preference (C) favors that industry, and (c) the transportation network (T) which services the region is capable of handling the increase without a significant increase in cost. This relationship is expressed as follows:

$$DI_{mk} = f(d_{mk}, C_{mk}, T_{mk})$$

$$m = l \ldots p$$
$$k = l \ldots \iota$$

Evidently, a dominant industry can be replaced by a change in regional demand, or a change in the capital investment preference (which can produce a senility effect upon the firms in the dominant industry), or a change in the transportation network.[3]

Concomittant with the emergence of regional dominant industries, is the emergence of *industry regions.* An *industry region* is a region in economic space linked by a common dominant industry (e.g. chemical industry; electrical industry region, etc.).

Within any given time period, there are several industries that are potential candidates for becoming a dominant industry in a region. Which of the industries actually becomes *the* or *a* dominant industry is dependent upon the regional capital investment preference and the degree of capital saturation, and the degree of dependence of the industry on and the intensity of use of the transportation network.

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either the firm's inputs or outputs will influence the location decision at the point of certainty and away from the point of uncertainty.

[2] For instance, Almon, Buckler, et al. [1, p. 55], found in their empirical work, which covered the period 1954-1971, that there were serious timing differences among some industries concerning their investment in plant and equipment.

[3] For instance, the study by Liew [13] provides clear evidence on the regional impact of a change in the transportation network.

A dominant industry's decline in one region may restructure the industry region but not necessarily reduce the aggregate output of the industry region. The impact of a decline of a dominant industry in a region depends on: (a) the extent of regional intradependence, the lesser the intradependence the less severe the impact;[4] and (2) the absence or presence of potential dominant industry candidates.

For the purposes of this paper, a *dominant industry* is an industry which accounts for 10% or more of a region's manufacturing output. This proposition is based upon the assumption that there exists a threshold level for an industry. Once this level (assumed to be 10% for the purposes of this study) has been achieved for an industry, it no longer is influenced but it becomes the industry that influences growth. This concept may be equally valid for other components of the economy, however, this study is limited to a focus on manufacturing.

Divergent Growth in Regional Manufacturing — A Problem

The role of the *dominant industry* in regional manufacturing economic growth studies is a passive one, in that it is subsumed under the caption of comparative advantage, industrial structure, or export base. The *industry region* approach is a controlled observational approach.

A priori there is a relationship between the output of the *dominant industry* and the manufacturing industry's total output in a region; whereas, the *industry region* concept is used as a means of observing the variations in the impact of the dominant industry in an idealized spatial context. This study intends to use the relationship between the dominant industry and regional manufacturing growth, and through the use of the industry region to probe at the statistical significance of the dominant industry as a possible explanation of divergence in regional manufacturing growth.

Related Literature

In most studies, the partial immobility of labor, regional comparative advantage and industrial structure constitute the framework for theorizing and empirical testing. The capital market is assumed to be perfect, and the rate of return on capital determines what amount of capital will be allocated to each industry and each region.

Though the regions within the U.S. are open economies, growth among the regions have been found to be unbalanced. The conclusion of the two major works in regional economic growth is that the divergence in regional manufacturing growth is the result of "area differentials in the growth of individual industries." [3, pp. 44-46; 10, pp. 11-12] Though no explanation has been

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[4] Regional intradependence is definitely a factor that has a role in explaining regional growth disparities, in this study this dependence reflects itself in the regional variations of the impact of the dominant industry — as measured by the output elasticity coefficients of the dominant industry.

offered for area differentials in growth by those two studies, the acceptance of unbalanced growth among regions seems to be well established [8, p. 101; 14, p. 25].

Other studies have offered some explanation for the divergence in regional growth such as the region's adaptability to change in accommodating itself to technological advancement [16], the proximity to supply of raw materials or to the markets for the products of the region [4], and internal linkages of a region as analysed for forward and backward linkages [6]. However, there seemingly can be many other plausible explanations for divergent growth among regions.

Shift-share analysis has been criticized [5, p. 16], and in its place is the concept of regional endowment — capital abundance versus labor abundance — which leads to regional specialization [15, p. 5]. However, regional specialization is an effect and not a cause.[5] In this sutdy, the concern is with the cause of industry regional growth differentials; the variation in regional impact of the dominant manufacturing industry on manufacturing growth in the regions of the U.S. may be a clue to an understanding.

Borts and Stein [3], using a neoclassical approach, placed great emphasis on the role of migration, which affects the labor supply fundtion, as a major determinant of regional growth patterns. Hulten and Schwab [12, p. 161] concluded for the period 1951-1978 in U.S. manufacturing that: (1) productivity slowdown occurred quite broadly across regions, it was not a regionally isolated phenomenon; and (2) capital and labor inputs were the chief determinants of interregional growth variations. It is within this latter context that the industry region approach can shed a different light on regional growth patterns.

Hulten and Schwab used the (nine) census region(s) as the unit(s) of observation — the region. In all the other studies cited, the 'state' is used as the operational definition of the region, except for one which used the county. The essence of this study, in which the *'state' economy* is the region, is that interregional differences in regional economic growth — measured in terms of manufacturing value-added, per-capita income, employees, population, unemployment and public spending — can be explained in great part by inter-regional differences in the growth of the dominant manufacturing industry and the rate of change in investment in the dominant manufacturing industry of each region. With the aid of the concept of an *industry region,* another view of regional economic growth is made possible for the purpose of analysis.

TESTABLE HYPOTHESIS AND METHODOLOGY

Hypothesis

A region's manufacturing growth is directly related to the growth of the

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5 According to Richardson [17, p. 8], there is a need to understand the direction of causation.

dominant industry in the region, and the variation among the "state" regions comprising an "industry" region in the responsiveness to the growth of the dominant industry reflects the leakage of manufacturing growth out of a region due to the differing degrees of manufacturing industries intradependence within the state regions.

This paper will examine the hypothesis, as stated above, over a ten year period (1960-1964, 1967-1971), because of data collection problems 1965 and 1966 were omitted. The census regions as defined by the U.S. Department of Commerce — New England, Mid Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, mountain, and Pacific — and thirty eight states (*the state* is essentially the framework for analysis (the region) in this study) are the geographical units of observation over the ten year period. Data for three industries — SICC 20, Food and Kindred Products; SICC 28, Chemical and Allied Products; and SICC 36, Electrical Machinery and Electronics — are analyzed on the Census region level. These three manufacturing industries are used to form three industry regions at the state level *only,* when such industries constitute a dominant industry (the manufacturing value added of that industry is ten percent or more of the state's total manufacturing value added). In the latter situation, the number of states constituting an industry region are less than the total number of states individually observed.

The Derived Models for Hypothesis Testing

Two tests of the dominant industry hypothesis have been devised: (1) a relational test of an output model, and (2) a predictive test of a growth model.

The first test (the validity or relational test) of the dominant industry hypothesis, referred to as the output model, uses time series data for the ten year period 1960-1964, 1967-1971. The variables are all logarithmic values of dollar levels over time, and a separate equation has been estimated for each state in this study. The output model is mathematically formulated as follows:

(1) $1RMVA_t = j(1MVARDI_t, 1IRDI_t)$

1RMVA = Log of Region's Manufacturing Value Added (Level of Output in Millions of Dollars)

1MVARDI = Log of Manufacturing Value Added of the Region's Dominant Industry (Level of Output)

1IRDI = Log of Investment (Capital Expenditures) of the Region's Dominant Industry

t = Time Period (1960-1964, 1967-1971); t = 1 to 10

Time series multiple regression equations were estimated relating the level of total manufacturing value added in a region to value added and investment by the dominant industry. This multiple regression model was estimated twenty-two times; once for each state included *in this phase* of the study.

Based on the dominant industry hypothesis, the expectation is that the dependent variable would show a positive significant relationship with each independent variable. The estimated partial regression coefficients can be interpreted as *elasticities* because the variables are in logarithmic form. Hence, to the extent that the results are significant, it would be possible to analyze the impact of a one percent change in the dominant industry's value added or capital expenditures upon the total state manufacturing value added.

The second test (the *predictive* test) of the dominant industry hypothesis, referred to as the growth model, uses cross sectional data on states in which every variable is an exponential growth rate calculated over the period 1960-1964, 1967-1971. The growth model uses output (manufacturing value added) as the primary measure of growth. The test of the hypothesis was conducted using multiple correlation analysis on the cross-sectional data for the states in each of the three selected industry regions (SICCs 20, 28 and 36). The growth model is mathematically formulated as follows:

(2) $RMEG_i = g(GMVARDI_i, GIRDI_i)$

RMEG = Region's Manufacturing Economic Growth

GMVARDI = Growth of Manufacturing Value Added of the Region's Dominant Industry

GIRDI = Growth of Investment (Capital Expenditures) in the Region's Dominant Industry

i = Individual State Observations, $i = 1$ to n

The dependent variable (RMEG) is the exponential growth rate for each state's total manufacturing value added for the ten year period (1960-1964, 1967-1971). The independent variables (GMVARDI and GIRDI) are respectively:

a) the exponential growth rate of the manufacturing value added of the state's dominant industry for the ten year period (1960-1964, 1967-1971); and
b) the exponential growth rate of investment (capital expenditures) in the state's dominant industry for the ten year period (1960-1964, 1967-1971)

The priori expectation is that the dependent variable will show a strong positive correlation with the two independent variables. Multiple correlation was performed but not multiple regression because the interpretation of partial regression coefficients for growth rate variables is not perfectly clear.

Basis of the selection of the industries: In order to assess the implication of the dominant industry, it seemed necessary that each industry, as a basis of selection, should possess three distinct characteristics; 1) the industry must contribute significantly to U.S. manufacturing; 2) the industry must be dispersed throughout the U.S. regions; and 3) the industry must have demonstrated growth over the time period covered by this study, 1960-1971.

Two industries were selected on the basis of the above criteria: Chemical and Allied Products, SICC 28 and Electrical Equipment and Supplies, SICC 36. However, in order to insure consistency of the findings in this study, it was necessary to include one other industry which did not possess the third criterion. On the basis of this consideration, Food and Kindred Products, SICC 20, was selected.

Determination of criterion #1 above was based upon manufacturing valued added, capital expenditures and employment. The determination of criterion #2 was based on importance to total output; that is, dispersion among the regions and growth over the ten year period. Selection on the basis of criterion #3 was satisfied on the basis of a growth score, which was constructed based upon a modified version of Estall's [8] approach and classification scheme: See Table 1.

In constructing Table 1, the six most important industries at the 2 digit level (SICC) were noted based upon 1971 manufacturing value added.

The importance of these six industries is evident from the following:

	1971
Total Manufacturing Value Added — SICCs 20, 28, 34, 25, 36 and 37	$178.9B
Total U.S. Manufacturing Value Added	$309.5B
Ratio of SICCs Total To U.S. Total	57.8%

TABLE 1
SELECTION OF INDUSTRIES

		Selection Criterion				
		Importance 1971 Rank		**Dispersion 1967**	**Growth 1971 Vs 1960**	
SICC	**Industry**	**Value Added**	**Capital Expenditures**	**Number of States**	**Growth Score**	**Type**
		(a)	(b)	(c)	(d)	
37	Transportation	1	*	17	39	0
20	Food	2	2	27	41	X
35	Machinery	3	4	16	12	A
28	Chemical	4	1	27	20	A
36	Electrical	5	5	22	16	A
34	Fabricated Metal	6	*	18	21	0

* not listed — rank is below rank #6

Column (a) — The ranks of the six most important industries in 1971 are shown.

Column (b) — The rank of each industry in terms of 1971 capital expenditures is shown if it falls within the first six ranks.

Column (c) — It is the dispersion of the six industries throughout the U.S. economy. The figures shown represent the number of states in which the industry accounts for 1 percent or more of the state's manufcturing value added.

Column (d) — The 'growth score' and 'growth type' of each industry is shown.

On the basis of this table the three industries were selected. SICCs 34 and 37 were eliminated based upon:

column (b) — less significant than SICCs 20, 28, 35 and 36;
(c) — not as dispersed (not represented at the 1% level in as many states) as SICCs 20, 28 and 36; and
(d) — growth type of each of these two industries is '0', but only 'A' and 'X' types are required (essential) in this study.

SICC 35 was eliminated based upon:

column (c) — not as dispersed (not represented at the 1 percent level in as many states) as SICCs 20, 28 and 36.

For a state to be selected when it contained a dominant industry, that industry must be the leading, or at least the second leading, industry in that state in terms of that industry's manufacturing value added in relation to the state's total manufacturing value added. The year 1971 was treated as the base year in the determination of the dominant industry.

Growth was calculated using 'exponential growth curve theory' as developed by Glover [11, p. 470] 'Exponential growth curve theory' as used in this paper is expressed as follows:

(3) $Y = ar^x$
Y = dependent (observed) variable
a = a constant (base)
r = rate of growth (multiplier)
x = time period (number of observations)

The growth rate for the serial data is calculated using the above formula. The exponential function is used because it is seemingly superior to the logarithmic function for serial data [7, p. 281].

Manufacturing Growth and Capital Expenditures

Manufacturing Growth Rates of Regions

The exponential growth rate (ten year annual compounded) for the period under review (1960-1964, 1967-1971) of U.S. total manufacturing value added, adjusted for price level changes, was 5.0 percent. Table 2 shows the exponential growth rates of total manufacturing value added for the nine census regions for the same time period. The exponential growth rates for the three selected industries (SICCs 20, 28 and 36) for the period 1960-1964, 1967-1971 are also presented in Table 2.

TABLE 2

CENSUS REGION'S GROWTH RATES OF TOTAL MANUFACTURING VALUE ADDED FOR SELECTED INDUSTRIES FOR THE TEN YEAR PERIOD: 1960-1964, 1967-1971

Census Region	Exponential Growth Rates of Manufacturing Value Added			
	Total	Chemical	Electrical	Food
	%	%	%	%
Mountain	6.3.	10.1	30.6	4.7
West South Central	8.0	10.2	17.2	6.1
East South Central	8.5	11.0	16.6	5.2
South Atlantic	6.8	8.4	14.8	6.1
West North Central	5.9	9.3	10.0	3.3
Pacific	5.2	7.9	9.7	3.8
East North Central	4.4	8.9	6.9	3.5
New England	3.2	10.0	6.5	2.3
Mid Atlantic	3.3	8.2	6.2	1.4
U.S.	**5.0**	**8.9**	**8.7**	**3.7**

Three census regions fell below the national average growth rate — New England, Mid Atlantic and East North Central. These three census regions had accounted for 61.1 percent of total U.S. manufacturing value added in 1960, whereas, in 1971 they accounted for only 55.0 percent of total U.S. manufacturing value added. Based upon the simple average of 5.7 percent for the regions' growth rates, the coefficient of variation is .33.

Growth Rate Distributions

The exponential growth rates of total manufacturing value added for the 38 states included in this study were (see Appendix A) calculated for the period 1960-1964, 1967-1971. The data (value added) was adjusted for price level changes through the use of the Gross National Product Implicit Price Deflator (GNPIPD). 1960 is the base year in this study. On an adjusted basis, the U.S. exponential growth rate for total manufacturing value added was 5.0 percent. There were fourteen states that experienced exponential growth rates which were less than the national average. A frequency distribution of the exponential growth rates of the 38 states included in this study is presented below:

TABLE 3

FREQUENCY DISTRIBUTION OF OBSERVED REGIONS' MANUFACTURING VALUE ADDED GROWTH RATES TEN YEAR PERIOD: 1960-1964, 1967-1971

Range — Percent	Frequency — States
2 - 3.9	7
4 - 5.9	14
6 - 7.9	8
8 - 9.9	6
10 - 11.9	2
12 - 13.9	1
Total	**38**

Chemical Industry Region: Those states, comprising the chemical industry region for the purposes of this study, in the year 1971 contributed 40.7 percent of the total chemical and allied products manufacturing value added of the U.S. (See Table 4) The U.S. growth rate for chemical and allied products manufacturing value added, for the period 1960-1964, 1967-1971, was 8.9 percent. The coefficient of rank correlation (between total and industry manufacturing value added growth rates) was found to be +.42; this is statistically a non-significant finding.

TABLE 4

COMPARATIVE STATISTICS FOR THE CHEMICAL INDUSTRY REGION STATES IN WHICH CHEMICAL AND ALLIED PRODUCTS MANUFACTURING IS A DOMINANT INDUSTRY PERIOD: 1960-1964, 1967-1971

State	Exponential Growth Rate of Chemical Industry	% of State Total Manufacturing Value Added			1971 Data Stated In 1960 Constant Dollars		
		1960	1967	1971	Value Added $000,000	Value Added as a % of U.S.	Group
New Jersey	9.7%	19.3	25.6	32.0	3,487	12.2	29.9
Texas	9.3%	23.2	22.0	27.7	2,886	10.1	24.7
Tennessee	9.3%	24.2	27.1	27.2	1,383	4.8	11.9
West Viginia	5.0%	36.5	44.6	46.6	841	2.9	7.2
Virginia	6.5%	19.4	21.7	19.9	777	2.7	6.7
Louisiana (1)	13.3%	24.2	28.2	38.1	1,011	3.5	8.7
South Carolina (1)	10.6%	15.5	18.1	23.2	742	2.6	6.3
Alabama (1)*	16.5%	8.0	13.7	15.5	533	1.9	4.6
Total					$11,660	40.7	100.0
U.S. Total					$28,652		

Electrical Industry Region: In 1971, the states, comprising the electrical industry region, accounted for 44,8 percent of total U.S. electrical machinery and electronics manufacturing value added (see Table 5). The U.S. growth rate for electrical machinery and electronics manufacturing value added, for the period 1960-1964, 1967-1971, was 8.7 percent. The coefficient of rank correlation (between total and industry manufacturing valued added growth rates) was found to be .9524, which is significant at the .01 level. In this industry grouping, there is a very strong association between the dominant industry's growth rate and that of the state's total manufacturing value added.

TABLE 5

COMPARATIVE STATISTICS FOR THE ELECTRICAL INDUSTRY REGION STATES IN WHICH ELECTRICAL MACHINERY AND ELECTRONICS MANUFACTURING IS A DOMINANT INDUSTRY PERIOD: 1960-1964, 1967-1971

State	Exponential Growth Rate of Electrical Industry	% of State Total Manufacturing Value Added 1960	1967	1971	1971 Data Stated In 1960 Constant Dollars: Value Added $000,000	Value Added as a % of U.S.	Group
California*	9.5%	9.4	14.5	14.5	3,249	12.8	28.6
Illinois (1)	6.5%	12.9	13.8	15.2	2,809	11.1	24.7
Indiana	8.7%	13.4	17.6	19.7	1,935	7.6	17.1
Massachusetts	5.5%	13.7	17.3	17.4	1,344	5.3	11.8
Kentucky (1)	14.1%	11.8	17.0	20.1	844	3.3	7.4
Connecticut (1)	5.4%	10.4	11.3	13.7	676	2.7	6.0
Arizona	23.8%	10.0	26.6	25.9	292	1.2	2.6
New Hampshire	9.5%	16.2	22.2	22.5	199	0.8	1.8
Total					$11,348	44.8	100.0
U.S. Total					$25,307		

(1) Not the dominant industry, but the second most important industry in the state.

* 1960 was the only year in which the amount was less than 10 percent. Base year in the selection of the dominant industry is 1971.

Food Industry Region: Seventeen states constituting the food industry region accounted for 35.5 percent of total U.S. food and kindred products manufacturing value added (see Table 6). The growth rate of food and kindred products manufacturing value added for the U.S. over the period 1960-1964, 1967-1971 was 3.7 percent. The coefficient of rank correlation was found to be .7183, which is significant at the .01 level.

(1) Not the dominant industry, but the second most important industry in the states.

* 1960 was the only year in which the amount was less than 10 percent. Base year in the selection of the dominant industry is 1971.

TABLE 6

COMPARATIVE STATISTICS FOR THE FOOD INDUSTRY REGION STATES IN WHICH FOOD AND KINDRED PRODUCTS MANUFACTURING IS A DOMINANT INDUSTRY PERIOD: 1960-1964, 1967-1971

State	Exponential Growth Rate of Food Industry	% of State Total Manufacturing Value Added			1971 Data Stated In 1960 Constant Dollars		
		1960	1967	1971	Value Added $000,000	Value Added as a % of U.S. Group	
Wisconsin	4.1%	15.1	13.2	15.9	1,274	4.8	13.5
Iowa	5.5%	31.8	25.5	34.3	1,274	4.8	13.5
Missouri	2.6%	16.0	13.8	14.0	992	3.7	10.5
Florida	10.2%	21.9	17.3	21.5	979	3.7	10.3
Minnesota	2.8%	23.6	18.8	19.6	893	3.3	9.4
Georgia	5.4%	15.4	12.1	12.6	777	2.9	8.2
Maryland	5.2%	13.2	14.1	16.5	665	2.5	7.0
Nebraska	5.2%	46.4	37.9	37.5	565	2.1	6.0
Colorado	6.9%	23.8	20.9	25.4	501	1.9	5.3
Oregon	4.5%	15.2	14.8	14.4	380	1.4	4.0
Kansas	1.1%	18.3	13.4	14.3	345	1.3	3.6
Oklahoma	4.1%	16.6	13.3	14.0	243	0.9	2.6
Idaho	8.2	34.2	28.9	36.2	228	0.8	2.4
South Dakota	1.7%	69.6	56.3	59.3	127	0.5	1.3
Utah	-1.3%	16.7	13.4	12.7	103	0.4	1.1
North Dakota	8.5%	45.0	36.4	37.8	68	0.3	0.7
New Mexico	1.8%	26.0	20.0	20.8	54	0.2	0.6
Total					$ 9,468	35.5	100.0
U.S. Total					$26,694		

Variation Among Exponential Growth Rates

Table 7 is a cross-sectional analysis of variance among the exponential growth rates of manufacturing value added for the three industries (SICCs 20, 28 and 36).

TABLE 7

ANALYSIS OF VARIANCE AMONG INDUSTRY REGIONS' EXPONENTIAL GROWTH RATES FOR MANUFACTURING VALUE ADDED OF THE DOMINANT INDUSTRY PERIOD: 1960-1964, 1967-1971

Source	Variation	Degrees of Freedom	Variance	F Value
Between Industries	179.68	2	89.84	5.5953*
Within Industries	490.45	30	16.3483	
Total	670.13	32		

* Statistically significant at the .01 level.

Thirty-three states, classified according to dominant industry within the three selected industries, were each represented in this test by their exponential growth rates as calculated for the manufacturing value added of the dominant industry for the ten year period 1960-1964, 1967-1971. The variation among the exponential growth rates was found to be statistically significant among the three selected industries.

MANUFACTURING CAPITAL EXPENDITURES

Census Regions and States: The exponential growth rates of capital expenditures were calculated for the period 1960-1964, 1967-1971 for total manufacturing, chemical manufacturing, electrical manufacturing and food manufacturing for the census regions and for 36 states. Fifteen states among the 36 states experienced lower exponential growth rates for manufacturing capital expenditures than the national exponential growth rate for manufacturing capital expenditures of 11.3 percent for the period 1960-1964, 1967-1971 (see Table 8). The rank correlation was .1482, which is statistically insignificant.

TABLE 8

EXPONENTIAL GROWTH RATES AND RANKING OF SLOW GROWTH STATES FOR THE TEN YEAR PERIOD: 1960-1964, 1967-1971

	Exponential Growth Rate of Manufacturing		Ranking of Growth Rates	
State	**Capital Expenditures**	**Value Added**	**Capital Expenditures**	**Value Added**
Oregon	10.9%	5.8&*	1	3
Illinois	10.8%	4.3%	2	8
Indiana	10.5%	4.8%	3	7
Mississippi	10.1%	5.0%	4	6
Kansas	9.6%	5.8%*	5	3
California	9.4%	5.2%	6	5
Massachusetts	9.3%	2.7%	7	13
Utah	9.1%	2.6%	8	14
Maryland	8.8%	2.6%	9	14
New Jersey	8.6%	3.3%	10	11
Connecticut	8.5%	3.6%	11	10
Idaho	8.4%	7.9%*	12	2
West Virginia	8.1%	2.8%	13	12
Wisconsin	8.1%	4.1%	13	9
Delaware	5.3%	8.3%*	15	1
U.S.	**11.3%**	**5.0%**		

* Above U.S. average

Selected Industries: The exponential growth rates of manufacturing capital expenditures in the U.S. for the three selected industries — Chemical and Allied Products (SICC 28), Electrical Machinery and Electronics (SICC 36), and Food and Kindred Products (SICC 20) — for the period 1960-1964, 1967-1971, were 11.9%, 12.8% and 9.6% respectively. The exponential growth rate for total manufacturing capital expenditures in the U.S. for the period 1960-1964, 1967-1971 was 11.3 percent.

Of the eight states included in this group, *chemical and allied products,* four states recorded exponential growth rates lower, and substantially lower, than the national exponential growth rates of chemical capital expenditures. Those states were West Virginia (3.8%), Virginia (5.1%), New Jersey (9.1%) and Tennessee (10.0%).

Growth rates for seven of the eight states included in this grouping, *electrical machinery and electronics,* were calculated. Arizona was excluded due to problems with the data — partially available. Only one state (Kentucky) had an exponential growth rate (16.0 percent) in excess of the national average; all others fell below the national average, and those deviations from the U.S. average were substantial: Connecticut - 6.9%, Indiana - 7.6%, California - 8.4%, New Hampshire - 9.8%, Illinois - 10.1%, Massachusetts - 11.3%.

Exponential growth rates of *food and kindred products* manufacturing capital expenditures were calculated for 13 states included in this group. Four states experienced exponential growth rates that were lower than the U.S. exponential growth rate of 9.6 percent: Missouri - 5.0%, Utah - 5.0%, Wisconsin - 9.3%, and Idaho - 9.3%.

RELEVANT TESTS OF THE HYPOTHESIS

DOMINANT INDUSTRY OUTPUT MODEL: RELATIONAL TEST

The relational test invloves the empirical evidence of the output model (1-1) for the dominant industry regions. Simple correlation analysis was performed between total manufacturing value added (dependent variable) and:

(a) the specific industry's manufacturing value added) independent variable);

(b) the specific industry's manufacturing capital expenditures (independent variable).

Chemical and Allied Products: The simple correlation coefficients for: (1) chemical manufacturing value added as the independent variable were found to be significant at the .01 level; and (2) capital expenditures were found to be significant at the .025 level, except for Virginia, in which case it is significant at the .05 level.

Table 9 presents the multiple regression results for the output model for those states in which chemical and allied products is the dominant manufacturing industry. The variation in total manufacturing value added for each of the eight states is substantially explained by the independent variables. Indeed, the lowest R^2 value is .881. The partial regression coefficients on the value added variable are positive as expected and significant at the .05 level or better. Those coefficients, which are *elasticity* estimates (relating a percent change in the dominant industry value added to a percent change in total state manufacturing value added), range from a low of +.37 for New Jersey to a high of +.88 for Tennessee. This suggests that *the impact of a change in chemical industry output upon a state's total manufacturing output varies a good deal among states.*

Although the partial regression coefficients on the capital expenditures variable are all positive as expected, in only one equation (Louisiana) is the coefficient significant. Hence it is not possible to draw any inferences about the impact of a change in capital expenditures in the chemical industry upon total state manufacturing output.

TABLE 9

COEFFICIENTS OF MULTIPLE CORRELATION AND DETERMINATION; REGRESSION COEFFICIENTS AND STANDARD ERRORS DOMINANT INDUSTRY: CHEMICAL MANUFACTURING PERIOD: 1960-1964, 1967-1971

State	Coefficient of Multiple R2	R	Constant — Logarithmic Value	Regression Coefficient and (Standard Error) Value Added	Capital Expenditures
New Jersey	.917	.957	2.7372	.3654** (.1195)	.0063 (.1220)
Virginia	.881	.938	1.4475	.6652** (.1233)	.0925 (.1175)
West Virginia	.969	.984	1.6840	.5014** (.0456)	.0557 (.0372)
South Carolina*	.941	.970	1.7706	.5674** (.1234)	.0640 (.0465)
Tennessee	.984	.992	0.9182	.8816** (.0713)	.0049 (.0549)
Alabama*	.964	.982	2.3520	.4007** (.0508)	.0474 (.0346)
Louisiana*	.958	.979	2.0234	.3871** (.0817)	.1023** (.0399)
Texas	.940	.970	1.3874	.6621** (.1684)	.1353 (.0944)

All Rs are significant at the .005 level.

* Not *the* dominant industry in the state, but *a* dominant industry — the second most important industry in the state.

** Significant at the .05 level.

Electrical Machinery and Electronics: The simple correlation coefficients for: (1) electrical machinery and electronics manufacturing value added were found to be significant at the .01 level, except for Connecticut in which case it is significant at the .025 level; and (2) capital expenditures were found to be significant at the .025 level, except for Massachusetts in which case it is significant at the .01 level.

Table 10 presents the multiple regression results for the output model for those states in which electrical machinery and electronics is the dominant industry. The variation in total manufacturing value added for each of those states is substantially explained by the independent variables. Except for Connecticut, all the R^2 values are above .90. As noted about the chemical industry equations, the partial regression coefficients on the value added variable for the electrical industry are all positive as expected and significant at the .05 level. The range of these elasticity estimates, however, is not as great. The lowest is +.33 (Massachusetts) and the highest is +.73 (Illinois). In only two of the seven equations are the regression coefficients on the capital expenditures variable mildly significant.

TABLE 10

COEFFICIENTS OF MULTIPLE CORRELATION AND DETERMINATION; REGRESSION COEFFICIENTS AND STANDARD ERRORS DOMINANT INDUSTRY: ELECTRICAL MANUFACTURING PERIOD: 1960-1964, 1967-1971

(n = 10)

State	Coefficient of Multiple R2	R	Constant — Logarithmic Value	Regression Coefficient and (Standard Error) Value Added	Capital Expenditures
Kentucky*	.984	.992	1.9900	.5380** (.0629)	.0356 (.0449)
Indiana	.980	.990	2.2089	.4873** (.0420)	.0955** (.0373)
New Hampshire	.979	.989	1.7654	.4982** (.0541)	.0136 (.0450)
California*	.975	.988	2.6203	.3966** (.0487)	.1419** (.0510)
Illinois*	.951	.975	1.8165	.7300** (.1704)	-.0304 (.1030)
Massachusetts	.947	.973	2.6717	.3320** (.0990)	.0868 (.0446)
Connecticut*	.800	.894	1.6492	.7149** (.2230)	.0487 (.1429)
Arizona	N/A	N/A	N/A	N/A	N/A

All Rs are significant at the .005 level.

* Not *the* dominant industry in the state, but a dominant industry — the second most important industry in the state.

** Significant at the .05 level.

NA = Not available, due to problems with the data.

Food and Kindred Products: The simple correlation coefficients for: (1) food and kindred products manufacturing value added were found to be significant at the .05 level or better in all except two cases, which were insignificant (Kansas and Utah); and (2) capital expenditures were found to be significant at the .025 level or better in all cases except Missouri and Utah, which were insignificant.

Table 11 presents the multiple regression results for the output model for those states in which food is the dominant manufacturing industry. The explanatory power of these equations is not quite as good as the other two industries' equations. Two R^2 values are above .90; four are in the .80-.89 range, and one is .692.

Table 11 shows that for the food industry equations, the partial regression coefficients on the value added variable are all positive as expected, but three of the seven coefficients are not significant at the .05 level. The range of the four significant estimates of elasticity is rather wide, going from +.88 to +1.85. In only two of the seven equations are the partial regression coefficients on the capital expenditures variable significant.

TABLE 11

COEFFICIENTS OF MULTIPLE CORRELATION AND DETERMINATION; REGRESSION COEFFICIENTS AND STANDARD ERRORS DOMINANT INDUSTRY: FOOD MANUFACTURING PERIOD: 1960-1964, 1967-1971 (n - 10)

State	Coefficient of Multiple R2	R	Constant — Logarithmic Value	Regression Coefficient and (Standard Error) Value Added	Capital Expenditures
Georgia*	.942	.970	-0.4949	1.4977** (.3581)	.0216 (.1418)
Colorado	.937	.968	2.0651	.2714 (.2583)	.2500** (.1042)
Florida	.895	.946	0.7887	.8844** (.2547)	.1407 (.1533)
Minnesota	.895	.946	-0.8294	1.4240** (.3385)	.2144 (.1010)
Missouri*	.875	.935	-1.6068	1.8481** (.2654)	.0195 (.0984)
Wisconsin*	.824	.907	1.6141	.6213 (.3365)	.1876 (.1340)
Iowa	.692	.832	1.0377	.7136 (.5268)	.1858 (.2462)

All Rs are significant at the .005 level, except for Iowa which is significant at the .01 level.

* Not the leading industry in the state, but the second most important industry in the state.

** Significant at the .05 level.

STATISTICAL PROBLEMS

Colinearity: There is a high degree of correlation between the independent variables (manufacturing value added of the dominant industry and capital expdenditures of the dominant industry), however, this situation does not present a real problem [18, p. 610-611].

Spurious Correlation: The effect of trend can give the appearance of correlation, when there is no causal relation. To overcome this problem, total manufacturing value added was adjusted for price level changes by the Gross

National Product Implicit Deflator (GNPIPD) and the dominant industries manufacturing value added was adjusted by the Wholesale Price Index (WPI); subsequent to this translation of the data, logarithmic values were computed and used in conjunction with the logarithmic values of capital expenditures which were unadjusted for price level changes.

Autocorrelation: The test for autocorrelation in this study was based upon the method developed by von Neumann [9, p. 340] which is as follows:

$K = [\Sigma (z_{t+1} - z_t)/n\text{-}1]/\Sigma z_t 2/n$

K = the coefficient of autocorrelation

z = the residual (actual value - predicted value)

t = time period

n = number of observations

The K values obtained in this study were then compared to the values as shown in Table 20.5 [9, p. 341] to determine the level of significance of autocorrelation present in the data examined. The results of the test for autocorrelation revealed that except for Virginia, Connecticut and Georgia no significant autocorrelation exists.

DOMINANT INDUSTRY GROWTH MODEL: PREDICTIVE TEST

For the purpose of the predictive test, the hypothesis is mathematically formulated as follows

(2-1) $RMEG_{ip} = g(GMVARDI_{ip}, GIRDI_{ip})$

RMEG = Exponential growth rate of the region's manufacturing value added

GMVARDI = Exponential growth rate of manufacturing value added of the region's dominant industry

GIRDI = Exponential growth rate of investment (capital expenditures) in the region's dominant industry

p = Industry Region (Chemical - SICC 28; Electrical - SICC 36; Food - SICC 20)

i = State Variable within Industry Region (Chemical - i = 1,2,3 .....8; Electrical - i = 1,2,3 ....7; Food - i = 1,2,3 ....7)

The exponential growth rates of RMEG, GMVARDI and GIRDI are single observations on growth rates, that is each variable is represented by a single growth rate for the ten year period (1960-1964, 1967-1971) as calculated using 'exponential growth curve theory' (see section on methodology). The exponential growth rate is a compounded rate of change, and as such captures the manufacturing change over the entire ten year period.

The analysis is conducted using multiple correlation on cross sectional data for each of the three industry regions; the exponential (ten year annually compounded) growth rates of the variables for eight states are used for Chemical - SICC 28, seven states for Electrical - SICC 36, and seven states for Food - SICC 20 (Tables 12, 13, and 14).

Chemical and Allied Products: The coefficient of multiple determination of the exponential growth rates shown in Table 12 was found to be .1546; the coefficient of multiple correlation was found to be .3935, which is a non-significant statistical finding.

TABLE 12

CHEMICAL INDUSTRY REGION - EXPONENTIAL GROWTH RATES FOR THE TEN YEAR PERIOD 1960-1964, 1967-1971

	Dependent Variable	Independent Variables	
State	**Total Manufacturing Value Added**	**Chemical Manufacturing Value Added**	**Chemical Manufacturing Capital Expenditures**
Tennessee	8.5%	9.3%	10.0%
Texas	7.8%	9.3%	15.0%
Alabama	7.6%	16.5%	17.3%
South Carolina	7.6%	10.6%	25.6%
Louisiana	7.1%	13.3%	18.7%
Virginia	5.9%	6.5%	5.1%
New Jersey	3.3%	9.7%	9.1%
West Virginia	2.8%	5.0%	3.8%

Electrical Machinery and Electronics: The coefficient of multiple determination of the exponential growth rates shown in Table 13 was found to be .9019; the coefficient of multiple correlation was found to be .9497, which is statistically significant at the .025 level.

TABLE 13

ELECTRICAL INDUSTRY REGION - EXPONENTIAL GROWTH RATES FOR THE TEN YEAR PERIOD 1960-1964, 1967-1971

	Dependent Variable	Independent Variables	
State	**Total Manufacturing Value Added**	**Chemical Manufacturing Value Added**	**Chemical Manufacturing Capital Expenditures**
Kentucky	8.3%	14.1%	16.0%
California	5.2%	9.5%	8.4%
New Hampshire	4.8%	9.5%	9.8%
Indiana	4.8%	8.7%	7.6%
Illinois	4.3%	6.5%	10.1%
Connecticut	3.6%	5.4%	6.9%
Massachusetts	2.7%	5.5%	11.3%

Food and Kindred Products: The coefficient of multiple determination of the exponential growth rates shown in Table 14 was found to be .3217; the coefficient of multiple correlative was found to be .5672, which is a non-significant statistical finding.

TABLE 14

FOOD INDUSTRY REGION - EXPONENTIAL GROWTH RATES FOR THE TEN YEAR PERIOD 1960-1964, 1967-1971

	Dependent Variable	Independent Variables	
State	**Total Manufacturing Value Added**	**Food Manufacturing Value Added**	**Food Manufacturing Capital Expenditures**
Florida	9.1%	10.2%	13.1%
Georgia	8.1%	5.4%	13.5%
Iowa	6.3%	5.5%	12.1%
Minnesota	6.1%	2.8%	11.0%
Colorado	6.0%	6.9%	17.3%
Missouri	5.0%	2.6%	5.0%
Wisconsin	4.1%	4.1%	9.3%

INTERREGIONAL DIFFERENCES

Within any *census* region, there were growth disparities — some states within any census region were high achievers, and others were poor achievpatterns between urban and rural units [11]. Rural sociologists, on the other hand, have been very concerned about measuring the precise meaning of "rural". Much of this work is inferential and based upon comparisons between urban and rural life patterns [18]. Generally, these scholars have agreed that urban-rural sociological differences exist, although the precise boundaries of those differences is difficult to establish [21].

In political science, relatively little work has been completed on the problem of rural-urban differences. Bryan [4], for example, has suggested that rural politics should be perceived in developmental-technological terms, and Sokolow [20] has begun to examine that phenomenon in depth.

Public administration has also made a relatively small investment in the field [25]. Some exceptions, however, exist. Seroka [19], in a study of rural and urban administrators in North Carolina, discovered differences in the perception of the importance of public policy issues between urban and rural area administrators. Lewis [13] found similar differences between urban and rural county managers, and Marando & Thomas [14] pinpointed urban-rural differences among county commissioners. Nevertheless, relatively little is known about rural administration, in general, and about the differences between urban and rural administration, in particular [3].

Even though the precise differences between urban and rural politics have not yet been completely charted, the case that meaningful differences exist between them can be accepted. The equally important question about rural homogeneity, however, has not been subjected to the same intensive scrutiny, and it deserves further examination. In recent years, some scholars and policy reformers have begun to question the accuracy and efficacy of the homogeneous rural model. James Copp [6] and John Wardwell [23], for example, offered independently the thesis that the division between urban and rural is not the only meaningful distinction for rural areas. Frank Bryan [42], and Ted Bradshaw and Edward Blakely [2], suggested that the growth of technology is an important explanation for this phenomenon, and the Hightower Report [10] implied that income and interest group criteria should replace the urban-rural dimension as the mcst significant factors affecting rural life. None of these research projects, however, examined the extent to which rural variation exists and affects the perception of rural problems.

There are several practical advanlages to measuring the magnitude of intra-rural variation on policy issues and identifying its determinants. First, assuming considerable intra-rural variation, policy issues which are "rural" can be separated from more localized and parochial policy issues. Second, public programs can be devised to meet more effectively and more efficiently rural needs. Third, the impact of political structure, statutes, and philosophy upon perceived rural needs can be separated from the allegedly deterministic impact of social-economic characteristics.

This article examines the proposition of rural homogeneity by analyzing the perceptions of rural county policy leaders towards administrative problems in their counties. Second, it measures the impact of socio-economic, political-structural, and individual background and attitudinal orientations on the regions as Tables 4, 5 and 6 reveal. The coefficients of variation for exponential growth rates for the states comprising the industry regions are Chemical - .3412, Electrical - .5087, and Food - .4016.

d) Rank correlation between the dominant industry and state's total manufacturing for the ten year period was found to be significant in two out of three of the industry regions: Electrical and Food. The coefficients of correlation are: Chemical - .31, Electrical - .96, and Food - .70.

e) Variation among exponential growth rates among the dominant industries using cross-sectional data were found to be statistically significant. (See Table 7)

f) Variation among exponential growth rates of capital expenditures were greater in some instances among census regions than among industry regions.

4) Geographic Location: Most (6) census regions had states that experienced slow and poor quality growth. Each census region experienced a mixed economic pattern over the period 1960-1964, 1967-1971.

5) Industry Region: The evidence (Table 7) reveals variations which are masked in the geographic location approach (Table 15).

CONCLUSION

DOMINANT INDUSTRY TEST — AN INTERPRETATION

In this study: (a) the state and the industry region approach seems to provide a better framework for analysis than the census region; and (b) the empirical findings are consistent with the priori expectations as reflected in the theory. Thus the dominant industry hypothesis is supported, based upon the finding for the *output* model: Equation (1). However, the finding of non-significant statistical coefficients for the *growth* model: Equation (2.1), in two out of three cases (industry regions), was contrary to the apriori expectations assuming a perfect capital market and regional manufacturing intra-dependence. This finding *may possibly* be attributed to imperfections (market failures) in the capital market due to the variety of forces, or the inadequacy of the transportation networks both of which negated regional intradependence. This apparent randomness in the findings for the growth model (the predictive test) may be interpreted as follows:

1) **Capital abundance** — Of the 38 states examined, the chemical industry region contained four of the nation's capital abundant states (Texas, New jersey, Louisiana and Tennessee). However, these states in terms of growth rates for total manufacturing value added, were ranked (except for Tennesee) rather low among the thirty-eight states reviewed. Their ranks were eleventh, thirty-third, fifteenth and fifth, respectively. It can be argued, in the case of those states, that capital abundance is not a function of higher marginal rates of return in those regions (states), but is caused by market failures — imperfections in the capital market. Also, capital expenditures (investment) is only a necessary and not a sufficient condition for regional manufacturing growth (over-capacity is not growth, only increased output for export for local

consumption is growth).

2) **Regional Intradependence** — The full multiplier effect of any industry cannot be felt in a region unless the supporting industries can respond to any change emanating from the industry experiencing growth. The point that is being stressed here is that the warranted growth of a region based upon the natural growth of the dominant industry can be impeded. It may very well be that, due to an unfavorable transportation network or the unavailability of money capital to the supportive industries thus inhibiting the response function, the full effect of the expansion in the dominant industry was not felt in Louisiana (with a dominant industry multiplier of .39) and particularly New Jersey (with a multiplir of .37). Since New Jersey and Louisiana are capital abundant states in this study, the low level of regional intradependence experienced in those states reflects the fact that the firms in the supporting industries were not responsive or were not able to respond to the change in demand for intermediate goods, which are the inputs for the dominant industry. Such inputs were provided by other states, thus, those two states were denied the growth that would normally accrue to them.

DIRECTIONS FOR FUTURE RESEARCH

The findings of this research does suggest that regionalization (geographic location) does not explain growth disparities, nor does the *dominant industry* by itself explain the divergent growth patterns among the states; for within each *industry region* there were states that were high achievers and others that were low achievers. Given the foregoing findings, the impact of transportation networks and the determinants of the regional flow of capital are other areas to be explored which may enhance the predictive power of the model. Apparently, the explanatory power of the model has not been diminished by the findings, but the predictive power of the model can be enhanced by the incorporation of two fctors: a transportation network coefficient and a regional capital flow coefficient.

APPENDIX A

GROWTH RATES OF MANUFACTURING VALUE ADDED (ADJUSTED FOR PRICE LEVEL CHANGES) FOR THE TEN YEAR PERIOD: 1960-1964, 1967-1971

	Exponential Growth Rates of Manufacturing Value Added			
Region Census/State	**Total %**	**Chemical %**	**Electrical %**	**Food %**
New England	**3.2**	**10.0**	**6.5**	**2.3**
New Hampshire	4.8		9.5	
Massachusetts	2.7		5.5	
Connecticut*	3.6		5.4	
Mid Atlantic	**3.3**	**8.2**	**6.2**	**1.4**
New Jersey	3.3	9.7		
East North Central	**4.4**	**8.9**	**6.9**	**3.5**
Indiana	4.8		8.7	
Illinois*	4.3		6.5	
Wisconsin	4.1			4.1
West North Central	**5.9**	**9.3**	**10.0**	**3.3**
Minnesota	6.1			2.8
Iowa	6.3			5.5
Missouri*	5.0			2.6
North Dakota	12.9			8.5
South Dakota	4.4			1.7
Nebraska	8.5			5.2
Kansas*	5.8			1.1
South Atlantic	**6.8**	**8.4**	**14.8**	**6.1**
Delaware	8.3			
Maryland*	2.6			5.2
Virginia	5.9	6.5		
West Virginia	2.8	5.0		
South Carolina*	7.6	10.6		
Georgia*	8.1			5.4
Florida	9.1			10.2
East South Central	**8.5**	**11.0**	**16.6**	**5.2**
Kentucky*	8.3		14.1	
Tennesee	8.5	9.3		
Alabama*	7.6	16.5		
West South Central	**8.0**	**10.2**	**17.2**	**6.1**
Arkansas	11.2			
Louisiana*	7.1	13.3		
Oklahoma*	5.5			4.1
Texas	7.8	9.3		
Mountain	**6.3**	**10.1**	**30.6**	**4.7**
New Mexico	5.6			1.8
Montana	3.4			
Idaho	7.9			8.2
Colorado	6.0			6.9
Arizona*	11.6		23.8	
Utah	2.6			1.3
Nevada	4.7			
Pacific	**5.2**	**7.9**	**9.7**	**3.8**
Washington*	4.5			
Oregon*	5.8			4.5
California*	5.2		9.5	
U.S.	**5.0**	**8.9**	**8.7**	**3.7**

* Not the dominant industry, but the second most important industry in the state.

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