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THE IMPACT OF LOCATION RELATIVE TO CITIES ON  
VILLAGE POPULATION CHANGE IN KANSAS

1950 - 1976

by

PETER JOSEF DOTZAUER

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A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

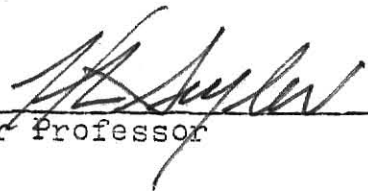
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## Chapter I

### INTRODUCTION

The overall population change of an area does not occur at an equal rate in each type or size class of settlement, or farm, hamlet, village, or city.<sup>1</sup> The changes among these various categories may be highly variable, and the relations between the patterns of changes may be manyfold and complex, yet research in this area has hardly scratched the surface. In official population statistics of the United States, the major categories distinguished are rural-farm, rural-nonfarm, and urban, whereby the rural-nonfarm population is made up of those living in places of less than 2,500 inhabitants, either incorporated or unincorporated, or in the open countryside where residents are not employed in farming.<sup>2</sup> Each of the categories have different forms of population change. The rural-farm population has declined steadily since 1920, when this category was recognized for the first time, whereas urban population increased consistently.

Functional changes in settlements have been revolutionary. Groop provides a detailed review of the literature focusing on this topic.<sup>3</sup> In regard to their functions, places of 2,500 population or less do certainly not form an independent or isolated settlement system. At least to a certain extent, their economic and demographic performance is tied to the fate of the other types of settlements; the farms as well as of the cities.

In the past, many papers have been devoted to the topic of

viability of village growth or decline. The question, "What is happening?" was asked rather than "Why is it happening?". This throws a light on the infancy of research on village population change. In the non-scientific literature, pessimistic views in respect to growth prevail, whereas scientific articles at least tend to agree on the point that bigger places have been gaining population, as a rule.<sup>4</sup>

### Background

Kansas was settled systematically east to west, although the density of settlement declined towards the west, partly due to lack of adequate rainfall. Initially, the settlement process was closely tied to agriculture, and urban areas were few in number.<sup>5</sup> Lower agricultural yields, mainly resulting from climatical conditions, and a higher share of rangeland remaining untouched by the plow were responsible for lower population density towards the west. Other villages, independent of agriculture, grew up as railway stations.<sup>6</sup>

The relatively early and dense settlement of Kansas resulted in an excessive number of villages.<sup>7</sup> A legacy from the past, the rural-nonfarm category currently consists of about 600 incorporated and 1,000 unincorporated places, most of them with a population of less than 1,000.<sup>8</sup> The per cent share of the incorporated places among all places is much higher in Kansas than in the country as a whole.<sup>9</sup> This departure is somewhat due to incorporation laws which are less restrictive than in other states.<sup>10</sup> For the same reason, unincorporated places have prevailed in the

lowest size classes, whereas those over 1,000 population only number about five. At least since 1955, the number of unincorporated places has fallen consistently, whereas the incorporated cities did not change significantly in number, though there were more incorporations than disincorporations. In this study, emphasis is restricted to incorporated places.

### The Problem

There are many processes affecting village population change, and these are related to the entire settlement system, with farms and cities, and the socio-economic structure in which this system is embedded. The rural-farm population has not fallen in an independent process, but because of mechanization and rationalization of agriculture. The urban population has risen because of economic development, at least to a considerable degree. These economic changes, which resulted in and were sustained by population shifts, affected the roles of many villages. With declining farm populations, many may have lost central place functions, and others may have gained new functions to serve either as commuter residences in the vicinity of bigger cities, or for retired persons. Functional changes express themselves in population changes, although the net population change may only be the result of opposing function-gaining and -losing processes. It is possible to establish an indirect but logical connection between village population change on the one hand, and farm and urban population change, on the other. Also urban population per se may affect village population change. The city population may stabilize

even with increasing economic opportunities, because the population increase one would expect does not occur in the city itself, but in the villages around it.

In this study, an analysis of village population change is focused on the impact of distance of villages to urban places (and some certain characteristics of them, like employment). It is anticipated that there is a systematic relationship between village population change and relative location relative to urban centers when other factors like change in number of farms are controlled for.

Problems for small city managers and planners often arise from a failure to understand the factors affecting village population change, especially as they relate to transformations within a system of settlements. There is need for research on the question why villages grow or decline. Although some scholars have tried to answer this question, the results of their works seem cryptic and somewhat contradictory. The resulting void in awareness among public administration officials and politicians is even more serious. Desired changes are hard to induce in the absence of an understanding of how a place is being affected by its disposition in a larger settlement system, and the dynamics of that system.

Many of the factors possibly influencing village population change have not been investigated to a satisfactory depth. Among them is certainly the locational impact of nearby urban places, which is the central issue of this research. This proposition will be underlined by a review of examples later in this work.

### Method of Approach

In order to find out the patterns and strengths of assumed relationships between village population change and other factors, correlation analysis was chosen as the mode of assessing association. Simple correlation methods can yield the degree of association between two variables. In multiple correlation, the effects of a group of independent variables, considered as a whole, on the dependent variable, are analyzed. The degree of association between two variables, controlling for the effects of a third variable or of a set of other variables, can be obtained by the application of partial correlation analysis. Multiple regression and subsequent beta weight analysis allows the assignment of relative weights to the factors assumed to influence village population change. Regression analysis leads to equations which may be used to predict the value of the dependent variable, given the value(s) of the independent variable(s). The residuals of a regression equation are the differences between the predicted and the actual values of the dependent variable. A case will seldom be predicted perfectly by a regression equation (unless the correlation is also perfect). But it is large residuals that make the degree of association low, and a few extreme residuals can mask what may be a pattern of relationship. Thus, analysis of extreme residuals is included in this work, because it is possible that regular patterns among these residuals may be detected. Or it may be that they are just cases with special conditions which may explain their weak performance in the correlation analysis.

Residual mapping is the method that can reveal patterns in the spatial distribution of "deviant" cases.

Special descriptive indices were derived from gravity and potential models as independent variables. The form of these is as follows:

$$I_i = \sum_{j=1}^K \frac{M_j}{D_{ij}^X};$$

whereby I = index,

M = mass variable (for instance, population),

D = distance variable,

X = distance friction exponent,

i = village

j = larger places in the vicinity of a village, and

K = number of larger places near a village.

Distance is expressed with various exponents to reflect "frictions" and to specify relative location of villages to population centers. The types of location measures have proved fairly successful in previous studies. Certain other variables, like change in number of farms and population density, are entered as control measures and for additional explanation of village population change. In certain cases, "dynamic" measures, indicating changes over time, will be treated as independent variables, in addition to the static variables like city population.

Analyses are made not only for an entire sample of villages, but also for certain sub-sets which may well reveal the existence of different patterns of associations between variables. Some sub-sets are of a quantitative kind, i.e. village size classes,

and some of a "qualitative" kind, where the criterion of distinction of the village is a non-quantifiable characteristic like location in a certain region or county, or another property. The development of a descriptive and predictive model for village population change is not of prime interest in this study; however, some steps in this direction are taken.

The study is restricted, as most of its forerunners, to incorporated places. For unincorporated places, population data are hard to obtain, and their reliability is doubtful.<sup>11</sup> For reasons of homogeneity, also those few unincorporated places of 1,000 or more for which census data are available, are omitted.<sup>12</sup>

With respect to the period of time considered, the study is restricted to the postwar period, the first population census used being 1950. It is too early to consider the results of the 1980 Census of Population, however, estimates by the Bureau of the Census for 1976 which are comparable to census figures are available for all incorporated cities of the United States.<sup>13</sup> Later in this report it will be shown that there is reason for the assumption that different patterns of population change have occurred at different segments of the time period considered. These segments will be investigated separately. A more detailed presentation of the methodology follows in the third chapter where the design of research and the plan of analysis are discussed.

#### Purpose of Study

The central theme in this study is whether the so-called size-distance concept or notion has really been exhausted in



previous studies, or whether additional explanation can be gained through a proper restatement and improvement of the operational treatment of the concept. In the following chapter, prominent size-distance studies, or studies which deal partly with this theme, are critically reviewed. Emphasis is placed on methodology in the literature review and in the further development of the size-distance concept.

While the major objective of this study is the determination of the significance of an improved system of size and distance variables, there are related secondary goals in respect to other variables and dimensions which may affect village population change. One is the careful selection of an adequate set of control variables where some experimentation is necessary, and another is the determination of the relative importance of the size and distance-related variables (or more complex indices derived from them).

To summarize, functional change in villages is not investigated. Population change may be viewed as an indicator of functional change, and in the concluding chapter interpretations of this relationship do appear. But here attention is focused on the magnitude of population change, and on the following aspects:

- (1) Relationship between village population change and indices of relative location for three periods: 1950-60, 1960-70, and 1970-76.
- (2) Relationship between village population change and relative location indices for the three periods while:



- (i) Varying measures of urban place attraction, or mass, in the potential model.
  - (ii) Varying method of computing the friction of distance, the exponent in the potential model.
  - (iii) Expressing distance in two ways; a measure of "effective" distance, and distance in road miles.
- (3) Relationship between village population change and indices of relative location by categories of village size and the size of mean places in the vicinity.
  - (4) Relationship between village population change and indices of relative location while controlling for other affecting factors.

#### Justification

As will be shown in the next chapter, many studies on small-town population change have been written by rural sociologists. Nevertheless, the theme is of central interest for geographers, for population shifts change the patterns of the landscape which they seek to interpret. When one looks to distances between villages and cities, and implicitly considers their distributions in his investigations, he conducts a kind of spatial analysis. However, this effort need not be only or mainly an analysis of spatial structure. When one attempts to better describe population changes a dynamic element is added where at least in part, spatial process is implied.

Geographers have not produced a voluminous quantity of research on villages. This seems to be a result of emphasis put on the study of urban places and metropolitan areas.<sup>14</sup> For public authorities, administrators, policy makers and planners it is crucial to know what has affected village population distribution and redistribution in the past. This knowledge is necessary to enable these people to gauge the impact of future changes that may come with changes of affecting factors (e.g. with the demographic or economic decline of bigger cities). It is also a prerequisite and basis for setting future investment priorities (e.g. public housing, schools, infrastructure etc.) in time or to introduce other corrective measures, ensure tax money is more efficiently used. One can only agree with Groop when he claims:

....villages and their resident populations deserve informed planning and policy decisions.<sup>15</sup>

In a related vein, Kale states that despite what should be a local or regional concern:

Encouragement of growth-stimulating economic activities - which quite possibly may determine the future of presently viable towns in rural areas - appears to be largely a function of priorities set by the federal government.<sup>16</sup>

The author adds that he hopes to contribute to the scientific basis the federal government should use for setting such important priorities.

There is a special justification for size-distance studies, which was convincingly articulated by Butler and Fuguitt:

The study of the small town has both practical and

theoretical implications for the understanding of rural population dynamics and general population change and redistribution. Central to this understanding is a knowledge of the factors affecting small-town population change is location. Underlying this factor is the postulate that population centers exist not separately but as an integrated part of the whole area, including both rural and urban elements.<sup>17</sup>

As this study aims at a sound investigation and an improvement of the size and distance-notion in relation to village population change, the effort in completing it is well justified.

### Expected Results

When the study was initiated, I expected to uncover a well defined set of relationship between village population change and locational or spatial associations of villages with larger urban places. A set of detailed hypotheses was derived both from previous research and from an extension of earlier findings. As a result of this study, the geographical size-distance concept, when improved and carefully applied, should prove to be of greater value than has been revealed in previous studies.

Non-agricultural employment, along with population, will serve as one of the mass variables representing urban places in the association indices developed in this work. This variable should be a more accurate indicator of the economic strength of a city than its population. When it is used, an important step is taken to recognize how the economic situation of a nearby city can effect village population change. Then, improved results in testing the hypotheses are expected. More detailed hypotheses will be started in the third chapter.

The study should allow interested analysts to distinguish

between approaches to the study of village population growth which seem less fruitful and those which seem promising for further research.

### Plan of Study

The core of this chapter has been the articulation of the purpose of this study and the creation of a foundation from which to proceed. The next chapter will be a review of geographical and non-geographical literature on village population change, with emphasis on papers which have considered the effect of distance from villages to urban places, and size of those centers. A typology of studies is presented to better put this effort into a research context. Also some methodologically interesting studies related to what appears here, even though they do not deal with village population change, are reviewed. Chapter Three further develops the methods employed to examine population change. A set of control variables are described and defended as part of a framework to test relevant hypotheses. The latter are also established, with the methods of testing outlined. Also data sources and shortages are identified. Findings from data analyses are presented in Chapter Four. A summary, including the evaluation of an improved size-distance concept, and conclusions, along with recommendations for future research, appear in Chapter Five.

## References

- <sup>1</sup>Terms like "hamlet", "town", "village", and "city" have almost as many definitions as they have users (cf. John Fraser Hart and Neil E. Salisbury, "Population Change in Middle Western Villages: A Statistical Approach," Annals of the Assoc. of Amer. Geographers 55 (1965), p. 140 ). Therefore, an arbitrary definition of the term village seems justified. However, rather than adding one more to the list of existing definitions, the study adopts that of Johansen and Fuguitt in, "Population Growth and Retain Decline: Conflicting Effects of Urban Accessibility in American Villages," Rural Sociology 44 (1979), p. 25. They defined villages as places of 2,500 or fewer residents. Earlier Brunner spoke of places up to 2,500 population as villages (Edmund deS. Brunner, "Village Growth 1940-50," Rural Sociology 56 (1951), p. 111) and those with less than 1,000 population he called small villages ("The Small Village: 1940-1950," Rural Sociology 57 (1952), p. 127). Although not always stated explicitly, these definitions were restricted to incorporated places. More details of the definition will be provided in Chapter Three.
- <sup>2</sup>cf. U.S. Bureau of the Census, U.S. Census of Population: 1960. Vol. I, Characteristics of the Population. Part 18, Kansas (Washington, D.C.: U.S. Government Printing Office, 1963), pp. XIV and XV.
- <sup>3</sup>Richard E. Groop, Small Town Population Change in Kansas -- 1950 to 1970, Unpublished Ph.D. dissertation, University of Kansas 1976, pp. 22-26. A related study is that of McIntosh, who investigated the functional change of cities which once were on railroads and now are by-passed by a highway - from farm servicing to providing low-cost rural housing for retired and laborers in nearby cities. (C. B. McIntosh, "Sidetrack Villages in East Central Illinois," Annals of the Assoc. of Amer. Geographers 49 (1959), pp. 197-198.
- <sup>4</sup>See Thomas Wheeler (ed.), A Vanishing America, The Life and Times of the Small Town, (New York: Holt, Rinehart and Winston, 1964). This book contains twelve essays on individual villages all over the United States which are praising the flourishing past of these declining, early towns. However, the impression conveyed that these are representative of the United States villages is truly false.
- <sup>5</sup>James F. Bock, The Regional Structure of the Kansas Economy, Unpublished Master's Thesis, Kansas State University, Manhattan, 1973, p. 1.
- <sup>6</sup>cf. C. B. McIntosh, "Sidetrack Villages in East Central Illinois," Annals of the Assoc. of Amer. Geographers 49 (1959), 197-198, and Huber Self, Environment and Man in Kansas. A Geographical Analysis, (Lawrence: The Regent Press of Kansas, 1978), p. 84.

- <sup>7</sup>cf. Steven Kale, "Small Town Population Change in the Central Great Plains: An Investigation of Recent Trends, The Rocky Mountains Social Science Journal, 12 (1975), p. 40.
- <sup>8</sup>Additional rural non-farm population may live on the fringes of incorporated places outside their corporate limits, as long as these incorporated places are not part of an urbanized area. Cf. U.S. Bureau of the Census, op. cit., pp. XIV, XV, XVII, and XVIII.
- <sup>9</sup>In 1960, the total number of places, incorporated and unincorporated, was 1,797 in Kansas and 109,998 in the U.S. While about 600 places in Kansas, roughly one third, were incorporated, the total number of incorporated places in the U.S., 17,000, represented a much smaller share. (see the 1961 Commercial Atlas & Marketing Guide ninety-second edition. (Chicago: Rand McNally Company, 1961), p. 19.
- <sup>10</sup>K.S.A. 15-116 (Kansas Statutes Annotated).
- <sup>11</sup>Official census data only identify population figures for unincorporated places of 1,000 population or more. (Alaska is an exception). The figures for the remainder are aggregated at the township level. Even so, certain types of unincorporated places, like military camps, were not included before 1970. In the annual publication by Rand McNally, Commercial Atlas and Marketing Guide, virtually all unincorporated places are identified. Nearly half of them include population figures which for the smaller places are estimated every few years (by a special department of the Rand McNally Company). The places not accompanied by a population figure are identified as "rural", "no population", or "part of...", appearing in the 1980 Rand McNally Commercial Atlas and Marketing Guide, (Chicago: Rand McNally & Company, 1980, 111th Ed., p. 10). (Cf. also comparable sections in older atlases). On a map of a Kansas atlas, "unincorporated nucleated population" is identifiable to the nearest fifty. See Roy H. Johnson and Charles J. Smith, eds., A Kansas Atlas, (Topeka: Kansas Industrial Development Commission, 1952), p. 16.
- <sup>12</sup>This may be justified with Fuguitt's conclusions that because of "... the instability of unincorporated places, in contrast to incorporated centers ... unincorporated places ... need to be considered separately ..." (Glenn V. Fuguitt, "Trends in Unincorporated Places, 1950-60," Demography 2 (1965), p. 371.
- <sup>13</sup>U.S. Bureau of the Census, "1976 Population Estimates and 1975 and Revised 1974 Per Capita Income Estimates for Counties, Incorporated Places, and Selected Minor Civil Divisions in ... " (State), Population Estimates and Projections, Series P-25, Nos. 740 through 789, Washington, D.C.: Government Printing Office. (Current Population Reports). The 1977 estimates could not yet



be considered in this study. More recent population figures are published by the States (f.i., Kansas State Board of Agriculture, "Population of Kansas, January 1, 1979, As reported by County Appraisers," Topeka: Kansas State Board of Agriculture, 1979, pp. 2-5), but these are not comparable with federal census figures because they refer to the de jure and not to the de facto population.

<sup>14</sup>This view is also supported in Craig R. Humphrey and Ralph R. Sell, "The Impact of Controlled Access Highways on Population Growth in Pennsylvania Nonmetropolitan Communities, 1940-1970," *Rural Sociology*, 40 (1975), p. 332.

<sup>15</sup>Richard E. Groop, op. cit., p. 8.

<sup>16</sup>Steven Kale, op. cit., p. 40.

<sup>17</sup>James E. Butler and Glenn V. Fuguitt, "Small-Town Population Change and Distance from Larger Towns: A Replication of Hassinger's Study," *Rural Sociology*, 35 (1970), p. 397.

## Chapter 2

### REVIEW OF RELATED LITERATURE

In the review of prior research appearing here, emphasis is placed on studies related to the size-distance concept, i.e., those who used distance to larger cities and/or their sizes directly or indirectly as independent variables to explain village population change. One source, a bibliography, on village research has an index in which the titles are grouped by topics like "Types of Villages and Economic Function" and "Factors Associated with Growth or Decline". Short statements about the contents are included with the titles listed.<sup>1</sup> Another bibliography emphasizes planning in villages.<sup>2</sup> A recent extensive review and a categorization of village studies is provided by Groop.<sup>3</sup> In drawing upon this literature, restriction to only a part such as of one of Groop's categories, "variables influencing growth and decline," is appropriate.

#### Roads and Relative Village Location

One can, in a rough generalization, categorize the size-distance studies as those which only deal with the relative location to certain types of roads and those which refer to the relationship of villages to larger settlements (or population concentrations) in an area. Studies of the first kind do not directly relate to the distance of villages to larger places. However, a village closer to an Interstate Highway has markedly better access to a neighboring larger place, for the Interstate



Highway System essentially connects large cities, and is a highspeed and low-cost transportation facility.<sup>4</sup>

Before proceeding to village population change studies, in this section, some coverage of "road" studies are of methodological interest for this research. The first is by Garrison who hypothesized that roads <sup>a</sup>very as travel facilities, with the effect that effective distance varies with the type of road.<sup>5</sup> Attempting to control for that effect, Garrison assigned different factors to actual distances on different types of roads.<sup>6</sup> Other authors, intending to provide a statewide traffic assignment model for Kansas, worked with another measure of effective or "qualitative" distance by applying the so-called sufficiency ratings which have been published annually or biennially by the Kansas Department of Transportation since 1953.<sup>7</sup> The authors stress that:

When sufficiency is used the minimum impedance route will be the path representing the "best" highways and roads - not necessarily the shortest. The sufficiency ratings are a relative measure of the quality of a road section. They relate to the speed that a particular section could be safely driven. One may think of sufficiency as miles per hour (MPH) sufficiency, that is, a rating of 80 means a section may be of such high quality that it may be driven at 80 MPH, whereas one with a rating of 40 is of such lower quality that a motorist should drive it at 40 MPH.<sup>8</sup>

Such effective distances have not yet been used in "size-distance studies" on village population change. However, Tarver and Urban, who worked on Oklahoma villages and cities, considered the type of road on which the village is situated as one of the factors affecting population change.<sup>9</sup>

Other studies have worked, directly or indirectly, with the distance of villages to Interstate or other controlled access highways. Hansen, whose book is about the turnaround in the redistribution of population favoring non-metropolitan areas, included as one major consideration in the interpretation of rural population change the (average) distance of a county from an Interstate Highway. Hansen also refers to a Gallup Poll survey released in 1968 which found that 56 percent of the respondents would prefer living in rural areas or villages if jobs were available. Among the other aspects which are of interest for this study is the increasing role of migration in the process of population change from 1950 to 1970. Kansas was among the states which, in large groups of contiguous counties, had fewer birth than deaths.<sup>10</sup> For these areas, population change figures are relatively good approximations of net migration. *have which*

In a study that relates to my work, [Humphrey and Sell] worked on the relationship between village population change and distance to controlled access highways in Pennsylvania. Control variables were size of place, absolute college and military population change, percentage of residents 15 - 24 years old (as indication about the attractiveness of an area), population density (relative high density was expected to inhibit further population growth), and finally, the distance to the nearest metropolitan community. They found toll roads have the same effects as interstate road networks. A significant relationship between village growth and distance to a controlled access highway was found for the periods

1950-60 and 1960-70, although population density and distance to a metropolitan community were more important. They found a negative relationship between village population change and the proportion of residents in the ages 15 - 24, which was interpreted that declining villages were losing residents of this age group - a posteriori a weak justification for the selection of this variable. Losing migrants of the ages 15 - 24 is part of the whole population change process and not an independent factor. In further investigations the distance variable (distance to metropolitan centers) was categorized into three groups by the authors, the thresholds being arbitrarily 15 and 25 miles. The strongest associations between the distance variable and most control variables, on the one hand, and village population change, on the other, were found among villages closer than 25 miles to metropolitan communities. Referring to the other distance variable (distance to closest controlled access highway interchange), the authors found that places grew even before the roads were opened - a probable anticipatory effect. However, the highways also might have been located to serve population already growing. When, as dependent variables, net migration data were used, instead of the average annual population growth, the results showed no appreciable differences.<sup>11</sup>

#### Villages in the Vicinity of a City

Studies on village population change which examine distance of the village to and/or size of nearby cities may be classified according to two different orientations. In one application,

the city stands in the center, and the villages in its vicinity are taken into consideration. The other category emphasizes the village and examines the influence of larger settlements in the vicinity. In this section, attention is paid to the former group. Here one can also include Beale's paper on nonmetropolitan population growth in the U.S. His study also focused on the so-called population turn-around since 1970. In it he presents results from a Wisconsin survey (by Zuiches and Fuguitt) which revealed that a majority of the respondents unsatisfied with urban life preferred their ideal rural or small town residence to be within 30 miles of a city of at least 50,000 people. But nearly two thirds ranked a more remote village as more desirable than a big city.<sup>12</sup> These findings indicate the importance of the direct influence a large city can exert on villages in its vicinity.

When Fuguitt and Thomas investigated small town growth in the United States 1940-60 (all incorporated places under 10,000 population were included), they found that location relative to large cities and metropolitan areas had a considerable effect on small town growth. This was concluded from a classification according to location of small towns. Locational categories were SMSA's, unbanized areas, and nonmetropolitan areas. Thus, distance was not "measured" exactly or directly, but indirectly through locational categories. The results also revealed a direct association between small town size and growth.<sup>13</sup>

Related aspects appear in a study by Schwarzweller who

inspected the rural scene throughout the United States. Based on findings by Beale, the author estimated that two thirds of the nonmetropolitan growth, 1970 to 1973, occurred in places adjacent to or within commuting distances of metropolitan areas. Village location with respect to large cities was also the central theme of a study by [Hart and Salisbury]. These authors found that for Middle Western Villages (incorporated cities under 1,000 population outside urbanized areas), proximity to a larger city was more influential than village size as a factor explaining village population change.<sup>15</sup> This is (inconsistent with findings of other studies,) such as Groop's on village population change in Kansas.<sup>16</sup> However, the authors believed that village population change is too complex to be satisfactorily explained by any simple set of variables. As a partial solution they chose to map two categories of areas: those within 25 miles of a place of 25,000 or more, and those of village growth 1950 - 1960. These areas turned out fairly congruent. It was concluded that village population change is a function of distance from the closest city of 25,000 or more. In another section, residuals from the regression were mapped. They found that "underpredicted" villages tended to lie closer to larger cities.<sup>17</sup>

Hassinger used a similar, although more attractive, conceptual and methodological framework when he studied factors influencing population changes in southern Minnesota villages between 1940 and 1950. He delimited his study area in a fashion that enabled him to regard all the villages within the area as

agricultural trade centers. He also took into account the quality, the amount of irrigation, the average farm size and the average value of farm products sold. Density of "non-incorporated" population was also considered. A central part of his study involved an analysis of "spatial relationship" with regard to larger centers and to distances between villages and larger centers. Two groups of larger centers, those between 2,000 and 5,000 population, and those over 5,000 were distinguished. Concentric circles were drawn around every center at distances of 7, 10, and 15 miles in order to classify the villages according to location within the four distance zones. There is no justification for exactly how these distance values, and size thresholds for the larger centers, were selected. Hassinger justified the 2,000 population threshold with the fact that, for instance, experiments with the value of 2,500 resulted in too large portions of the study area being outside the first three distance categories. Villages with county seat function and/or a high school were investigated separately. The major hypothesis of Hassinger's paper, that bigger and smaller centers would have different effects on village population change, was supported by the findings. The percentages of villages which grew at certain rates were calculated for each of the distance zones, and it was found that more villages grew at higher rates when they were closer to centers of 5,000 population or more and when they were more distant from centers between 2,000 and 5,000. High levels of significance were especially prominent for villages with



populations over 400. The different growth patterns around smaller and bigger centers were interpreted as results of competitive versus cooperative effects. Villages with a population over 400 seemed more likely to be in direct competition with smaller centers.<sup>18</sup>

Butler and Fuguitt, who replicated Hassinger's 1956 study, generally found the same types of relationship between village population change and distance to smaller and larger towns. Smaller centers obviously have a competitive effect on nearby villages, in contrast to the larger cities, which seem to have beneficial effects on small-town population growth. In contrast to Hassinger, the authors did not consider centers smaller than 2,500 population, and they also included the more urbanized part of northern Minnesota. There, however, they found that the location of a place in this part of the state was more important than distance to a larger center.<sup>19</sup>

In contrast to this and other works, Rikkinen published a paper where more detail concerning the distance variable was revealed. His study, which focused on village population change in the surroundings of one large city, Duluth, avoided the generalization of grouping distance values into arbitrarily defined intervals. The three decades from 1930 to 1960 were considered separately. The author tried to control for the effect of the city of Cloquet by using the distance to the closer of the two cities as an independent variable. In a rough abstraction, we may summarize Rikkinen's findings on village population change

(other sections dealt with rural township population change) as follows: There were different relationships between population change and distance to Duluth in the three decades. In the thirties the association was positive for distances up to 30 miles. In the forties, the same association was negative, tending to be insignificant after 25 to 35 miles. Finally, in the fifties the association was more strongly negative, especially in the distance category up to 20 miles. A disturbing feature of the analysis was the very strong positive association between 0 and 4 miles. It should be noted, however, that these generalizations were derived from a fairly small number of cases, and that high deviations in single cases were quite common.<sup>20</sup>

#### Village Location Relative to Nearby Cities

In this segment attention is placed on another type of inquiry. Rather than drawing circles around cities and examining which villages lie within the circles, other studies have examined relative location from the village's vantage point. This is the category in which this study belongs. Most of the previous studies in this vein, like those in the second group, did not consider both distance to and size of nearby cities. Those efforts where an attempt was made to include size and distance tend to rely upon very simple quantitative analysis. For example, in their work on South Dakota villages 1949 - 1960, Field and Dimit considered, among other factors, the location of a village with respect to a metropolitan center, the size of the village, and its previous growth experience. They stated that small agricultural



trade centers were mostly declining, whereas other villages, which have been able, because of their advantageous location, to attract migrants, have not declined. With the improvement of transportation, they reasoned, bigger trade centers were able to exert an influence over an enlarged territory, and the number of centers had to decline. In their results, the authors found, apart from county seats, size of village and distances to the nearest SMSA and city with 10,000 population or more to be the most important predictors of village population change. Among the three size classes of villages distinguished, the 500 to 999 group showed the highest correlations between population change and distance variables. The level of significance was higher for the second decade of the time period studied. But the degrees of explanation were not very high, possibly a result of using simple correlation analyses.

In a recent dissertation on village population change by Groop over the period from 1950 to 1970, a similar approach was taken in a section dedicated to size and distance tests. The sample population consisted of all incorporated Kansas cities of less than 1,000 inhabitants. Distances to the nearest places of the following size categories were measured: more than 1,000, 5,000, 10,000, and 25,000 population. A linear relationship between village population change and distance to a larger place was implicitly assumed. However, when he graphically related village population change to distance (which has been broken down in 10-mile intervals), a non-linear relationship was found.

The distance to the nearest place of more than 1,000 population seemed least associated with small town growth or decline.

In another segment of his study, a set of independent variables were selected to be applied in a multiple regression analysis, with village population change as the dependent variable. The first independent variable was chosen was that indicating distance to cities of various size classes. Distance to cities bigger than 10,000 and to those bigger than 25,000 was equally strongly associated with village population change. However, the choice of the 10,000 threshold was justified with the fact that distance to cities of more than 10,000 population showed a distribution closer to a normal distribution than distance to cities of more than 25,000 inhabitants.

The second independent variable to be selected in Groop's study was the mean age of the village population. The age structure of the villages was intended to serve as a substitute measure for migration data which were unavailable. Higher average ages were thought to indicate populations left from outmigration, and a negative association between population and mean age was hypothesized. Another variable indicated village housing costs relative to the costs in nearby urban places. Then, a value representing business activity was calculated for every village. Following suggestions by Hart and Salisbury, also the relative importance of the largest employer in the village was also measured.

Two additional independent <sup>what</sup> were the average rural population

change in the area (townships) surrounding the village, and the last one was the 1950 population of the village. These two variables were hypothesized to be positively associated with village population change.

The intercorrelations between independent variables were presented in a matrix. For two variables, business activity and relative importance of the largest employer,  $r$ -values were fairly small. Moreover, they were negative, which was different from what one should expect. No significance levels were indicated. When subjected to a multiple regression analysis, these variables, and also the distance variable, added little to the percentage of explained variation. The residuals from the multiple regression were mapped. Again, it was found that near metropolitan centers villages grew faster than predicted. In a further step of his study, Groop performed a typology of villages by a factor analysis based on the seven independent variables. The villages were clustered to six groups according to their factor scores. No further analyses were made with the clusters.<sup>22</sup> However, different types of villages may perform quite differently in regression analyses.

Whereas Groop considered the distance of a village to the next city exceeding a certain threshold value, Fuguitt took into account the size of the largest place within 30 miles. In his study on village population change in Wisconsin 1950 - 1960 he used three independent variables: Size of village, population change in the surrounding area, and location. The universe

consisted of all incorporated places in the state with fewer than 2,500 inhabitants. What Fuguitt called a location variable was actually the size of the largest place within 30 miles of the village. The distance between the village and this place was ignored. The 30 mile threshold for distance was regarded to be the outer limit for commuting. The variables most highly associated with village population change were found to be nonvillage growth and size of the largest place within 30 miles. The correlation coefficients were highest for places between 1,000 and 2,499 population and lowest for those under 500.<sup>23</sup>

Together with Beale, Fuguitt later completed a more sophisticated study where both size and distance measures were taken into account. The authors investigated the population change of all incorporated places of the U.S. up to 50,000 inhabitants from 1950 to 1970. The cities were divided into size classes, according to their initial population levels. The percentages of growing places among all places in each class was calculated. The lowest percentages appeared in the lowest classes. The authors were the first to make a "double consideration" of location with respect to bigger cities. On the one hand, the size of the biggest place in the county where the village was located was considered, and the distance to metropolitan centers, on the other. The results, based on a cross-classification, revealed that villages in counties where the biggest place had more than 10,000 population, and which were more distant than 100 miles to metropolitan centers, were growing fastest. In the study the proximity to inter-

state highways was also controlled. The total nonmetropolitan population grew at least twice as rapidly in counties containing interstate segments as in other counties. Proximity to the interstate system seemed especially important in rural areas. Incorporated cities in counties where the biggest place had less than 2,500 inhabitants grew much faster when they were located near the system (except for the Southern section of the United States).<sup>24</sup>

In a recent nation-wide study, Johansen and Fuguitt asserted that areas surrounding large cities captured the largest share of the overall population growth, and that each village's growth has largely depended on its supporting economic base and its location relative to other centers of employment and service activities. The direct relationship between village population change and proximity to larger urban places as treated in other studies, was interpreted as a "... response to employment and other opportunities available ... through commuting, whereas more isolated villages lack this locational advantage." The authors worked with a potential model in order to calculate association indices between villages and cities over 10,000 population within a radius of 50 miles. The distance values were cubed. Residuals were used as the dependent variable based on a simple regression of population variables at two different points of time. To a large degree, the population of a village can be "predicted" by its population at an earlier point of time. The residuals control for this unwanted effect and can be viewed as a "base-free"

measure of population change.] Together with changes in village business activity, and the accessibility index, this variable was incorporated into a path analysis model. The accessibility measure was thought to influence both population change and business change, whereas population change itself was assumed to be a cause of business change.<sup>25</sup> Although this predetermination of the direction of effects, which is necessary to create a path model, is questionable (business change may as well affect population change), the model had satisfying predictive results.

#### Summary, Evaluation, and Critique

The literature reviewed here reveals how many different shadings of the size-distance concept have been applied. In many instances, size and distance values were categorized, and the associations with village population change were presented where relative location was very imprecisely analyzed. Sometimes, such as in the studies by Field and Dimit, and Groop, only distance to the nearest city of, say, 10,000 or more population was considered, but not its size. When Groop measured the distance between the village and the nearest place of more than 1,000 inhabitants, he only recognized the bare existence of that place, but not whether it had 1,000, 10,000, or 100,000 inhabitants.

In other studies, only size of nearby places (and not distance) has been considered. For instance, Fuguitt (1964) used as an independent variable the size of the largest place within 30 miles of a village, without controlling for the real distance which could have been 2, 12, or 22 miles. Only a few studies have

considered both size and distance, but mostly in categorized terms, like Hassinger (1956) and Hart and Salisbury (1965).

In research up to this writing, only location with respect to one larger, nearby place has been considered for each village, with the single exception being Johansen and Fuguitt (1979). They, for the first time, used a potential model in order to explain village population change. These authors calculated an association index for each village, considering all cities over 10,000 population within a radius of 50 miles. After having tried different exponents for the denominator (distance measure), the authors decided that the cube appeared to lead to the best results. Up to this time, the potential model had been used only to explain industry growth, such as the work by Ray and Lewis.<sup>26</sup>

#### The Size of the City

It has been argued that different thresholds for the size and distance values have been applied. The use of minimum size thresholds for "larger" cities have appeared in order to distinguish them from smaller towns with little or no impact on village population change. In some cases maximum thresholds for distance values were employed by researchers, and cities of any size beyond this distance to a village were assumed to be too far away to have any (significant) influence. Threshold values have also been applied in order to distinguish city size or distance categories. Many of these thresholds were selected arbitrarily, or their selection was not justified adequately. When the size of a city or of cities which should influence village population



growth were used in previous studies, minimum threshold values of 2,500, 5,000, 10,000, 25,000, and even 50,000 for city sizes were applied. Only two studies worked with lower values. Hassinger (1956) justified the selection of the 2,000 threshold only technically, although he admits on another page that industry was concentrated in places over 2,500 and especially in those over 10,000. The purely technical justification that only by the application of the 2,000 threshold most areas will lie within certain distance zones of cities seems not apt to lead to acceptable results about the real world. Moreover, the thresholds for the distance categories were selected purely arbitrarily.<sup>27</sup>

Another author, Groop, experimented with an even lower threshold, 1,000. However, this was not justified by any fact or reasoning, and the results were disappointing. In earlier studies, the minimum threshold selected for a large city was, logically, somehow related to the maximum threshold of the places for which population change was being investigated. Thus, Fuguitt and Thomas considered all incorporated places up to 10,000 population with respect to their location relative to SMSA's (which contain core cities of at least 50,000). Fuguitt, working alone, did not even set up a minimum threshold for "bigger" cities when he took into account the largest place within 30 miles of a village. In a sparsely settled area such a larger, nearby place may be much smaller than, say, 1,000 inhabitants.

Although the use of certain minimum size thresholds for cities in most studies were not justified, some justification



can be found for many of them. No justification can be found for the use of thresholds smaller than 2,500, which is the minimum value used in this study. Little justification can be found for Hassinger's assertion that industry was concentrated in centers larger than 2,500 and particularly in those larger than 10,000, for the respective threshold values. Several types of industries tend to concentrate in larger places, partly in order to take advantage of the so-called agglomeration effect.

In a paper by Nesmith reference is made to an economic smalltown study where minimum markets were set out in terms of numbers of customers required for the maintenance of a reasonable income for the proprietors. 5,000 inhabitants (and a market radius of 25 miles) were considered appropriate.<sup>28</sup> In a related vein Clawson found that cities smaller than 5,000 are not likely to have much industrial or other employment unrelated to agriculture, nor much tributary, open-country, non-farm population.<sup>29</sup> In the study by Hart and Salisbury, an a posteriori justification appeared for a threshold population of 25,000. Finally, relating back to an essential passage from Beale's paper where he reported on the Wisconsin survey by Zuiches and Fuguitt, it was found that a majority of the masses dissatisfied with urban life, preferred their ideal rural or small town residence to be within 30 miles of a city of at least 50,000 people. Taken together, the judgement reported in the studies cited is a strong justification for applying a high minimum threshold in size-distance studies of village population change.

Previous studies, as a rule, do not explicitly inform as to whether they applied the, say, 5,000 minimum threshold to the beginning, midpoint, end, or average of the time period covered. City and village populations are, however, not stable. On the other hand, few practical problems might have arisen from this fact because there may have been very few cities which passed a pre-determined threshold during the time period covered.

Properties of larger cities other than size in terms of population never have been applied in the line of research reported here. This may partly be justified by the unavailability of data for cities of 5,000 population and less. But, for instance, Groop, who had access to Dun and Bradstreet commercial ratings for every incorporated city (and which are very expensive and very difficult to obtain), used them only as a village property, and not as a variable of the nearby larger cities. Quite remarkable, however, is the fact that population change measures of larger cities were never applied, while population changes in the rural hinterland of the villages enjoyed recognition by Fuguitt (1964) and Groop. A dynamic variable, village population change, has been described or explained by a static variable, size of a nearby city, regardless of the city's demographic performance, i.e. whether it lost or gained population or whether it was subject to stagnation.

#### The Distance Variable

When one turns to the distance variable in analyses of village population change, it has often been expressed only in

terms of village location in an area category relative to a large city, such as the study by Fuguitt and Thomas. Hassinger also categorized the distance from centers into concentric-zone groups, the distinctions being 7, 10, and 15 miles. Humphrey and Sell used the values of 15 and 25 miles for the same purpose. All of these values were selected arbitrarily, and only the 25 mile maximum distance received some a posteriori justification in the paper by Hart and Salisbury. In contradiction, Fuguitt and Beale even used a maximum distance value of 100 miles. Other studies, such as those by Field and Dimit, and Groop, set no outer limit to the distance they considered when identifying a city of a certain minimum size that could affect a village in its vicinity. Fuguitt and Johansen set as the maximum distance of a city they would consider to be up to 50 miles. This was certainly arbitrary. In a different study Fuguitt applied a 30 mile limit because he considered it as the outer limit of commuter residence.

After reviewing applications in the relevant literature, it is much easier to find a fairly strong justification for the use of the 30 mile limit. Referring again to the study by Zuiches and Fuguitt, as cited in Beale, a majority of respondents were sensitive to the availability of a city of at least 50,000 people within 30 miles of a smalltown residence. As further support, Schwarzweller estimated that two thirds of the nonmetropolitan growth, 1970 to 1973, occurred in places lying within commuting distances of metropolitan areas. A widely accepted value for that outer commuter limit was the distance of 30 miles. It may,

however, have increased more recently.<sup>30</sup>

Many studies have used straight line distance between villages and nearby larger places. Some have used road distance, an example being Hart and Salisbury. One even used a "mixture": Johansen and Fuguitt generally worked with euclidian distances, but used highway distances where major obstacles appeared in an area. According to Olsson, it must be admitted, partly contradicting some earlier arguments, that the extra work in computing other than air distances is very often not justified. A work by Nordbeck is referred to, which revealed the fact that actual street distances and straight-line distances in the U.S. are correlated so highly that practical results would be very little influenced by the kind of measurement used.<sup>31</sup>

None of the studies done on village population change have measured the distance between a village and a city in terms other than mere quantitative miles. Road quality has only been controlled for in studies such as those by Garrison, and by Russell, Jatko, and Ahsan, though these did use different techniques. The fact that, for instance, driving time and effective distance could be more than double on a "bad" road, in comparison with a section of a "good" road of equal length, has been ignored. Only Tarver considered the effect of at least the type of road on which a village was located.

### Conclusion

One can conclude that the size-distance concept, although applied in many variations, has seldom received proper methodo-

logical attention. Some unsophisticated measures have been used. But, after unsatisfactory results, attention was quickly turned to other relevant independent variables instead of a further development of the concept. It is the aim of this work, to develop the concept more completely. The intention is, thus, to gain a higher level of explanation of village population change.

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## Chapter III

### METHOD OF STUDY

#### The Universe of Study

As noted earlier in this paper, population change of places in Kansas with a population of less than 2,500 is scrutinized. The places must have been continuously incorporated during the period from 1940 (census) to 1976 (time of estimate).<sup>1</sup> Places which were larger than 2,500 population in any earlier census, but reported as smaller in either the 1970 census or the 1976 estimate (or both) were included in the study. 509 places met these criteria. Places which were larger than 2,500 population in both 1970 and 1976 were classified as "cities" to be referred to in the size-distance tests.<sup>2</sup> Theoretically, these and larger places could have been included in the study, but it seemed more logical to avoid an overlap and the "risk" that, at certain times, the distance from a village to a city yields a measure to a place which is smaller than itself.

#### The Dependent Variable

There are various ways of measuring village population change. The simplest, and most frequently used, is the relation of the populations of two points of time. Some have calculated figures like "population in time B as percent of population in time A", which is essentially the same as the above, only multiplied by a factor of 100. In correlation and regression analyses, the application of the average growth rate should lead

to the same results, because it conveys the same information.<sup>3</sup> Quite different measures, however, have been employed. One is "the population in time A as percentage of the peak population", used by Salisbury and Rushton.<sup>4</sup> The use of this variable does not seem very justified, because the peak population which is referred to may have existed at any time, and many ups and downs may have been experienced by the village since then.

In what is judged to be a superior technique, a measure developed by Johansen and Fuguitt was adapted for this study. It was the residual of the simple regression between population figures at two different points of time. It was intended to serve as a "base-free" measure of population change, because it had a zero correlation with the initial population.<sup>5</sup> The application of this measure avoids problems due to small initial populations, and it controls as well for the "statistical contamination" of geographical and historical data mentioned by Hart and Salisbury. In the sample of their Midwestern villages, the authors found by simple correlation, that 91 percent of the variation of the 1960 population was explained statistically by the 1950 population.<sup>6</sup> Johansen and Fuguitt were the first to try for such properties of population data, and they got satisfying results. For this reason, the same technique will be applied in this research.

All studies up to now have worked with measures of relative population change. Theoretically, absolute change can also be considered. There is, however, little reason to believe that the

application of the absolute population change would yield satisfactory results. The capacity of smaller villages to absorb growth is, in absolute terms, always lower than in larger ones. There is only one technical complication opposing this rule, at least partly: Generally, larger villages are more densely populated than smaller ones, and thus, more of the growth of smaller villages can occur within existing corporate limits, whereas the growth of larger villages is more likely to spill over into unincorporated territory and is, therefore, not registered by the census. Fuguitt and Beale noticed this effect when working with North Dakota data, where village acreage figures were available.<sup>7</sup> Villages close to large cities have subdivisions in unincorporated territory which may be annexed.<sup>8</sup> The data situation does not allow one to control for such annexation and spillover growth into unincorporated territory, or subsequent decline in such territory. But if these complications would seem to justify the application of an absolute rather than a relative measure of population change, this can be accomplished by using the residual variable employed by Johansen and Fuguitt. This is a somewhat special measure which unifies the advantages of relative and absolute measures. The residual itself is expressed, on the one hand, in absolute terms. That is, there may actually be 212 fewer people in a village than one would expect according to the regression equation. But on the other hand, this variable is dependent on the village size and thus also has properties of a relative measure.

Some village growth may be a function of annexation of people who have been resident for a long time. Data limitations do not allow the consideration of annexation as a factor influencing village growth. Up to this point, mention has been made only of village population change as a whole. However, this research does not attempt to explain all components of population change. Natural population change should rest within the domain of sociologists, social psychologist, and demographers. Strictly speaking, this study seeks only to find an explanation for the migration components of the change, for the net migration. It would certainly be desirable to look at in-and outmigration separately, and separately for various age groups, but the data are not available. Theoretically, it is possible to calculate a substitute measure for village migration data. However, this would require one to assume each village as having the same natural population change as the county in which it is situated. A share of the county's migration data would be assigned to each village within the county, weighted according to its share of county population. The results, however, would be questionable, because the natural population change within a county may vary considerably among its urban centers, villages, and farms. However, Humphrey and Sell, in their study on population growth of Pennsylvania villages, found when net migration was substituted for the average annual population growth, the results did not change substantially.<sup>9</sup> This serves as justification for the fact that the population change variable is used here as if it

were the net migration component.

A researcher cannot hope to explain the "erratic fluctuations" of population as mentioned by Hart and Salisbury. These authors thought certain types of population fluctuations were responsible for "incontrollable" components of village population change, which become larger for smaller villages. They argued that these fluctuations were related to the changing size of the family or group occupying a house. Whereas the number of houses in a village normally does not change drastically in intercensal periods, the number of people in a house may rise or fall considerably due to the life cycle stage of the occupying family. These fluctuations may balance each other, on the average. But the probability that they do not is larger in smaller villages. Therefore, for the smallest villages, one would expect the largest variation and the widest distribution of residuals and thus, the smallest degree of explanation.

Census Population data from 1950, 1960, and 1970, and the Bureau of the Census population estimates for 1976 are the source of raw data for the dependent variable. The comparability of census data and the estimates has been noted in the introductory chapter of this work.<sup>11</sup> As will be explained later, there will be a separate investigation of each intercensal period and of the period from 1970 to 1976. Therefore, three different dependent variables had to be computed.

#### Size and Distance Variables

Having described the derivation of the dependent variables(s),

emphasis is now placed on an explanation of how the independent variables were derived. The focus is on the variables relating to the size of cities and the distance between them and villages. A discussion of the selection of other independent or control variables will be provided at a later stage.

### Distance Variable

For each of the 509 villages, all "cities" within a road distance of 35 miles to the village were considered.<sup>12</sup> For each city, four distance variables were measured: the first was the highway distance not considering interstate highways, and the second was the highway distance considering interstate highways. The third and fourth were the corresponding distances adjusted for road quality.<sup>13</sup> The first variable was obtained from a highway map of 1950, and the second from a highway map of 1976.<sup>14</sup> The third and fourth variables were derived from a sufficiency rating map of 1978 which showed state highway sections of different rating intervals.<sup>15</sup> This is basically the same kind of information that Russel, Jatko, and Ahsan used in their study. As noted in the last chapter, the distance units derived from incorporating these sufficiency ratings may be interpreted as units reflecting driving time.<sup>16</sup> These sufficiency ratings have been computed since 1953 annually or biennially. It is said that

.... the Sufficiency Ratings .... are based on an Engineering Appraisal of each section of the Rural State Highway System.. .. The Rating of an individual section of road depends on how it compares with specific standards, and how much traffic it carries .... Ratings .... indicate the relative need for improvement of each section of the Rural State Highway System .... Kansas develops its ratings on the basis of 100

points being a perfect rating. The sufficiency rating procedure .... consists of determining the rating values for a number of individual geometric and condition features of each section of roadway. The summation of these individual ratings provides a basic rating .... The majority of the rating values are based on mathematical comparisons of geometric measurement to a set of standards. The balance of the rating values are judgement evaluations of condition characteristics .... The various data elements that are taken into consideration when developing rural sufficiency ratings on each section of highway fall into one of two categories: condition, or geometric, and driver considerations.<sup>18</sup>

The basic methodological difference in this study compared to the work by Russel, Jatko, and Ahsan is that these authors worked directly with the adjusted ratings. Here it is assumed that the use of the rating intervals as they appear on the map is sufficiently accurate. The authors cited above had access to special computer programs and data tapes, but the extra work of replicating their procedures seems unjustified.<sup>18</sup> On maps produced by the Kansas Dept. of Transportation, adjusted, road quality ratings are shown at 10-point intervals. Only the ratings below 40 appeared in an undifferentiated way. The midpoints of the intervals were taken, except for the lowest interval below 40. For that interval, a "weighted midpoint" was calculated by the author according to a graph showing percent of miles rating below indicated sufficiency ratings.<sup>19</sup> The midpoint was defined by a vertical line which cut the area under the graph into two pieces of equal size, as shown in Figure 1. The point was found at the sufficiency rating mark of 33.6610879.

To summarize this argument, for the seven intervals displayed on the referenced maps, average ratings of 33.6610879, 45,



**THIS BOOK  
CONTAINS  
NUMEROUS PAGES  
WITH DIAGRAMS  
THAT ARE CROOKED  
COMPARED TO THE  
REST OF THE  
INFORMATION ON  
THE PAGE.**

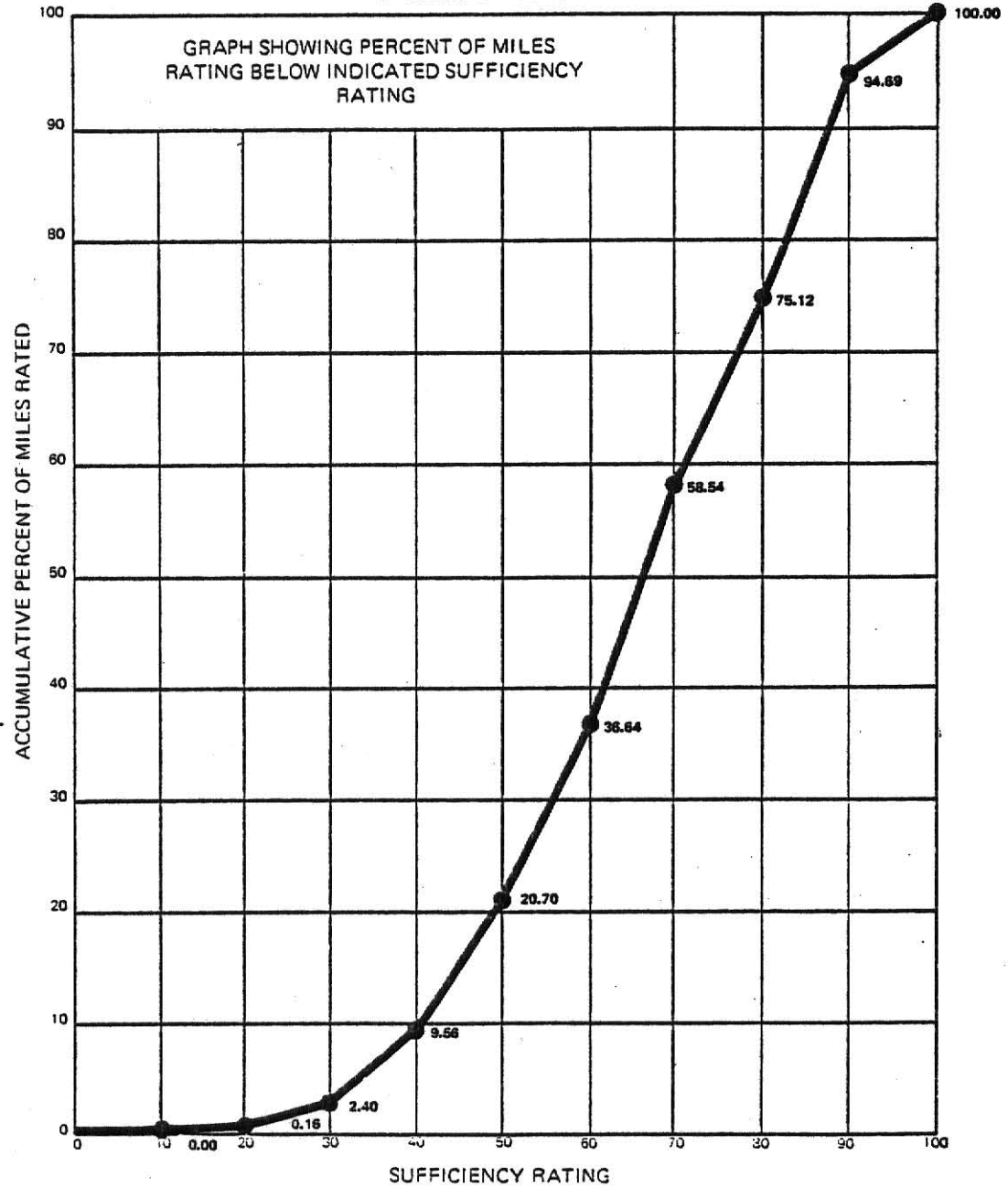
**THIS IS AS  
RECEIVED FROM  
CUSTOMER.**

FIGURE 1

KANSAS STATE HIGHWAY SYSTEM  
RURAL SUFFICIENCY RATING

1978

(Interstate Excluded)



Source: Kansas Department of Transportation, Planning and Development Department, Kansas rural highway Sufficiency Report 1978, Topeka, 1978

55, 65, 75, 85, and 95 were used. To take them as averages required the presupposition that the sufficiency ratings were equally distributed within all 10-point intervals. The reciprocal values of the average ratings were calculated, and these were multiplied by a factor of 95 which made the final value for the highest sufficiency rating interval one, for the sake of convenience (see Table).

TABLE 1

## Sufficiency Rating Intervals and Final Factors

| Sufficiency Rating Intervals | Final Factors |
|------------------------------|---------------|
| 90-100                       | 1.0000        |
| 80- 89                       | 1.1177        |
| 70- 79                       | 1.2667        |
| 60- 69                       | 1.4616        |
| 50-559                       | 1.7273        |
| 40- 49                       | 2.1112        |
| below 40                     | 2.8223        |
| Average                      | 1.6438        |

Source: Author's computations, partly based on information from Kansas Department of Transportation, Planning and Development Department, Kansas Rural Highway Sufficiency Report 1978, Topeka 1978, pp. 15 and 19.

"Effective distances" were calculated on the basis of road mileages and the final factors. The mileage along each portion of a road were multiplied by the appropriate factors. Thus, the

portions of roads in the lower rating intervals got higher factors for calculating the "effective distance" from road distance. For instance, 10 miles of road in the fifth interval (50-59) represented an "effective distance" of 17.273 "new units" (see Table 1). As noted therein, these units may be thought of as units of driving time.

Problems arose from two sides. First, road and "effective" distances to cities in neighboring states had to be measured. Highway maps of these states were used.<sup>20</sup> For road distances, there were no problems of comparability. The highway sufficiency ratings for the States of Colorado, Nebraska, and Oklahoma, seemed more or less comparable to those of Kansas, although in Oklahoma, the design features had a higher weight in comparison with the condition features, when compared to Kansas and Nebraska.<sup>21</sup> In some cases, the sufficiency rating maps of these states indicated intervals different from those used by the Kansas Dept. of Transportation map, but the final factors for each interval were calculated in the same fashion as displayed above. For instance, for the interval 80-100, the 90 midpoint was taken as average, and the interval was assigned the final factor of 1.0589. For the lowest intervals, the final factor was calculated under the assumption that the cumulative graph published for Kansas was also roughly representative for the neighboring states, as there were no comparable curves available for them.<sup>22</sup>

The lack of sufficiency ratings for the State of Missouri was a problem. In this state, so-called service ratings are

computed. These indices, however, are identified separately for road condition, safety, and capacity, and they are in no way comparable to the sufficiency ratings in the other states.<sup>23</sup> The mileages of portions of roads in Missouri, therefore, were assigned the average final factor of 1.6438 (see Table 1). For Interstate and other multilane highways, an average sufficiency rating of 90 was assumed (this value was roughly representative for the Kansas Interstate and other multilane highways).<sup>24</sup> The corresponding final factor was applied to correspondent portions of highways. These were thought to be defensible estimates. Minor deviations introduced by this operational decision should be insignificant, because the portions of roads in Missouri involved only a small share of all roads.

A second problem rested with the fact that not all villages were located on State or Interstate highways. Many of them only had access by a county road, sometimes paved, sometimes gravel, and a few times even earth. These county roads were not given sufficiency ratings. An operational solution for this problem involved treating paved county roads as identical to State highways of the seventh category (below 40) in Table 1, and by assigning a final factor of 5 to unpaved county roads.<sup>25</sup> There were also some multilane highways in Kansas exempted from sufficiency ratings, namely, the Kansas Turnpike, and certain "urban" highways in the SMSA's. These highways were treated like the multilane highways in Missouri.

Preferably, state highways were considered. Paved and un-

paved county roads, however, were not only considered when this was necessary to have access to a village, but also, in order to ensure larger places were within the 30 or 35 mile distance, when county roads were shorter.<sup>26</sup> The corresponding "effective distances", based on sufficiency ratings, however, do not necessarily correspond to the same routes, but to the "minimum driving time" routes. In most cases minimum road distance routes and minimum driving time routes were identical. Also in most cases, the route between the village and a nearby larger place was divided into several portions of unequal length, and with different sufficiency rating intervals. However, the mileages of all portions were multiplied by the correspondent final factors, and the results were added together. Thus the "effective distance" between one village and one of the nearby larger places was calculated.

As there were no Interstate highways in 1960, the system being extensive one decade later, it was thought necessary to consider those highways for 1970 and 1976, whereas they could not have been included in earlier time periods.<sup>27</sup> Road distances were measured to the nearest mile. In the computation of the effective distance, results were rounded to the nearest whole number.

#### Size of the Cities

An important aspect of the research reviewed above involved justification for the use of a threshold value lower than 2,500 when examining the relationship between village change and the

size of a nearby larger place. In order to incorporate recent trends and to exempt smaller urban places with fluctuating populations would place them over and below a minimum threshold, this effort considers only these settlements which were above the 2,500 threshold in both 1970 and 1976. Larger places not meeting this requirement were treated as villages. Sometimes it happened, that larger places which were not yet incorporated in 1950 or even 1960, were fairly large by 1970 or 1976. These places could not be ignored, and therefore, were included in the analysis. In most cases, it was possible to get earlier population figures for those larger places which attained the status of incorporation later in the period covered by this study. In the census reports, unincorporated places of 1,000 population or more have been reported. In other cases, population figures from the Rand McNally atlases were used.<sup>28</sup> In a few, the population figure for a population cluster still unincorporated in 1950 or 1960 was larger than 1,000. Such a cluster did not appear in the census report of 1950 or 1960 which should list it if it is larger than 1,000. In these contradictory cases a population of 999 was assumed.

Population figures for larger settlements and the distance measures served as raw variables for the calculation of association indices. For the purpose of computing population change figures for each period, also the population figures of 1950, in addition to those of 1960, 1970, and 1976, had to be included.<sup>29</sup> However, not only were population (and population change) figures



of larger places used, but also non-farm employment figures. This was thought to be a step towards the recognition of the economic role and function of the city, how it influences village population change. In various census tables, occupational characteristics of the inhabitants were identified for all places of 2,500 population or larger. The total numbers of employment were reduced by the numbers appearing in the categories "farmers and farm managers" and "farm laborers and farm foremen".<sup>32</sup> The resultant figures represented almost exclusively employment in the secondary and tertiary sectors. These employment figures also allow some speculation about the importance of cities as service centers, since the employment of service establishments is also included. From the 1960 census, such figures were available only for places larger than 10,000 population, however, not for places between 2,500 and 10,000. Values were substituted for these missing figures through application of a special calculation. The average of the population - nonagricultural employment ratio of 1950 and 1970 was taken. Given the assumption that this midpoint represented the ratio of 1960, the nonagricultural employment could be computed from the 1960 population figures, according to the following equations:

$$\frac{POP50}{EMP50} = R50 \text{ (1); } \frac{POP60}{EMP60} = R60 \text{ (2); } \frac{POP70}{EMP70} = R70 \text{ (3); whereby}$$

POP50 is the city population in 1950,

POP60 is the city population in 1960,

POP70 is the city population in 1970,

EMP50 is the non-agricultural employment in 1950,

EMP60 is the non-agricultural employment in 1960,

EMP70 is the non-agricultural employment in 1970,

R50 is the population-employment ratio in 1950,

R60 is the population-employment ratio in 1960, and

R70 is the population-employment ratio in 1970.

If EMP60 is unknown and if we suppose that

$$R60 = \frac{R50 + R70}{2} \quad (4);$$

or, in other words, if we suppose that the population-employment ratio in 1960 lies "in the middle" between the 1950 and 1970 ratios, we may calculate the unknown non-agricultural employment figures for cities between 2,500 and 10,000 which are missing for 1960, from the above equations:

$$\frac{POP60}{EMP60} = \frac{R50 + R70}{2} \quad (4 \text{ and } 2); \text{ therefore,}$$

$$EMP60 = \frac{2POP60}{R50 + R70}; \text{ therefore,}$$

$$EMP60 = \frac{(2POP60)(POP50)}{EMP50} + \frac{(2POP60)(POP70)}{EMP70}.$$

It is reasonable to assume that this computation leads to the closest approximation of the missing employment figures from the data available. Some additional figures were missing when, for instance, a place had 2,600 inhabitants in 1970, but only 2,400 in 1950 and therefore did not appear in the occupational characteristics tables of the 1950 census. In this case, and in comparable cases, the population-employment ratio of 1960 was also assumed for 1950, or that of 1970 was applied for 1960 and 1950, and in a similar way to that demonstrated above, the missing values were calculated. No employment figures for 1976 could be obtained. As an approximation, they were calculated by applying the average of the 1960 and 1970 population-employment ratios to the 1976 population figure, and the way of calculation was basically the same as shown above.

#### The Computation of the Association Indices

For each larger place within 35 miles of a village, the

population and nonagricultural employment variables and the distance measures, as described in the previous segments, were collected. Places of more than 5,000 population in both 1970 and 1976 were separated from smaller ones in order to maintain the option of retesting the findings of Hassinger and Butler and Fuguitt for Kansas.<sup>31</sup> Larger places were also separated according to whether they were within a road distance of 30 miles from a village or in a zone between 30 and 35 miles. This was a necessary prerequisite for the testing of which radius comes closer to the real commuting distance in Kansas, whether the commuting radius has increased recently, or whether it is larger in Western than in Eastern Kansas. Thus, four categories of cities were obtained. For each category, a maximum of three larger places, or cities per village was allowed. In most cases, this was more than sufficient. In some cases, however, there were more than 3 larger places near a village within certain categories, notably in the vicinity of Kansas City and in Southeastern Kansas.<sup>32</sup> In these cases, larger places were combined by pairs or groups within the four categories of mass measures. The decisions of which cities to combine was based on the similarity of their distance values to the village. For instance, if there were four larger places over 5,000 inhabitants at distances of 5, 13, 24, and 28 miles from a village, the latter two were combined, because the difference of their distance values was the least in comparison to all other possible combinations. If there was no clear decision possible with respect to the road distance

(for instance, if the distances of the four cities were 4, 8, 12, and 16 miles), effective distance values were taken into account. Population and nonagricultural employment figures of the combined cities were added, and their actual and "effective" distances to the villages were calculated as weighed averages.

It could not reasonably be decided whether the weights should be population or employment figures, and in any case, these weights would have been different at each point of time. As a compromise, a weight was used which was half composed of the average population figure from 1940 to 1976 and half of the average nonagricultural employment figure from 1950 to 1970. This weight was thought to be most representative over the entire period from 1950 to 1976, although different methods of computation would have made little difference in the results.

In the cases where there were fewer than three nearby larger places zero values were filled in for the population, employment and distance variables. In order to avoid division by zero in the automatic calculation of association indices, the insignificant amount of 0.0001 was added to all distance values after they had been exponentiated (exponentiation will be discussed later).

A series of indices was calculated for each village, based on the version of the potential model presented earlier. The model is based on the assumption that the influence of a mass on another point is dependent on the "size" of the mass and its

distance from a place being influenced, a model transferred from physics to the social sciences.<sup>33</sup> While a gravity model expresses a level of interaction between two points, a potential model sums up the whole "potential" of influence, or possible affect, one or a series of masses is exerting on another point.<sup>34</sup> Here, the influence of larger places on villages is scrutinized; therefore, only the masses of the larger places are taken into account in the models. Four measures of mass was used: population, population change, non-agricultural employment, and employment change. For change measures, absolute change figures were selected, since it is more likely that village population change will be a function of absolute population or non-agricultural employment change in nearby larger places, rather than of relative change. A village will respond in different ways to a change in nearby, larger places of, say, ten percent when represents 600 people out of 6,000 or when it represents 3,000 places of employment out of 30,000. In these absolute change figures, the size of a nearby, larger place in terms of population or nonagricultural employment - is represented, unlike relative figures.

There are also 4 types of distance, road and effective distances considering and not considering interstate highways. The latter two (road and effective distances not considering interstate highways) were applied for the period 1950-60, and the other two distance measures for the later periods. By 1960, the construction of the interstate highway network had not yet

begun in Kansas, but much of it was completed 10 years later. The rationale for using distances considering interstate highways for the 1960-70 period is based on the conviction that highway planning leads growth. Fuguitt and Beale, and Hart, Salisbury and Smith represent the view that highway planning is rather a consequence than a cause of population growth.<sup>37</sup> That may be true when highways were designed to link large, growing cities. However, it is hard to imagine that the villages between the large cities have any impact on highway planning. For them, a planned highway is rather a cause for future population change than a consequence of past demographic performance. This view is in accordance with the findings of earlier authors who found that places grew even before the roads were opened - a probably anticipatory effect (cf. p. 17).

For each combination of "masses" and distance measures, six types of association indices were calculated, considering,

1. the nearest larger place of more than 5,000 inhabitants within 30 miles,
2. all larger places of more than 5,000 inhabitants within 30 miles,
3. all larger places of more than 5,000 inhabitants within 35 miles,
4. all larger places between 2,500 and 5,000 inhabitants within 30 miles,
5. all larger places between 2,500 and 5,000 inhabitants within 35 miles, and
6. all over 2,500 inhabitants within 35 miles.

There were eight groups of such six indices for one point of time, and for one distance decay exponent to be tested, where the mass and distance variables were combined in the following manners:

1. population and road distance,



2. employment and road distance,
3. population change and road distance,
4. employment change and road distance,
5. population and effective distance,
6. employment and effective distance,
7. population change and effective distance, and
8. employment change and effective distance.

Thus, 48 different indices were obtained. For the sake of convenience and easy reference, the indices are called IA1 to IA48 for 1950-60, IB1 to IB48 for 1960-70, and IC1 to IC48 for 1970-76. IA1 to IA6 are the indices of the first group, where the mass variable population is applied in combination with the road distance for the period 1950-60. When specific exponents are applied to the distance variables, it is indicated as "IA6/.5" (exponent 0.5), "IB17/.1" (exponent 0.1), or "IC48/2" (exponent 2).

In a gravity or potential model, exponents may be applied to either the mass or the distance variable, or both, if there is justification for doing so. Manipulation of the masses has seldom been applied in social science.<sup>36</sup> One should, however, be reminded that authors like Groop, and Field and Dimit, who did not take into account city's size, implicitly used the exponent of zero for mass without justification. In the traffic model constructed for Kansas, Russel, Jatko, and Ahsan tested various exponents for population or mass variable in order to adequately describe and predict the traffic between population concentrations.<sup>37</sup> This has little to do with explanation, and it is no surprise that an engineering study lacks the reasoning expected in the social science. In this effort, the mass variables are not manipulated, and therefore, negative values as appearing in



the population or employment change variables, which could not be exponentiated, need not to be altered.

In contrast to the masses, exponents have been applied many times to the distance variable, and there has been little agreement about what exponents should be used. For various research problems, different exponents were found to convey the best results.<sup>38</sup> Taylor has suggested a method of calibrating best fitting exponents.<sup>39</sup> However, that method cannot be used for potential models, because potential models cannot be transformed to linear equations, unlike gravity models. A solution could come from a computer program for non-linear multiple regression, but it would be prohibitively expensive to run a program of this kind, given the likely insignificance of added information. Theoretically, infinitely many tests runs could be made in respect to the exponents, which may vary with place (or region) and time. The exponents may also be a function of any variable involved; they may be larger for larger villages, and for smaller centers. They may even be a function of the distance, for instance increase with distance. This could be incorporated in a gravity model by writing,

$$I = \frac{M}{(D^x)(a)(b^c)(D)} ;$$

whereby I is the association index,  
 M the mass variable,  
 D the distance variable,  
 a, b, and c constants to be fitted experimentally,  
 x the distance decay exponent,

and it had been so applied in the study by Russell, Jatko, and Ahsan. From all the options of experimenting with exponents, only

these were chosen: different exponents are tested for different periods and for different types of larger places, whether they have between 2,500 and 5,000 or more than 5,000 inhabitants.

Exponents smaller than zero are not tested, because this would imply that the influence of a larger place on nearby villages increases with its distance, which seems illogical. By just considering the size of a city within 30 miles of a village, Fuguitt (1964) implicitly set the distance decay exponent zero, but it is not reasonable to assume that a city has the same influence on a village which is 2 miles away as on another which is 25 miles away. An exponent of 1 would imply that the influence of a "mass" decreases with its distance, and that the relation between influence and distance is linear. An exponent of 2 would specify that, when the distance doubles, the influence decreases to one-fourth. Another exponent of lower than 1 means that the influence decreases less than half. In all of these considerations it is, of course, assumed, that the distance deflator of influence appears in the denominator of a potential model formula.

#### Initial Tests Applied to the Association Indices

Simple correlation analyses were made with population change (expressed in residuals, as described above) as dependent variables, and the association indices as independent variables. Simple regression and correlation is a technique often used by geographers.<sup>41</sup> Here it is used to determine which association indices or groups of indices best describe village population

change, and to support or challenge the results of Hassinger's study that cities under 5,000 population have an effect on village population change different from that of larger cities. During the first test runs, the exponents of 2 and 0.5 are used. Depending on the results of these runs, a decision was made about the direction in which to proceed (to smaller or larger exponents).

### Hypotheses

No specific hypothesis is implied concerning the value of the best fitting distance decay exponents, except that it is reasonable to assume that it is higher for the places between 2,500 and 5,000 than for larger places. Smaller centers should have a weaker influence on population change, which may additionally be expressed, besides smaller "masses", in larger exponents for the distance variables. It is believed that effective distance is a more realistic expression than road distance; therefore, better results, i.e., higher correlation coefficients, are expected when effective distance replaces road distance in the computation of the association indices. Non-agricultural employment should be a better expression of the economic influence of a larger place on a village than population. Therefore, better results are expected by using this variable. Better results are also expected when the static mass variables (population and employment) are replaced by dynamic mass variables (population change and employment change), because it seems more logical to explain the variation in a dynamic variable (village population

change) by another dynamic variable than by a static variable like raw population size of larger places. Among the dynamic mass variables, employment change is expected to be the better for the same reason that employment is expected to convey better results than population.

The rural population of the hinterland of a village has never been used as a variable to explain village population, but only the rural population change. It seems reasonable to apply the same principle to the larger places that might influence nearby villages. It is further expected that the results should be better if all places over 5,000 population within a certain distance of a village are considered, instead of only that one nearest to a village. One may further hypothesize that the commuting radius has expanded with increasing mobility of the population. Therefore, in later periods a 35 mile-limit should be better than 30 mile limit, especially for places exceeding 5,000. Weak and negative relationships between association indices and village population change are expected when places between 2,500 and 5,000 population are scrutinized, based on the findings by Hassinger which were repeated by Butler and Fuguitt. In the case of these smaller places, a 30 mile-limit may work better than a 35 mile-limit, because smaller places may very likely have a smaller sphere of influence than larger cities, be the influence "cooperative" or "competitive", in respect to a village.

To sum up this argument, the highest positive correlation

with village population change is expected for the indices which are calculated on the basis of nonagricultural employment change (as mass variables) and effective distance as the distance variable, and which consider all places larger than 5,000 inhabitants within 30 miles of a village for the earlier period(s), and within 35 miles for the later period(s). That is, in my terminology, the indices IA44, IB44 or IB45, and IC45, should convey the best results for the three periods, respectively. The highest negative correlations are expected for indices calculated on the basis of the same variables as described above, but considering all places between 2,500 and 5,000 inhabitants within 30 miles of a village. These indices are here called IA46, IB46, and IC46.

#### The Other Independent or Control Variables

Whereas the major interest of this effort is the influence of larger places on population change in nearby villages, there are other factors also influencing small town growth or decline. With varying success, different factors have been considered in previous studies. Not all of them can be included in analyses appearing here. Some variables are very time-consuming to obtain, such as Groop's average rural population change in the area surrounding the village, consisting of four adjacent townships. Moreover, it is difficult to justify their use or they are not without arbitrariness. Consideration of four townships adjacent to a village, for example, is no less arbitrary than the consideration of the whole county in which the village is located. Other potentially important variables are very difficult and

expensive to obtain. For instance, when they are based on Dun and Bradstreet commercial ratings. However, it is essential to develop a set of control variables, even with relatively modest means, in order to determine the relative importance of the influence of the larger places among all variables considered.

When consideration of the direct influence of larger places is of major interest, accessibility of villages to these centers is also taken into account, by measuring the distance between village and city. A more direct and general measure of the accessibility a village enjoys with respect to larger places is its distance from the nearest interchange with a controlled-access highway. This variable has been taken into account by Hansen, Humphrey and Sell, and Beale and Fuguitt in their studies. Significant (negative) relationships to village population change were found. As noted previously that multilane highways are a cause rather than a consequence of village growth. A higher growth is expected for those villages closer to such a highway. That is, a negative association is expected between village population change and distance to the nearest interchange with a controlled access highway.

The distance between a village and the nearest interchange with a controlled access highway is expressed in terms of effective distance as described above. Being a more realistic expression of distance than more road distance, better results or higher degrees of explanation are expected when effective distance is

used, instead of road distance, for any decay exponent applied.

Distance is certainly an important measure of accessibility, but there must be also a facility to overcome it. In the United States, that is mostly the private automobile. One may reason that the accessibility of a city increases not only when that city is closer to a village, but also when there are more cars to reach it. In this vein, Hart and Salisbury hypothesized that village growth since 1940, and especially since 1945, is attributable to the automobile, for now the daily trip to work is as easy or even easier than the weekly shopping trip used to be. It has, they assert, conferred greater employment mobility on the village dweller.<sup>42</sup> Thus, with increasing relative motorization, an increasing village population is generally expected. However, whether such relationship of this kind really exists has yet to be tested. Due to the lack of automobile registration data on a village basis, the number of cars registered in a village's county, divided by the county population, was taken as relative motorization measure.<sup>43</sup> As an independent variable, relative motorization change was applied in regression and correlation analyses where village population change was the dependent variable for each period. According to the considerations discussed above, a positive relationship was expected between relative motorization change and village population change.

Besides the groups of factors influencing village population change which are related to their accessibility to larger



places, there is another group of measures that relate to characteristics of the area within which a village is located, the immediate, rural, farm-dominated environment of the village. A very general measure of the characteristics of a village's surroundings is population density. [Humphrey and Sell hypothesized that relative high density inhibits further population growth. However, Hassinger, who considered the density of "non-incorporated" population, suggested that higher density leads to village growth, because there is more "rural support" for the village and its function as an agricultural trade center.<sup>44</sup> Kansas somewhat resembles, in settlement and farm structure, southern (rural) Minnesota (where Hassinger's work was confined). It is unlike<sup>in?</sup> urbanized Pennsylvania (where Humphrey and Sell worked).] Therefore, a positive association is expected between population density and village population change. For each village, population density is expressed by that of the county in which it is located.

As a more direct measure of the area characteristics of a village's vicinity, attention is also paid to the number of farms. It was hypothesized that a decline in number of farms is disadvantageous for village growth. In other words, a positive association was expected between the change in the number of farms and change in village population. The absolute change in number of farms within a county was taken. However, as one farm cannot support every village in the county, the absolute change figure was multiplied by a village's share of county population.

In other words, the change in number of farms within a county was divided up among the county's villages, weighed according to their populations.

[When the number of farms declines, village population loss may be a consequence. However, the effect of that factor may be partly offset by an increase in farm income. So, rise of farm income was predicted to have a positive relationship with village growth. The variable was calculated in a similar way as the "farm change" variable. Absolute income change in a county was multiplied by a village's share of county population.] Actually, "value of farm products sold" was used, which should be a good indicator of farm income. In the agricultural censuses, farm income figures were published, but the latest census was in 1971, and no figures could be obtained for 1976. Therefore, figures from the annual or biennial reports of the Kansas State Board of Agriculture were used. Since value of farm products sold is shown individually for field crops and other farm products (mostly livestock), the figures were added. The value reflected average seasonal price for most products.<sup>45</sup> The number of farms was obtained from these publications also.

After having considered variables related to larger places with respect to nearby villages and an immediate, rural environment, one may look to the village itself and its own characteristics. An indicator of the stability of the other factors influencing population change is the association between village population change and the previous growth experience of a village.

Many studies have considered previous growth experience as a variable, among them Field and Dimit.<sup>46</sup> Based on the assumption of stability of the influence generated by other factors, a positive relationship between previous growth experience and village population change is hypothesized. Previous growth experience was calculated on the same basis as the dependent variable, and thus, expressed as residual. The previous growth experience refers to change occurring over the last decade.

As another property of the village many studies have taken the absolute size of the village into account, and all of them found a significant relationship between village size and population change. This study, however, looks to village size in terms of size classes, as subsamples. Thus, more detail can be revealed, for instance, concerning the nature of the relationship (linear or curvilinear). An overview of the sub-samples considered is made later.

### Three Periods of Time Considered Separately

Analyses with all the variables described above are made separately for three periods 1950 - 1960, 1960-1970, and 1970 - 1976. A year-by-year investigation would be even more interesting, for changes in relationships could be revealed to a greater detail, but the data were not available. Some of the previous studies covering more than a decade or intercensal period, like Groop's, did not consider separately the intercensal periods they included, despite data availability, and despite the fact that several previous scholarly reports demonstrated different

patterns of relationship between village population change and various independent variables. Notably, Rikkinen revealed different types of association between village population growth and distance to Duluth for the three decades he covered.<sup>47</sup>

Fugitt and Beale, for instance, observed that there was generally less growth in the sixties than in the fifties, although in certain areas smaller places were more likely to grow in the sixties.<sup>51</sup>

Many studies have showed that especially since 1970, there is a pattern of population shifts quite different from what could be observed before, sometimes being called the "big turnaround.". That term should indicate the reversal of the direction of population shifts to urban-rural or metropolitan-non-metropolitan migration.<sup>49</sup> Different patterns of relationship between village population change and factors influencing it would be concealed by treating the time span 1950 - 1976 as a single period. The degrees of explanation would not only be very likely lower, but also misleading to a certain extent. Therefore, each analysis in this study is made separately for each of the three periods.

#### Subsamples of Villages

It seems reasonable that differentiation of separate periods and the selection of certain subsamples from the total sample may reveal different patterns of relationship. Some of these deserve attention.

#### Village Size Classes

As noted above, one type of subsample to be analyzed here is size class of villages. The entire span of 0 to 2,500 in-

habitants is divided into 10 intervals of equal size. Thus, the size classes contain villages with less than 250 inhabitants for the first class, from 250 to 500 for the second, and so forth. In order to make the limits of the size classes more stable and to largely avoid the cases where village size class during intercensal periods, it was determined, for instance, that only those villages which had over 1,000 population in both 1970 and 1976 were large enough to qualify for the fifth size class. Those which were larger than 1,250 in either 1970 or 1976, but not at both points of time, still belong to the fifth size class. Previous studies which used the size of a village to explain its growth found that there is a positive relationship between village size and population change.<sup>50</sup> Therefore, higher degrees of explanation are expected for "higher" size classes. Hassinger, who also worked with village size classes, found that high levels of significance were especially prominent for villages with populations over 400. When a negative relationship appeared with smaller centers (2,500 - 5,000 inhabitants), this was interpreted as a result of more direct competition.<sup>51</sup>

#### Size of Largest City

For purpose of subsample analysis, villages are also classified according to the largest place within 35 miles. One class is formed by the villages which don't even have a larger place of more than 2,500 inhabitants within a distance of 35 miles. In their cases, there is no correlation between the association index (which is always zero) and population change.

For them, the distance to the nearest interchange with a controlled access highway is hypothesized to be the most important variable explaining population change. Other village classes are formed by the size of the largest city within 35 miles in the following manner:

more than 2,500, but less than 5,000,  
 more than 5,000,  
 more than 10,000,  
 more than 25,000, and  
 more than 50,000.

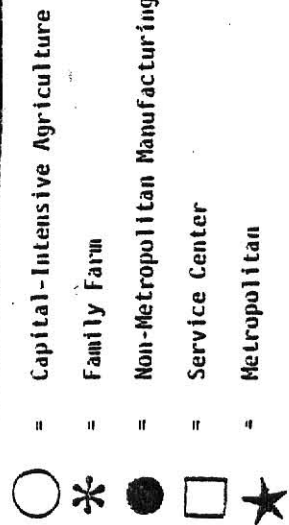
These size thresholds, although appearing repeatedly in related literature, are certainly arbitrary. But their use should be sufficient to test the hypothesis that, higher degrees of explanation for village growth are achieved where there are larger, nearby places. The Winconsin survey by Zuiches and Fuguitt (cf. page 19) reported that those dissatisfied with urban life prefer to live within 30 miles of a city of at least 50,000, which was a major basis for this hypothesis.

#### Functional Type of County

Another basis for subsample distinction is the functional type of county the village is located in. Flora et al. made a functional typology of nonmetropolitan Kansas counties on the basis of several variables related to their economic situation for the purpose of migration analyses.<sup>52</sup> Four types of counties were distinguished, as indicated on Map 1:

Capital Intensive Agriculture Counties,  
 Family Farm Counties,  
 Non-Metropolitan Manufacturing Counties, and  
 Service Center Counties.

# Kansas Counties by Functional Type and Delineation of Eastern and Western Kansas



Source: Jan L. Flora, Cornelia Butler Flora, Wayne White, Richard Leiker, Tommy Garnet, Karen Albach Duch, and Jean Jespersen Bartholomew, Kansans on the Move, Manhattan: Kansas State University, Population Research Laboratory, 1980 (mimeographed), part 1, p. 7



The first type was further subdivided into livestock counties, irrigation counties, and dryland crop counties, but these subtypes seemed too detailed for application in my study. Together with the metropolitan counties, defined by law, there were five types of counties included in this analysis. More specifically, five types of villages, classified according to which type of county they belong, were used. For agricultural types, larger places could be expected to have a smaller degree of influence than that exerted by manufacturing and service activities. It was thought likely that the smallest association exists for capital intensive agricultural counties (which would be most independent of larger cities), and that the correlation is highest for manufacturing counties (which provide the places of employment for those migrating to villages).

### Regions

The consideration of functional types of counties affecting resident villages is already a step towards the investigation of regional variations in the results of analyses. Functional types, however, are not large regions, because they are not always made up of a block of contiguous counties. It seemed beyond the scope of this report to make a regionalization of Kansas for the purpose of subsample analysis. No existing subdivisions into regions seemed adequate for these analyses.<sup>56</sup> Therefore, the only regions considered were Eastern and Western Kansas, also shown on Map 1.<sup>54</sup>

### County Seats

In addition to the types of subsamples described above,

those county seats which were smaller than 2,500 in population, and therefore were villages, enjoyed special consideration. Some earlier studies have shown that county seats display patterns of growth different from other villages. Hassinger found that the county seat property itself is a factor predicting village growth, and that county seats were growing faster than villages of comparable size.<sup>55</sup> In addition, Hassinger's findings were supported by Field and Dimit.<sup>56</sup> It is reasonable to assume that county seats, although they grow faster than places of comparable size, are more independent of influence by nearby, larger places, and probably also of other factors. Therefore, low correlations are expected for this subsample.

There is a large number of possible and meaningful combinations of all these kinds of subsamples. For instance, one might wish to look to villages with a population of less than 500 in the family farm counties of Eastern Kansas. However, the consideration of such subsample combinations goes beyond the scope of this report.

### Final Analyses

With the total sample, and all subsamples, simple and multiple linear regression analyses and beta weight calculations were made. As independent variables representing the influence of larger places on village population change, association indices were selected, depending on the initial findings. Because of limited funds and space, partial correlation and residual analyses were restricted to the total sample. With respect to partial

correlation analyses, given that six control variables were considered, first order partials were omitted for technical reasons (the available computer program allows only the investigation of partials of five different orders). Residual analyses were conducted following multiple regression applications for the total sample only. The extreme residuals, i.e. those with a distance of more than two standard deviations between observed and predicted value, were mapped and subjected to t-tests. T-tests (tests of significance of differences between sample means) were made in order to determine whether the extreme residuals are different from other villages, according to certain characteristics. For instance, an hypothesis is tested that the extreme positive residuals (underpredicted cases) obtain for villages regularly larger than the average village. In addition, as suggested by earlier studies, extreme positive residuals were examined to see if they tend to be close to larger cities. Therefore, t-tests were made for the mean association index values. Negative and positive residuals, of course, were investigated separately.

## References

- <sup>1</sup>In a later section, the use of a variable controlling for previous growth experience is justified. For computing this variable, related to the 1950 - 1960 period, 1940 census data have to be used. Therefore, the village had to be incorporated at least in 1940.
- <sup>2</sup>The discussion of this minimum threshold for "cities" follows later in this chapter.
- <sup>3</sup>This variable was employed by Graig R. Humphrey and Ralph R. Sell, "The Impact of Controlled Access Highways on Population Growth in Pennsylvania Nonmetropolitan Communities, 1940 - 1970," Rural Sociology: 40 (1975), p. 335.
- <sup>4</sup>Neil E. Salisbury and Gerard Rushton, Growth and Decline of Iowa Villages: A Pilot Study, Iowa City: State University of Iowa Studies in Geography, No. 4, 1963, p. 2.
- <sup>5</sup>Harley E. Johansen and Glenn V. Fuguitt, "Population Growth and Decline: Conflicting Effects of Urban Accessibility in American Villages," Rural Sociology: 44 (1979), p. 28.
- <sup>6</sup>John Fraser Hart and Neil E. Salisbury, "Population Change in Middle Western Villages: A Statistical Approach," Annals of the Assoc. of Amer. Geographers: 55 (1965), pp. 151-152.
- <sup>7</sup>Glenn V. Fuguitt and Calvin L. Beale, Population Change in Nonmetropolitan Cities and Towns, Economic Research Service, U.S. Department of Agriculture, Washington D.C., 1976 (Agricultural Economic Report No. 323), p. 6.
- <sup>8</sup>cf. Hart and Salisbury, op. cit.
- <sup>9</sup>Craig R. Humphrey and Ralph R. Sell, "The Impact of Controlled Access Highways on Population Growth in Pennsylvania Nonmetropolitan Communities, 1940-1970," Rural Sociology: 40 (1975), p. 342.
- <sup>10</sup>Bureau of the Census, U.S. Census of Population: 1950. Vol I, Characteristics of the Population. Part 18, Kansas, Washington, D.C.: U.S. Government Printing Office, 1952, Table 7; ibid., 1960, Washington, C.C., 1963; ibid., 1970, Washington D.C., 1973; and ibid., 1976 Population Estimates and 1975 and Revised 1974 Per Capita Income Estimates for Counties, Incorporated Places, and Selected Minor Civil Divisions in Kansas, Population Estimates and Projections, Series P-25, No. 755, Washington, D.C.: U.S. Government Printing Office (Current Population Reports), Table 1.

- <sup>11</sup>for method of estimate, see Bureau of the Census, 1976 Population Estimates, op. cit., pp. 1-2.
- <sup>12</sup>cf. footnote 2.
- <sup>13</sup>The comparability of road distances and "effective distances" was the major reason for ignoring air distances. Another reason was pointed out above, that Kansas, where rectangular road patterns are prevalent, has a relatively low correlation between air and road distances.
- <sup>14</sup>Kansas Department of Transportation, Official Highway Maps, 1950 and 1976, Topeka, 1950 and 1976.
- <sup>15</sup>Kansas Department of Transportation, Planning and Development Department, Kansas rural highway Sufficiency report, Topeka, 1978, pp. 18-20.
- <sup>16</sup>Eugene R. Russell, James H. Jatko, and Mohammed Ahsan, Investigation and Development of a Statewide Traffic Assignment Model for the State of Kansas. Final Report (mimeographed). cf. Chapter II.
- <sup>17</sup>Kansas Department of Transportation, Planning and Development Department, op. cit., p. 1. For more detail, see pages 3 and 5.
- <sup>18</sup>Russell et al., op. cit., Chapter II, P. 3 and pp. 6-8.
- <sup>19</sup>Kansas Department of Transportation, Planning and Development Department, op. cit., p. 15.
- <sup>20</sup>1950 and 1976 Official Highway Maps of Colorado, Missouri, Nebraska and Oklahoma.
- <sup>21</sup>State Department of Highways, State of Colorado, Division of Transportation Planning, Colorado 1977 Sufficiency Rating Study, Denver, 1977 (map); Nebraska Department of Roads, Planning Division, 1977 Nebraska Highways Sufficiency Rating Report, Lincoln 1977, P. 10, 58, and 103; Oklahoma Department of Transportation, 1978 State Highway Needs Study and Sufficiency Rating Report, Volume I, Oklahoma City 1978, Appendix, Dist. 1 and 8.
- <sup>22</sup>Kansas Department of Transportation, Planning and Development Department, op. cit., p. 15.
- <sup>23</sup>Missouri State Highway Department, 1978 Service Ratings, Interstate and Primary Systems of Highways, Jefferson City 1978 (mimeographed); and Missouri State Highway Department, Division of Planning, 1979 Service Ratings for Supplementary Systems of Highways, Jefferson City, 1978, and personal correspondence of the author with the Missouri Highway and Transportation Commission.



- <sup>24</sup>The Interstate System in Kansas had an average sufficiency rating of 91.75. Kansas Department of Transportation, Planning and Development Department, op. cit., p. 7.
- <sup>25</sup>Although this was somewhat arbitrary, the author concluded from previous experience, that it would not be safe to go faster than 20 miles per hour. Keeping in mind the statement by Russell et al., op. cit., p. 11, that one may think of sufficiency ratings or relating to miles per hour safely driven, the use of the final factor 5 seems justified. This solution was still thought to be better than to use the factors calculated by Garrison (Chapter II, footnote 6), because there is no comparability with the factors derived from sufficiency ratings. The former is related to transportation costs, whereas the latter are an expression of driving time.
- <sup>26</sup>The discussion of these maximum distance values follows later in this chapter.
- <sup>27</sup>Originally, there was an intention to consider sufficiency ratings for every point of time, 1950, 1960, 1970, and 1976. The ratings were published annually from 1953 to 1970 (except for 1957 and 1962), and then biennially. The 1980 issue is not yet available. It was thought that improvement of roads and highways decreased the effective distance to cities. In a pretest, the average sufficiency ratings for each year and for each of the six districts in Kansas were obtained. The values before and after 1968 (the year, when the rating procedures changed) were made comparable by multiplying the newer values by the relations of the 1968 "old" and "new" values for each district. Contrary to expectations, there was not a steady rise in the ratings. They moved up and down, but changed only insignificantly. The variation over time was always smaller than the regional variation among the districts, and in most cases the ranks of districts, according to their average rural sufficiency ratings remained unaltered most times. A similar picture could be drawn from an investigation of the development of road mileage. For this reason, it seemed justified to look at the sufficiency ratings at only one point of time, without considering changes annually for the period covered. The sufficiency ratings of the 1978 report were closest to the all-time averages. A special test was made to resolve the question of whether there had been significant changes in road mileage and quality between 1950, the first point of time covered, and 1953, the year sufficiency ratings were first reported. A sample of 50 routes between villages and cities was taken, and the road quality as indicated on the official highway maps of Kansas for 1950 and 1953 was compared. In more than 90 percent of the cases there was no difference between 1950 and 1953, and even in the remainder of the cases, there were not only improvements but also deteriorations. Significant changes in road mileage and "effective distance" occurred only during the sixties when most of the

Interstate highway system was constructed, and these changes were taken into account.

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- 30 Bureau of the Census, U.S. Census of Population, *op. cit.*, 1950: tables 35 and 39, 1960: table 74, and 1970: tables 86, 105, and 118.
- 31 cf. footnotes 19 and 20, Chapter II.
- 32 These cases were so few that they would not have justified the preparation of one more data card for each case. Nearly 500 of the 509 new cards would have been filled with zeros.
- 33 Introductions to the gravity and potential models are provided by Gerald A. P. Carrothers, "An Historical Review of the Gravity and Potential Concepts of Human Interaction," *Journal of the American Institute of Planners*, 22 (1956), No. 2, pp. 94-102; Gunnar Olsson, *Distance and Human Interaction, A Review and Bibliography*, Uppsala: Regional Science Research Institute 1964 (Bibliography Series Number Two), pp. 43-70; and Peter J. Taylor, *Distance Decay in Spatial Interactions*, London: Institute of British Geographers (Concepts and Techniques in Modern Geography 2), pp. 8-27.
- 34 A review of the development and application of the potential model is provided by Stephen G. Lewis, *Relative Location and Industrial Growth*, unpublished Master's Thesis, Kansas State University 1978, pp. 27-35.
- 35 Fuguitt and Beale, *op. cit.*, p. 13; and John Fraser Hart, Neil E. Salisbury, and Everett G. Smith, Jr., "The Dying Village and Some Notions About Urban Growth," *Economic Geography* 44 (1968) pp. 343-349.



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- 37 Russell et al., op. cit., pp. 21-55.
- 38 Olsson, op. cit., pp. 57-63.
- 39 Taylor, op. cit., pp. 12-14.
- 40 Russell et al., op. cit., pp. 46-55.
- 41 Yeates, Maurice, An Introduction to Quantitative Analysis in Human Geography, New York: McGraw-Hill Book Company, 1976, p. 67. For more detailed discussion of regression and correlation, see Hubert M. Blalock, Social Statistics, New York, McGraw-Hill Book Company, 1972, pp. 361-472.
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- 43 Car registration data are published by the Kansas Motor Vehicle Department, Annual Reports 1950, 1960, 1970, and 1976, Topeka, (mimeographed).
- 44 Humphrey and Sell, op. cit.; and Edward W. Hassinger, Factors Associated with Population Changes in Agricultural Trade Centers of Southern Minnesota, 1940 - 1950, unpublished doctoral thesis, University of Minnesota, 1956.
- 45 Kansas State Board of Agriculture, 37th Biennial Report, 1949 and 1950, 44th Report, 1960/1961, 54th annual Report, 1970-71, and 60th Annual Report with Farm Facts for 1976/1977, Topeka, 1950, 1961, 1971, and 1977.
- 46 These studies are listed in Suzanne M. Smith, An Annotated Bibliography of Small Town Research, Madison: Wisconsin University, Dept. of Sociology, 1970 (mimeographed). Among them is the report by Donald R. Field and Robert M. Dimit, Population Change in South Dakota Small Towns and Cities, 1940-1960, Brookings: South Dakota State University, Rural Sociology Department, Agricultural Experiment Station, Bulletin S71, March 1970.
- 47 Kalevi Rikkinen, "Change in Village and Rural Population with Distance From Duluth," Economic Geography: 44 (1968)., pp. 312-325.
- 48 Fuguitt and Beale, op. cit., p. 6.
- 49 The population "turnaround" is described in Calvin L. Beale, The Revival of Population Growth in Nonmetropolitan America, Washington, D. C.: U.S. Department of Agriculture, Economic Development Division, Economic Research Service ERS-605, 1975;

- Harry K. Schwarzweller, "Migration and the Changing Rural Scene," Rural Sociology 44 (1979): Calvin L. Beale and Glenn V. Fuguitt, The New Pattern of Non-metropolitan Population Change, Madison, University of Wisconsin, 1976 CDE (Center for Demography and Ecology) Working Paper 75-22 (Revised 7-1976) : Jan L. Flora, Cornelia Butler Flora, Wayne White, Richard Leiker, Tommy Garnet, Karen Albach Duch, and Jean Jespersen Bartholomew, Kansans on the Move, Manhattan: Kansas State University, Population Research Laboratory, 1980 (mimeographed): and Cornelia B. Flora, Kansas Population 1975, Topeka: Department of Administration, Division of Planning and Research, 1977.
- <sup>50</sup>Humphrey and Sell, op. cit.; Hart and Salisbury, op. cit.; Field and Dimit, op. cit.; Richard E. Groop, Small-Town Population Change in Kansas -- 1950 to 1970, unpublished ph.D. dissertation, University of Kansas, 1976; and Glenn V. Fuguitt and Donald W. Thomas, "Small Town Growth in the United States: An Analysis by Size and by Place," Demography 3 (1966).
- <sup>51</sup>Hassinger, op. cit., pp. 134-138.
- <sup>52</sup>Jan L. Flora et al., op. cit.
- <sup>53</sup>A review of existing subdivisions is given in James F. Bock, The Regional Structure of the Kansas Economy, unpublished Master's Thesis, Kansas State University 1973, pp. 4-6 and pp. 68-69.
- <sup>54</sup>This boundary is arbitrary in a scientific sense, but "correct" in a geometric sense. It also coincides with planning region boundaries (cf. Bock, op. cit., p. 69), and with Development Analysis subregion boundaries (Kansas State University, Center for Community Services, Regional Delineation for Kansas, Manhattan 1966).
- <sup>55</sup>Hassinger, op. cit., p. 81.
- <sup>56</sup>Field and Dimit, op. cit., p. 17.

## Chapter IV

### FINDINGS

This chapter is divided into two parts. First, the results of the initial tests with the association indices are presented and interpreted. Those indices to be used in further analyses are selected. The second part provided the results of the final analyses, including simple and multiple correlation and beta weights analyses for the total sample and all subsamples, and partial correlation and residual analyses for the total sample. The first section should provide the answer to the question where further research emphasis should be placed. It should also contain information of interest for planners who should know, for instance, whether the population of a city or the change of its employment figure has a larger impact on village population change in its vicinity.

#### Results of the Initial Tests with Association Indices

The simple correlation coefficients between the association indices and village population change are given in Tables 2, 3, and 4, for the three periods. For each period, the results are shown, using three different distance decay exponents, 0.1, 0.5, and 4. The critical absolute values for correlation coefficients in Tables 2, 3, and 4 are 0.077022 (for significance level .05), 0.095687 (for significance level .01), and 0.117555 (for significance level .001).

TABLE 2

Simple Correlations Between Village Population Change  
and Association Indices, 1950 - 1960

| Correlation Coefficients |             |             |           | Correlation Coefficients |             |             |           |
|--------------------------|-------------|-------------|-----------|--------------------------|-------------|-------------|-----------|
| Index                    | Exp.<br>0.1 | Exp.<br>0.5 | Exp.<br>4 | Index                    | Exp.<br>0.1 | Exp.<br>0.5 | Exp.<br>4 |
| IA1                      | .2993       | .2924       | .0825     | IA25                     | .2994       | .2956       | .0744     |
| IA2                      | .3888       | .3822       | .0833     | IA26                     | .3870       | .3759       | .0757     |
| IA3                      | .4738       | .4765       | .0836     | IA27                     | .4733       | .4748       | .0761     |
| IA4                      | -.0560      | -.0535      | .0513     | IA28                     | -.0578      | -.0636      | .0216     |
| IA5                      | -.0712      | -.0683      | .0513     | IA29                     | -.0726      | -.0769      | .0215     |
| IA6                      | .4700       | .4720       | .0853     | IA30                     | .4695       | .4701       | .0768     |
| IA7                      | .2950       | .2882       | .0828     | IA31                     | .2951       | .2914       | .0761     |
| IA8                      | .3811       | .3747       | .0835     | IA32                     | .3792       | .3679       | .0773     |
| IA9                      | .4698       | .4730       | .0839     | IA33                     | .4694       | .4712       | .0778     |
| IA10                     | -.0580      | -.0550      | .0507     | IA34                     | -.0601      | -.0659      | .0211     |
| IA11                     | -.0714      | -.0686      | .0506     | IA35                     | -.0729      | -.0777      | .0210     |
| IA12                     | .4668       | .4693       | .0854     | IA36                     | .4664       | .4673       | .0784     |
| IA13                     | .3507       | .3328       | .0852     | IA37                     | .3510       | .3372       | .0871     |
| IA14                     | .4805       | .4620       | .0863     | IA38                     | .4798       | .4614       | .0898     |
| IA15                     | .5062       | .4956       | .0865     | IA39                     | .5061       | .4973       | .0902     |
| IA16                     | .3639       | .3545       | .0671     | IA40                     | .3602       | .3346       | .0496     |
| IA17                     | .3573       | .3579       | .0672     | IA41                     | .3546       | .3418       | .0498     |
| IA18                     | .5076       | .4968       | .0888     | IA42                     | .5076       | .4985       | .0923     |
| IA19                     | .3657       | .3466       | .0855     | IA43                     | .3664       | .3527       | .0921     |
| IA20                     | .4960       | .4784       | .0865     | IA44                     | .4956       | .4793       | .0942     |
| IA21                     | .5048       | .4954       | .0866     | IA45                     | .5049       | .4982       | .0945     |
| IA22                     | .3498       | .3369       | .0662     | IA46                     | .3457       | .3144       | .0478     |
| IA23                     | .3425       | .3402       | .0662     | IA47                     | .3392       | .3208       | .0478     |
| IA24                     | .5066       | .4968       | .0892     | IA48                     | .5067       | .4997       | .0969     |

TABLE 3

Simple Correlations Between Village Population Change  
and Association Indices, 1960 - 1970

| Correlation Coefficients |             |             |           | Correlation Coefficients |             |             |           |
|--------------------------|-------------|-------------|-----------|--------------------------|-------------|-------------|-----------|
| Index                    | Exp.<br>0.1 | Exp.<br>0.5 | Exp.<br>4 | Index                    | Exp.<br>0.1 | Exp.<br>0.5 | Exp.<br>4 |
| IB1                      | .2721       | .2754       | .0933     | IB25                     | .2718       | .2699       | .0946     |
| IB2                      | .2890       | .2970       | .0937     | IB26                     | .2864       | .2813       | .0949     |
| IB3                      | .3488       | .3593       | .0940     | IB27                     | .3479       | .3514       | .0953     |
| IB4                      | .0503       | .0395       | .0254     | IB28                     | .0524       | .0481       | .0357     |
| IB5                      | .0857       | .0714       | .0255     | IB29                     | .0872       | .0775       | .0357     |
| IB6                      | .3500       | .3596       | .0948     | IB30                     | .3491       | .3516       | .0982     |
| IB7                      | .2709       | .2746       | .0934     | IB31                     | .2706       | .2691       | .0923     |
| IB8                      | .2871       | .2950       | .0939     | IB32                     | .2844       | .2785       | .0927     |
| IB9                      | .3462       | .3568       | .0942     | IB33                     | .3453       | .3486       | .0931     |
| IB10                     | .0362       | .0260       | .0248     | IB34                     | .0381       | .0338       | .0356     |
| IB11                     | .0706       | .0568       | .0248     | IB35                     | .0718       | .0619       | .0356     |
| IB12                     | .3472       | .3570       | .0950     | IB36                     | .3462       | .3488       | .0958     |
| IB13                     | .2162       | .2242       | .0837     | IB37                     | .2134       | .2098       | .0810     |
| IB14                     | .2658       | .2675       | .0854     | IB38                     | .2625       | .2503       | .0826     |
| IB15                     | .3369       | .3350       | .0862     | IB39                     | .3362       | .3279       | .0838     |
| IB16                     | .1780       | .1710       | .0379     | IB40                     | .1789       | .1734       | .0380     |
| IB17                     | .2107       | .2022       | .0380     | IB41                     | .2120       | .2026       | .0380     |
| IB18                     | .3383       | .3360       | .0884     | IB42                     | .3575       | .3289       | .0882     |
| IB19                     | .2235       | .2305       | .0445     | IB43                     | .2212       | .2187       | .0776     |
| IB20                     | .2716       | .2728       | .0457     | IB44                     | .2684       | .2563       | .0789     |
| IB21                     | .3392       | .3371       | .0462     | IB45                     | .3383       | .3297       | .0799     |
| IB22                     | .2122       | .1985       | .0373     | IB46                     | .2134       | .2006       | .0377     |
| IB23                     | .2375       | .2243       | .0374     | IB47                     | .2394       | .2269       | .0377     |
| IB24                     | .3405       | .3381       | .0474     | IB48                     | .3396       | .3307       | .0832     |

TABLE 4

Simple Correlations Between Village Population Change  
and Association Indices, 1970 - 1976

| Correlation Coefficients |             |             |           | Correlation Coefficients |             |             |           |
|--------------------------|-------------|-------------|-----------|--------------------------|-------------|-------------|-----------|
| Index                    | Exp.<br>0.1 | Exp.<br>0.5 | Exp.<br>4 | Index                    | Exp.<br>0.1 | Exp.<br>0.5 | Exp.<br>4 |
| IC1                      | .3408       | .3310       | .0041     | IC25                     | .3479       | .3581       | .0404     |
| IC2                      | .4473       | .4462       | .0055     | IC26                     | .4527       | .4659       | .0433     |
| IC3                      | .3744       | .4000       | .0057     | IC27                     | .3781       | .4173       | .0435     |
| IC4                      | .1004       | .1453       | .3932     | IC28                     | .1061       | .1824       | .4192     |
| IC5                      | .0536       | .1081       | .3932     | IC29                     | .0599       | .1481       | .4192     |
| IC6                      | .3738       | .4001       | .0289     | IC30                     | .3777       | .4181       | .1175     |
| IC7                      | .3360       | .3268       | .0054     | IC31                     | .3431       | .3537       | .0405     |
| IC8                      | .4491       | .4479       | .0069     | IC32                     | .4542       | .4665       | .0434     |
| IC9                      | .3738       | .3997       | .0071     | IC33                     | .3774       | .4163       | .0436     |
| IC10                     | .0925       | .1371       | .3908     | IC34                     | .0979       | .1730       | .4192     |
| IC11                     | .0476       | .1014       | .3908     | IC35                     | .0537       | .1403       | .4192     |
| IC12                     | .3735       | .4000       | .0292     | IC36                     | .3772       | .4172       | .1129     |
| IC13                     | .2172       | .2144       | -.0195    | IC37                     | .2228       | .2398       | -.0250    |
| IC14                     | -.0650      | -.0628      | -.0226    | IC38                     | -.0652      | -.0637      | -.0298    |
| IC15                     | -.0885      | -.0850      | -.0227    | IC39                     | -.0895      | -.0894      | -.0298    |
| IC16                     | .2790       | .3615       | .4198     | IC40                     | .2881       | .3974       | .4195     |
| IC17                     | .1799       | .2994       | .4198     | IC41                     | .1925       | .3524       | .4195     |
| IC18                     | -.0823      | -.0705      | .2555     | IC42                     | -.0828      | -.0697      | .3727     |
| IC19                     | -.0342      | -.0434      | -.0613    | IC43                     | -.0321      | -.0328      | -.0412    |
| IC20                     | -.1686      | -.1792      | -.0642    | IC44                     | -.1728      | -.2026      | -.0461    |
| IC21                     | -.1921      | -.2028      | -.0643    | IC45                     | -.1964      | -.2266      | -.0462    |
| IC22                     | .2296       | .3194       | .4197     | IC46                     | .2360       | .3539       | .4195     |
| IC23                     | .1572       | .2673       | .4197     | IC47                     | .1658       | .3127       | .4195     |
| IC24                     | -.1861      | -.1897      | .1364     | IC48                     | -.1900      | -.2100      | .3255     |



For the sake of convenience, abbreviations of the indices are repeated here:

IA1 to IA6: using road distance and city population,  
 IA7 to IA12: using road distance and city employment,  
 IA13 to IA18: using road distance and population change,  
 IA19 to IA24: using road distance and employment change,

IA25 to IA30: using effective distance and city population,  
 IA31 to IA36: using effective distance and city employment,  
 IA37 to IA42: using effective distance and population change,  
 IA43 to IA48: using effective distance and employment change.

The indices marked "IA" refer to the first period (1950 - 1960), those marked "IB" to the second, and those marked "IC" to the last. Within each group of six indices, the individual indices indicate the consideration of the following larger places with respect to each village:

First index: nearest larger place of more than 5,000 inhabitants within 30 miles,  
 Second index: all places of more than 5,000 inhabitants within 30 miles,  
 Third index: all places of more than 5,000 inhabitants within 35 miles,  
 Fourth index: all places between 2,500 and 5,000 inhabitants within 30 miles,  
 Fifth index: all places between 2,500 and 5,000 inhabitants within 35 miles, and  
 Sixth index: all places of more than 2,500 inhabitants within 35 miles.

In most instances, the exponent of 0.5 (the square root) of the distance led to the best results. For certain indices, however, the results were much better when the exponents were much higher. Smaller exponents, in other cases, led to only slightly higher correlations, and it cannot be determined with a high degree of confidence that the smaller exponent really gives a better description of the association between the index and the dependent variable. The indices where exponents considerably higher than



one yielded significantly better correlations are those for the period 1970 - 1976 and indicating the influence of the larger places with population between 2,500 and 5,000. For these indices, however, the results again improve only slightly by using distance exponents of 4 or 6 instead of 2. Thus, no significant conclusion can be drawn about whether the best fitting exponent is 2, 4, or 6. It can be concluded that, for most indices, the exponent is significantly smaller than one, and for others, it is significantly larger. But it is never in the neighborhood of one.

A distance exponent significantly lower than one indicates that the influence of a city decreases at a lower rate than distance decreases. For instance, a city which is ten times more distant from a village than another, still exerts one-third of the second city's influence, instead of one-tenth (when the city populations or other mass variables are held constant).

The only significant change over time in distance decay occurred for the indices describing the influence of larger places with populations between 2,500 and 5,000 in all three periods. For them, the exponent rose from about 0.5 to 4 between the second and third periods, indicating a significant change in the role of the smaller centers. The hypothesis that the distance decay exponent is higher for smaller centers than for larger ones is partially supported. It is not supported for the first and second periods, but clearly for the third. The hypothesis that application of the effective distance measures yields better results

cannot be supported in general. During the first or second periods, the results are not significantly different from what was gained by using effective distance instead of road distance. That can only be interpreted in a way that road quality, or the deviation from "normal" driving time attributable to variations in road quality, was not a factor influencing village population change. The results are also not strikingly different for the third period, but they are consistently better for most of the indices when effective distance is used. However, it cannot be said with confidence that the impact of road quality has increased recently.

The simple correlations between road distance and effective distance are 0.737 for the first period (not considering interstate highways), and 0.732 for the other periods (considering interstate highways). These figures are based on a sample which included the distances between each village and the next larger place of more than 2,500 population within a radius of 35 miles. There were 461 such cases. Villages for which there was no city within 35 miles were omitted. The coefficients indicate that only slightly more than fifty percent of the variation in the effective distance is explained by road distance. Despite this difference, the results for the indices did not differ significantly. That underlines the unimportance of road quality.

It was further hypothesized that city employment, used as a mass variable in the association indices, is a better predictor

of village population change than population. However, support for such an assertion is not found. Employment is an even slightly worse predictor than population, in all three periods, although the results are only insignificantly different. The insignificance of this difference is certainly attributable to the high correlation between city population and employment (0.999 for 1950, 1960, 1970, and 1976, in the 121 "cities" considered). The variations in population and employment are so similar that population seems to be a good descriptor of the economic situation of a city.

Another hypothesis offered above was that dynamic variables, population change and employment change, would yield higher correlations with village population change than the static measures, population and non-agricultural employment. Such an assertion is definitely supported for 1950 - 1960. The reverse, however, is true for the second period. And in the last period, the dynamic variables work even worse. Here, the indices related to smaller (2,500 to 5,000 inhabitants) and larger centers (over 5,000) must be distinguished. For the smaller centers, Hassinger found weak negative influences on village growth between 1940 and 1950. Butler and Fuguitt found that to be true also in the following decade, for Minnesota. My association indices based on population and employment, show that it also seems to hold for the decade 1950 - 1960 in Kansas. The correlations are negative, but they are not significant at the .05 level in most instances. In the second period, however, they turn to positive,

although still insignificant. Even higher positive numbers appear for 1970 - 1976, and they are significant at the .01 or .001 levels. This turnaround of the smaller centers' influence on village growth may be interpreted as changing form being competitive to supportive. It has already been noted that this turnaround is accompanied by a sharp rise of the distance decay factor for these smaller centers. That means that the turnaround is not so sharp in the more distant centers. Another piece of evidence for this interpretation is the fact that those indices related to smaller centers within 35 miles do not yield higher correlations than those related to centers within only 30 miles for the last period.

When dynamic variables are used for the creation of association indices, instead of population or non-agricultural employment, however, there are high positive associations (significant at the .001 level) in each period. This seems a contradiction to the associations described above, but may be attributable to moderately high and varying correlations between static and dynamic variables in the 121 cities, as shown in Table 5.

TABLE 5  
Correlations Between Static and Dynamic "Mass Variables"  
for Cities

| Association between the measures     |             |  | r     |
|--------------------------------------|-------------|--|-------|
| Population in 1960/Population Change | 1950 - 1960 |  | .574  |
| Population in 1970/Population Change | 1960 - 1970 |  | .612  |
| Population in 1976/Population Change | 1970 - 1976 |  | -.766 |

Table 5, continued

| Association between the measures                 | r     |
|--------------------------------------------------|-------|
| Employment in 1960/Employment Change 1950 - 1960 | .240  |
| Employment in 1970/Employment Change 1960 - 1970 | .640  |
| Employment in 1976/Employment Change 1970 - 1976 | -.837 |
| Population in 1960/Employment Change 1950 - 1960 | .269  |
| Population in 1970/Employment Change 1960 - 1970 | .637  |
| Population in 1976/Employment Change 1970 - 1976 | -.826 |

One may speculate about the reasons why population change or employment change in smaller centers has an influence on village population change quite different from that of population or employment for the first period. It may be interpreted that mere population or employment of a city is unrelated to village population change (the significance level is lower than .05), whereas the dynamic variables are good predictors, as hypothesized initially. This does not contradict the earlier interpretation of the influence change of the smaller centers as a turnaround, because for the second period, the correlations between the static and dynamic variables are significantly higher than for the third period (see Table 5). The fact that these correlations are negative for the third period is discussed in the course of the interpretation of the indices related to cities larger than 5,000 inhabitants.

The indices related to cities larger than 5,000 show a distinct pattern of relationship to village population change. Those which are based on the static variables all yield positive relationships with village population change significant at the

.001 level (that level of significance is, of course, only true for the smaller distance decay exponents which best describe the influences of these indices). These correlations are highest in the first period, drop considerably in the second, and rise again in the third. The indices based on the dynamic variables change their associations with village growth in a quite different way. High correlations in the first period become significantly weaker in the second, although still significant at the .001 level, and ultimately turn around to be negative in the third period. Technically, this development has its counterpart in the change of the association between static and dynamic variables from positive (first and second periods) to negative (third period, see Table 5). Practically, this turnaround may be attributable to a phenomenon already noticed by several scholars: the reversal of the direction of population shifts to urban-rural migration (cf. pg. 68). Large cities still have an advantageous influence on village growth, when they are measured by population or employment. At the same time, however, some of these cities could lose population in the third period, which could explain the negative correlation coefficients. The growth of the cities which, in the earlier periods, inspired village growth, no longer occurs in the cities themselves, but probably outside corporate limits (spill-over growth) and/or in villages close to those cities, and/or outside corporate limits of those villages. Thus, the reversal of the general direction of population shifts in the seventies is responsible for the



negative correlations for indices based on dynamic variables. It is beyond the scope of this study to attempt to isolate causes of this reversal.

The hypothesis that consideration of all cities in the vicinity of a village yields better results than just the closest one was supported by findings. The indices are higher in all cases, and in most of them they are significantly higher. This was expected because it seemed illogical that only the closest larger place near of a village should influence its growth or decline, if there is another city just slightly more distant. Further improvements were attained when the 35 mile limit was taken instead of the 30 mile radius for the indices related to the larger centers (more than 5,000 inhabitants). Therefore, it is probable that the commuting radius was larger than 30 miles even during the 1950 - 1960 period, in contrast to the original hypothesis. The fact that the 30 mile limit seemed more related to the radius of influence of smaller centers during the third period was discussed above. It was interpreted as a partial or side-effect of a functional change in smaller centers in relation to nearby villages in their neighborhood.

No significantly different results were attained by using employment change instead of population change as a variable expressing the likely influence of larger places. This may be attributable to the high correlation between population change and employment change, which was .930 for 1950 - 1960, .986 for 1960 - 1970, and .981 for the third period. A close association



between population change and employment change may be explained, for shrinking populations, by the fact that the employment figures are rather an expression of supply than demand. For rising populations, this suggests the possibility that higher demands have always been met by the creation of new places of employment, or that this opportunity expansion induced population increases.

#### Summary and Selection of Association Indices

The patterns of relationships discussed above are far more complex than anticipated in the initial hypotheses. The distance decay exponents for larger centers, in a constant way, remain significantly smaller than one. Those for smaller centers jump to larger values, probably attributable to a changing role of these places. The differences in results are always insignificant, when effective distance is used, instead of road distance, although the correlations are consistently higher for most of the 48 indices. However, correlations were quite unstable over time. The static variables, used as "mass measures" in the potential model, were the best predictors of village population change on the average for all three periods. This fact, and the relative stability of direction and strength of relationship with village growth or decline, are reasons why the selection of indices is further restricted to those calculated on the basis of static variables. Employment, as a "mass" variable, never worked better than population and therefore, is not considered. On the whole, the consideration of a 35 mile limit yielded better results than

the application of a 30 mile radius for both smaller and larger centers.

There were associations of a different nature between the indices based on smaller centers (2,500 to 5,000 population) and village population in the three periods. There were also different distance decay exponents, whereas the larger centers remained stable in this respect. These differences could not be recognized in the indices considering all places of more than 2,500 inhabitants (IA30, IB30, and IC30). Therefore, for the final selection, there remained only the indexes IA27 and IA29 for 1950 - 1960, IB27 and IB29 for 1960 - 1970, and IC27 and IC29 for the last period. These indices were then used as independent variables, together with others, in multiple correlation analyses. In order to be able to estimate the consequences of this decision, multiple regression results attained by the application of other indices bearing high simple correlation coefficients are compared. If the results by using other indices are not significantly higher than those using the indices selected above, the selection is fully justified. The results are presented in Table 6.

TABLE 6

Multiple Correlation Analyses using Different Association Indices

| Period      | Association Index or Indices | Multiple R |
|-------------|------------------------------|------------|
| 1950 - 1960 | IA27/.5, IA29/.5             | .52809     |
|             | IA30/.5                      | .52449     |
|             | IA39/.1, IA40/.1             | .54840     |
|             | IA42/.1                      | .54142     |

Table 6, continued

| Period      | Association Index or Indices | Multiple R |
|-------------|------------------------------|------------|
| 1960 - 1970 | IB27/.5, IB29/.1             | .41549     |
|             | IB30/.5                      | .41478     |
|             | IB 6/.5                      | .41765     |
| 1970 - 1976 | IC27/.5, IC29/4              | .56635     |
|             | IC30/.5                      | .50737     |

The largest differences in the results between the selected and other indices occur in the first period for those indices based on dynamic variables which have significantly higher simple correlations with village population change, as discussed above. But even those differences are insignificant. In most of the other cases, the selected indices yield higher multiple correlation coefficients than potential "rivals."

#### Distance to Nearest Highway Interchange

Some pretests had to be made with the variable indicating the distance to the nearest interchange with a controlled access highway. In a way similar to that applied to the distance measures used for the calculation of the association indices, a pattern of relationships was derived. Both road distance and effective distance values were subjected to different exponents, and the transformed variables were correlated with village population change, with results as shown in Table 7.

TABLE 7

Simple Correlations Between Village Population Change and Distance to the Nearest Interchange with a Controlled Access Highway

| Period      | Exponent | Correlation Coefficients |                    |
|-------------|----------|--------------------------|--------------------|
|             |          | Road Distance            | Effective Distance |
| 1950 - 1960 | 0.5      | -.2832                   | -.2924             |
|             | 0.25     | -.3013                   | -.3032             |
|             | 0.1      | -.2791                   | -.2760             |
| 1960 - 1970 | 0.5      | -.1989                   | -.1951             |
|             | 0.25     | -.2220                   | -.2141             |
|             | 0.1      | -.2184                   | -.2093             |
| 1970 - 1976 | 0.5      | -.1852                   | -.2006             |
|             | 0.25     | -.2066                   | -.2179             |
|             | 0.1      | -.1989                   | -.2065             |

The distance decay exponent for this variable is significantly lower than one. The value of 0.25 seems to be a good approximation, although the values of 0.1 and 0.25 do not yield significantly lower results. The use of effective distance did also not result in correlations significantly different from those attained by the application of road distance. As with the association indices, effective distance worked worst in the second and best in the third period. On the average, it worked slightly better than road distance. This and the consideration that it is a more realistic expression of distance than road miles serve as basis for the decision to select the effective distance, transformed by the exponent of .25, as a measure of distance to the nearest interchange with a controlled access highway. This

variable was used as one of the independent variables for the calculation of the multiple correlation coefficients in Table 6. The association between this distance measure and village population change is, as hypothesized, negative in all three periods. The relationship is significant at the .001 level. So, closeness of a village to an interchange with a controlled access highway is advantageous for its growth. When distance increases, this advantage decreases, but it does so at a lower rate than distance increases. Road quality, as operationalized here, plays only an insignificant role. The strength of the relationship is significantly stronger for the first period than for the two other periods. This may be viewed as a proof of the suspicion that highway planning has an anticipatory growth-inducing effect. In the first period, when there were not yet any controlled access highways in Kansas, the variable yielded the highest correlation with village population change. The fact that the strength of the relation dropped during the subsequent periods may be viewed as a degree of saturation of population growth on the basis of distance to the nearest highway interchange.

### Final Analyses

In this segment, the results of all analyses made for the total sample and subsamples are presented. Results of the partial, simple, and multiple correlation and regression analyses, and the analysis of extreme residuals, for the entire sample of villages are discussed first.

### Total Sample

As pointed out above, technical considerations necessitated restriction of partial correlation analysis to five different orders. Working with six control variables, there were 15 possible combinations for the second order, 20 for the third, 15 for the fourth, 6 for the fifth, and one for the sixth order. Thus, 57 partial correlation coefficients were computed for each of the two association indices selected in each of the three periods. The correlation coefficients are presented in Table 8. The variables controlled are represented by capital letters each, according to the following key:

E = distance to the nearest interchange with a controlled  
access highway,  
P = previous growth experience,  
R = population density,  
M = relative motorization change,  
F = change in number of farms, and  
L = change in farm income.

Discussion of the results is essentially restricted to those partial correlation coefficients which are higher than the corresponding simple correlation coefficients. Disturbing variables, which have a depressing effect on the association between the indices and village population change, are not considered. Discussion of their effects would require the development of a causal model which includes all variables, a task beyond the scope of this effort. Here, an attempt is made to determine whether the influence of the association indices is higher when the effects of other variables are controlled. For the index IA27, only a few (six) partial correlation coefficients are

TABLE 8

Partial Correlations Between Selected Indices and  
Village Population Change

| Control  | IA27  | IA29   | IB27  | IB29  | IC27  | IC29  |
|----------|-------|--------|-------|-------|-------|-------|
| simple r | .4748 | -.0769 | .3514 | .0872 | .4183 | .4194 |
| EP       | .4107 | -.0357 | .2445 | .1060 | .3286 | .4194 |
| ER       | .3653 | -.1283 | .1505 | .0211 | .1765 | .3203 |
| EM       | .4197 | -.0506 | .3076 | .1029 | .3880 | .4113 |
| EF       | .4046 | -.0509 | .2896 | .0943 | .3628 | .4168 |
| EL       | .4101 | -.0549 | .3000 | .0951 | .3580 | .4063 |
| PR       | .3843 | -.1447 | .1253 | .0264 | .1742 | .3318 |
| PM       | .4822 | -.0521 | .2788 | .1027 | .3797 | .4230 |
| PF       | .4717 | -.0536 | .2609 | .0951 | .3577 | .4268 |
| PL       | .4713 | -.0549 | .2667 | .0948 | .3429 | .4144 |
| RM       | .4030 | -.1596 | .1697 | .0129 | .1990 | .2990 |
| RF       | .4013 | -.1608 | .1733 | .0057 | .1994 | .3201 |
| RL       | .4003 | -.1643 | .1720 | .0042 | .1879 | .3119 |
| MF       | .4802 | -.0683 | .3486 | .0848 | .4275 | .4221 |
| ML       | .4852 | -.0722 | .3484 | .0830 | .4120 | .4100 |
| FL       | .4705 | -.0729 | .3439 | .0791 | .4086 | .4177 |
| EPR      | .3513 | -.1120 | .1165 | .0365 | .1649 | .3381 |
| EPM      | .4194 | -.0324 | .2516 | .1102 | .3449 | .4155 |
| EPF      | .4079 | -.0336 | .2316 | .1015 | .3205 | .4221 |
| EPL      | .4096 | -.0355 | .2445 | .1032 | .3131 | .4115 |
| ERM      | .3684 | -.1252 | .1532 | .0289 | .1835 | .3053 |
| ERF      | .3654 | -.1237 | .1560 | .0231 | .1865 | .3304 |
| ERL      | .3641 | -.1285 | .1552 | .0210 | .1766 | .3203 |
| EMF      | .4150 | -.0470 | .2965 | .0984 | .1812 | .4134 |
| EML      | .4211 | -.0500 | .3069 | .0991 | .3758 | .4045 |
| EFL      | .4053 | -.0508 | .2989 | .0943 | .3625 | .4156 |
| PRM      | .3868 | -.1412 | .1290 | .0333 | .1846 | .3184 |
| PRF      | .3845 | -.1448 | .1302 | .0284 | .1855 | .3409 |
| PRL      | .3846 | -.1435 | .1301 | .0258 | .1749 | .3323 |
| PMF      | .4802 | -.0505 | .2675 | .0982 | .3769 | .4255 |
| PML      | .4795 | -.0522 | .2734 | .0981 | .3607 | .4138 |
| PFL      | .4688 | -.0529 | .2664 | .0937 | .3526 | .4228 |
| RMF      | .4032 | -.1575 | .1754 | .0135 | .2110 | .3070 |
| RML      | .4020 | -.1598 | .1748 | .0124 | .1978 | .2981 |
| RFL      | .4008 | -.1613 | .1816 | .0050 | .1969 | .3203 |
| MFL      | .4808 | -.0688 | .3501 | .0815 | .4250 | .4179 |



Table 8, continued

| Control | IA27  | IA29   | IB27  | IB29  | IC27  | IC29  |
|---------|-------|--------|-------|-------|-------|-------|
| EPRM    | .3545 | -.1096 | .1203 | .0433 | .1706 | .3234 |
| EPRF    | .3516 | -.1110 | .1210 | .0394 | .1746 | .3489 |
| EPRL    | .3517 | -.1115 | .1216 | .0363 | .1656 | .3386 |
| EPMF    | .4169 | -.0308 | .2387 | .1057 | .3382 | .4179 |
| EPML    | .4183 | -.0326 | .2516 | .1074 | .3315 | .4089 |
| EPFL    | .4066 | -.0334 | .2420 | .1025 | .3190 | .4206 |
| ERMF    | .3683 | -.1218 | .1584 | .0306 | .1942 | .3150 |
| ERML    | .3668 | -.1252 | .1582 | .0290 | .1817 | .3042 |
| ERFL    | .3644 | -.1243 | .1643 | .0236 | .1834 | .3308 |
| EMFL    | .4163 | -.0467 | .3057 | .0983 | .3852 | .4135 |
| PRMF    | .3868 | -.1421 | .1336 | .0349 | .1965 | .3274 |
| PRML    | .3869 | -.1407 | .1343 | .0327 | .1842 | .3181 |
| PRFL    | .3849 | -.1434 | .1387 | .0277 | .1842 | .3402 |
| PMFL    | .4772 | -.0505 | .2730 | .0968 | .3744 | .4221 |
| RMFL    | .4023 | -.1582 | .1841 | .0129 | .2089 | .3046 |
| EPRMF   | .3547 | -.1094 | .1245 | .0459 | .1812 | .3340 |
| EPRML   | .3547 | -.1095 | .1258 | .0433 | .1698 | .3227 |
| EPREL   | .3521 | -.1104 | .1298 | .0397 | .1728 | .3484 |
| EPMFL   | .4156 | -.0310 | .2490 | .1067 | .3418 | .4180 |
| ERMFL   | .3669 | -.1224 | .1670 | .0313 | .1903 | .3128 |
| PRMFL   | .3869 | -.1415 | .1426 | .0343 | .1955 | .3246 |
| EPRMFL  | .3548 | -.1093 | .1337 | .0464 | .1787 | .3310 |

higher than the simple correlation coefficient, although the difference is not large. For all of them, relative motorization change is one of the control variables; previous growth experience and change in farm income appear in four of these six coefficients. Change in number of farms is included in three values. These are the only control variables appearing in those partial correlation coefficients higher than the simple correlation measure, and in those slightly smaller. Whenever the effect of distance to the nearest controlled access highway interchange or population density is controlled, the coefficients are significantly smaller.

The control variables with the most advantageous influence on the correlation between association indices and village population change are motorization change and farm income change, the second order partial of which is the highest coefficient.

Population density and distance to the nearest highway interchange are influential variables probably because they are both related to the association indices. It is probable that distance to the nearest highway interchange is less where population density is higher, and that the latter is higher where the association index is higher or, in other words, where big cities are. The second period exhibits some differences from the first. Every partial coefficient is higher than the simple measure. Those which are closest to it indicate the same control variables as listed above, with the exception of previous growth experience which is a "disturbing" control variable in the second period. The pattern of the third period is very similar to that of the second, with the exception that two partial coefficients are slightly larger than the zero-order measure.

For smaller centers (between 2,500 and 5,000), other control variables raise the correlation coefficients between the association indices and village population change. The impact of these variables (in terms of improvement of the correlation coefficient) is very strong in the first period, declines drastically in the second and becomes insignificant in the third. In the first period, the control variables are population density, farm income change, farm number change, and previous growth

experience, indicating a heavier rural influence on the smaller centers in that period.

For the period, 1960 - 1970, distance to interstate highway interchanges is the most important control variable, followed by those which were important in the preceeding period. In the last period, the dominance of the distance variable withered away. The "rural" control variables revealed much higher negative associations in the first and slightly higher positive correlations in the second and third periods. This is another indication of the changing role of the smaller centers which was discussed above. For larger centers, the importance of the "rural" variables is smaller.

Before the influences of single control variables can be discussed more confidently, it is necessary to look at the simple correlation coefficients and the beta weights of these variables. Together with the multiple correlation coefficients, these measures are presented in Table 9, for all periods. The abbreviation key for the control variables is the same as that used for Table 8. In the cases where discrepancies exist between simple correlation coefficients and beta weights, independent variables are associated with each other, to certain degrees. For this effect is controlled when beta weights are considered. In this respect, beta weights are similar to partial correlation coefficients and are better indicators of the importance of independent variables than simple  $r$  values.

The figures in Table 9 reveal that the importance of large

TABLE 9

Results of Correlation Analyses and Beta Weights  
for Total Sample

| Variable   | 1950 - 1960 |         | 1960 - 1970 |         | 1970 - 1976 |         |
|------------|-------------|---------|-------------|---------|-------------|---------|
|            | r           | beta    | r           | beta    | r           | beta    |
| IA/B/C/27  | .47477      | .45140  | .35138      | .19356  | .41729      | .10236  |
| IA/B/C29   | -.07688     | -.06779 | .08719      | .04794  | .41941      | .29625  |
| E          | -.30316     | -.12709 | -.21413     | -.09199 | -.21791     | -.14177 |
| M          | -.05952     | -.08089 | -.00924     | -.07880 | .00578      | -.14543 |
| R          | .28459      | -.02662 | .33449      | .14415  | .40318      | .15087  |
| F          | .08102      | .00558  | .13490      | .11159  | .19643      | .19822  |
| L          | -.01166     | -.00978 | -.09055     | .09439  | -.13917     | .08457  |
| P          | .17661      | .13033  | .25445      | .09940  | .25124      | .14227  |
| multiple R | .52809      |         | .41549      |         | .56635      |         |

Critical absolute r values: .076569 (.05 level)  
.094823 (.01 level)  
.115957 (.001 level)

city influence decreased during the three periods. The nature of the small center influence appear to have changed from competitiveness to cooperation, and grown relatively stronger in the last period. The relationship between village population change and distance to the nearest controlled access highway interchange was - as hypothesized - negative in all three periods. Relative motorization change was not related to village population change, in contradiction to the hypothesis of a positive association. This would not be revealed by looking at the partial correlation coefficients (Table 8) alone. In the first period, there was even an insignificant negative relationship. Population density was - as hypothesized - always positively associated with village

growth, and the weight of this variable increased steadily over time. The association was significant at the .001 level for each period. Also, as hypothesized, the change in number of farms was positively correlated with population change, significant at the .05 level in the first period and at the .001 level in the second and third periods. The correlation with farm income change was nonexistent for the period 1950 - 1960, and negative at the .05 and .001 significance levels, in the subsequent periods. This findings contradicts the expectation of a positive relationship.

[It seems that increase in farm income became disadvantageous for village growth. Instead of supporting the village's economic base, the better-earning farmers increasingly by-passed the village with possibly a resulting "agro-business" decline.] If this speculation is true, and the farmers increasingly have turned to larger places, positive correlations can be expected for the larger village size classes. If not, the conclusion would be that the farmers turned to even larger places.

The association between population change and previous growth experience is positive in all three periods, with a significance at the .001 level. That is in accordance with expectations and indicates a relative stability over time of the other factors influencing village population change. It can be summarized that the factors related to the immediate rural environment of the village gained in weight relative to the other factors.

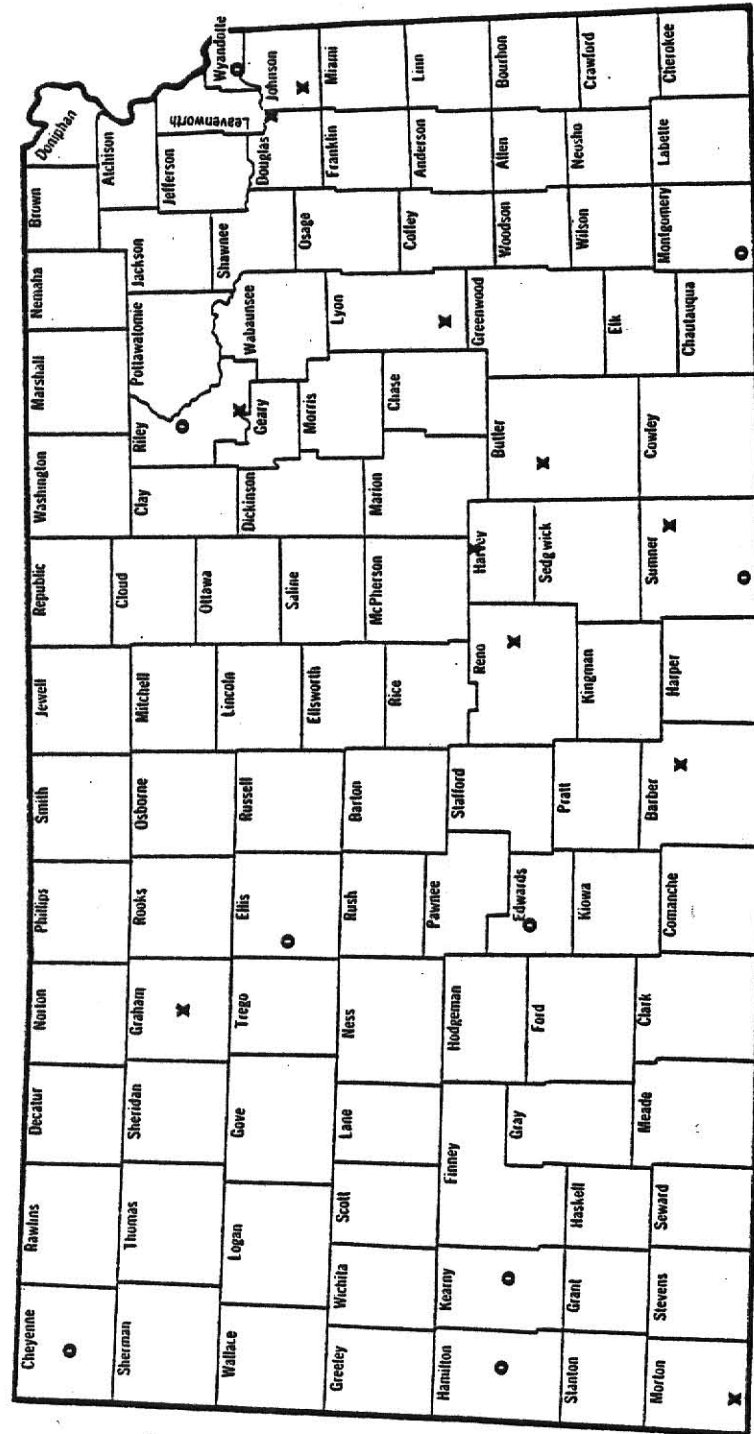
The respectively more important of the two association indices in each period had the highest beta weights. In each

period, it was more important than any other single factor, among all factors included in the analysis. This is one major result of this study, that the influence of places larger than 2,500 inhabitants within the commuting radius of a village is the most important single factor predicting population change. This importance was not recognized in earlier studies, due to inadequate methods of operationally defining variables that express the influence of larger places on villages in their vicinity. The multiple R coefficients were .528, .415, and .566 for the respective periods. The corresponding percentages of explained variation were 27.9, 17.3, and 32.1. Paralleling the initial tests concerning the association indices, the lowest degree of explanation was attained for the second period.

The relatively low multiple R values mean, of course, that the multiple regression equation developed in the study does not allow accurate prediction of village population change values. However, in a few cases, there are unusually large deviations between observed and predicted values, i.e. extreme residuals. In statistical theory, residuals of more than two standard deviation units are considered extreme, although this is an arbitrary characterization. The two standard deviation limit is adopted for this study. The villages representing extreme residuals are indicated on Maps 3, 4, and 5 for the three periods. In a rough descriptive generalization of the distribution of these villages, one may say that the positive residuals (underpredicted cases) tend to lie in the Eastern

FIGURE 3

## Extreme Residual Villages 1950 - 1960

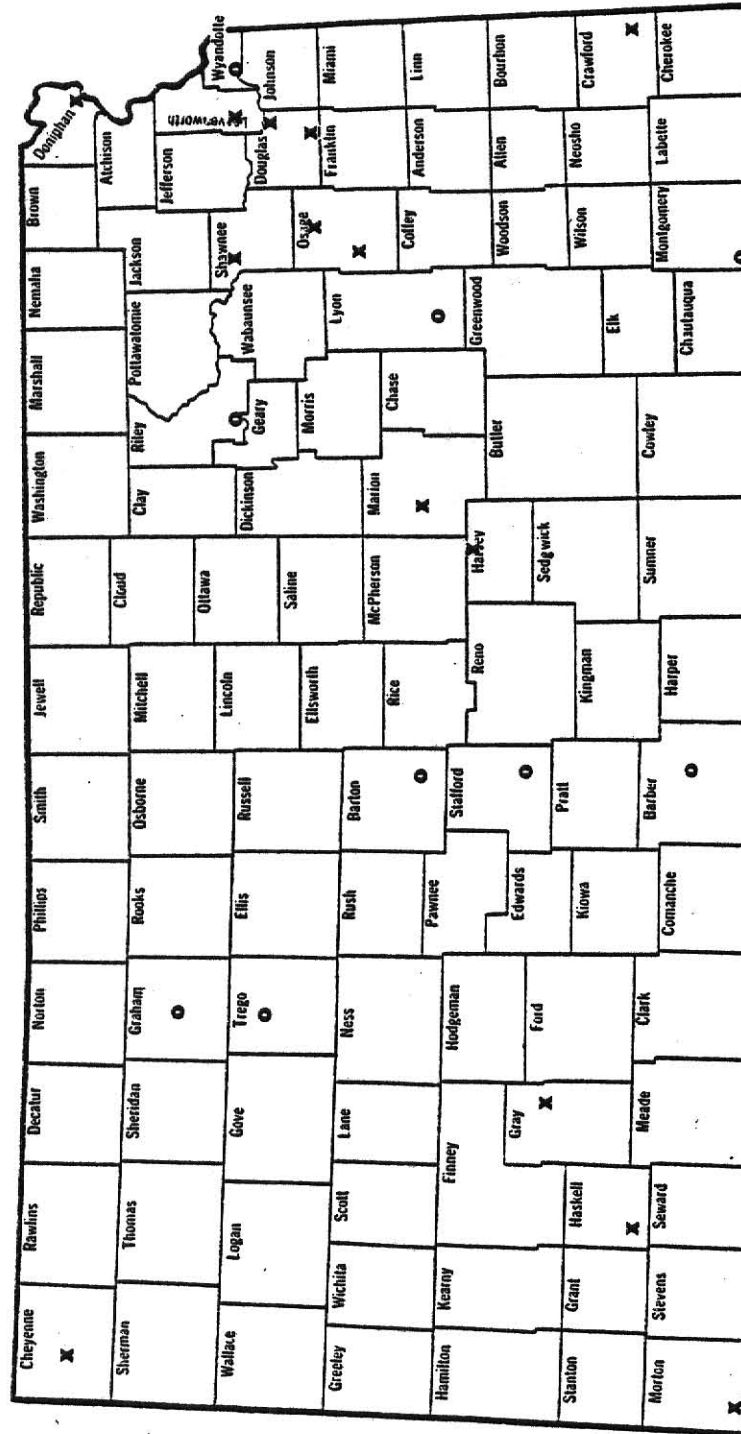


Legend • overpredicted villages  
 x underpredicted villages



FIGURE 4

Extreme Residual Villages 1960 - 1970



Legend • overpredicted villages  
x underpredicted villages



half of Kansas, whereas most of the overpredicted cases are in the western parts of the state during the 1950 - 1960 period. This distribution is less distinctive in the second period, and it is reversed in the third. The numbers of cases are too small to apply to chi-square tests to determine if significant obtains for frequencies in areal classes. Whereas in the earlier periods underpredicted villages often lay closer to metropolitan centers, and overpredicted ones distant from larger cities, this was less true in the third period. However, it cannot be concluded that this is a part of the so-called population turnaround of the seventies, because the underpredicted small towns in the Western half of the state are all county seats.

In order to find out more about the characteristics of the residuals, t-tests (tests of significance of difference between means) were applied. In addition, the consistency and stability of the residuals were examined. Villages indicating both positive and negative residuals were larger than the remainder of the places, on the average. The differences were all significant at the .001 level, although the t-values were even higher for the positive residuals. That might indicate a tendency for larger villages to have more extensive irregular fluctuations than smaller ones, in contrast to what might be expected. To a large degree, however, the larger villages will naturally show larger residuals than smaller places. Residuals, being differences of observed and predicted population change

values, which are residuals themselves, are expressed in absolute rather than in relative terms. Thus, they are directly related to village size. For instance, in a village of one hundred, a residual value of six may indicate a higher relative deviation than a value of 30 in a village with a population of 1,000. Actually, there are many smaller places which have higher relative deviations than the extreme residuals.

Other characteristics subjected to the t-tests were the indices selected previously for further analysis. It was found that positive residuals tend to lie closer to larger cities than other villages, which is consistent with the findings of other studies, but the t-value was significant at the .05 level only in the second period. There does appear to be a distinct trait attributable smaller centers. In the first period, these villages were subject to less influence from smaller centers than other places. The difference was significant at the .001 level. In the second and third periods, this relation was non-existent or insignificant, which may be another expression of the changing role of the smaller center. For positive residuals, the "relative freedom" from influence of smaller centers can be interpreted as relative freedom from competition. This is in accordance with findings presented earlier in this study. Hassinger's interpretation that larger villages were in more direct competition with smaller centers is supported by the fact that the positive residual values are significantly larger than for other villages. The results of the t-tests are shown in

Table 10.

Only a minority of the residuals showed consistency. Many more were extreme negative residuals in one period and extreme positive residuals in another. The strangest behavior was observed for Ogden in Riley County, which was underpredicted in 1960, overpredicted in 1970, and again underpredicted in 1976. An explanation may involve the closeness of the village to the Ft. Riley military installations and the heavy dependence on fluctuations in military populations. The demographic performance of villages like Baldwin, De Soto, Hillsboro, and Osage City, which were positive residuals in the second, but negative in the third period, may be explained in a way that, after a period of extensive growth, these places approached their capacities for further growth within corporate limits. There may

TABLE 10

## Results of T-tests with Extreme Residuals

| Variable                                     | 1950 - 1960<br>t-values | 1960 - 1970<br>t-values | 1970 - 1976<br>t-values |
|----------------------------------------------|-------------------------|-------------------------|-------------------------|
| Positive Residuals (Underpredicted Villages) |                         |                         |                         |
| Village pop.,<br>end of decade               | 5.3328805               | 8.3673034               | 10.053907               |
| IA/B/C27                                     | 1.6329505               | 1.6641565               | 1.4275113               |
| IA/B/C29                                     | -4.119006               | 0.53788244              | -1.0225087              |
| Negative Residuals (Overpredicted Villages)  |                         |                         |                         |
| Village pop.,<br>end of decade               | 3.4225726               | 4.2028711               | 2.94606613              |
| IA/B/C27                                     | 0.74327845              | 0.81783583              | 1.059232                |
| IA/B/C29                                     | -7.0436063              | 0.32707577              | 1.0408356               |

Table 10, continued

Critical absolute t values: 1.645 (.05 level)  
 2.326 (.01 level)  
 3.291 (.001 level)

have been spill-over growth into unincorporated territory not recognized in official population figures. Reverse cases (first stagnation or decline and then extensive growth) may be due to annexations. All in all, both positive and negative residuals have little in common which would explain their unpredictable population change. There must be other factors which have not yet been considered.

### Size Classes

In the following section, the simple and multiple correlation results and the beta weights for all subsets are presented and analyzed. Figures are shown for ten size classes in Table 11.

TABLE 11  
 Results of Correlation Analyses and Beta Weights  
 for Village Size-Classes

| Variable           | 1950 - 1960 |         | 1960 - 1970 |         | 1970 - 1976 |         |
|--------------------|-------------|---------|-------------|---------|-------------|---------|
|                    | r           | beta    | r           | beta    | r           | beta    |
| 0 - 250 Size Class |             |         |             |         |             |         |
| IA/B/C27           | .23289      | .31122  | .22292      | .28170  | -.11232     | -.15274 |
| IA/B/C29           | .03894      | .06372  | .07339      | .05823  | .04126      | .13040  |
| E                  | -.14177     | -.03689 | -.05146     | .06883  | -.08472     | -.07316 |
| M                  | .04608      | .05746  | -.17724     | -.21343 | -.11949     | -.03434 |
| R                  | .08901      | -.16969 | .18770      | -.00236 | .11962      | .18971  |
| F                  | .23876      | .26711  | .18915      | .20266  | .55563      | .48534  |
| L                  | .04201      | -.03343 | -.01264     | .06378  | -.14260     | -.01668 |
| P                  | .11297      | .04861  | -.04285     | -.07290 | -.28986     | -.23494 |
| multiple R         | .36823      |         | .37625      |         | .63903      |         |

Table 11, continued

Critical absolute r values: .117931 (.05 level)  
 .145730 (.01 level)  
 .177667 (.001 level)

## 250 - 500 Size Class

|            |         |         |         |         |         |         |
|------------|---------|---------|---------|---------|---------|---------|
| IA/B/C27   | .27345  | .19091  | .12363  | .10792  | .26261  | .17488  |
| IA/B/C29   | -.21237 | -.17062 | -.03150 | -.12495 | -.08119 | -.09288 |
| E          | -.21026 | -.04520 | -.22855 | -.20127 | -.20405 | -.15956 |
| M          | -.22554 | -.05615 | -.06326 | -.08075 | -.13353 | -.24983 |
| R          | .15423  | -.02485 | .15660  | .09683  | .20932  | -.11405 |
| F          | .45178  | .45744  | .31735  | .32894  | .33950  | .26099  |
| L          | -.10644 | -.23824 | -.08918 | .12855  | -.26356 | -.16941 |
| P          | .10542  | -.02778 | -.14175 | -.32580 | .19739  | .15144  |
| multiple R | .57954  |         | .47021  |         | .50859  |         |

Critical absolute r values: .162891 (.05 level)  
 .198189 (.01 level)  
 .247285 (.001 level)

## 500 - 750 Size Class

|            |         |         |         |         |         |         |
|------------|---------|---------|---------|---------|---------|---------|
| IA/B/C27   | .54094  | .39675  | .35227  | -.06080 | .86411  | .21683  |
| IA/B/C29   | .03156  | .01227  | .10022  | -.04824 | .89792  | .68224  |
| E          | -.40312 | -.22286 | -.29156 | -.14479 | -.28391 | -.08887 |
| M          | -.00883 | -.03795 | .03545  | -.06045 | -.14026 | -.10801 |
| R          | .42989  | -.15694 | .40238  | .32762  | .71024  | -.05817 |
| F          | .55495  | .38083  | .46076  | .32626  | .24800  | .04476  |
| L          | -.05213 | -.04280 | -.35040 | .13616  | -.39691 | -.06016 |
| P          | .23231  | .18680  | .37316  | .11838  | .21342  | .06026  |
| multiple R | .70174  |         | .54078  |         | .92026  |         |

Critical absolute r values: .237915 (.05 level)  
 .294947 (.01 level)  
 .360960 (.001 level)



Table 11, continued

## 750 - 1,000 Size Class

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|            |         |         |         |         |         |         |
|------------|---------|---------|---------|---------|---------|---------|
| IA/B/C27   | .82713  | 1.08001 | .64528  | .82084  | .66689  | .59613  |
| IA/B/C29   | .00582  | -.05174 | .31146  | .09429  | -.10435 | .01714  |
| E          | -.44480 | -.08239 | -.35065 | .01583  | -.41344 | -.12485 |
| M          | -.08967 | -.03728 | .22265  | .20785  | .28713  | -.01402 |
| R          | .67855  | -.37692 | .65915  | -.94554 | .59862  | -.07710 |
| F          | .46764  | .14761  | .59670  | .61363  | .15004  | -.09269 |
| L          | -.09037 | -.03560 | -.06229 | -.56381 | -.21256 | .04053  |
| P          | .10641  | .04500  | .44942  | -.13985 | -.41344 | -.12485 |
| multiple R | .86848  |         | .79435  |         | .71713  |         |

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Critical absolute r values: .320937 (.05 level)  
.396821 (.01 level)  
.483547 (.001 level)

## 1,000 - 1,250 Size Class

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|            |         |         |         |         |         |         |
|------------|---------|---------|---------|---------|---------|---------|
| IA/B/C27   | .57915  | .33218  | .21925  | -.06542 | .37449  | -.05012 |
| IA/B/C29   | -.20580 | -.06382 | .06135  | .34150  | -.08694 | .27442  |
| E          | -.58257 | -.29762 | -.10230 | -.27249 | -.04017 | .05766  |
| M          | -.17513 | -.34418 | .03634  | .08897  | .41764  | .01960  |
| R          | .48295  | .03822  | .09421  | -.71468 | .44518  | .01693  |
| F          | .65284  | .41501  | .47621  | .74289  | .66143  | .58532  |
| L          | -.12695 | -.20352 | -.20213 | -.62838 | -.28821 | -.32453 |
| P          | -.03577 | -.21039 | .25738  | -.16907 | .39612  | .38604  |
| multiple R | .87289  |         | .63848  |         | .77742  |         |

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Critical absolute r values: .332233 (.05 level)  
.411066 (.01 level)  
.487077 (.001 level)

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Table 11, continued

## 1,250 - 1,500 Size Class

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|            |         |         |         |         |         |         |
|------------|---------|---------|---------|---------|---------|---------|
| IA/B/C27   | .48979  | -.06362 | .39155  | -.42350 | .58246  | 1.18806 |
| IA/B/C29   | -.18055 | -.02332 | .24933  | .03956  | -.16432 | .18454  |
| E          | -.55040 | .36947  | -.08346 | .12186  | -.23075 | -.06462 |
| M          | -.53938 | -.56775 | .38500  | .44922  | .39454  | .17839  |
| R          | .35727  | .69855  | .42015  | 1.12861 | .44762  | .22493  |
| F          | .40294  | -.38004 | .59453  | .74391  | .14959  | .03365  |
| L          | -.61692 | -.62876 | -.21842 | .91560  | -.07603 | 1.09686 |
| P          | .54494  | .56850  | .07991  | .18597  | .29320  | -.22493 |
| multiple R | .93308  |         | .85916  |         | .84564  |         |

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Critical absolute r values: .459155 (.05 level)  
.563388 (.01 level)  
.675976 (.001 level)

## 1,500 - 1,750 Size Class

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|            |         |         |         |         |         |          |
|------------|---------|---------|---------|---------|---------|----------|
| IA/B/C27   | .79615  | .76443  | .72912  | .25680  | -.31459 | -2.43592 |
| IA/B/C29   | .38100  | .15909  | .41294  | -.53802 | .28896  | .26041   |
| E          | -.78289 | -.14824 | -.40800 | .79431  | .33702  | 1.23389  |
| M          | .07201  | -.15770 | .25673  | -.14225 | -.38791 | .68530   |
| R          | .70813  | -.42520 | .78842  | 2.10914 | -.25050 | 2.00660  |
| F          | .00816  | .49053  | .36810  | -.19495 | .00433  | .52000   |
| L          | -.24901 | .21811  | -.31930 | .56433  | .16175  | -.14639  |
| P          | -.58936 | -.89927 | .32872  | -.17234 | -.32914 | -1.43338 |
| multiple R | .97597  |         | .97917  |         | .85216  |          |

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Critical absolute r values: .515449 (.05 level)  
.628971 (.01 level)  
.746077 (.001 level)

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Table 11, continued

| 2,250 - 2,500 Size Class    |         |          |         |              |         |          |
|-----------------------------|---------|----------|---------|--------------|---------|----------|
| IA/B/C27                    | -.29475 | -.05279  | .61670  | -1.73921     | -.27841 | -1.24113 |
| IA/B/C29                    | -.36293 | -1.11877 | .05916  | -.99493      | .02111  | -.59948  |
| E                           | .11772  | 1.15532  | -.14201 | -.70980      | -.17404 | .34958   |
| M                           | .10767  | -.11639  | -.35723 | -1.04228     | .02278  | -.76122  |
| R                           | -.39803 | .31738   | .54909  | 2.35902      | -.35550 | 4.29904  |
| F                           | .00809  | 1.27298  | .32083  | .31872       | .41255  | 1.60362  |
| L                           | .40270  | -.14615  | -.13380 | -.19911      | .39223  | 4.20233  |
| P                           | .32849  | .68798   | -.27469 | .19605       | -.54094 | .30908   |
| multiple R                  | .74389  |          | .84384  |              | .93223  |          |
| Critical absolute r values: |         |          |         |              |         |          |
|                             |         |          | .566804 | (.05 level)  |         |          |
|                             |         |          | .686448 | (.01 level)  |         |          |
|                             |         |          | .803449 | (.001 level) |         |          |

The same variable abbreviations appearing in Table 8 are used in Table 11. When the ten size classes are examined as a whole, it seems there are higher multiple R coefficients and higher levels of explanation for higher size classes. The fact that the coefficients do not steadily rise with the highest size classes may be an expression of the fact that in those classes, county seats hold an increasing share of villages. It was hypothesized that county seats would be relatively more independent of external factors with respect to their demographic performance, and therefore would yield lower correlation coefficients. The trend of a steady rise in the multiple R is more disturbed in the third than in the other periods. The value for the 500 - 750 group is unexpectedly high. Before these details can be discussed, a look at the influence of individual

factors is necessary.

The general association between multiple R and size class is in accordance with earlier studies which found size to be an important factor influencing village growth. However, as will be seen, quite different patterns of influences by individual factors do exist for different size classes. For the smallest class, the influence of larger centers is positive during the first two periods (significant at the .001 level), whereas it is non-existent (that is, insignificantly negative) in the third. The influence of smaller centers was positive at all times, but insignificant. Keeping in mind the low significance of this association, one may see this as an affirmation of earlier findings by other authors; the smallest villages are not subject to direct competitive with centers between 2,500 and 5,000 population. Distance to the nearest interchange with a controlled access highway is negatively related to population change, which is only significant in the first period, at the .05 level. Motorization change is not related to village growth in the first period, and the association is negative in the subsequent periods (at the .01 level in 1960 - 1970 and at the .05 level in the last period). Population density is advantageous for village growth, but this is only significant for the second (.001 level) and the third period (.05 level).

The positive association of village decline with decline in number of farms is significant at the .001 level in all three periods. It is especially strong in the third, where, at the

same time, city influence is insignificant. This fact marks a tendency for an increased influence by "agricultural factors" over "city influence." This tendency is also supported by the influence of farm income change which has no influence between 1950 and 1970, but a negative impact in the last period (significant at the .05 level). Previous growth experience changes its nature of association with village growth from low positive in 1950 - 1960 to strongly negative (at the .001 level) in 1970 - 1976. This seems to indicate that there is less and less continuity in growth or decline for individual villages. During the first two periods, the most important single factor explaining village growth or decline is city influence, followed by change in number of farms. The latter factor is the most important in the last period. The large impact of this factor is responsible for the high multiple R of the last period, which made a jump from relatively moderate values in earlier periods.

There are few clear, easy-interpretable trends in the role of individual factors for the remaining size classes. The big city influence is significantly positive in most size classes and periods. However, there are size classes with "drops" in the second period, where the factor was insignificant or weaker than in the other periods. All size classes between 250 and 1,500 population fall into this category. A decline over time is characteristic of the influence in the 1,500 - 2,000 population classes and, as mentioned above, in the smallest class. In the 2,000 - 2,250 class, city influence seems to be increasing,

and in the highest class, it is only significant during the second period. Quite irregular is the influence of smaller centers. For villages with 250 - 500 people, it is significantly negative at the .01 level in the first period and then insignificant, supporting earlier interpretations concerning initial competitiveness and a subsequently changing role for smaller centers. The changing role concept is also supported by the fact that in the 500 - 750 population class and last period, the smaller center influence is very strongly positive, after having been insignificant earlier. However, for the first period, an insignificant association was not expected. Rather one expected a stronger negative association than that appearing in the 250 - 500 population class. It was also expected that larger villages were in more direct competition with smaller centers than smaller villages. Therefore, an analysis would yield higher negative coefficients. The correlations are insignificant for all higher size classes. Even these insignificant values are always negative in the first period. For the villages up to 1,500 inhabitants, distance to the nearest interchange with a controlled access highway is negatively correlated with village population change in all periods, although some coefficients are insignificant. The associations are stronger in the higher size classes and became weaker over time. For the higher size classes, the relationships are irregular and mostly insignificant.

As in the smallest size class, motorization change is also negatively correlated with population change in the 250 - 500



population class, and the relationship is also significant in the first period, at the .01 level. For higher size classes, the association is irregular (positive coefficients also appear) and mostly insignificant. The positive values tend to appear in the later period, which can be viewed as another expression of declining negative association.

For villages up to 1,500 inhabitants, population density is positively associated with population change. The coefficients are highest in the 750 - 1,000 population class. Positive associations would, as discussed in the third chapter, indicate a more urbanized setting where density is so high that it could inhibit further growth. But they occur so irregularly that this interpretation is not meaningful.

Where the number of farms declined, villages were always likely to lose population. Throughout the size classes at all periods, the association is positive or, in a few cases, non-existent. The lower degrees of association prevail in the size classes higher than 1,250 population. Farm income is mostly negatively correlated with village population change in all size classes, at all times. The most prominent exception is the highest size class. This may indicate the correctness of the speculation that better-earning farmers, by-passing the smaller places, brought their business to places between 2,500 and 5,000, and probably to larger places. For the size classes with more than 1,500 population, the associations are insignificant. For the lower size classes, the impact of this factor increases with

time, and a turnaround of this pattern can be observed in the 750 - 1,000 range. It is easy to understand that for larger villages, agricultural influences are lower than for smaller ones, and tend to decrease in influence, rather than increase. Smaller villages have a less independent economic base and are more heavily dependent on agriculture.

The most unstable factor influencing population change is the previous growth experience of a village. Correlations seem to vary randomly in strength and nature with size classes and periods of time.

The beta weights of the variables indicate their relative weights in multiple regression equations. The most important individual factors explaining village growth are the influence of larger places and change in number of farms. No general trend for size class or period is recognizable, and it cannot be determined which of the factors on the whole is more important. Distance to the nearest controlled access highway interchange ranks third in importance, in most instances, and its weight declines in the third period. The importance of farm income change becomes higher in the upper size classes. Not much confidence, however, can be placed on these patterns of relative importance. The major result of the consideration of different size classes is that these size classes show quite different patterns of association between village population change and influencing factors at different times. These patterns are not always clearly interpretable. Unfortunately, for higher size

classes with a small number of cases, the significance levels are often too low to allow interpretation. This is a limitation of quantitative analysis. Size classes can be combined to supra-classes, or villages in other states can be included in the research, in order to attain higher significance levels. But this may conceal size class-related and regional differences. The insignificant correlation coefficients of the higher size classes are very different for the same variables in adjoining size classes. These differences would disappear by a combination of the classes, probably without increasing the significance, despite a higher numbers of cases. The most stable conditions concerning patterns of correlation exist in the size classes up to 1,000 or 1,500 population. In the upper classes they become irregular. The nearly exclusive adherence of both extreme negative and positive residual villages to upper size classes may be an expression of that fact. The larger multiple R values for higher size classes, although impressively high, in some instances are produced by factors working quite differently in the individual classes.

#### Size of Largest City

Villages were not only distinguished according to their sizes, but also according to the size of the largest place within a distance of 35 miles. The results of the analyses are shown in Table 12.

TABLE 12

Results of Correlation Analyses and Beta Weights  
for Subsamples According to Largest Neighboring City

| Variable                             | 1950 - 1960 |         | 1960 - 1970 |              | 1970 - 1976 |         |
|--------------------------------------|-------------|---------|-------------|--------------|-------------|---------|
|                                      | r           | beta    | r           | beta         | r           | beta    |
| Largest City Smaller Than 2,500      |             |         |             |              |             |         |
| E                                    | -.36757     | -.35904 | .01466      | -.15839      | .00047      | -.94897 |
| M                                    | .02789      | .04354  | -.15823     | -.08349      | -.16233     | -.09542 |
| R                                    | .06624      | .25101  | -.07997     | -.00217      | .03322      | .02208  |
| F                                    | .13915      | .18265  | .58284      | .61521       | -.04026     | .02380  |
| L                                    | .10322      | .16369  | .01446      | .09972       | -.18125     | -.17172 |
| P                                    | .05632      | -.00573 | -.13658     | -.26053      | -.16609     | -.17031 |
| multiple R                           | .43795      |         | .63770      |              | .27334      |         |
| Critical absolute r values:          |             |         |             |              |             |         |
|                                      |             |         | .263563     | (.05 level)  |             |         |
|                                      |             |         | .323418     | (.01 level)  |             |         |
|                                      |             |         | .395936     | (.001 level) |             |         |
| Largest City Between 2,500 and 5,000 |             |         |             |              |             |         |
| IA/B/C29                             | -.09366     | .00717  | -.00935     | -.03509      | .24137      | .23311  |
| E                                    | -.23481     | -.15271 | .18521      | .05495       | -.00307     | -.07650 |
| M                                    | -.09578     | -.08239 | -.41735     | -.45020      | -.12914     | -.19048 |
| R                                    | -.27084     | -.03422 | -.24530     | -.24706      | -.13863     | .01495  |
| F                                    | -.10736     | -.11994 | .14217      | .09334       | .05503      | .14438  |
| L                                    | .26849      | .06520  | .05634      | .28283       | .28818      | .30393  |
| P                                    | -.23481     | .32515  | -.19686     | -.25675      | .28917      | .27443  |
| multiple R                           | .45872      |         | .58202      |              | .50390      |         |
| Critical absolute r values:          |             |         |             |              |             |         |
|                                      |             |         | .184755     | (.05 level)  |             |         |
|                                      |             |         | .225169     | (.01 level)  |             |         |
|                                      |             |         | .281098     | (.001 level) |             |         |
| Largest City Larger Than 5,000       |             |         |             |              |             |         |
| IA/B/C27                             | .52028      | .49215  | .36204      | .13110       | .42869      | .10340  |
| IA/B/C29                             | -.11801     | -.10120 | .06716      | .04996       | .43958      | .32087  |
| E                                    | -.30510     | -.09185 | -.26744     | -.12444      | -.24373     | -.14465 |
| M                                    | -.07914     | -.09272 | .05361      | .00329       | .03311      | -.12537 |

Table 12, continued

|            |         |         |         |        |         |        |
|------------|---------|---------|---------|--------|---------|--------|
| R          | .31532  | -.00930 | .34406  | .16221 | .41849  | .11968 |
| F          | .13128  | .03583  | .05597  | .02031 | .24770  | .25426 |
| L          | -.05351 | -.02344 | -.16047 | .07790 | -.16240 | .07950 |
| P          | .16742  | .09038  | .34129  | .19379 | .25180  | .16082 |
| multiple R | .56703  |         | .44103  |        | .59761  |        |

Critical absolute r values: .089414 (.05 level)  
.110667 (.01 level)  
.135221 (.001 level)

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Largest City Larger Than 10,000

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|            |         |         |         |         |         |         |
|------------|---------|---------|---------|---------|---------|---------|
| IA/B/C27   | .53029  | .46095  | .34059  | .08714  | .41903  | .10175  |
| IA/B/C29   | -.13675 | -.08360 | .03007  | .02236  | .46284  | .36545  |
| E          | -.36794 | -.14817 | -.24701 | -.07348 | -.21763 | -.14435 |
| M          | -.09005 | -.03129 | .31355  | .15320  | .39022  | .05236  |
| R          | .34369  | .03129  | .31355  | .15320  | .39022  | .05236  |
| F          | .14934  | .04848  | -.03010 | -.07335 | .26422  | .27736  |
| L          | -.14665 | -.06237 | -.20481 | .05021  | -.13030 | .07897  |
| P          | .17520  | .07100  | .39373  | .27859  | .24738  | .19373  |
| multiple R | .59947  |         | .44959  |         | .60964  |         |

Critical absolute r values: .110928 (.05 level)  
.137136 (.01 level)  
.162890 (.001 level)

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Largest City Larger Than 25,000

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|            |         |         |         |         |         |         |
|------------|---------|---------|---------|---------|---------|---------|
| IA/B/C27   | .47573  | .22126  | .34363  | .08944  | .42247  | .02379  |
| IA/B/C29   | -.04228 | -.05236 | .05298  | -.02778 | .53235  | .38629  |
| E          | -.45249 | -.15924 | -.28148 | -.08548 | -.25995 | -.14808 |
| M          | -.03437 | -.02813 | .15306  | .09896  | -.07753 | -.24553 |
| R          | .35722  | .11808  | .32975  | .10836  | .45170  | .10585  |
| F          | .09367  | -.21854 | .05393  | .00901  | .20676  | .07069  |
| L          | .19478  | .08556  | -.28398 | .00215  | -.30051 | .11241  |
| P          | .59461  | .50450  | .40131  | .27302  | .28838  | .26347  |
| multiple R | .72031  |         | .46221  |         | .66739  |         |

Critical absolute r values: .176866 (.05 level)  
.215601 (.01 level)  
.267734 (.001 level)

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Table 12, continued

| Largest City Larger Than 50,000                 |         |         |         |         |         |         |
|-------------------------------------------------|---------|---------|---------|---------|---------|---------|
| IA/B/C27                                        | .65947  | .35505  | .42381  | -.10783 | .56443  | .29065  |
| IA/B/C29                                        | .32032  | -.00277 | .48694  | .36239  | .64875  | .26851  |
| E                                               | -.38870 | .35645  | -.29968 | -.09014 | -.21262 | -.05698 |
| M                                               | .12370  | -.07256 | .27722  | .11726  | -.04494 | -.33510 |
| R                                               | .44145  | .03440  | .39177  | -.18826 | .52765  | .07598  |
| F                                               | .26051  | -.16126 | .20633  | .09809  | .29988  | .03078  |
| L                                               | .63256  | .35645  | -.43079 | -.14620 | -.47353 | -.28698 |
| P                                               | .61736  | .19150  | .53510  | .39021  | .12863  | .00928  |
| multiple R                                      | .76702  |         | .63918  |         | .74285  |         |
| Critical absolute r values: .263945 (.05 level) |         |         |         |         |         |         |
| .327043 (.01 level)                             |         |         |         |         |         |         |
| .400195 (.001 level)                            |         |         |         |         |         |         |

The same variable abbreviations are used as in Table 8. The first group of villages included the most isolated cases none of these had a city with a population of more than 2,500 in its neighborhood. The association indices were zero for these places. Of the remaining factors, distance to the nearest interchange with a controlled access highway was negatively related to village growth in the first period (significance was .01), and later had no influence. This is in accordance with the notion of highway planning leading growth, and later saturation of growth resulting from this factor. The other variables are, in most instances, not significantly related to population change. The only exception is the high association of village decline and a decrease in number of farms in the second period, which is mainly responsible for the relatively high multiple R in that period.

The next subset is made up of those places with a place larger than 2,500 but smaller than 5,000 within commuting radius of villages. The influence of these smaller cities in the subsample affirms the earlier interpretation of a changing role for these cities. A weak negative influence changes to significantly positive, at the .01 level. Interesting is the negative influence of motorization change (significant only in the second period). An increase in the number of cars in a county relative to its population was disadvantageous for village growth. The village was being by-passed by the supporting rural population where motorization increased. This was less true, however, in the first and third periods, and the influence of farm income may be another expression of that fact. This influence is, unlike that for the total sample, positive (and this is significant exactly in those periods when the disadvantageous influence of motorization change was insignificant). The positive effect of rising farm income for these villages can be interpreted as failure of the better-earning farmers to transfer their business to larger places. The larger places were possibly too far away. This transfer occurred to a certain degree only in the second period. But then, probably due to rising gasoline prices, disappeared again in the third period.

Population density was negatively associated with population change (significant only in the first two periods). One would not expect a negative association for rural settings. Previous growth experience was not related to population change, and the



association was increasingly negative (at the .001 level) in subsequent periods. This probably reflects an increasing discontinuity in respect to growth or decline of the individual place. It is likely that there are important factors governing village population change which have not been recognized in this effort. For, it is hard to find a plausible explanation for the fact that exactly those village which had grown earlier lost population later, and vice versa.

Growth of villages in the vicinity of a city of at least 5,000 population is heavily subject to big city influence. The association is positive and significant at the .001 level in all three periods. This is also true for the villages closer to even larger cities. The decline of this factor's weight over time is also prominent for villages close to cities with populations of more than 5,000, 10,000, or 25,000, but not for those in the sphere of metropolitan centers. The earlier interpretation of the changing role of smaller center influence is further supported for each of the subsamples discussed here. For the last one (villages close to cities with a population of more than 50,000), the smaller centers even had competitive influence on villages in the first period, and increased their high positive impact from the second to the third period.

Motorization change is unrelated to population change. Population density has an advantageous influence on village growth in all of the subsets, even in that consisting of villages close to metropolitan centers. The importance of this variable,

however, varies considerably within the individual subsamples and over time. Change in number of farms is either positively related to population change, or the association is non-existent. There seems to be a "low" in this variable's influence in the sixties. This association is in accordance with the initial hypothesis.

Farm income change has, as a rule, an increasing disadvantageous influence on village growth, which increases over time. Exceptions are villages close to cities of more than 25,000 inhabitants, in the first period. Previous growth experience is a good indicator of population change in each period (this positive relationship is mostly significant at the .001 level). This is in contrast to the more isolated villages, with no town of 5,000 or more inhabitants in their neighborhood, which show a quite instable demographic performance. A positive correlation indicates a certain degree of continuity of growth. In the first period, the city influence is the most important individual factor predicting village population change, followed by distance to the nearest controlled access highway interchange, except for villages near metropolitan centers. There, astonishingly, farm income change is a more important factor. In the second period, city influence is weaker, with previous growth experience and population density being the more important factors. In the third period, the association indices are regaining significance. The one indicating influence of smaller centers even surpasses the other one. The higher the minimum size of the largest city in

a village's neighborhood, the higher the correlation multiple coefficient, though they are lowest in the second period.

To summarize what appears above, villages show quite different patterns of associations between population change and independent variables whether they have no city of more than 2,500 inhabitants in its neighborhood, none of more than 5,000, or whether they are closer to a larger city. This fact per se is an indication of the influence of cities - however direct or indirect - on village population change.

#### Functional Type of County

As stated in the previous chapter, the total sample was divided into subsets of villages according to their location in functional types of counties. The types distinguished were metropolitan, non-metropolitan manufacturing, service center, family farm, and capital intensive agriculture counties as shown in Map 1. The results of the analyses of these sub-samples of villages are shown in Table 13.

TABLE 13

Results of Correlation Analyses and Beta Weights  
for Villages in Different Types of Counties

| Variable                          | 1950 - 1960 |        | 1960 - 1970 |        | 1970 - 1976 |        |
|-----------------------------------|-------------|--------|-------------|--------|-------------|--------|
|                                   | r           | beta   | r           | beta   | r           | beta   |
| Villages in Metropolitan Counties |             |        |             |        |             |        |
| IA/B/C27                          | .52461      | .35207 | .42987      | .31332 | .59010      | .03636 |
| IA/B/C29                          | .30762      | .55901 | .52069      | .48995 | .78720      | .68395 |
| E                                 | -.26769     | .09668 | -.30459     | .17822 | -.07767     | .09823 |

Table 13, continued

|            |         |         |         |          |         |         |
|------------|---------|---------|---------|----------|---------|---------|
| M          | .05783  | .69536  | .52025  | 1.32912  | -.14076 | -.04709 |
| R          | .08796  | -.13637 | .39115  | -1.20489 | .52234  | .19669  |
| F          | -.07248 | -.35281 | .04811  | .166636  | .10681  | -.09759 |
| L          | .44189  | .55540  | -.44443 | .31379   | -.38335 | .02023  |
| P          | .50477  | .06019  | .55922  | .38896   | .19602  | .20854  |
| multiple R | .75658  |         | .80111  |          | .82722  |         |

Critical absolute r values: .376386 (.05 level)  
.435274 (.01 level)  
.529286 (.001 level)

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Villages in Non-Metropolitan Manufacturing Counties

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|            |         |         |         |         |         |         |
|------------|---------|---------|---------|---------|---------|---------|
| IA/B/C27   | .46534  | .40896  | .21818  | -.10530 | .07691  | -.03645 |
| IA/B/C29   | -.27940 | -.08250 | -.08430 | .04461  | -.06086 | -.06254 |
| E          | -.40214 | -.18000 | -.37379 | -.17915 | -.34669 | -.31051 |
| M          | -.24306 | -.08986 | -.11327 | .13870  | .00663  | -.16630 |
| R          | -.09997 | -.01443 | -.09232 | -.14089 | .25437  | .23287  |
| F          | .15968  | .16517  | -.23115 | -.02902 | .17440  | .17028  |
| L          | -.31263 | -.12309 | .30066  | .16893  | .04850  | .00052  |
| P          | .30422  | .16099  | .53418  | .50734  | .41301  | .36818  |
| multiple R | .64806  |         | .60501  |         | .59040  |         |

Critical absolute r values: .178678 (.05 level)  
.217775 (.01 level)  
.271998 (.001 level)

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Villages in Service Center Counties

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|            |         |         |         |         |         |         |
|------------|---------|---------|---------|---------|---------|---------|
| IA/B/C27   | .27591  | .17355  | .27028  | .12066  | .32491  | .25273  |
| IA/B/C29   | -.03961 | .00596  | .08396  | -.08946 | -.01343 | -.02384 |
| E          | -.13093 | -.12089 | -.08459 | .12930  | -.28017 | -.23253 |
| M          | -.09542 | -.13262 | .05976  | .00064  | -.31673 | -.42673 |
| R          | .24884  | .24831  | .32402  | .33828  | .33236  | -.10092 |
| F          | .11423  | .09131  | -.27049 | -.34803 | .22135  | .22927  |
| L          | -.13093 | -.12089 | .05802  | -.17031 | -.24547 | .11099  |
| P          | .18330  | .11526  | .07206  | -.04867 | .19178  | .11746  |
| multiple R | .43632  |         | .45229  |         | .54335  |         |

Critical absolute r values: .211584 (.05 level)  
.258398 (.01 level)  
.321246 (.001 level)

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Table 13, continued

| Villages in Family Farm Counties                   |         |         |         |         |         |         |
|----------------------------------------------------|---------|---------|---------|---------|---------|---------|
| IA/B/C27                                           | .21992  | .18709  | .24558  | .22963  | .17763  | .13805  |
| IA/B/C29                                           | -.07714 | -.00027 | -.00032 | .00041  | .04142  | .02128  |
| E                                                  | -.26358 | -.14229 | -.12907 | -.05004 | -.18873 | -.21513 |
| M                                                  | -.14145 | -.12580 | .04523  | -.07535 | -.09551 | -.13060 |
| R                                                  | -.04179 | -.01022 | .15278  | .10744  | .10295  | .06370  |
| F                                                  | .04157  | .00502  | .09952  | .07565  | .20515  | .15031  |
| L                                                  | .08137  | .05955  | -.04130 | -.06126 | -.19472 | -.11896 |
| P                                                  | .19670  | .15320  | -.02876 | -.09773 | -.19447 | -.26269 |
| multiple                                           | .36343  |         | .30909  |         | .43399  |         |
| Critical absolute r values: .105235 (.05 level)    |         |         |         |         |         |         |
| .130141 (.01 level)                                |         |         |         |         |         |         |
| .158831 (.001 level)                               |         |         |         |         |         |         |
| Villages in Capital Intensive Agriculture Counties |         |         |         |         |         |         |
| IA/B/C27                                           | -.02760 | -.04862 | .00493  | .15267  | .27237  | .30674  |
| IA/B/C29                                           | .01866  | .00503  | .40581  | .41492  | .17197  | .09674  |
| E                                                  | .03057  | -.00734 | .00759  | .06014  | .17911  | .04207  |
| M                                                  | -.08049 | -.11054 | -.17456 | -.04443 | -.04121 | -.13625 |
| R                                                  | .11324  | .04792  | -.23855 | -.32126 | .14906  | .06465  |
| F                                                  | -.38203 | -.41414 | .28104  | .21092  | .06257  | .08723  |
| L                                                  | .06851  | .19760  | .29057  | .17223  | .14802  | .22283  |
| P                                                  | -.05660 | -.05760 | -.06155 | .05317  | .45628  | .40108  |
| multiple R                                         | .43651  |         | .60002  |         | .58687  |         |
| Critical absolute r values: .252478 (.05 level)    |         |         |         |         |         |         |
| .313148 (.01 level)                                |         |         |         |         |         |         |
| .383413 (.001 level)                               |         |         |         |         |         |         |

The hypotheses raised advanced with reference to the functional types are supported. Big city influence is greatest on villages in the metropolitan counties, followed by manufacturing, service center, family farm, and capital intensive agriculture counties. Cities in the manufacturing counties, especially in

metropolitan areas, provide industrial places of employment and therefore exert the greatest influence on village growth. Service centers surpassed the manufacturing cities in influencing village growth in the second and third periods. This indicates an increasing importance of the service sector for the regional economy. Villages in agricultural counties were least influenced by cities. There was no relationship at all for the capital intensive agricultural counties (except in the last period), which were most independent of big city influence. The influence of the smaller centers changed over time from negative or insignificant to insignificant or positive, a pattern already observed for other sub-samples. It was generally weak in service and agricultural counties, except in capital-intensive agriculture counties during the second period. Distance to the nearest highway interchange was negatively related to population change, except for villages located in capital-intensive agriculture counties. This is another indication of the independence of accessibility characteristic of these villages.

The impact of motorization change has a more complex pattern of relationship with village population change. The only groups of villages for which there is a positive association for one of the time periods are those in the shadow of metropolitan areas. Only villages of capital-intensive agriculture counties do not show any significant relationship. This may also be an indication of the fact that even with increasing motorization, villages are not by-passed, because larger places are too far away.



Villages in metropolitan counties are positively influenced by population density, an influence which increases over time. So, even in urban settings, population density is by far not so high as to preclude further growth. On the contrary, it leads to growth. With some restrictions, the influence of population density is very similar in the other types of "non-rural" counties. As one would expect, the influence of an increase or decline in number of farms is insignificant for villages in metropolitan counties. However, the impact of the other agricultural variable, farm income change, is strong and, confusingly, the correlation is positive in the first period and negative subsequently. To a certain degree, the influence of the "agricultural variables" is similar in the villages of manufacturing counties. In the service center counties, it varies irregularly over time. Their influence is surprisingly weak in the villages of agricultural counties, and a clear trend is only visible in the family farm counties. The positive influence of farm change increases over time, and the impact of income change switches from positive to negative. The latter fact means that better-earning farmers who initially took their business to villages later turned to larger places. They could not do this so extensively in capital-intensive agriculture counties, because in these isolated areas larger places were too far away. This is expressed in positive correlation coefficients.

Previous growth experience is a good predictor of village population change in metropolitan and, even more, in manufacturing



counties. It is insignificant or unstable elsewhere.

The weight of the association indices is increasing over time in metropolitan counties. However, the importance of a big city (with a population of more than 5,000) influence is declining. Declining also are the weights of the agricultural variables, which in the first period are as high as the "city variables". The relative importance of both association indices decreases in manufacturing counties, whereas no clear trend exists for the agricultural variables. In the second and third periods, the most important single factor predicting village population change is the distance to the nearest controlled access highway interchange. In the first period, this factor ranks only second behind the association index referring to larger cities. In service center counties, this index ranks first only in the third period, indicating an increase of its weight.

In family-farm counties, influence of cities larger than 5,000 population is the most important single factor predicting village growth, in the first and second periods. It still ranks second in the seventies, where change in number of farms takes the lead. In capital-intensive agriculture counties, the agricultural variables dominate, and the weights of the association indices, like their corresponding simple correlation coefficients, are close to zero. The cities, however, gained influence over time, expressed by higher beta weights. In the second period the influence of the smaller centers (which are more common

than large cities in the isolated areas of the capital-intensive agriculture counties) is clearly the most important factor.

### Eastern and Western Kansas

When the eastern and western "halves" of Kansas were analyzed separately, strikingly different patterns of association between village population change and various factors were found. The delimitation of the "halves" was indicated in Map 1. Results of the analyses are shown in Table 14.

TABLE 14

Results of Correlation Analyses and Beta Weights  
for Eastern and Western Kansas

| Variable                                        | 1950 - 1960 |         | 1960 - 1970 |         | 1970 - 1976 |         |
|-------------------------------------------------|-------------|---------|-------------|---------|-------------|---------|
|                                                 | r           | beta    | r           | beta    | r           | beta    |
| Villages in Eastern Kansas                      |             |         |             |         |             |         |
| IA/B/C27                                        | .57497      | .48048  | .39560      | .07791  | .44308      | .06936  |
| IA/B/C29                                        | -.12616     | -.06822 | .05640      | .6158   | .45146      | .32400  |
| E                                               | -.44177     | -.17747 | -.33139     | -.13971 | -.32077     | -.21373 |
| M                                               | -.09922     | -.10273 | .06820      | .00501  | .05273      | -.12116 |
| R                                               | .36622      | -.01956 | .38499      | .18216  | .44662      | .15882  |
| F                                               | .21559      | .06021  | .03533      | -.02588 | .22475      | .19127  |
| L                                               | .02814      | .01749  | -.25223     | .02385  | -.17213     | .03524  |
| P                                               | .35666      | .16626  | .42032      | .24934  | .23291      | .09880  |
| multiple R                                      | .66262      |         | .49894      |         | .60831      |         |
| Critical absolute r values: .090634 (.05 level) |             |         |             |         |             |         |
| .112170 (.01 level)                             |             |         |             |         |             |         |
| .137047 (.001 level)                            |             |         |             |         |             |         |
| Villages in Western Kansas                      |             |         |             |         |             |         |
| IA/B/C27                                        | -.07306     | -.00461 | .05232      | .07390  | .22635      | .18685  |
| IA/B/C29                                        | -.02396     | -.00370 | .13368      | .17962  | .03923      | .05158  |
| E                                               | -.07014     | -.10101 | .12429      | .03796  | .14273      | .06496  |

Table 14, continued

|                                                 |         |         |         |         |         |         |
|-------------------------------------------------|---------|---------|---------|---------|---------|---------|
| M                                               | -.05658 | -.06361 | -.22372 | -.14281 | -.08714 | -.03192 |
| R                                               | -.09899 | -.20340 | -.21218 | -.19887 | -.05863 | .03185  |
| F                                               | -.26410 | -.29750 | .29433  | .28507  | .11552  | .19874  |
| L                                               | .01267  | -.03396 | .10000  | .11581  | .23122  | .28210  |
| P                                               | .08384  | -.03235 | -.17343 | -.12646 | .30621  | .17691  |
| multiple R.                                     | .32634  |         | .47345  |         | .44313  |         |
| <hr/>                                           |         |         |         |         |         |         |
| Critical absolute r values: .158586 (.05 level) |         |         |         |         |         |         |
| .190450 (.01 level)                             |         |         |         |         |         |         |
| .240724 (.001 level)                            |         |         |         |         |         |         |
| <hr/>                                           |         |         |         |         |         |         |

Generally, the multiple R values were higher for villages in the eastern part of the state. The influence of the bigger cities was always significant at the .001 level for eastern villages, whereas in the West, this factor appear to have gained significance only recently. High correlations were obtained also for the distance to the nearest highway interchange in Eastern Kansas, whereas in the West, they were insignificant and sometimes even positive. A striking difference between East and West is the influence of population density. It is positively associated with village growth in the East over all the periods considered, and significant at the .001 level. In Western Kansas, the correlations are negative (although significant only in the second period). One would expect exactly the opposite, or at least a stronger positive influence for population density in the West, since this part is more rural than the East. During the first period, the correlation with change in the number of farms is negative, a paradox which was observed in the subsample of villages located in capital-intensive, agriculture counties. It is

a paradox because it suggests that decline in number of farms promoted village growth, instead of undermining the economic base and forcing population decline. Perhaps those giving up farming and moving, initially moved to villages only. Previous growth experience is a good predictor of village growth only in the East (significant at the .001 level in all three periods). The results for the total sample resemble more those of Eastern Kansas, because of its high share of villages. Thus, the totally different pattern for the West is concealed.

#### County Seats

The last subsample to be discussed consists of those villages which are administrative seats for their counties. The results of these analyses are shown in Table 15. The hypothesis was that all factors have lower influences on the demographic performance of county seats. It was thought that they were more independent of external influences than other villages, having an important function per se. The hypothesis is supported. Only a few factors have influence significant at the .05 level, and in certain periods. County seats were not independent of change in number of farms, but this was significant only in the second period. The negative correlation with big city influence, in the third period, suggests that these centers became competitive with the smaller county seats.

TABLE 15

Results of Correlation Analyses and Beta Weights  
for county Seat Villages

| Variable                    | 1950 - 1960 |         | 1960 - 1970 |              | 1970 - 1976 |         |
|-----------------------------|-------------|---------|-------------|--------------|-------------|---------|
|                             | r           | beta    | r           | beta         | r           | beta    |
| IA/B/C27                    | .03035      | .01451  | .10022      | .16562       | -.31227     | -.35398 |
| IA/B/C29                    | -.17561     | -.19110 | .18707      | .27351       | .19292      | .14058  |
| E                           | -.16668     | -.18169 | .22922      | .14737       | -.02170     | -.31635 |
| M                           | -.14148     | -.15642 | -.23146     | -.21785      | -.10224     | -.20775 |
| R                           | -.08686     | .05300  | .05547      | -.08295      | -.24529     | -.10955 |
| F                           | .04228      | -.03536 | .30555      | .26946       | .12184      | .10067  |
| L                           | .11103      | .22560  | .12466      | .03821       | .16403      | .14996  |
| P                           | -.00545     | -.12617 | -.26737     | -.21702      | .12356      | .17015  |
| multiple R                  | .32566      |         | .54255      |              | .50052      |         |
| Critical absolute r values: |             |         |             |              |             |         |
|                             |             |         | .247230     | (.05 level)  |             |         |
|                             |             |         | .339773     | (.01 level)  |             |         |
|                             |             |         | .375639     | (.001 level) |             |         |

Summary

In the first part of this chapter, the results of a systematic approach to the calculation of potentials, were discussed. Although effective distance, or the consideration of road quality, received major attention in this study, its use did not make appreciable differences in explained variation. The best "mass variable" for cities, in all three periods considered, was population, although the dynamic variables worked much better in the first period. For the sake of continuity, those association indices which were good predictors of village population change in all three periods were selected for further analysis.

On the whole, there is a significant relationship between city influence and village population change. The impact of the cities is more important than any of the other factors considered. However, this is not true for all sub-samples of villages. Although for certain sub-samples, impressively high multiple correlation coefficients were achieved (especially for villages in higher size classes), these figures are not very convincing because the influences of individual factors sometimes seem to vary randomly in strength and nature. There are also considerable regional differences in individual variables' influence. City influence is least in the western part of Kansas, in the agricultural counties, especially in the capital-intensive agriculture counties, and among county seats.

When the variables other than those indicating city influence were used as control variables in partial correlation analysis, the association between big city influence and village population change became weaker, in most instances, whereas the index for smaller centers was found to be higher than shown in simple correlation. Few insights on variability of results were gained by the analysis of extreme residuals. Positive residuals (underpredicted villages) tended to be close to larger cities, but this was not significant at the .05 level when subjected to a t-test. Few residuals showed continuity over time.

## Chapter V

## SUMMARY AND CONCLUSIONS

Summary

The purpose of this study has been to determine the degree of impact of cities on village population change in Kansas since 1950. In the survey of prior research, it was found that proper attention was never paid to the size-distance concept. An attempt was made to address the discrepancies by operationalizing the impact of cities on village population change in a systematic way. Based on the results of this systematic approach, further analyses were made in order to determine the relative importance of the cities' influence within a set of factors thought to have an impact on village population change.

Multiple regression coefficients were computed in order to determine the amount of variation in population change that could be explained by the co-variation of a set of descriptive indices. Analyses were made for the total sample of 509 villages, and for certain sets of sub-samples. For the total sample, partial correlation coefficients and extreme residuals were discussed. From an inspection of partial correlation coefficients, it was determined which other factors have a positive influence on the association between city influence and village population change. Extreme residuals were discussed in order to find out whether there are systematic deviations and whether the location of extreme cases suggests the existence of other factors not



included in this effort.

Analyses were conducted for three periods, 1950 - 1960, 1960 - 1970, and 1970 - 1976. The impact of cities was thought to be different for different groups of villages. Therefore, the total sample was divided into subsamples according to size of village, size of largest city in the neighborhood of a village, location in a functional type of county, location in the Eastern or Western "half" of Kansas, and a final group of county seats.

The systematic operationalization of city influence revealed that it does not make an appreciable difference whether effective distance (i quasi driving time units) is considered, instead of road distance. The same was true for a variable indicating the distance to the nearest interchange with a controlled access highway. Differences in results were also insignificant when city non-agricultural employment rather than city population was considered. Dynamic variables characterizing the cities (population change and employment change) yielded significantly better results than the static measures (population and non-agricultural employment) in the fifties, and significantly worse results subsequently. The change measures, thus, proved to be unstable and unreliable predictors of village population change.

Cities smaller than 5,000 have an association with village population change different from that of larger centers. Larger cities always had an advantageous impact on village population change. The influence of smaller centers changed from competitive

to advantageous. This difference was acknowledged by choosing two different association indices describing city impact. Consideration of a 35-mile radius yielded better results than a 30-mile limit, except for the smaller centers after 1960. The best-fitting distance-decay exponent was about 0.5 in all periods, again with the exception of the smaller centers in the last period, where it was about 4. It was always better to take into account more than one city larger than 5,000 in the neighborhood of a village. The association indices selected for further analyses were based on effective distance, city population, the 35-mile limit, and the distance exponent of 0.5 (except for the index referring to smaller centers in the last period, where the exponent was 4).

The impact of the cities, operationalized in this way, is the most important individual factor predicting village growth among all factors considered, in all three periods, for the total sample. Other important factors were population density and distance to the nearest interchange with a controlled access highway. This pattern is even more distinguished in East Kansas, whereas in the West, city influence is much lower, as are the multiple R values. The association between cities larger than 5,000 population and village population change is only slightly higher, if for the effect of certain other variables is controlled. For the smaller center index, the correlation coefficient is raised considerably in several instances, revealing a higher impact of this variable than indicated by a simple

correlation coefficient.

For the different sub-samples of villages, quite different patterns of factors influencing population change are revealed. For size classes larger than 1,000 or 1,500, there are few interpretable trends. In most instances, the change in the role of smaller centers can be observed. It changed from competitiveness to cooperation, and the related index had mostly higher correlations with population change than with the index for the cities larger than 5,000. The influence of cities, i.e. both indices, were lowest during the second period in most cases. The patterns of association are so different that further research is needed to make meaningful generalizations.

#### Conclusions and Suggestions for Further Research

Several steps were taken in this study to improve the explanatory power of the so-called size-distance concept. Some have proven successful. Even if what appears here represents but a few of the possibilities for methodological improvement, it has been demonstrated that the influence of cities on village population change is higher than revealed by earlier studies. Among the factors considered, location relative to larger population clusters ranks first in importance, in many instances. The influences are not stable over time, and there is no justification for the consideration of one or two periods of time, if one wants a more incisive understanding of village population change. The multiple correlation coefficients obtained were not strikingly high. This could indicate that proper attention was

not paid to factors influencing population change other than city influence, especially in Western Kansas.

With this approach the consideration of, say, only the last period, 1970 - 1976, or not analyzing the three periods separately, would have lead to generalizations which might be misleading. The changing role of smaller centers would not have been discovered; instead, a disagreement with results attained in prior research would have been obtained. In order to find out long term trends in the influence of various factors, it may be necessary to consider even more than three periods.

Population and population change, when used as mass variables characterizing cities, showed different associations with village population change in different periods. To be assured of an understanding of how associations like these change, more periods should be considered in further research. An expectation that stability, or at least clear trends, would be revealed the considering of only three periods was not fulfilled.

Further emphasis should also be placed on the selection of indicators which describe the economic situation of a city than population or employment figures. While it should be advantageous to experiment with mass measures, this study found no support for the time-consuming effort required to compute a distance which controls for road quality. The radii of 30 and 35 miles, as outer commuting distance limits, were adopted from other studies. However, special research is necessary to determine that these distances recognize regional and temporal variations.

Some variables were operationalized to capture the essence of of the agricultural milieu. They were expressed by relating a proportionate share of a county attribute to a village. Association indices, describing city impact, could be subjected to a similar operation. The support a large city can give to villages in its neighborhood may be distributed among five or 25 settlements. Any competition among villages for support from nearby cities was not considered in this study. Perhaps this could be expressed through an allocation measure. A further improvement may be gained by using residuals as dynamic variables describing city influence, to be computed in the same manner as the dependent variable.

The regional variations of the individual factors' influences are considerable, and more research is necessary to determine the nature of regional patterns of influence. It seems especially worthwhile to determine regional variations of the distance decay exponent. Also, referring to village size classes, intervals for analyzing the size-distance relationship for smaller villages should be made narrower. As a result, clearer trends may be revealed.

To sum up this argument, the attempt to improve the size-distance concept was successful. The concept has not received proper attention previously. This study indicates that further improvement may reveal even more clearly the impact of the cities on village population change.

The results of this study do not directly contradict

earlier findings, although additional relationships were discovered. Hassinger's notion of a competitive influence of smaller centers on villages can be supported, although it was also found that this competitiveness later turned into support. Detailed results affirmed this notion of a changing role of the smaller centers with respect to village population change. The affect of another phenomenon discovered by other authors, the reversal of population trends from rural-urban to urban-rural shifts in the seventies was supported in this study. Of course, no agreement could be reached with studies which used faulty or insufficient methods to operationalize the influence of cities on village population change.

There are many different approaches to research on village population change. The approach used in this effort may well be even more fruitful than could be demonstrated in this limited application. At the very least, my work should contribute to the dialogue on village population change, especially where attempts are made to apply a locational perspective.

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THE IMPACT OF LOCATION RELATIVE TO CITIES ON  
VILLAGE POPULATION CHANGE IN KANSAS

1950 - 1976

by

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AN ABSTRACT OF A MASTER'S THESIS

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This study investigated the influence of the accessibility to cities on village population change. A version of the potential model was applied to obtain measures of accessibility for three temporal cross-sections, 1950 - 1960, 1960 - 1970, and 1970 - 1976. Population, non-agricultural employment, population change, and employment change served as mass variables characterizing probable influence of the cities. In addition to road distance, an effective distance measure was applied, which controlled for road quality. Cities with populations of more and less than 5,000 were considered separately. Potentials were computed which considered the nearest city of more than 5,000, all cities of more than 5,000 and all cities with populations between 2,500 and 5,000. The potential measures also discriminated between village accessibility based on a radius of 30 and 35 miles for each class of city size.

Static mass variables (population and non-agricultural employment) were found to be better predictors of village population change than the change measures. The latter yielded better correlation results only in the fifties. For larger cities, the consideration of all rather than one within 30 miles yielded higher coefficients, and a further improvement was gained by the application of a 35-mile limit. The influence on villages by smaller cities changed from competition to support over the study period. Whereas most influences showed distance decay exponents of 0.5, the latter change was accompanied by a rise of the exponent



to 4.0. The application of the "effective distance" measure did not yield a significant rise of the explained variation.

Accessibility measures used in this study led to higher levels of explanation than previously revealed. They were the most important individual factors influencing village growth or decline, when compared with six other factors: distance to the nearest highway interchange, change of relative motorization, population density, change of number of farms and of farm income, and previous growth experience. This influence, though declining over time, was not revealed in prior research. The multiple correlation coefficients for the total sample were 0.53, 0.42, and 0.57, for the periods 1950 - 1960, 1960 - 1970, and 1970 - 1976. Partial correlation analyses showed that only the influence of smaller cities is significantly higher than a zero-order correlation, when controlling for the effects of other factors.

Subsamples of villages were distinguished according to village size, size of largest city within 30 miles of a village, location in Eastern or Western Kansas, and location in functional types of counties. Different patterns of influence were discovered for the subsamples in the three different periods considered. Clear trends such as higher influence for cities in higher size classes, were restricted to villages up to 1,000 or 1,500 inhabitants. There were no clear trends over time indicating variables losing or gaining influence. However, findings to suggest that relationships are not stable over time.