Staff Papers Series

Staff Paper P76-21
Title V Report 8

June, 1976

AN ANALYSIS OF NONMETROPOLITAN GROWTH IN MINNESOTA

Ronald J. Dorf
and
Robert A. Hoppe

Department of Agricultural and Applied Economics

University of Minnesota
Institute of Agriculture, Forestry and Home Economics
St. Paul, Minnesota 55108

Staff Paper P76-21
Title V Report 8

June, 1976

AN ANALYSIS OF NONMETROPOLITAN GROWTH IN MINNESOTA

Ronald J. Dorf

and

Robert A. Hoppe

AN ANALYSIS OF NONMETROPOLITAN GROWTH IN MINNESOTA*

R. J. Dorf and R. A. Hoppe**

The recognition that nonmetropolitan growth may be occurring in the United States is relatively new. In the early 1970's, a preference for a rural type residence was noted by a number of survey studies. Mazi and Rawling [14] found that nationally a large group of persons considered moving to rural areas in the near future. Zuiches and Fuguitt [8,9], in a survey of Wisconsin residents, found that of the respondents expressing a preference to live in a rural area a majority desired a small town or open area within thirty miles of a city of at least 50,000 population. [8] At first glance, the desire of people to live in nonmetropolitan areas is at odds with the long term decline of nonmetropolitan areas. The Economic Development Division of ERS [6] in a national study concluded that the 1,700 nonmetropolitan counties in the United States experienced a net outmigration of ten percent between 1960 and 1970. This outmigration was centered on the early twenties age groups, leaving an older population base. A high fertility rate for the remaining young adults maintained a large population under 14 years of age. Agriculture

---

* Paper presented at Midwest Regional Science Association meetings, Bowling Green, Ohio, April 30 - May 1, 1976.

** Research Associate and Research Specialist, Department of Agricultural and Applied Economics, University of Minnesota.

was the main source of employment followed by manufacturing, trade, and state and local government. This economic base produced a per capita income two-thirds that of metropolitan counties. The towns in the nonmetropolitan counties demonstrated uneven growth with half the towns gaining population and half losing population.

The use of aggregate county data masked many growth trends. Beale [2] in his national study of nonmetropolitan growth for the same time period found a number of nonmetropolitan areas experiencing population growth; the Ozarks, Tennessee Valley, Texas hill country, and Upper Great Lakes cutover lands. For the Ozarks region, in particular, the growth was based on new recreation and retirement areas created by reservoir development. Gustafson [14], as did Borchert and Carroll [3], concluded that rural nonfarm population grew in the nonmetropolitan counties of the Upper Midwest between 1960 and 1970. Borchert and Carroll found that while sixty percent of the counties in Minnesota lost population between 1960 and 1970, over ninety percent of the counties increased their rural nonfarm populations. Gustafson, in his study of the Upper Midwest, found the largest increases in rural nonfarm population to be in the counties (1) adjacent to Minneapolis-St. Paul, (2) in the lake, wooded, and rolling land areas of central Minnesota, and (3) northern and central Wisconsin. For the same Wisconsin counties for which Gustafson found increasing rural nonfarm population between 1960 and 1970, Erickson and Huddlestrom [7] found overall population growth between 1970 and 1974. In these counties, the smaller cities and non-urban areas were growing most rapidly with manufacturing industries supplying new employment opportunities. The larger cities in the counties depend more on

retail trade, services, and government to provide new jobs. Finally, employment gains were larger than population gains indicating either commuting or the labor force participation rates were increasing.

The study presented here was undertaken to answer questions concerning nonmetropolitan growth in Minnesota. As local governmental units in nonmetropolitan areas of the state became aware that they were experiencing or could expect growth in the near future they began to propose new state programs and enabling legislation to deal with perceived problems. However, before sound new programs can be undertaken or new enabling legislation passed, it should be determined whether nonmetropolitan growth is a homogeneous (the same statewide) or heterogeneous (unrelated for different areas of the state) phenomenon. If nonmetropolitan growth is homogeneous throughout the state, a singular set of program and enabling legislation applied statewide should deal adequately with the problems stemming from nonmetropolitan growth. Heterogeneous nonmetropolitan growth would require a number of different programs and enabling legislation to deal with the variety of nonmetropolitan growth problems faced by local governments. The purpose of this study was to determine if homogeneous or heterogeneous nonmetropolitan was occurring in Minnesota. Further, if heterogeneous growth were occurring, what are the structural and spatial aspects that made it heterogeneous.

Methodology

The preceding review of literature disclosed two points to consider in designing a study of nonmetropolitan growth. First, it is not

altogether clear that nonmetropolitan growth is a phenomenon based on shifting populations, an economic revitalization of rural areas based on new employment patterns, or a composite of both.

Growth in the most general context is defined as the increase in some occurrence or activity. The studies reviewed used one or more of the following to measure to determine the occurrence of nonmetropolitan growth; population changes, changes in the income base, expansion or contraction of the employment base, or changes in the occupation mix. It can be argued from a policy perspective, however, that a single measure or a series of single measures are generally lacking. The policy makers deal with the overall dimensions of growth occurring in an area. In most cases growth is a compilation of interrelated changes that can vary within or among counties. This reduces the problem of specifying growth to one of determining which measures of growth are moving together or not moving together. Growth is then defined by a set of variables increasing or decreasing together for an area over time.

Applying this definition of growth, this study took a multivariable approach to specifying nonmetropolitan growth in Minnesota. The data used came from the U.S. Census 4th Count General Characteristics of the Population data tapes for both 1960 and 1970. From the variables on the tape, employment by industry was selected to measure changes in employment opportunities, employment by occupation for both males and females was used to measure changes in labor force participation and job mix, the family income pyramid was used to measure income change, and the male-female population pyramids were used to measure population changes. Table I lists the 102 varia-

TABLE I

Variables Used in Study

Employment by Industry:

1 Agriculture
2 Mining
3 Construction
4 Furniture
5 Primary Metals
6 Fabricated Metals
7 Machinery
8 Electrical Machinery Equipment
9 Motor Vehicles
10 Other Durable Goods
11 Food and Kindred Products
12 Textile Mill Products
13 Printing
14 Chemical
15 Other Nondurable Manufacturing
16 Railroad Express
17 Trucking Warehouse
18 Other Transport
19 Communications
20 Utilities
21 Wholesale
22 Foods, Dairy Products
23 Eating, Drinking
24 Other Retail
25 Finance, Insurance, and
26 Business Services
27 Repair Services
28 Private Household
29 Other Personal Services
30 Entertainment
31 Education Government
32 Education Private
33 Welfare
34 Hospitals
35 Other Professional Services
36 Public Administration

Male Employment by Occupation:

37 Professional and Technical, Male
38 Farmer, Farm Manager
39 Managers Office and Proprietor
40 Clerical and Kindred
41 Sales Workers
42 Craftsman and Foremen
43 Operative and Kindred
44 Service Workers
45 Farm Laborers
46 Laborers

Female Employment by Occupation:

47 Professional & Technical, Female
48 Farmer, Farm Manager
49 Managers, Office Proprietor
50 Clerical and Kindred
51 Sales Workers
52 Craftsmen
53 Operatives
54 Private Household
55 Service Workers
56 Farm Laborers
57 Laborers

Family Income Pyramid:

58 Family Income Under $1000
59 Family Income $1000-$1999
60 Family Income $2000-$2999
61 Family Income $3000-$3999
62 Family Income $4000-$4999
63 Family Income $5000-$5999
64 Family Income $6000-$6999
65 Family Income $7000-$7999
66 Family Income $8000-$8999
67 Family Income $9000-$9999
68 Family Income $10,000-$14,999
69 Family Income $15,000-$24,999
70 Family Income $25,000 - Over

Male Age Pyramid:

71 Under 5 Male
72 5-9
73 10-14
74 15-19
75 20-24
76 25-29
77 30-34
78 35-39
79 40-44
80 45-49
81 50-54
82 55-59
83 60-64
84 65-69
85 70-74
86 75 - Over

Female Age Pyramid:

87 Under 5 Female
88 5-9
89 10-14
90 15-19
91 20-24
92 25-29
93 30-34
94 35-39
95 40-44
96 45-49
97 50-54
98 55-59
99 60-64
100 65-69
101 70-74
102 75 - Over

bles included in these six variable sets.

Second, the studies reviewed demonstrate that nonmetropolitan growth is not a homogeneous phenomenon across all nonmetropolitan areas. Nonmetropolitan growth may only occur in limited areas of a large geographical region, or a nonmetropolitan county may show overall decline while one or two of the county population sectors may be experiencing growth. The spatial dimension of nonmetropolitan growth is comprised of two components; growing and nongrowing counties and growing and nongrowing population sectors within the counties. The census collects data on a county basis by place of residence. The county population is divided into three sectors: urban, rural nonfarm and rural farm. These sectors define specific types of living conditions a person can choose within a county. The use of such a delineation permits a determination of how people change their residential location preferences in relation to changing economic conditions. This delineation allows the examination of the locational aspect of nonmetropolitan growth within counties. The county total values (summation of the urban, rural nonfarm, and rural farm population sectors) were used as a fourth sector to allow a comparison of information gained or hidden using a three sector population approach over a county aggregate approach.

The most direct measure of growth is the net change between 1960 and 1970 for each of the 102 variables by county sector. These are used as the base measure of change in the study:

$$NC_{isj} = X_{isj1970} - X_{isj1960}$$

Where:

NC_{isj}	=	net change for variable i for sector s in county j between 1960 and 1970.
$X_{isj1970}$	=	value for variable i for sector s in county j in 1970.
$X_{isj1960}$	=	value for variable i for sector s in county j in 1960.
i	=	1 102
s	=	1 4
j	=	1 87

Net change shows only the underlying direction and magnitude of growth. Net change cannot determine the unique local growth that may indicate potential future difference in direction and magnitude of growth for areas of the state. All counties in the state could be experiencing employment growth in two industries, but some counties could be growing relatively more in one industry than the other. Net change would determine the employment growth in both industries but miss the relative employment shifts that are occurring. The unique local or residual growth is the growth over or below the underlying state growth rate. This is the conceptual framework for the shift and share model. A modified version of the shift and share model that takes into account both the four county population sectors and six variable sets was employed to estimate the local or residual change, R_{kisj} $(X_{kisj1960})$, for each variable by observation. A separate shift and share model was run for each variable set by county population sector. The growth or change is relative to the underlying change for a particular population

sector in the state and not the overall state growth rate. This procedure resulted in a consistent set of residual change estimates for each variable for each of the four county population sectors.

$$NC_{kisj} = S_k (X_{kisj1960}) + M_{kis} (X_{kisj1960}) + R_{kisj} (X_{kisj1960})$$

Where:

NC_{kisj}	=	net change for variable i in variable set k between 1960 and 1970 for sector s in county j.
$X_{kisj1960}$	=	value for variable i in variable set k for sector s in county j in 1960.
S_k	=	the growth rate for variable set k for sector s for the state.
M_{kis}	=	the growth rate for variable i in variable set k for sector s for the state with the state S_k change netted out.
R_{kisj}	=	the residual growth rate for variable i in variable set k for sector s in county j with the S_k and M_{kis} growth rates netted out.
k	=	1 6
i	=	1 . . . . 36, 37 . . . . 46, 47 . . . . 57, 58 . . . . 70, 71 . . . . 86, 87 . . . . 102.
s	=	1 4
j	=	1 87

In studies to determine interrelationships between variables and/or to determine spatial geographic groupings factor analysis is

used extensively. Adelman and Morris [1], Cattel [5], and Dorf [6] used factor analysis to determine basic relationships between economic and social variables. Casey [4] and Hagood [12, 13] used factor analysis to delineate homogeneous regions. Mingo and Catelonello [15] used factor analysis for both purposes in their study of change in Oklahoma counties between 1960 and 1970.

This study also uses factor analysis to determine variable relationships and spatial groupings of counties experiencing like growth. The net change variables were analyzed by R mode factor analysis to discern those variables in the data sets changing in relationship to each other. Since the number of variables exceeds the number of observations for the R mode factor analysis, the data were separated into two sets, then factored, and a single composite factor loadings matrix was formed. The net change and residual changes were Q mode analyzed to establish groupings of counties experiencing similar patterns of growth for the county population sectors. The Q mode analysis of the net change determined general groupings of counties experiencing similar overall growth. The Q mode analysis of the residual change produces subgroups of counties having similar local or residual growth patterns. The varimax rotation was utilized for both the R and Q factor runs. This minimized the variance between the variables or counties and maximized the variance between the extracted factors. The result is to minimize the interdependence between any set of extracted factors or county groupings.

Analysis

Table II gives the cumulative percent of variance in overall

growth explained by the significant (eigen value greater than one) factors for each of the four county population sectors. Comparatively, the rural farm sector has the largest number of significant factors explaining the smallest percentage of the total variance. The urban sector on the other hand has the fewest significant factors accounting for the largest percentage of variance explained. Rural nonfarm lies between the urban and rural farm sectors both in the number of significant factors and percentage of variance explained. The variation in growth among the counties' urban sectors is more fully accounted for than the variation in growth for the counties' rural sectors. The larger number of significant factors shows rural growth to be more heterogeneous than urban growth. The smaller percentage of total variance explained for the rural population sectors shows rural growth to have a larger random component. The dominance of the county total by the urban sector is markedly apparent. The county total has one significant factor more than the urban sector while explaining two percent less of the total variance. The addition of the rural sectors to the urban in the county total sector should decrease the percentage of variance explained given their larger random component. The slight decrease in the total variance explained indicates that the urban sector accounts for the largest part of the explained variance in growth for county aggregate totals.

The composite R mode factor loadings matrix for the four sectors is given in Table III. These loadings can only determine concurrent changes in variables. No direction of causation can be determined because of the design of this study. The economic interpretation of the growth relationship is that changes in the local industrial employ-

ment base cause other socio-economic changes in a local area. In a number of places in the paper for explanatory purposes, the economic or the industrial employment explanation of growth is used to define the overall growth occurring in the county population sectors. The factor loadings in Table III show which variables had high or low association with a particular extracted factor. Since the varimax rotation was utilized, the difference in variance among variables is minimized for a particular factor. High loadings in Table III designate sets of variables whose variance in their net change measures were concurrent by county population sectors in Minnesota between 1960 and 1970.

TABLE II

Cumulative Percent of Variance Explained by Significant Factors

	Significant Factors									
Sector	1	2	3	4	5	6	7	8	9	10
County Total	67	82	88	91	93					
Urban	76	86	92	95						
Rural Nonfarm	50	64	69	72	74	75				
Rural Farm	18	28	33	37	41	44	46	49	51	53

The factor loadings for the county total sector in Table III shows three positive growth factors and two negative growth or decline factors. From the economic viewpoint, the three growth factors are associated with increased employment in manufacturing, trade, services, and government. The declining factors were associated with decreased employment in agriculture and mining. The lack of high loadings on factor four and five for the county total sector and factor four for the urban sector in

TABLE III
Composite Factor Loadings for Net Change by County Sector

Var #	County Total					Urban				Rural Nonfarm							Rural Farm									
	1	2	3	4	5	1	2	3	4	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10
1	07	00	08	-1 00	00	00	- 06	- 48	15	12	17	- 99	06	- 05	02	- 02	- 75	- 09	- 12	- 10	- 18	- 20	- 08	18	- 04	- 06
2	- 02	07	- 05	07	- 90	- 07	02	08	- 98	- 01	25	06	- 12	- 06	- 71	04	- 04	18	- 68	- 13	- 08	- 11	06	05	09	01
3	64	65	36	00	00	73	65	13	- 09	95	00	- 10	- 06	17	03	07	09	57	- 02	42	- 05	11	- 28	- 05	- 24	10
4	- 86	02	- 10	14	06	- 90	- 11	- 20	25	23	09	21	- 24	30	- 16	23	13	- 04	47	20	- 02	- 03	05	07	- 14	16
5	48	33	00	- 03	- 67	46	25	02	- 77	46	- 07	- 17	06	- 17	- 01	02	- 07	14	55	- 18	- 03	05	- 02	- 09	33	- 06
6	19	53	77	- 07	02	14	85	47	07	84	07	- 08	14	11	01	12	- 05	03	- 18	28	45	02	03	- 24	16	12
7	87	23	37	- 01	- 10	85	37	32	- 09	85	20	00	04	05	00	00	14	02	01	12	02	14	03	00	15	70
8	70	32	49	- 08	- 11	69	54	41	- 08	67	23	- 08	15	- 12	- 01	06	- 18	- 15	- 07	02	36	06	- 02	- 06	55	- 02
9	70	46	15	- 05	- 12	76	48	00	- 12	59	18	- 06	- 12	03	00	13	- 10	- 02	03	10	03	02	43	- 11	03	- 03
10	- 85	32	- 32	05	07	- 84	- 04	- 50	04	59	- 06	07	- 37	08	- 11	13	06	30	12	51	15	- 15	- 07	- 37	13	15
11	- 91	07	- 19	01	01	- 91	- 10	- 28	04	20	05	00	05	08	- 04	78	34	11	13	14	- 23	- 01	38	28	27	00
12	- 87	05	18	10	33	- 87	- 12	- 33	27	29	- 76	11	- 06	22	- 02	10	13	05	- 10	10	- 05	01	- 01	05	- 11	- 04
13	- 06	73	- 20	06	- 18	03	33	- 64	- 39	84	04	00	16	29	- 19	05	12	12	02	22	00	46	- 33	- 02	20	- 01
14	50	10	78	- 07	06	42	40	77	02	65	- 13	- 16	58	09	- 06	17	13	32	- 25	37	11	14	17	50	05	- 02
15	55	- 13	77	- 01	- 13	45	28	81	- 01	67	07	- 15	46	19	02	- 10	10	06	17	77	- 05	09	03	00	00	05
16	- 85	19	- 31	02	- 30	- 86	- 06	- 40	- 23	- 01	66	00	- 26	11	- 37	33	19	- 02	67	07	- 04	00	- 02	02	- 02	04
17	44	56	58	- 05	- 20	46	76	35	- 21	62	19	- 17	30	03	- 01	34	20	05	- 10	- 05	18	23	- 11	15	37	- 05
18	79	53	- 05	03	- 10	94	12	- 17	- 21	81	20	04	00	06	- 07	09	20	05	00	14	15	20	10	38	- 13	02
19	79	34	39	01	08	84	42	24	01	68	- 18	04	12	14	- 05	07	11	41	02	21	06	11	- 15	09	18	- 01
20	75	27	47	04	17	82	34	34	15	75	07	08	12	14	00	- 04	06	27	- 25	41	23	18	00	- 17	- 07	- 11
21	94	30	10	00	- 06	95	24	08	- 14	87	00	10	05	07	04	11	22	14	- 17	11	19	29	- 15	- 21	16	- 14
22	71	39	46	05	- 19	73	48	35	- 26	76	- 24	04	11	28	- 19	- 03	12	14	- 26	11	33	15	- 06	06	24	01
23	93	16	29	02	01	92	25	28	- 00	89	03	- 13	08	25	- 04	04	03	48	- 21	01	- 11	- 01	- 10	- 22	03	18
24	93	31	09	05	- 04	94	28	04	- 13	92	- 21	- 03	- 10	21	04	16	42	35	12	- 11	13	45	04	05	13	- 30
25	94	26	15	00	- 09	94	25	14	- 12	89	14	- 06	04	18	- 03	14	33	08	- 08	15	- 27	29	38	- 31	- 23	04
26	97	19	- 02	00	- 07	96	14	01	- 14	81	13	- 15	- 01	- 07	05	05	08	13	- 22	03	27	16	- 20	- 09	- 03	20
27	92	31	- 12	00	- 10	95	19	- 11	- 18	59	23	- 21	02	27	- 01	27	05	13	- 10	06	07	- 13	15	- 63	12	- 06
28	- 97	03	- 12	- 08	- 11	- 96	- 09	- 20	- 08	11	14	- 15	01	00	00	10	- 88	- 06	06	- 09	00	- 03	18	03	00	- 03
29	87	33	27	- 01	- 12	90	34	19	- 13	77	17	00	03	14	- 17	14	- 27	39	- 06	00	- 03	03	00	01	30	- 18
30	89	36	- 07	05	04	95	20	- 14	- 10	64	- 18	- 03	35	36	- 09	- 02	11	27	- 03	04	16	- 23	05	- 01	29	- 27
31	94	14	24	03	00	93	22	24	- 03	91	- 07	- 13	01	36	- 02	- 01	17	31	- 21	00	- 03	25	- 08	- 31	00	- 29
32	77	02	51	04	00	72	28	53	03	61	- 15	- 06	18	06	- 05	03	09	12	12	23	03	12	- 46	- 02	05	- 04
33	89	16	23	- 06	11	93	24	19	06	25	30	- 20	51	08	26	07	02	07	00	00	66	08	06	07	07	- 11
34	94	14	22	02	00	94	22	22	- 03	71	- 04	12	- 18	32	11	16	01	52	09	- 01	14	32	- 03	13	09	01
35	97	08	15	03	02	95	18	23	- 01	84	- 25	06	19	41	06	- 06	38	48	06	- 04	39	18	06	- 07	00	01
36	65	52	46	00	- 07	72	57	30	- 05	85	04	- 04	- 04	18	- 08	16	07	03	- 04	12	20	67	00	17	- 03	11
37	91	21	33	00	- 07	89	29	31	- 08	93	08	- 06	07	13	02	09	09	38	- 39	05	18	29	- 19	11	- 05	07
38	00	00	16	- 79	07	- 84	- 06	- 08	15	12	10	- 73	04	06	01	- 04	- 72	- 08	- 18	- 02	- 28	20	- 17	16	- 07	00
39	83	45	05	03	- 28	87	31	01	- 34	86	11	08	- 12	10	- 13	16	33	47	- 02	11	29	16	22	25	14	- 10
40	30	81	11	04	- 41	31	61	- 17	- 65	82	08	01	- 14	20	- 16	30	25	- 06	- 37	11	- 09	40	05	23	- 10	15
41	30	89	14	- 01	- 02	48	71	- 27	- 25	88	00	00	01	15	01	14	07	19	- 05	09	31	15	19	- 21	- 13	06
42	01	85	50	- 02	- 05	- 10	95	15	- 22	91	- 03	- 06	11	19	- 02	20	08	67	- 13	42	16	29	- 01	- 26	- 06	05
43	02	57	30	00	- 70	00	63	23	- 67	62	49	- 05	- 12	18	- 33	38	04	13	16	21	04	15	07	- 03	72	28
44	93	13	32	02	00	90	26	31	- 01	88	- 08	06	16	- 18	- 07	- 03	- 01	31	- 02	11	31	00	04	- 08	37	- 01
45	- 06	- 12	- 15	- 71	02	- 27	- 33	- 72	05	- 10	- 03	41	04	06	01	17	- 65	- 16	- 06	- 17	11	24	- 04	22	08	- 14
46	75	58	05	09	01	83	48	- 13	02	73	00	02	- 25	04	- 15	00	10	11	43	40	00	03	- 01	08	26	02
47	96	16	17	03	05	95	21	19	- 09	93	01	03	09	- 07	- 01	- 06	21	35	00	07	- 06	47	- 37	- 05	21	- 07
48	- 13	08	02	- 30	- 41	- 86	13	- 06	07	- 03	60	- 27	17	15	- 16	06	- 10	04	30	- 10	13	15	14	- 04	- 08	- 04
49	92	20	10	08	- 21	93	20	13	- 21	49	- 08	01	10	02	- 68	06	14	07	13	- 05	03	64	04	02	14	04
50	94	20	23	01	- 04	93	27	21	- 07	95	02	- 04	16	07	01	09	34	22	- 12	15	18	56	- 02	- 20	03	06
51	82	32	35	04	- 12	81	44	25	14	79	- 18	02	20	05	- 13	03	24	03	07	09	16	09	26	- 06	17	- 33

Variables are listed according to Table I

TABLE III CONT'D
Composite Factor Loadings for Net Change by County Sector

Var	County Total					Urban				Rural Nonfarm							Rural Farm									
	1	2	3	4	5	1	2	3	4	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10
52	89	21	35	05	00	88	33	28	-04	78	-20	-02	18	-12	-10	-14	30	35	06	05	11	09	00	-20	10	-12
53	63	55	47	03	-03	67	65	26	-05	84	00	-07	11	35	-06	02	20	02	-03	69	18	07	02	-01	18	00
54	-94	11	-14	-09	-14	-95	-06	-23	-11	34	16	-11	00	03	03	06	-83	-06	00	-08	07	-06	25	-06	03	03
55	95	16	23	03	03	94	24	23	-00	92	-01	-06	06	-08	05	18	16	79	-03	07	25	-06	01	-05	09	-08
56	-02	02	00	-54	-11	-29	-28	-16	09	21	21	-28	07	-16	11	-19	-25	03	03	-14	-08	-07	22	01	-05	-03
57	93	23	14	05	00	94	25	12	-06	52	-06	14	22	11	30	24	01	17	07	03	58	03	-10	-13	10	02
58	-64	15	-05	-48	-33	-91	-01	-20	-31	13	67	-09	11	-31	05	07	-69	-02	-07	00	-00	-07	14	-07	31	-04
59	-87	00	-14	-25	-34	-95	-10	-21	-17	08	86	-06	-03	-14	-21	02	-75	07	02	-16	-10	-15	08	-11	40	00
60	-88	-03	-16	-20	-34	-94	-13	-21	-17	10	84	-07	07	-01	-12	01	-79	07	04	-17	-07	-26	-05	-05	18	-11
61	-83	-01	-21	-16	-45	-91	-09	-27	-25	02	93	-10	-05	00	-07	07	-66	14	10	-15	-16	-17	00	-06	-03	-29
62	-84	-12	-25	-08	-42	-90	-15	-28	-24	-17	91	-09	-19	-03	10	19	-20	-18	43	-06	-11	-00	-07	04	-12	-49
63	-89	-19	-28	01	-26	-91	-22	-30	-25	-29	77	04	-15	10	20	41	25	03	17	-06	-06	01	-05	20	-33	-38
64	-92	-25	-23	05	-12	-92	-36	-25	-05	-26	22	24	-26	24	09	76	38	-07	05	07	00	09	-12	-04	-58	-31
65	-94	-25	-18	08	00	-93	-26	-20	02	03	-44	23	-04	34	01	74	38	19	-06	12	09	-10	00	08	-66	02
66	-89	-17	-07	15	33	-91	-24	-11	25	43	-75	00	10	21	-10	32	52	17	-15	19	-14	16	09	14	-42	05
67	22	44	41	23	69	36	42	51	58	70	-65	07	07	15	-06	03	44	09	-32	32	12	31	13	-05	-15	08
68	84	39	28	01	21	87	36	30	10	85	-46	-07	10	09	-07	-13	44	29	-26	20	24	33	-06	06	-11	43
69	90	34	20	-01	09	91	32	23	02	89	-23	-15	02	14	-03	-29	48	26	-04	24	00	36	-08	08	03	37
70	94	29	09	00	03	94	28	13	-04	77	-23	-06	12	15	02	-43	29	17	00	10	00	21	00	02	07	23
71	-90	27	-14	-07	-24	-96	00	-18	-15	79	45	00	-05	05	11	36	-89	03	-08	02	-10	02	09	00	10	-04
72	19	95	20	-02	04	32	90	26	-00	97	09	-01	04	06	00	13	-68	23	-06	21	-02	12	10	09	04	10
73	72	63	19	02	17	81	53	21	04	94	-21	-04	04	14	-07	02	-15	72	-01	04	03	15	04	00	-03	-17
74	85	40	26	03	17	88	35	28	07	86	-36	-03	17	17	-08	-09	-03	57	06	11	-04	-08	-14	19	01	10
75	90	33	22	01	05	90	31	24	01	79	10	21	00	38	02	-06	-55	09	-06	05	03	-07	-01	-05	-07	-09
76	77	57	24	-05	03	83	47	27	-04	96	03	-08	-07	06	08	11	-69	-08	-07	13	-06	15	01	-10	-01	07
77	17	94	06	-09	-09	26	89	10	-24	93	18	-08	04	01	11	19	-84	-01	-14	-05	05	08	-08	17	04	13
78	-86	47	-04	00	-11	-95	23	-13	-08	92	15	-05	03	19	-07	17	-62	29	-03	08	00	01	-20	07	04	-27
79	25	93	11	-08	-13	40	86	14	-22	92	12	-10	01	18	-14	09	-47	50	13	05	-07	-08	25	-13	15	-18
80	66	71	02	-03	-16	78	59	04	-16	85	33	-06	00	26	-05	-03	-48	27	14	-10	-11	-12	00	-09	16	-05
81	63	71	12	00	09	76	61	12	-00	78	-07	-15	-05	33	-15	08	-38	09	-03	10	-16	18	-17	08	02	06
82	27	20	60	-09	66	38	33	70	45	-37	-73	-13	00	15	-34	13	-18	23	-25	-06	-30	11	-09	-08	-17	-12
83	45	39	20	-09	39	62	53	33	-06	24	-54	-25	-06	31	-08	41	01	05	02	00	06	-00	01	02	-01	-04
84	-88	-05	-19	-01	-30	-90	-02	-19	-32	08	-16	-06	05	54	-17	27	-08	-01	08	13	01	04	-19	-11	-05	-25
85	-20	32	04	13	-84	-32	30	13	-84	32	59	26	05	30	-07	-03	-02	09	06	00	00	-21	04	01	10	-02
86	89	20	31	05	13	90	20	33	06	27	-18	-04	-08	67	30	01	00	-13	00	00	06	30	12	-03	-24	-03
87	-90	24	-16	-06	-25	-96	-01	-20	-17	78	41	01	-11	06	10	41	-90	-04	-02	-15	05	04	02	06	09	-09
88	07	95	26	-03	-01	11	91	35	-08	97	10	-04	07	08	01	10	-77	25	-06	09	12	00	-10	05	-06	07
89	71	63	23	00	17	81	51	24	06	96	-14	-05	03	11	-07	07	-32	66	-06	12	03	04	-04	02	00	04
90	85	41	22	06	15	88	36	24	06	87	-33	00	07	26	-10	-03	02	68	-08	07	-11	-07	11	04	-09	18
91	90	34	22	01	05	91	31	24	-00	91	-03	16	-04	24	02	08	-65	-01	-01	-04	25	-13	00	18	-22	-12
92	76	59	22	-05	07	84	47	25	-00	97	02	-08	-02	04	07	10	-75	00	15	04	00	17	-04	04	-12	04
93	-35	91	-01	-02	-03	-58	77	-10	-15	95	09	-13	07	00	03	18	-58	31	-16	14	13	00	-15	-02	-08	13
94	-82	49	-17	02	-15	-91	27	-24	-13	91	16	-11	-03	20	-06	17	-46	53	03	07	-04	01	14	02	06	-35
95	07	97	04	-06	-12	20	94	00	-21	90	08	04	-05	22	-20	16	-45	20	12	-10	-15	00	02	-01	42	-06
96	67	70	03	-04	-10	74	62	03	-19	83	-02	-19	02	32	-24	-12	-41	12	-06	-11	06	-06	00	-05	04	08
97	59	58	36	00	26	70	56	36	08	65	-43	-16	-15	24	-18	18	02	46	09	-02	-27	11	10	06	-28	-15
98	54	41	35	06	48	69	41	42	26	42	-40	-06	01	24	-17	29	03	-01	-30	23	-22	34	-03	-10	-12	-16
99	37	34	01	06	64	69	42	05	31	26	-56	-03	03	48	-06	27	-19	00	07	12	15	-18	-04	-21	-07	01
100	43	12	62	07	00	54	19	70	-05	13	-08	00	15	61	-08	20	-25	05	00	-04	-01	00	09	05	23	-08
101	83	35	31	00	-13	84	34	34	-14	38	-07	01	-14	59	-07	-02	-17	07	08	09	-04	13	-03	12	-01	05
102	93	17	23	02	17	93	18	28	09	23	-39	03	-13	64	21	05	06	16	07	06	-01	04	04	-10	-11	14

-Variables are listed according to Table 1

Table III shows that the variation in agricultural and mining employment has little association with the variation in other variables. The high factor loadings for the occupation, income, and age variables were on the first three factors for both the county total and urban population sectors. The difference in the "factor structure" between the county total and urban population sectors is the singular declining agricultural factor (factor four) for the county total population sector.

The most pervasive point concerning both the rural nonfarm and rural farm sectors is the relatively small percentage of variance explained by the factors with high negative loadings for the agricultural employment variable. In Table II factor three of the rural nonfarm sector explained five percent of the total variance while factor one of the rural farm sector explained 18 percent of the total variance. The decline in agricultural employment was rather uniform across the state. The factors with high loadings for industrial employment outside of agriculture accounted for 69 percent of the variance in the rural nonfarm sector and 35 percent of the variance in the rural farm sector. The variance in rural nonfarm and farm growth were associated, therefore, with variations in changing employment opportunities outside of agriculture. Variations were predominately in government, welfare, hospital, and manufacturing employment for the rural farm sector while the rural nonfarm sector demonstrated variations in almost all industries.

Variations in the income, occupation, and age variables were associated with variations in industrial employment. Few variables in Table III had high loadings on the factors with high negative loadings for agricultural or mining employment. The decline in these industries

demonstrated little associative effect on the economic and social growth of the counties. The factor loadings for the occupational variables by population sector showed variations in rural farm growth associated mostly with variations in the female occupation classes. Only two male occupations both manual in nature, craftsmen and operative, had relatively high positive loadings. For the female occupational variables, there were relatively high loadings for managers, clerical, operatives, service workers, and managers. For both the urban and rural nonfarm sectors, the occupational variables male and female generally loaded high indicating an increase in the male and female work force in most occupational classes. Both the urban and rural farm sectors showed declines for female private household workers while the rural nonfarm had an increase. The rural nonfarm sector had a positive increase in female farmer or farm manager while for the factor on which mining employment loaded negatively there was a high negative loading for female managers. The number of families with income below $9,000 decreased in all income groups for the urban sector and increased for each income group above $9,000. The rural nonfarm sector had growth in all income groups both above and below the $9,000 urban break point. The number of rural farm families with income below $8,000 decreased while there was no positive indication of increasing number of families with income over $10,000. Since only the rural nonfarm sector had an increase in the number of families with incomes below $8,000, an absolute shift of low income families into the rural nonfarm sector occurred between 1960 and 1970. The age pyramid variables showed decline in most age groups for the rural farm population and an increase in most age groups for

both the urban and rural nonfarm sectors. Both the urban and rural farm populations had decreases in the under 5 years age cohort while rural nonfarm had an increase. The rural nonfarm population as a group, therefore, was choosing to have more children while both the urban and rural farm populations were choosing to have fewer children.

The geographical groupings of counties from the Q mode factor analysis for both the sectors' net and residual changes are presented in Figures I to IV. The net change groupings delineate the sectors of counties experiencing similar overall growth in the state. The residual change delineates groupings of counties by population sectors experiencing the same relative growth in the state. The factor scores were analyzed to determine the predominant industrial employment changes occurring in a particular delineated sector grouping of counties. The predominant employment changes were then used to identify the groupings of counties in Figures I to IV. The groupings, however, more accurately delineate counties' sectors that underwent the same composition of employment, occupational, income, and age changes between 1960 and 1970. Any grouping of counties in Figures I to IV resulted from the interaction of some or all of the independent factors found in Table III. These interactions prevent a clear delineation of county groupings based on the independent factors in Table III.

The net change in Figure I delineates three groupings of counties experiencing similar overall growth or change. The majority of counties

FIGURE 1

Growing or Declining Counties With Shuttle Growth, 1960 to 1970
For Total County

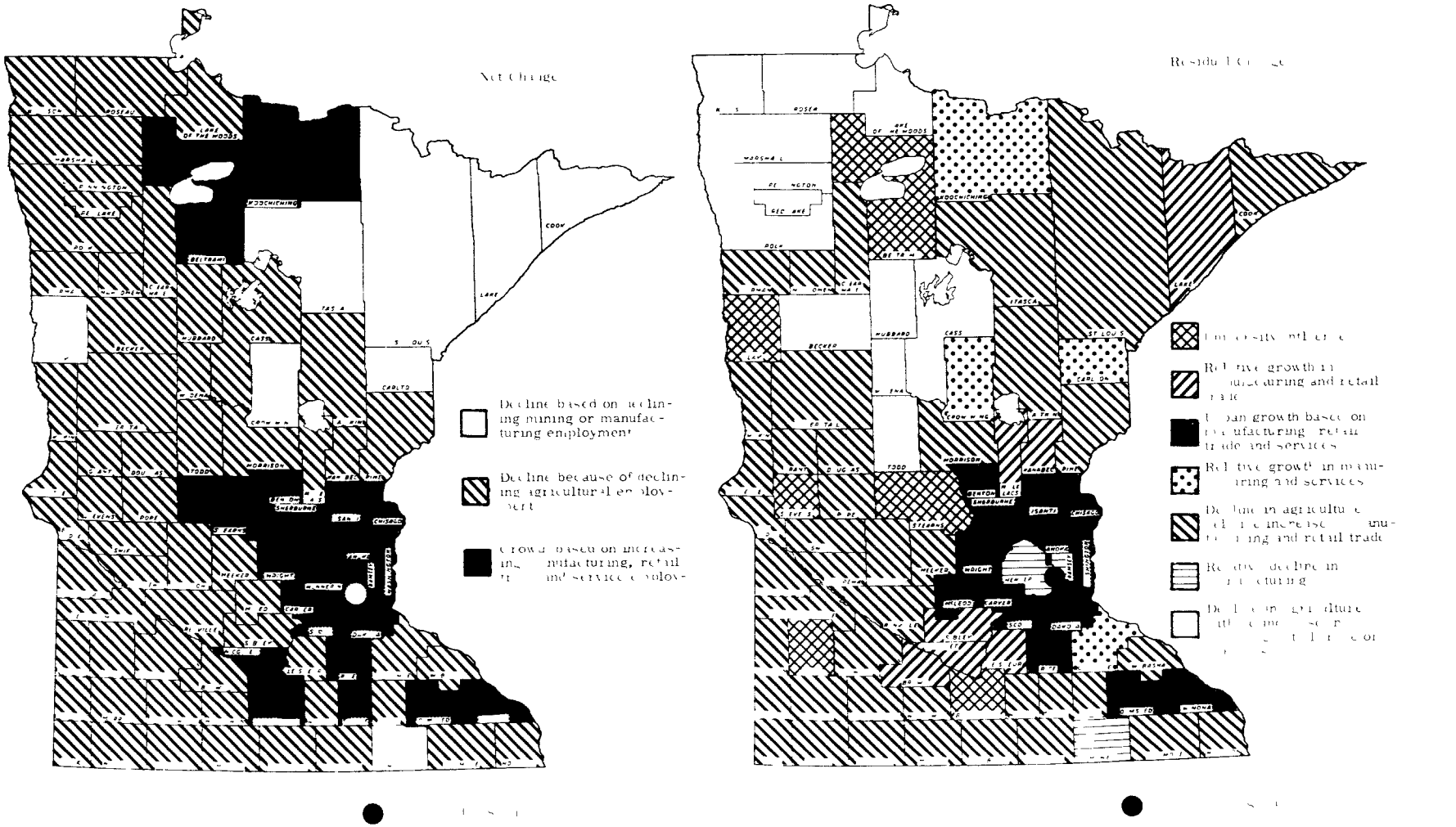


FIGURE II

Grouping of Counties With Similar Growth 1960 to 1970
For Comprehensive Planning

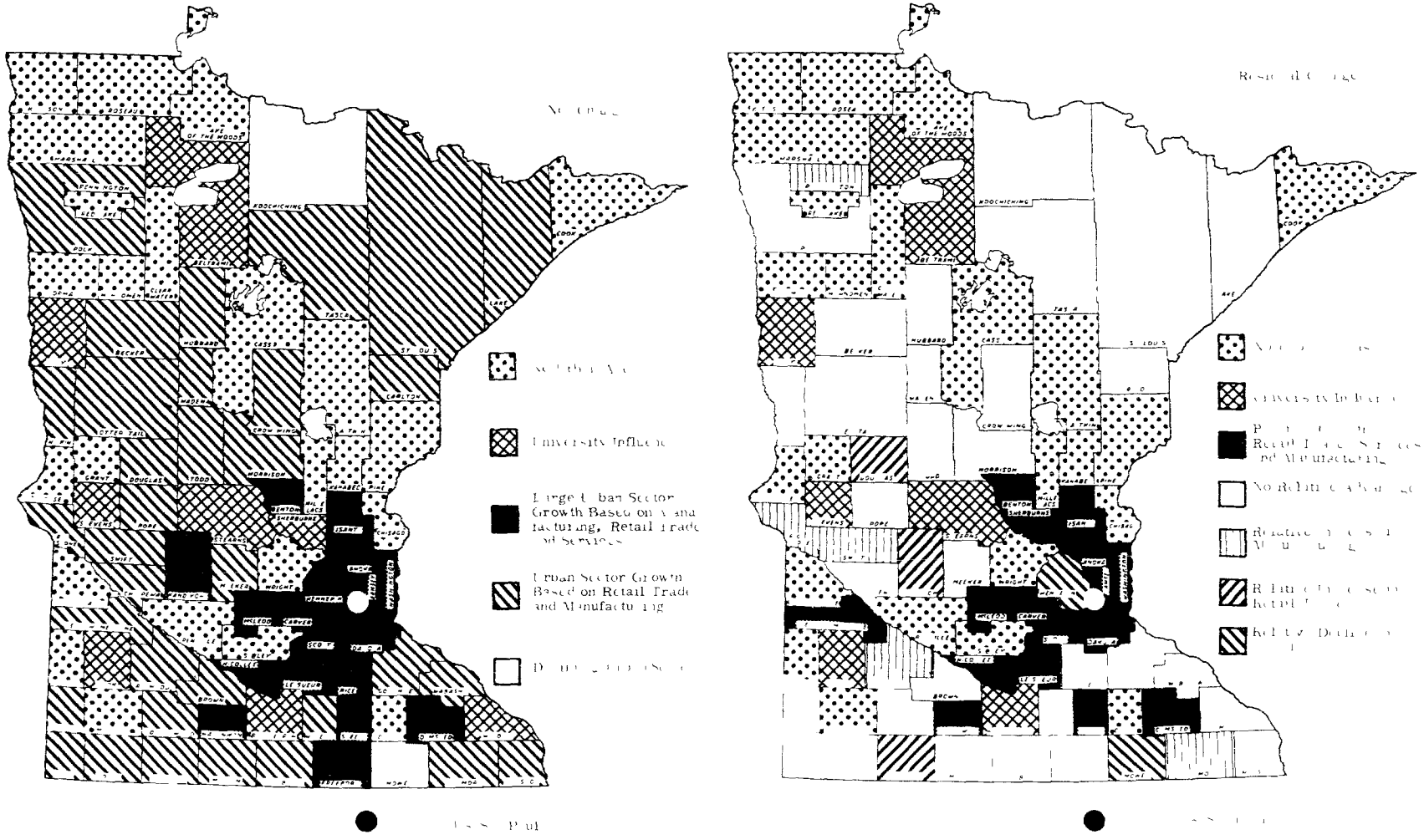
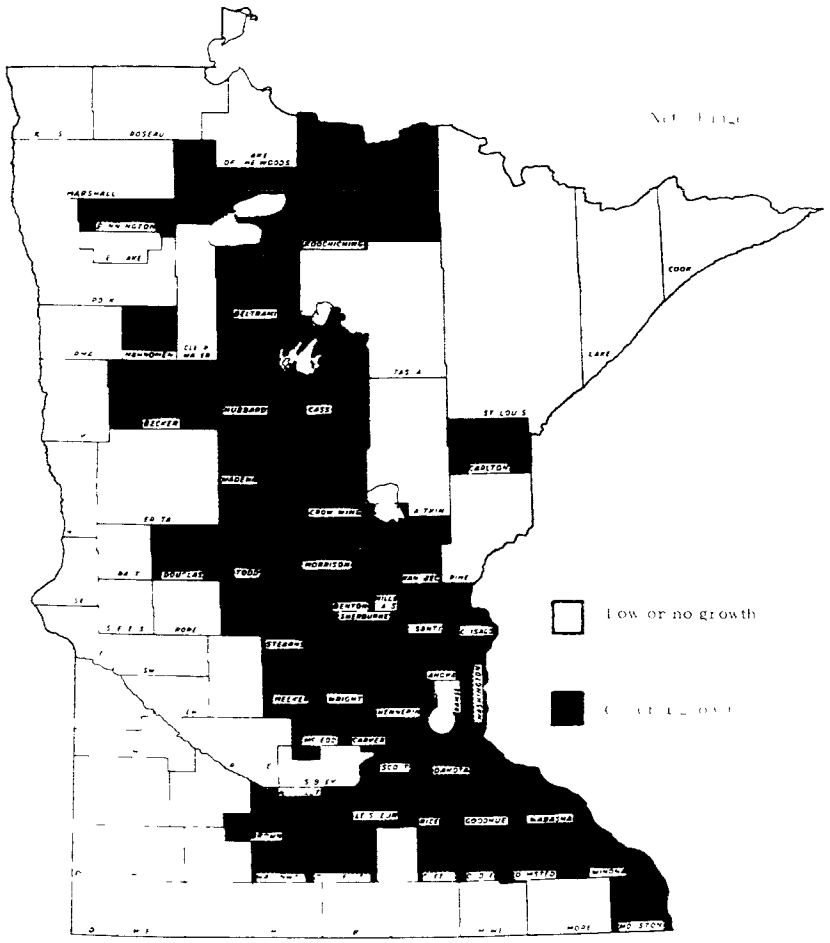


FIGURE III

Groups of Counties With Similar Growth 1960 to 1970 for County Rural Nonfarm Sector



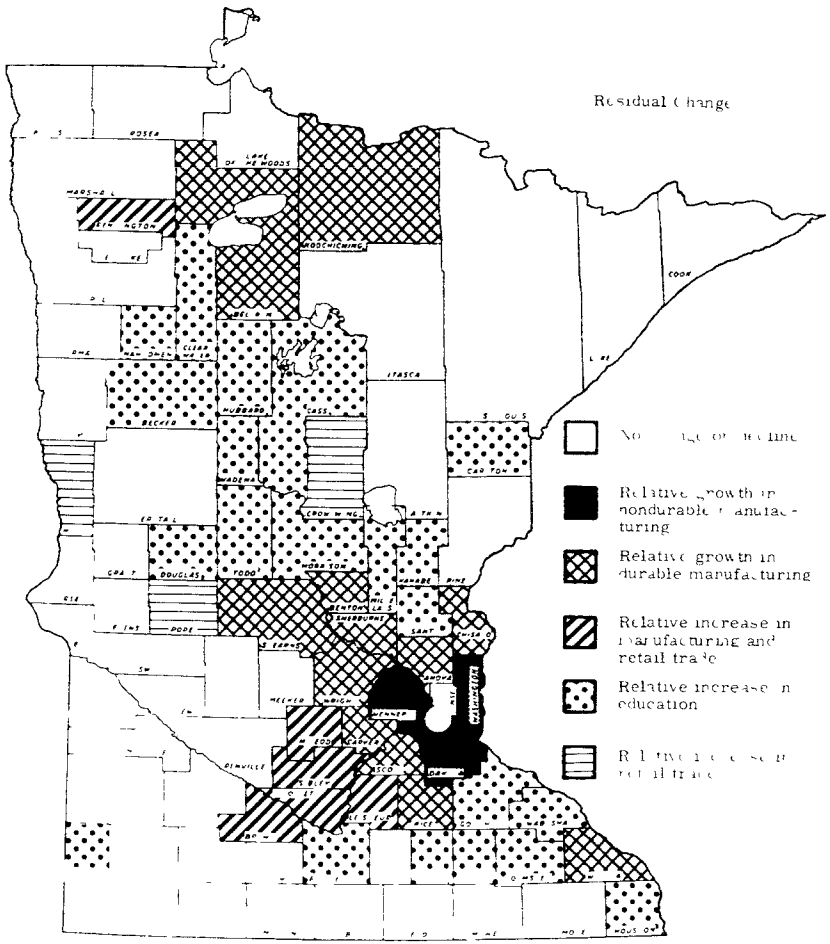
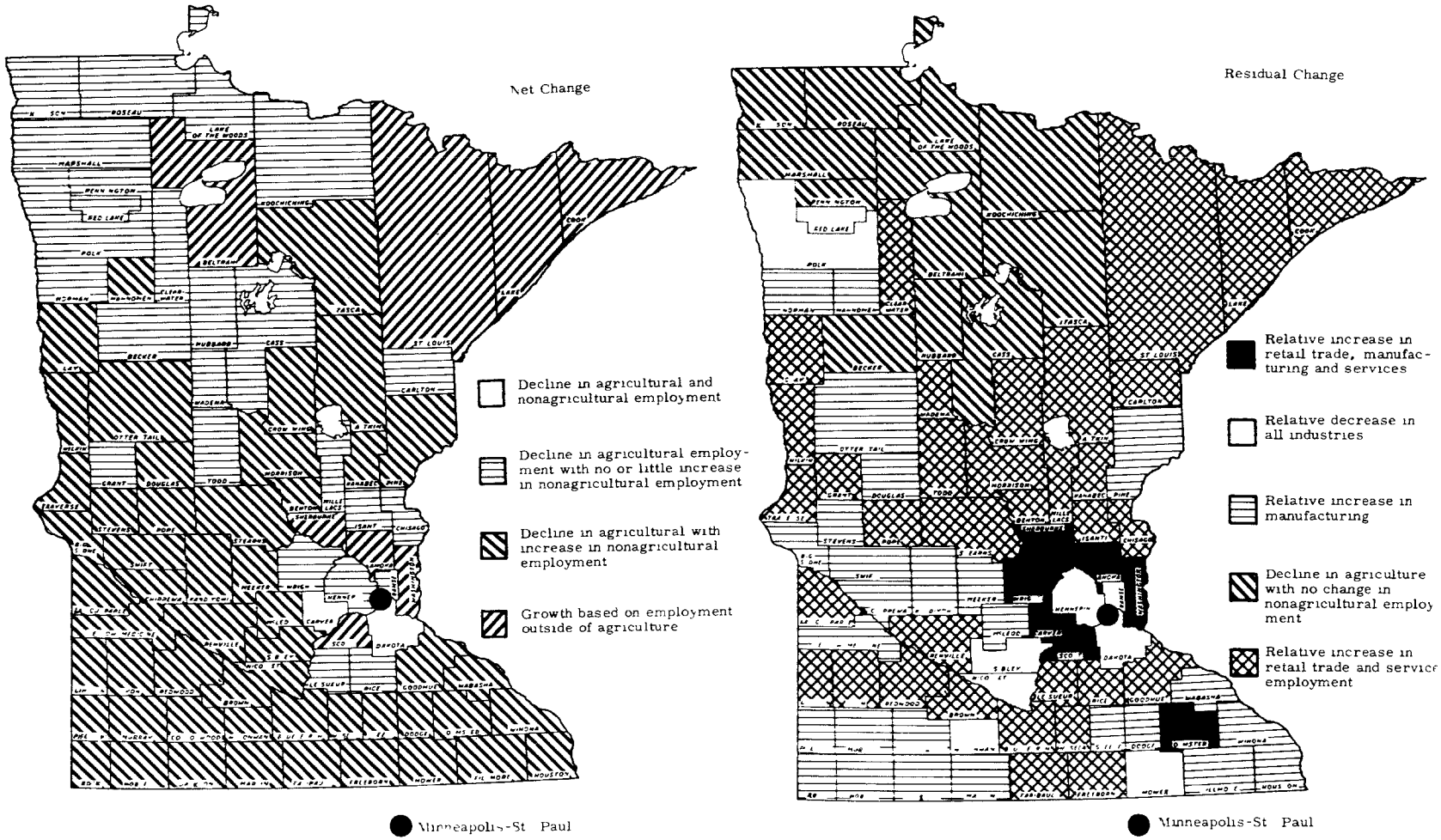


FIGURE IV

Grouping of Counties With Similar Growth 1960 to 1970
For Rural Farm Sector



within 100 miles of Minneapolis-St. Paul experienced employment growth in most industries except agriculture and mining. Declines in agricultural employment was the predominant employment change for the second grouping of counties generally located over 100 miles from Minneapolis-St. Paul. For the third grouping of counties, declines in mining and/or manufacturing were the predominant industrial change. The residual change showed that a number of relative shifts were occurring within the overall net change. Relatively the counties surrounding Minneapolis-St. Paul experienced overall growth while central Minneapolis-St. Paul had a relative decline in residence employed in manufacturing. A group of six counties emerged whose only discernable similarity is the presence of a large university. The counties in the central and northwest portions of the state demonstrated no relative growth while the remainder experienced relative growth in manufacturing and retail trade.

In Figure II there are four groupings of counties with similar net change for their urban sectors. Urban sectors experiencing general growth were in the counties surrounding Minneapolis-St. Paul. The counties with large universities relative to their population grouped together again indicating that their predominant effect was felt in the cities where they are located. The remainder of the urban sectors demonstrated increased manufacturing or retail trade employment. For the residual change, the urban sectors in counties surrounding Minneapolis-St. Paul gained relatively in all employment. The urban sectors in counties over 100 miles from Minneapolis-St. Paul experienced relative growth in either manufacturing or retail trade. The six university counties

again grouped together indicating the relative advantage of being a university town in the 1960's.

In Figure III, the net change variables produced for the rural nonfarm sector two groupings of counties. Both groupings of counties demonstrated overall growth. The difference in the two groupings was the magnitude of growth occurring. A low to moderate level of overall growth occurred in the better agricultural counties located in the south and western portions of the state and the mining counties in the northeast corner of the state. A higher level of overall growth occurred in counties with woods, water orientation, and rough land running from the southeast corner to the north central portion of the state. The residual change produced six groupings of counties. One of these groupings, that was almost identical to the low growth grouping of counties for the net change, showed no relative growth. The relative growth, therefore, occurred in the counties delineated by the net change as high growth counties. The high growth counties within 100 miles of Minneapolis-St. Paul had relative growth in manufacturing and retail trade. The majority of the high growth counties over 100 miles from Minneapolis-St. Paul had relative growth in educational employment. If the relative growth in educational employment was a short term adjustment taking place in the 1960's, growth could slow in the 1970's.

The rural farm sector has four groupings of counties in Figure IV for the net change variables. Declining agricultural employment was predominant throughout the state. The major groupings reflected access to nonagricultural employment. The rural farm sector was able to increase its nonagricultural employment in the south and central portions

of the state but not in the northwest. The counties surrounding Minneapolis-St. Paul produced a mixed pattern of rural farm decline and rural farm increase. This indicates two trends. First, full time farmers in net are leaving agriculture in some counties around Minneapolis-St. Paul. Second, in other counties people with their main employment outside agriculture are taking agricultural employment on a part time basis. The residual change supports this contention by showing relatively the largest increases in manufacturing, retail trade, and service employment by the rural farm sector to be in the counties surrounding Minneapolis-St. Paul. The rural farm sector in south and west central counties had relative increases in manufacturing employment. The rural farm sector in counties running north-south through Minneapolis-St. Paul had relative growth in retail trade and service employment.

Summary and Conclusions

The study determined that differences in nonmetropolitan growth existed among counties as well as among population sectors in counties. Differential growth in employment by industry was concurrent with differential changes in the age pyramids, income pyramid, and occupational mix for the county sectors. The decline in agricultural and mining employment demonstrated little concurrence with changes in the other variables. Overall variations in the age, income, and occupational variables were concurrent with variations in manufacturing, trade, service, and government employment. Nonmetropolitan growth was, therefore, dependent both on government and private decisions. Growth based on

government action was most apparent where private growth was lacking. Growth resulting from private decisions was concentrated in an area extending 100 miles from Minneapolis-St. Paul. For the counties within 100 miles of Minneapolis-St. Paul, growth was more pronounced in each population sector.

The variations in overall county growth were mostly explained by variations in urban growth. Both the urban and rural nonfarm sectors had employment gains in most industrial and occupational classes. Rural farm growth was predominately in blue collar type jobs. The rural farm and urban sectors both had a decrease in the number of families with income under $8,000 and in the under 5 age cohorts. The rural nonfarm sector on the other hand, had increases in the number of families with income under $8,000 and in the under 5 age cohorts. This shows an absolute shift of low income families into the rural nonfarm sector that maintained high fertility rates. If such a trend continues, rural county and township governments face increased demand for services while lacking the income base to pay for them. Further, this leads to the conclusion that nonmetropolitan growth has within it a residence selection process. Local governments thus deal with different classes of people and thus different problems resulting from nonmetropolitan growth. The implications for state programs and legislation of such heterogeneous growth is that a single set of programs or legislation will not deal with local problems. Variable programs and legislation are needed that give local governmental units the ability to deal with the unique growth problems they face because of the variable composition of growth and the residence selection process.

REFERENCES

1. Adelman, D. and C. T. Morris, "Factor Analysis of the Interrelationship Between Social and Political Variables and Per Capita Gross National Product," Quarterly Journal of Economics, 1965.
2. Beal, C. L., "The Revival of Population Growth in Nonmetropolitan America," ERS-605, Economic Research Service, United States Department of Agriculture, 1975.
3. Borchert, J. R., and D. D. Carroll, "Minnesota Settlement and Land Use 1985," Minnesota State Planning Agency, 1970.
4. Casey, G. W., "The Regional Interpretation of Population and Housing Pattern in Manhattan Through Factor Analysis," Geographical Review, 1960.
5. Cattell, R. B., "The Dimensions of Culture Patterns by Factorization of National Characteristics," Journal of Abnormal and Social Psychology, 1949.
6. Dorf, R. J., "An Analysis of Manufacturing Location Factors for Communities 2,500 to 50,000 Population in the West North Central Region," Ph. D. Dissertation, Kansas State University, 1976.
7. Economic Development Division, "Characteristics of U.S. Rural Areas With Noncommuting Population," Economic Research Service, U.S. Department of Agriculture, 1972.
8. Erickson, R. and J. Huddleston, "Small Community Growth," State Planning Office Report DOA-SPO-75-8(1), Department of Administration, State of Wisconsin, 1975.

9. Fuguitt, G. V. and J. J. Zuiches, "Residential Preferences: Implications for Population Redistribution in Nonmetropolitan Areas," Population Distribution and Policy, Vol. 5 of research reports of the U.S. Commission on Population Growth and the American Future, 1972, pp. 617-630.

10. Fuguitt, G. V. and J. J. Zuiches, "Residential Preferences and Population Distribution," Demography, Vol. 12, No. 3, August 1975.

11. Gustafson, N.C., "Recent Trends Future Prospects A Look at Upper Midwest Population Changes," Upper Midwest Council, Minneapolis, Federal Reserve Bank, 1973.

12. Hagood, M. J., "Statistical Methods of Delineation of Regions Applied to Data on Agricultural and Population," Social Forces, 1943.

13. Hagood, M. J., "An Examination of the Use of Factor Analysis in the Problem of Sub-Regional Delineation," Rural Sociology, 1941.

14. Mazi, S., and S. Rawlings, "Public Attitude Towards Population Distribution Issue," Population Distribution and Policy, Vol. 5 of research reports of the U.S. Commission on Population Growth and the American Future, 1972, pp. 599-616.

15. Mingo, K. A. and R. F. Catalanello, "The Differential R Factor Analysis Technique: A Multivariate Tool for the Measurement of Regional Change Patterns," unpublished paper Oklahoma State University, 1973.