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AN ECONOMIC ANALYSIS OF INTER-COUNTY VARIATION IN
RESIDENCE PATTERNS OF FARM FAMILIES IN UTAH,
KANSAS, CALIFORNIA, IOWA, AND TEXAS

by

Leroy V. Clifford

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Economics

Approved:

UTAH STATE UNIVERSITY
Logan, Utah
1972

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ABSTRACT

An Economic Analysis of Inter-County Variation
in Residence Patterns of Farm Families
in Utah, Kansas, California, Iowa, and Texas

1964

by

Leroy V. Clifford, Master of Science

Utah State University, 1972

Major Professor: Dr. B. Delworth Gardner
Department: Agricultural Economics

This study was undertaken to determine which factors, if any, are responsible for inter-county variation in the percent of farm operators residing off the farm in California, Iowa, Kansas, Texas, and Utah.

These states were selected for this study because of their wide representation of the various types of agricultural and sectional differences. These states vary significantly in type of farm, tenure conditions, off-farm employment opportunities, cultural patterns, remoteness of farms from town, and other variables.

Forward step-wise regression analysis was utilized in each of the states to correlate percent of farm operators residing off the farm with type of farm, farm sales, tenancy, non-commercial farms, off-farm employment, remoteness, college education, and average off-farm income.

In addition to the above variables, percent of Mormon farm operators and percent of non-white farm operators were used only in the Utah and Texas analyses respectively.

Using the results of the regression analyses, it was possible to determine those variables, which a priori, were considered to be important determinants of the trend toward greater off-farm residence of farm families.

(125 pages)

INTRODUCTION OF THE PROBLEM AND JUSTIFICATION
FOR RESEARCH

The migration of people from the farms to the urban centers of the United States is an old phenomenon and has been thoroughly studied. What is comparatively recent is the time trend since World War II for an increasing number of farm families which depend on farming for all or part of their livelihood to establish their place of residence off the farm. What are the reasons for establishing residence off the farm? Is the trend likely to continue? These are questions which must be answered before adequate planning can be done in both urban and rural areas.

Before the above questions can be answered some type of theoretical conceptualization of the phenomenon of shifting farm residence must be formulated and an identification of the causal factors influencing it must be made.

There has been much written about migration and its apparent causes. Demographic, economic, and technological developments in the United States are rapidly changing the distribution of people between cities and rural areas, and within the latter. The so-called agricultural revolution is affected by this population redistribution and in turn affects where people live and do business.

Living standards and economic affluence, on the average are lower in the rural areas than in the urban centers. Per capita incomes are lower, housing is more inadequate, the quality and quantity of education is generally more substandard, health services and facilities are less satisfactory, many social amenities and public services when available are more costly and of more inferior quality, and the real consumption costs of many goods and services which are market allocated are higher in the rural areas than they are in urban areas. These numerous disadvantages exist despite a myriad of social subsidies and governmental programs in rural areas.

Many farm people and residents of small rural towns have reacted to these poorer living conditions by leaving agriculture and migrating to larger towns and cities. Other farm families which elect to remain in agriculture as a source of livelihood apparently have been moving the family residence from the farm site to settlements, villages, towns, and cities, in order to escape the disadvantages of isolated, rural living.

The facts are clear and impressive. In 1950, only 5.1 percent of farmers reporting residence location for census enumerators indicated that they lived off the farm. By 1954, this figure had risen to 6.2 percent, by 1959 to 7.6 percent, and by 1964 to 9.5 percent. This national trend applies to every state within the United States.

Even though higher percentages of farm families live off the farm in some states than others, this trend for an increasing number of farm families residing off the farm is taking place in every section of the country.

Some states have a much higher percentage of off-farm residency than others. Utah, which ranked highest in the percent of farm operators residing off the farm in 1964, had 26.3 percent off-farm residence compared to 17.2 percent in 1954. This is an increase of 9.1 percentage points in just ten years. Texas, a state having large increases in off-farm residence, ranked fourth in 1964 with 21.4 percent compared to 12.6 percent in 1954.

When viewed at the county level, even more variation in the percentages shows up. Several Utah counties reported that over 50 percent of the farm operators lived off the farm in 1964 while several counties in Texas exceeded 60 percent for the same year. The 1969 agricultural census, which has already been taken but not yet completely compiled and analyzed, will be interesting to study to ascertain if the national, state, and county trends have continued since 1964.

Studies are now under way at Utah State University that will test the empirical significance of those causal variables alleged to be important in explaining the trend toward greater off-farm residence of farm families throughout the United States. A preliminary study by

Gardner (1) shows a clearly defined trend toward more farm families establishing their place of residence off the farm. Gardner's nationwide and state studies attempt to determine what factors are responsible for this trend. His analysis attempts to find out why farm families are changing their place of residence, to make projections of off-farm residence ten and thirty years hence, and to explore the implications for resource-use planning, public policy, and institutional and community development in the rural areas. Gardner's analysis consists of two steps: (1) cross-classification of census data relating off-farm residence to type of farm, size of farm, farm sales, farm ownership patterns, and off-farm employment opportunities, and (2) a regression analysis that attempts to explain interstate variation in the percent of farm operators residing off the farm using the cross-sectional classifications listed in (1).

Knowledge of what is happening and why thousands of farm families are changing their place of residence annually from the farmsite to towns and cities is of critical current importance. Firm knowledge relating to farm-family residence and the reasons underlying the shifts taking place will assist officials and legislatures in government and officers of farm organizations and private business to establish guidelines and initiate programs which will lead to more optimal settlement patterns and

increase the "quality" of life of farm people and the efficiency of resource use in the nation's hinterlands.

As a part of this broader study, this thesis project attempts to explain inter-county variation in off-farm residence in five states--Kansas, Iowa, California, Utah, and Texas. These states were chosen for this study because of their wide representation of the various types of agriculture and sectional differences. These areas vary significantly in type of farm, tenure conditions, off-farm employment opportunities, cultural patterns, remoteness of farms from towns, and others. Iowa, for example, is broadly representative of the Corn Belt, Texas contains a large portion of the Cotton Belt, Kansas is representative of the Great Plains, California is an extremely diverse state, and Utah is somewhat representative of the Mountain States, but with some unique cultural characteristics.

This study employs analytical techniques, in the five states selected for study, similar to those used by Gardner in his analysis to explain interstate variation in off-farm residence. The major hypothesis of the study is that there exist definable and measurable physical, social, economic, and cultural forces within and surrounding the farm which weigh heavily in influencing the family's decision to establish residence off the farm.

OBJECTIVE

The main objective of this study was as follows:

1. To determine which independent variables account for inter-county variation in the percent of farm operators residing off their farms in the five states studied.

To determine the explanatory significance of the independent variables four criteria were utilized from the output of multiple regression analysis. First, a "t" test was used to determine whether the simple partial coefficient of correlations were significantly different from zero. Secondly, partial regression coefficients in a multi-variable equation were tested for statistical significance. Thirdly, the standard partial regression coefficients ("the partial regression coefficients when each variable is in standard measure") were computed for each independent variable and ranked according to size. Fourthly, the step-wise regression technique utilized enters, one at a time, those variables most influential in explaining variation in the dependent variable. The relative order of entrance, therefore, is some indication of the relative importance of each independent variable. A priori, some of the independent variables were: sales of farm, type of farm,

farm tenancy, non-commercial farms, off-farm employment, and remoteness.

The results of these measures were used only as indicators of the significance of each variable as no single criterion alone was considered sufficient. Sometimes the various criteria gave contradictory results. If all the indicators consistently showed strong significance the variable was considered significant. If there were contradictory results, judgement had to be exercised in deciding whether or not the variable was significant by a careful assessment of all four indicators.

SOURCE OF DATA

Both primary and secondary sources of data were used. The principal secondary data came from the United States Census of Agriculture which contains information on residence of farm operators for the six census periods beginning with 1940 and ending with 1964. Primarily, the 1964 census data were used in the cross-sectional analysis. Other basic data were obtained from:

- (1) The Directory of the General Authorities and Officers of the Church of Jesus Christ of Latter-Day Saints (1964),
- (2) the Statistical Abstract of Utah, 1964, and
- (3) unpublished material and papers written by Gardner.

REVIEW OF LITERATURE

Although there has been much literature produced concerning farm-city migration, no substantial empirical work has previously been published on the residence patterns of farm families. In keeping with the objective of this study, this review of literature has been limited to a few carefully selected publications which seem to be of special relevance to the study problem. Literature was also reviewed which used analytical methods pertinent to the objective of this study.

The literature review is grouped under four main headings: A. Farm Residence Location, B. Rural Settlement Patterns, C. Central Place Theory and Village Growth, and D. Migration From Rural to Urban Areas.

Farm Residence Location

Gardner (1) is presently conducting a study at Utah State University on "Shifts in Farm Family Residence." Gardner's study is concerned with finding out the following: why farm families depending upon agriculture as a source of livelihood are establishing residence off the farm in increasing proportions, making projections of off-farm residence ten and thirty years hence, and exploring the implications for resource-use planning, public policy,

and institutional and community development in rural areas.

He has been particularly interested in the identification of important variables which cause variation among states in the percentage of farm operators living off the farm. His analysis consists of two steps: (1) some cross-classifications using aggregate census data relating off-farm residence to type of farm, sales of farm, tenancy, whether or not the farm is a commercial farm, availability of off-farm work, remoteness of farm location, condition of farm housing, and non-farm income, and (2) a cross-sectional regression analysis that attempts to explain interstate differences in the percent of farm operators who live off the farm. He used multiple regression techniques and employed a "t" test to determine whether the partial regression coefficients were significantly different from zero. The size of the simple partial correlation coefficients was also tested for statistical significance. The magnitude of the coefficient of determination was considered as a measure of goodness of fit for the various regression equations. The results of Gardner's analysis are summarized in Tables 1, 2, and 3.

Rural Settlement Patterns

Galpin (2) conducted a classic study in 1915

Table 1. Simple Correlation Coefficients Between Off-Farm Residence and Eight Independent Variables for Various Population of States, 1964

Coefficient	Population				
	I ¹	II ²	III ³	IV ⁴	V ⁵
r_{YX_1}	-.435**	-0.579**	-0.747**	-0.361**	-.713**
r_{YX_2}	.075	-.041	.028	.104	-.016
r_{YX_3}	.042	.296	.450**	-.033	.391**
r_{YX_4}	-.038	-.033	-.113	.068	.078
r_{YX_5}	.349**	.232	.062	.442**	.156
r_{YX_6}	.495**	.544**	.536**	.484**	.520**
r_{YX_7}	.049	.336**	.422**	.013	.490**
r_{YX_8}	.596**	.509**	.656**	.576**	.629**

* Denotes statistical significance of coefficient at .10 probability level

** Denotes statistical significance of coefficient at .05 probability level

¹Population I. Includes all 46 observations

²Population II. 36 observations, excludes La., Ark., Miss., Ala., Tenn., Ga., S.C., N.C., Va.

³Population III. 35 observations, same as II except Utah also is excluded

⁴Population IV. 38 observations, excludes W.Va., Md., Pa., N.J., N.Y., R.I., Conn., Mass., N.H.

⁵Population V. 27 observations, excluded in II, III, IV

Table 2. Multiple Regression Coefficients Showing Effects of Eight Independent Variables on Off-Farm Residence for Various Population of States, 1964.

Coefficient	Population				
	I ¹	II ²	III ³	IV ⁴	V ⁵
a	11.69	12.25	14.42	11.66	15.59
b ₁	-0.06336 (0.04210)	-0.07397 (0.05095)	-0.1242** (0.0371)	-0.06262 (0.05445)	-0.1336** (0.0433)
b ₂	-0.1994** (0.0632)	-0.1691** (0.0809)	-0.07700 (0.06016)	-0.2140** (0.0317)	-0.09940 (0.07050)
b ₃	0.09168 (0.08816)	0.1606 (0.1057)	0.09333 (0.07592)	0.1122 (0.1079)	0.1399 (0.0965)
b ₄	-0.03707 (0.03252)	-0.05651 (0.03344)	-0.02765 (0.02765)	-0.05150 (0.05852)	-0.05817 (0.05759)
b ₅	0.4712** (0.1510)	0.4369** (0.1727)	0.09562 (0.13660)	0.5197** (0.2038)	0.1428 (0.2070)
b ₆	0.001106** (0.000537)	0.001487** (0.000705)	0.0003031 (0.0005412)	0.001210* (0.000651)	0.0004749 (0.0006832)

Table 2. Continued

Coefficient	Population				
	I ¹	II ²	III ³	IV ⁴	V ⁵
b ₇	-0.4636** (0.1892)	-0.1294 (0.1166)	0.2678 (0.2705)	-0.4564* (0.2353)	0.3318 (0.3101)
b ₃	0.001134** (0.000382)	0.0002889 (0.0001939)	0.0005665 (0.0004391)	0.001070** (0.000473)	0.0004015 (0.0005576)
R ₂	.629	.596	.773	.607	.742
Order of variables removed from step-wise regression	X ₃ , X ₄ , X ₆ X ₁ , X ₇ , X ₂ X ₅ , X ₃	X ₇ , X ₈ , X ₃ X ₄ , X ₅ , X ₂ X ₆ , X ₁	X ₆ , X ₅ , X ₄ X ₂ , X ₃ , X ₇ X ₉ , X ₁	X ₄ , X ₁ , X ₃ X ₆ , X ₇ , X ₂ X ₅ , X ₈	X ₆ , X ₃ , X ₄ X ₂ , X ₈ , X ₃ X ₇ , X ₁

* Denotes statistical significance of coefficient at .05 probability level

** Denotes statistical significance of coefficient at .01 probability level

Numbers in parenthesis are standard errors of regression coefficients.

Table 3. Summary Results of Relationships Between Off-Farm Residence and Eight Explanatory Variables, 1964

	Population I.	Population II.	Population III.	Population IV.	Population V.
X ₁ (Type of Farm)	yes ^a (yes)	yes (yes)	yes (yes)	no (yes)	yes (yes)
X ₂ (Sales of Farm)	yes (no)	? ^c (no)	no (no)	yes (no)	no (no)
X ₃ (Tenancy)	no ^b (no)	no (no)	no (yes)	no (no)	yes (yes)
X ₄ (Non-Commercial Farm)	no (no)	? (no)	no (no)	no (no)	no (no)
X ₅ (Off-Farm Work)	yes (yes)	yes (no)	no (no)	yes (yes)	no (no)
X ₆ (Remoteness)	yes (yes)	yes (probably yes)	no (yes)	yes (yes)	no (yes)

Table 3. Continued

	Population I.	Population II.	Population III.	Population IV.	Population V.
X_7 (Condition of Housing)	yes (no)	no (yes)	? (yes)	yes (no)	yes (yes)
X_3 (Farm Income)	yes (yes)	no (yes)	yes (yes)	yes (yes)	yes (yes)

The word, yes or no, not bounded by parentheses is the conclusion yielded by the regression analysis, whereas the word in parentheses states whether or not the simple correlation coefficient is significant.

- a If yes, independent variable is unambiguously significant.
- b If no, independent variable is unambiguously non-significant.
- c ?, independent variable is of questionable significance.

analyzing the governmental structure of rural areas in Wisconsin. He was extremely critical of the practice of establishing county boundaries without due consideration given to the common interests and social activities of people in the rural areas. The farmer and his family did not feel a part of the community and, therefore, did not share in the economic, political, and social advantages of community life. Galpin made several suggestions that might bring people into the mainstream of community life, but they did not include the shifting of residence to town, probably because it was not technologically possible to leave the farm in that day.

A survey conducted by Anderson (3) in the Great Plains in the 1940's and early 1950's clearly showed the increasing costs of living in the rural areas as the rural population declines as a result of migration. Anderson notes that some farm families are attempting to surmount the existing obstacles by establishing two residences, one on the farm and one in town, but no systematic analysis of this phenomenon was undertaken.

Kraenzel's (4) survey showed that public services and social amenities in rural areas lag behind those in urban centers. He advocates special subsidies and extension of effective government to the rural areas to overcome the discrepancies in the quality of living in the rural and urban localities. He seemed to sense the

emerging attraction of the larger community for the farm family.

Marion Clawson (5) has raised some of the most penetrating and thoughtful questions of all those concerned with rural settlement. His early research in the 1940's in the Columbia Basin was concerned with how farm layout could be managed in a new irrigation project to permit efficient management of the farm and yet offer maximum opportunity for social intercourse with neighbors and access to public utilities and social amenities. Many alternative settlement patterns were considered and the one selected as "best" was a "line" settlement of farm residences along the major roads. Transportation, communication, marketing, and public utility costs would be minimized and social contacts with neighbors would be easier than with unplanned settlement.

Dr. Clawson (6) in another publication asks the question of whether farmers ought to live on the farm at all and, if so, in what kinds of clusters of farm dwellings. He delineates the factors which should bear importantly on the decision, the forces preventing movement from the status quo and those pulling in the direction of change.

Goldschmidt (7), a sociologist writing in the 1940's, asked some of the same general questions about shape and size of farms as the Columbia River investigators.

He interviewed farm families in five locations in the Northwest in order to determine family preferences and how these matched up with actual settlement patterns. He found that farm families desired one or two close neighbors but seldom had more than three. Goldschmidt argues that surveying practices were responsible for the rectangular farm layouts, road patterns, and resulting farmstead locations. He fails to mention that the Homestead Laws and the Reclamation Laws required the residence of families on the land which probably accounts for much of the on-farm settlement that is characteristically American.

The very recent work of Ulrich (8) provides a link between settlement patterns and central place theory and village growth. Ulrich's objective is to develop an operational model of a rural spatial economy containing a wide range of important spatial and other linkages. Inputs into the model include such things as farm structure, productivity and income of the labor force, and levels of exogenous manufacturing and government employment. The output variables include population, income, employment by sex, occupation, and output level of eight production sectors. From the model, Ulrich determines the desired size of an economic market area. He is able to specify population, income, employment, and economic structure under conditions where agriculture is assumed to exist alone, and where agriculture is supplemented by exogenous

manufacturing and government employment. The results of Ulrich's work are of some relevance to this study in that they indicate the sizes and structures of local economies that would appear to be competitive and viable. But, residence location of farm families is an important determinant of optimal community size and structure, and Ulrich's model could have been strengthened by including this variable in his analysis. In summary, even though Clawson and Anderson have suggested the alternatives open to the farm family in choosing residence location, no systematic study, except for Gardner's recent analysis, has attempted to deal with this question.

Central Place Theory and Village Growth

The subject matter suggested by this sub-heading is relevant because it bears on the question of community viability and optimum size. If farmers are to live off the farm in towns, it is important that these towns are viable and capable of providing goods and services not available at the farm.

The classic study of central place theory is that of Christaller (9), writing in Germany in the early 1930's. He lists groups of institutions providing central functions and then matches central place activities to these institutions. He considers central places of various sizes and develops a theory to locate these central places

relative to each other. They are classed as local market areas, service market areas, and central cities. The relevance of all of this is that various goods and services are available only in certain central places. It is the bundle of goods and services available in the central place which determines the advantages of living on or off the farm.

Hodges (10) conducted a study in which he attempted to predict which trade centers would survive and grow and which would not. Hypotheses were formulated and tested. Small centers have a smaller chance to survive than larger ones. Centers located closer to other larger centers have a smaller chance than those located further away. Hodges infers that the residence of the population within a trade center area (either on the farm or off) will make little difference to the total demand for goods and services. This is unlikely, especially for public services and social amenities, if for no other reason than the accessibility for these things is far different for a family in town and one on the farm.

Berry and Garrison (11) conducted a study also concerned with central places. They subdivided central places into towns, cities, regional capitals, regional metropolises and national metropolises. These orders of central places form a national system of cities and their surrounding community fields. They then describe the

functions of the various orders of central places.

Fox (12) was concerned with the problem of defining the bounds of what he calls a "functional economic area" and the structure of government it implies. In Galpin's day, before advent of the automobile, a self-contained trade area in the Midwest was approximately 50 square miles in area, and a county was a fairly suitable organ of government. Today, however, if shoppers spend one hour travelling to a trade center the size of the area would be more like 5,000 square miles and include as many as 600,000 people. Governmental, social, and economic institutions, suitable in a horse and buggy age are no longer adequate and must be replaced.

There is a high degree of validity in Fox's argument in answering the question of trade center scale and structure. The argument is of little use, however, in answering the question of the optimal population distribution within the economic area. People in agricultural areas may be living on the land or they may be in towns or cities.

Migration From Rural To Urban Areas

The question of migration is of peripheral interest to this study. The ever changing composition of the American rural population is an established fact and has been the subject of much research. The number of people

leaving agriculture influences the supply of farm housing available to those who remain. Migration also influences the per capita cost of goods and services to those people who remain in the rural areas as markets become smaller and service costs are spread over fewer people.

A conference held in Stillwater, Oklahoma on May 17-18, 1968, consisted of papers by some of the best-known students of migration.

The first statement by Professor Dale Hathaway (13) was a description of the migration trends of black and white Americans over the past five years and the reasons for this migration. The primary reason advanced by Dr. Hathaway was the difference in living standards in the towns as compared to the farm.

Dr. Calvin L. Beale (14) of the USDA stated that social motivations as well as economic ones are inducing migration.

Professor C. E. Bishop (15) made the point that rural poverty must be eliminated if the rate of migration is to be diminished and Dr. Albert Shapero (16) indicated that he believes that young people would continue to leave the rural areas, even though income differentials did not exist, in search of adventure and excitement.

The focus of the conference was on employment opportunities existing in agriculture as opposed to those outside. But, advances in technology and rising income

levels impinge just as much on where farm people choose to live as they do on how many people can be employed in agriculture. The question of farm-family residence was never mentioned during the conference.

THEORETICAL CONSIDERATIONS, DEVELOPMENT
OF VARIABLES AND PROCEDURE

Theoretical Framework

Farm households, regardless of residence location on or off the farm, are producers and consumers, and thus simultaneously make both production and consumption decisions. If a family is rational in its decisions, and if not constrained by income limitations and discrimination or other non-economic barriers, it can be assumed to choose that residence location which will maximize its satisfactions. Living on the farm will impose certain costs and produce certain benefits to various family members. So will living off the farm. Not only monetary benefits and costs must be considered, but also those which are non-monetary, intangible, and perhaps even unmeasurable as well. Social, political, as well as economic factors must be considered if relevant.

Maintenance of residence on or off the farm is a decision which embodies more than just "decision making" based on present costs. It involves also a subjective evaluation of future gains and losses in utility from the different residence alternatives.

Farming is relatively free of institutional

constraints on the number of hours a farm operator can work. Hence, the farm operator is "free" to allocate his time among the various production and consumption activities confronting him. It should be emphasized, however, that it is the farm household and not merely the farm operator that is the utility-maximizing entity.

The farm family is assumed to make decisions which will maximize utility. One such decision is whether or not to move off the farm. It seems desirable to incorporate a temporal dimension to the analysis. This is accomplished by assuming that utility (U) is an annual quantity. In other words, farm household decisions are made on the basis of expected utility, $E(U)$. Expected utility may vary from year to year since there is no a priori reason to assume it will be constant. The household can visualize a flow of $E(U$'s) over some relevant time horizon (s years) which may be discounted back to the present for decision-making purposes. The result is a "present value" of the flow of annual utilities, V , defined as:

$$V = \sum_{t=1}^s \frac{E(U_t)}{(1+r)^t}$$

where "r" is the rate of discount and "t" is a given year extending from 1 to s.

The household decision-maker can estimate a value for "V" for residence on the farm and another for

residence off the farm. Thus, residence location will be determined on the basis of the highest "V."

Empirical Procedure

Of primary concern in the statistical analysis was the identification and testing of any independent variables which a priori could have a significant influence on residence locations of farm families. Causal variables were selected which seemed to be theoretically related to the relative costs of either production or consumption decisions faced by the farm family, and which would be different if the family lived on rather than off the farm.

The main statistical tool used to provide this information was a multiple regression analysis. As earlier indicated the criteria used to determine the significance of the independent variables were simple partial correlation coefficients and partial regression coefficients both tested for statistical significance, standard partial regression coefficients ranked according to size, and the order in which the independent variables entered the regression model. In all cases, these techniques were utilized to determine the significance of various factors and to specify the degree of statistical confidence which could be attached to certain relationships found in the data.

Multiple Regression Analysis

Multiple regression analysis is a method of determining the effect of several independent variables upon a single dependent variable. Various statistical tools have been devised to help determine the absolute and relative importance of the various independent variables which a priori could have a significant influence on the dependent variable.

In order to test the hypothesis that several factors influence farm operators in Utah, Kansas, Iowa, California, and Texas to establish place of residence off the farm, a number of independent variables were included in the regression analysis. Each state analysis provided information about the importance of selected variables in explaining the inter-county variation in the percent of off-farm residence of farm families. The independent variables are discussed more thoroughly in the next section of this thesis. The general model used was:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 \\ + b_7X_7 + b_8X_8 + \delta$$

where:

Y = Percent of farm operators reporting off-farm residence (1964)

X₁ = Percent of farm operators in Group I type

farms (dairy, poultry, and livestock feeding)
(1964)

X_2 = Percent of farm operators with Gross Farm
Sales over \$10,000 (1964)

X_3 = Percent of farm operators operating "other"
farms (part-time, part-retirement, and abnormal)
(1964)

X_5 = Percent of farm operators working off the
farm 100 days or more (1964)

X_6 = County contains a community with a popula-
tion of 10,000 or more, or the county
boundaries are within 30 miles of such a town or
city (1964)

X_7 = Percent of farm operators with one or more
years of college (1964)

X_8 = Average income of all persons in farm
household from sources other than farm
operated (1964)

γ = A random error term

Selection and Development of Variables

An a priori selection of variables thought to be important in accounting for the inter-county variation in percent of farm operators living off the farm consists of the following: Type of farm, sales of farm, tenancy, whether farm is non-commercial, off-farm employment,

remoteness of farm, education of farm operator, average income of entire farm household from off-farm sources, religion, and race.

Percent of farm operators living on
the farm (1964), (Y)

In order to obtain a measure of the importance associated with the shift in residence patterns of farm families, it was necessary to find an indicator which would portray differences in residence patterns of farm operators. The indicator chosen was the dependent variable (Y), percent of farm operators reporting off-farm residence.

The dependent variable was calculated from data taken from the United States Census of Agriculture (17). Information on farm residence location was available in the agricultural census only since 1940 at 5-year intervals, therefore, no time series analysis was used, except for describing the trends. In aggregate, the number of farm operators is identical to the number of farms. This analysis explicitly excludes, therefore, those farm workers, such as hired and migratory, who are employed in agriculture, but who do not "operate" farms.

Percent of farm operators living off the farm was calculated for each county within the five states under study. Certain counties, however, were deleted and not included in the Utah, California, and Texas analyses.

In the Utah analysis, Daggett County was excluded from the analysis. The California analysis excluded Alpine, Mono, San Francisco, and Sierra Counties. In the Texas analysis, the following counties were excluded: Aransas, Crane, Culberson, Jeff Davis, Kenedy, King, Loving, Reagan, Sterling, Upton, Ward, and Winkler. These counties were excluded from each of the respective analyses because it was felt the number of farms in each of the respective counties was not sufficiently large for the data to be reliable.

The basic data used to calculate this independent variable were total number of farm operators reporting place of residence and total number of farm operators reporting residence off the farm. The total number of farm operators reporting residence off the farm was divided by the total number of farm operators reporting place of residence which gave the percent of farm operators living off the farm for each county.

Percent of farm operators in Group I
type farms (Dairy, poultry and livestock
feeding) (1964) (X_1)

Percent of farm operators engaged in Group I Type farms was selected as an independent variable because it seems logical to suppose that residence location of farm operators might be affected by the type of farm enterprise. For example, some utilize labor and management reasonably

constantly throughout the year, while others are strictly seasonal. If labor is not required at the farm, then the "costs" of being away from the farm would decline.

In an attempt to measure the effect of type of farm enterprise on off-farm residence patterns of farm operators, it was necessary to separate those farm enterprises which were thought to utilize labor and management fairly constantly during the year from those thought to utilize strictly seasonal allocations of labor and management. Group I type farms--dairy, poultry, and livestock feeding--were thought to require a more even or constant allocation of labor and management throughout the year than Group II type farms--wheat, cotton, fruit and nut, and vegetable.

The data used to develop this independent variable were taken from the United States Census of Agriculture. The basic data used were total number of farms and total number of farms which were classified as Group I type of farms. Total number of Group I type farms was divided by the total number of farms which gave the percent of farm operators engaged in Group I type farm enterprises.

The expected sign of the regression coefficient would be negative, indicating that counties which have a "high" percentage of farms of the first type (dairy, poultry, and livestock feeding) could be expected to have a "low" percentage of farm operators living off the farm.

Percent of farm operators with gross
farm sales over \$10,000 (1964) (X_2)

Gross farm sales was selected as an independent variable mainly as an indicator of size of the farm operation. Scale factors can be expected to impinge on residence patterns of farm families, both in terms of influencing income constraints on consumption and in affecting "costs" of living away from the farm. Large scale production could be expected to be associated with high gross incomes. Providing off-farm consumption is a strongly superior good with high income elasticity, the income effect would be in the direction of inducing off-farm residence, ceteris paribus, and the sign of the regression coefficient might be expected to be positive. On the other hand, if the scale of the farm is large, it might imply that the operator is a full-time farmer and the opportunity costs of living away from the farm would be high. In this case, the expected sign of the regression coefficient would be negative. There is no way of knowing in advance which influence would outweigh the other.

The Census of Agriculture gives the total number of farms in each county in various sales classes. The number of farms with sales over \$10,000 annually was put in one class and the number with sales under \$10,000 in another. This variable is simply the number of farms with sales over \$10,000 divided by the total.

Percent of farm operators who are
managers and tenants (1964) (X₃)

The 1964 Census of Agriculture classifies farm tenure into four classes: (1) full owners, (2) part owners, (3) managers, and (4) tenants.

The percent of farm operators who were managers and tenants was calculated by dividing the number of farm operators who were managers and tenants by the total number of farms.

If there is anything to the adage that "a man loves more that which he owns than that which he rents," it would be expected that managers and tenants might then live off the farm in greater proportion than those who own all or part of their farms. Owners and part owners might tend to live on the farm where they can look after their interests better than if they lived in town. Moreover, it would seem that the amount of utility or satisfaction an owner derives from living on his own farm might be greater than that derived by a manager or tenant who lives on someone else's farm. Not enough is known about this subject to formulate a definite hypothesis, although this variable is expected to show some statistical significance.

Percent of farm operators operating
"other" farms (part-time, part-retirement
and abnormal) (1964) (X₄)

The Agricultural Census classifies "other" farms

into three groups as follows: (1) part-time farms (those with a value of sales of farm products ranging from 50 to 2,499 dollars if the operator was under the age 65 and, he worked off the farm 100 days or more during 1964 and the off-farm income received by him and his family was greater than the value of farm products sold from the farm), (2) part-retirement farms (those with value of farm sales of 50 to 2,499 dollars but the farm operator was 65 years of age or older), and (3) abnormal farms (farms operated by hospitals, schools, penitentiaries, churches, grazing associations, and government agencies, regardless of the value of farm products sold). The total number of farm operators operating "other" farms was divided by the total number of farms to yield this variable.

We do not know a priori what the expected sign of the regression coefficient would be since the relationship between residence location and "other" farms might be expected to vary depending upon which type of "other" farm is being considered. It should be pointed out, however, that part-time farmers might be expected to live off the farm in greater proportion; whereas, part-retirement farmers might be expected to live on the farm in greater proportion. Abnormal farms, on the other hand, are so few in number and contribute so little to the total that for all intents and purposes they can be ignored in the analyses.

Percent of farm operators
working off the farm 100 days
or more (1964) (X₅)

As time passes, more and more farmers are working off the farm part-time. In 1949, 38.9 percent of all United States farmers worked off the farm, and 23.3 percent worked off the farm 100 days or more. In 1964, these figures had risen to 46.3 percent and 32.1 percent respectively. If this phenomenon is, in fact, exerting an impact on off-farm residence locations of farm operators, total resources available to the family should increase as non-farm income increases, although probably some of the increase in non-farm income will be offset by decreases in farm income as time is shifted from farm work to off-farm work. In addition, it is probable that more travel time will have to be expended in getting to and from the off-farm source of employment and thus will increase the "costs" of living on the farm. The implications on residence would seem to be clear on both counts. The expected sign of the regression coefficient would be positive. Ceteris paribus, the greater the percent of farm operators working off the farm 100 days or more, the greater the proportion of farm families residing off the farm and vice versa.

The Census of Agriculture lists the number of operators working off the farm 100 days or more. This

variable was calculated by dividing the number of farm operators reported working off the farm 100 days or more by the total number of farm operators.

County contains community with a population of 10,000 or more, or the county boundaries are within 30 miles of such a community (1964) (X₆)

A study by Berry and Garrison (11) in the Midwest shows that communities with populations greater than 25,000 tend to "reach out" to the hinterlands that surround them. Thus, they provide a wide range of public services and highly developed markets for farm products, farm inputs, and off-farm employment opportunities for family members. For these reasons, as nearby cities approach this size and become even larger, families may be able to live on the farm and still obtain some of the benefits of city life. Contrariwise, Berry believes that smaller cities and towns do not have these linkages to the hinterlands. Thus, "ceteris paribus," it may be that counties which have only small towns will have a "low" proportion of farm households living on the farm since to get any urban services at all it is necessary to move to town. The opposite would also hold true.

Variable X₆ was selected as an independent variable because it would seem reasonable that in the more remote agricultural areas of the country, such as the plains states and the mountain states, there aren't so many towns

of the size of 25,000 and larger. There are greater numbers of size 10,000 and it is assumed that in these sparsely populated areas a city size of 10,000 might serve the same functions as a city size of 25,000 in a more populous area.

Cities extend their influence to people in nearby counties just as they do to people in their own county. It was decided that if a county boundary was within 30 miles of a city 10,000 and above (or about one-half hour travel time) the county would be considered in the same group as if it actually did have such a city.

Moreover, given the size of the city and services, the "costs" of living on the farm are positively related to the remoteness of the farm and conditions which increase the difficulty of travel, such as "slow" and "winding" roads, bad weather conditions, and so on. Therefore, the expected sign of the regression coefficient would seem to be negative indicating that if the county contained a community with a population of 10,000 or more, or if the county boundaries are within 30 miles of such a town, the "costs" of living on the farm should be reasonably "low" and the percent of farm operators living off the farm should also be "low."

The basic data used to calculate this variable were taken from the Rand-McNally commercial road atlas. In developing this variable, those counties which had a

community with a population of 10,000 or more, or the county boundaries were within 30 miles of such a community, were given a dummy variable value of "1." If the county did not contain a community with a population of 10,000 or more, or the county boundaries were not within 30 miles of such a town or city, it was given a dummy variable value of "0."

Percent of farm operators with one
or more years of college (1964) (X_7)

Educational level of the farm operator was selected as an independent variable because it has been observed that farm people who leave the farm to attend college seemingly get exposed to urban living and take on many of the values and consumption habits of an urban population. Their tastes and preferences for urban commodities become quite strong. As a result, many seem to be unwilling to return to the farm since it means giving up the benefits and conveniences of urban life.

We know that a small percentage of youngsters actually return to the farm after graduation from college. Employment opportunities there are not very attractive compared to alternatives and many leave agriculture altogether. But even those who remain in agriculture must decide whether to return to the farm to live. Another factor is the relative costs of educating a family living on the farm as opposed to one living in town. Farm

parents who are highly educated might be expected to prefer the same type of education for their children. Once the children reach school age the question of educating the children becomes a very important consideration and certainly should have some influence on where the family is to live. If the farm lies within a reasonable commuting distance from a quality school, there may be little pressure to move since the children can easily commute to school from the farm. However, if a school of reasonably high standards is not available or within commuting distance, the farm family must come to grips with the question of where to live. If the "costs" of living on the farm and bussing the children are so great as to warrant a change in residence location for the sake of the children's educations, the farm operator might well decide to move off the farm and commute to the farm in order to do his farm work. In this way, the children as well as the rest of the family can enjoy the superior services that are usually available in the cities.

If the relationships just discussed do, in fact, hold true, the expected sign of the regression coefficient should be positive. This would indicate that those counties with a "high" percentage of farm operators with one or more years of college could be expected to have a "high" percentage of farm operators residing off the farm, ceteris paribus.

Agriculture census data were used to develop this variable. Total number of farm operators in each county with one or more years of college was divided by the total number of farms in the county which gave the percentage of farm operators with one or more years of college training.

Average Income of all persons in
farm household from sources other
than farm operated (1964) (X_3)

Family income has always been an important factor in consumption decisions of households. Average income of all persons in the farm household from sources other than the farm operated was selected as an independent variable because employment opportunities for members of the farm family are equally as important as the off-farm employment of the farm operator. A proxy variable for the extent of off-farm employment by members of the farm family would seem to be the income accruing to persons in the farm household from sources other than farming.

In recent years non-farm earnings of the farm population have run roughly 50 percent of farm earnings, or non-farm earnings have been roughly a third of their total earnings. Should this trend toward greater non-farm earnings continue, other things equal, the "costs" of being isolated out on the farm would seem to increase. Thus, the expected sign of the regression coefficient should be positive--a positive relationship between percent of farm

operators living off the farm and average farm family income from off-farm sources.

Average income of all persons in the farm household from sources other than farm operated was derived from data taken from the U.S. Census of Agriculture. Total income from sources other than farm operated was divided by the number of farm households in each county.

Percent of farm operators who
are Mormon (1964) (X_9)

Religious affiliation was hypothesized to be an important factor influencing residence patterns in Utah. Percent of farm operators who are members of the Church of Jesus Christ of Latter-Day Saints was selected as an independent variable because Mormon settlements in Utah were characterized by Mormon families establishing homes in town but working the farms outside. The reason was that their social, cultural, and even educational activities, as well as religious rites, were closely tied to the local church which usually was located in town.

The expected sign of the regression coefficient would be positive, i.e., there should be a positive relationship between the percent of farm operators who are Mormon and the percent of farm operators living off the farm.

Information for developing this variable was taken from the Directory of the General Authorities and Officers

of the Church of Jesus Christ of Latter-Day Saints (18). This variable was used only in the Utah analysis. The basic data used were total population in each county and the Mormon population within the county.

Although data concerning LDS population by county were not available in the Directory, it did give the name of stakes (a local organization consisting of 5-10 wards of 400-800 people each), stake population, and the location of the stake. From this information, it was possible to identify in which county the various stakes were located. Then, by adding up the population figures of each stake within the county, the Mormon population by county was obtained.

The Mormon population in each county was divided by the total population of that county to yield the percentage Mormon (19). It was assumed that the percentage of farm operators who were Mormon was the same as the percentage of the total population which was Mormon.

Percent of farm operators who
are nonwhite (1964) (X₁₀)

Farmers in minority groups such as American Indians and Negroes might well be an important determinant of off-farm residence patterns in Texas. Although there is some evidence that discrimination against these minority groups is mitigating in recent years, no doubt discriminatory treatment, especially in towns and cities, has prevented as

many farmers from moving off the farm as would have been the case had this discrimination not existed. Discrimination against minorities in towns and cities might be expected to increase the "costs" of living in town, thus discouraging minority groups from moving off the farm or establishing residence in town.

The expected sign of the regression coefficient would be negative. There should be a negative relationship between the percent of farm operators who are non-white and the percent of farm operators living off the farm, ceteris paribus.

Data used to develop this variable were taken from the Agricultural Census. The census divided people into two groups: white and non-white. The non-white group consisted of Indians and Negroes. Mexican-Americans were included as white as per the census. To obtain variable X_{10} , the non-white agricultural population was divided by the total agricultural population in each county.

ANALYSIS, RESULTS, AND DETERMINATION
OF SIGNIFICANT VARIABLES

This Chapter includes a discussion of the statistical results obtained from the multiple regression analysis for each of the five states.

California

There are 54 counties considered in this analysis. Table 4 shows that R^2 is .681 meaning that the entire model in California does quite well, and thus explains 68 percent of the inter-county variation in off-farm residence.

Determination of significant variables

Results for simple partial correlation coefficients, partial regression coefficients and their standard errors, standard partial regression coefficients ranked according to size, and the order in which the independent variables entered the regression equation are presented in Table 4.

Percent of farm operators in
Group I type farms (dairy, poultry
and livestock feeding) (X_1)

All of the four criteria used to determine significance indicate that this variable was of lesser importance

Table 4. Criteria for Determining Significant Independent Variables, California, 1964

Independent Variable	Simple Partial Correlation Coefficient	Multiple Regression Coefficient ¹	Standard Partial Regression Coefficient ²	Order in Which Variables Entered the Equation ³
X ₁ (Type of Farm)	-0.285686**	-0.119970** (0.071742)	-0.197312 (4)	5
X ₂ (Sales of Farm)	0.574596	0.064265 (0.172429)	0.134965 (7)	1
X ₃ (Tenancy)	-0.413246**	-0.302130** (0.077459)	-0.401398 (1)	3
X ₄ (Non-Commercial Farms)	-0.505516**	-0.032217 (0.214425)	-0.136272 (6)	7
X ₅ (Off-Farm Work)	-0.530632**	-0.193470 (0.196973)	-0.210773 (3)	6
X ₆ (Remoteness)	-0.171634	-0.763412 (2.591500)	-0.029569 (8)	8

Table 4. Continued

Independent Variable	Simple Partial Correlation Coefficient	Multiple Regression Coefficient ¹	Standard Partial Regression Coefficient ²	Order in Which Variables Entered the Equation ³
X ₇ (College Education)	0.430710**	0.168828** (0.093418)	0.182017 (5)	4
X ₈ (Average Off-Farm Income)	0.540563**	0.107792** (0.054711)	0.215907 (2)	2

The Coefficient of Determination (R^2) is .681.

* Denotes statistical significance of coefficient at .10 probability level.

** Denotes statistical significance of coefficient at .05 probability level.

1 The numbers in parentheses are standard errors of regression coefficients.

2 The number in parentheses is the rank of each coefficient according to magnitude.

3 The numbers indicate the order in which each variable entered the regression model.

in the analysis than some other variables. The simple partial correlation coefficient (-0.2857) was quite low, however, when subjected to a "t" test turned out to be significant at the $\alpha = .05$ level. The calculated "t" value for the partial regression coefficient was significant at the $\alpha = .05$ level. The standard partial regression coefficient ranked fourth in relation to the others, and the variable entered the regression equation fifth in order of importance.

The algebraic signs of the coefficients were negative as expected. This suggests that counties with a "high" percentage of farm operators involved in dairy, poultry, or livestock feeding operations could be expected to have a "low" percentage of farm operators living off the farm. Increases in Group I type farms should be associated with decreases in off-farm residence of farm families.

On the basis of these results, it was concluded that variable X_1 did have some causal effect on the dependent variable.

Percent of farm operators with gross
farm sales over \$10,000 (X_2)

The criteria used to determine the significance of this variable gave highly contradictory results. The computer output showed this variable entering the regression equation first in importance as well as having

the highest simple partial correlation coefficient (0.5746). In addition, a "t" test on the simple partial correlation coefficient showed that it was statistically significant at the $\alpha = .05$ level.

However, the partial regression coefficient and standard partial regression coefficient both appeared to suggest weak influence for this variable. The partial regression coefficient was not significant at the $\alpha = .05$ level. The rank of the standard partial regression coefficient was seventh in relation to the others.

In attempting to explain why these indicators were highly contradictory it was found that considerable inter-correlation existed between this variable and variables X_4 and X_5 . The upshot is that the regression coefficient for X_2 was highly significant at the $\alpha = .05$ level before the inclusion of variables X_4 and X_5 into the regression equation.

Prior to variable X_5 entering the regression equation, the values of the partial regression coefficient and calculated "t" value for variable X_2 were 0.2215566 and 5.43611 respectively. With the inclusion of variable X_5 , the value of the partial regression coefficient and calculated "t" value for variable X_2 dropped considerably to 0.117466 and 1.19568. With the inclusion of variable X_4 the value of the partial regression coefficient and calculated "t" value for variable X_2 dropped even lower to

0.073495 and 0.43782 respectively. Judging from these results, it was concluded that the partial regression coefficient did have much more significance than the computer output actually showed when all the variables were included and, therefore, the explanatory power of this variable was probably suppressed by the presence of multicollinearity in the complete model.

The algebraic signs of the coefficients were positive as expected. On the basis of the evidence it was concluded that gross farm sales had a significant effect on the dependent variable.

Percent of farm operators who are managers and tenants (X_3)

All four tests for significance indicate that percent of farm operators who are managers and tenants was of some importance in explaining inter-county variation in percent of off-farm residence. The simple partial correlation coefficient (0.4132) was fairly strong. A "t" test on the simple partial correlation coefficient and partial regression coefficient indicates that both coefficients are significantly different from zero at the $\alpha = .05$ level. The rank of the standard partial regression coefficient was highest, in relation to all others, and this variable was third in importance to enter the regression model.

The algebraic signs of the coefficients were

negative. This suggests that counties with a "high" percentage of farm operators who are managers and tenants have a "low" percentage of off-farm residence of farm operators.

From these results it was concluded that this variable was important in this analysis.

Percent of farm operators
operating "other" farms (part-time,
part-retirement and abnormal (X_4))

This is another case where the indicators are highly contradictory. The simple partial correlation coefficient (-0.5055) was significant at the $\alpha = .05$ level. However, the calculated "t" value of the partial regression coefficient was nonsignificant at both the $\alpha = .05$ and $\alpha = .10$ levels of significance. The standard partial regression coefficient ranked sixth, in relation to the others, and the variable was seventh in importance to enter the regression equation.

This apparent inconsistency among the indicators may be explained by the presence of intercorrelation between this variable and variables X_2 and X_5 . The effect of this intercorrelation was not easy to obtain since variable X_4 entered the regression equation in the stepwise model after variables X_2 and X_5 . It was therefore impossible to gauge the effects on the regression coefficient for X_4 by omitting variables X_2 and X_5 . Nevertheless, inspection of the simple correlation coefficients

revealed strong multi-collinearity. It was concluded, therefore, that the explanatory power of variable X_4 in the regression model might well have been suppressed.

The signs of the coefficients were negative. This suggests that if the earlier theoretical relationships were valid the effect of part-retirement farms on off-farm residence outweighed the effect of part-time farms. It suggests that counties with a "high" percentage of part-retirement farmers can be expected to have a "low" percentage of farm operators living off the farm.

Based on these results and keeping in mind the multi-collinearity that existed between this variable and variables X_2 and X_5 , it was concluded that this variable did have some explanatory importance in the analysis.

Percent of farm operators
working off the farm
100 days or more (X_5)

This variable also gave contradictory results. The simple partial correlation coefficient (-0.5306) was second highest. It was also significant at the $\alpha = .05$ level of significance. The calculated "t" value of the partial regression coefficient was not significant even at the $\alpha = .10$ level. The standard partial regression coefficient ranked third in importance, which is reasonably high. And the variable entered the regression equation sixth which is low.

The inconsistency between the simple partial

correlation coefficient and partial regression coefficient may be explained by the presence of intercorrelation between this variable and variables X_2 and X_4 . However, the existence of multicollinearity does not account for the negative signs of the coefficients. The problem here is that the algebraic signs of the coefficients are different than those expected a priori.

A simple explanation of this unexpected result is not easy to give since there appears to be no logical basis for this negative relationship. It could be, however, that California has some special characteristics not found in the other four states studied. California agriculture is very heterogeneous. The farms are much smaller on average and not quite as prosperous as those in Iowa and Kansas. Practically every county, with the exception of one or two, has one or more towns or cities with a population of 10,000 or more. In several counties, the population figures run up into the hundred thousands, and in some cases, into the millions. A very high percentage of all the farms in California are located either in or near to these counties which have large towns or cities.

These data, therefore, lead one to suspect that if the notion that a city with a population of 10,000 or more does, in fact, reach out like an umbrella into the surrounding hinterlands, thus providing the various urban public services and amenities to those people in the rural

areas, there would seem to be fewer reasons for the farm operator to establish place of residence off the farm, especially when considering the disadvantages of living in the cities, such as pollution, crime, etc.

Since the counties with large urban centers would provide much off-farm employment, the conclusion is that these same counties have both high off-farm employment and low off-farm residence. It is the essential "urbanness" that creates both phenomena.

Of the four criteria used to determine significance, only two ranked this variable as having important explanatory significance. Under these circumstances and taking into consideration the presence of multicollinearity between this variable and variables X_2 and X_4 , it was concluded that this variable yielded ambiguous results and only tentatively could explanatory significance be attributed to it.

County contains a community with population of 10,000 or more, or county boundaries are within 30 miles of such a town or city (X_6)

All four tests for significance indicate that this variable was of little importance in the analysis. The simple partial correlation coefficient (-0.1716) was very low and was not significant at the $\alpha = .10$ probability level. The calculated "t" value of the partial regression coefficient was not significant at the $\alpha = .10$ level. The

standard partial regression coefficient ranked eighth, or last, in importance, and this variable was the last variable to enter the regression equation.

The signs of the coefficients were negative as expected. This suggests that those counties with a town or city of population 10,000 or more, or with the county boundaries within 30 miles of such a town or city tend to have a "low" percentage of farm operators living off the farm. This is particularly important in this analysis because it helps support the rationale used in explaining the inconsistency of signs in variable X_5 .

Percent of farm operators
with one or more years of
college (X_7)

The simple partial correlation coefficient (0.4307) was significant at the $\alpha = .05$ level. The calculated "t" value of the partial regression coefficient ranked fifth, in relation to the others, and the variable was fourth in importance to enter the regression equation.

The signs of the coefficients were positive as expected. This suggests that counties with a "high" percentage of college-educated farmers tend to have a "high" percentage of farm operators living off the farm, and vice versa.

Based on these results, it was concluded that this variable was an important determinant in explaining off-farm residence.

Average income of all persons
in farm household from sources
other than farm operated (X_8)

All four criteria indicate that this variable was very important in this analysis. The simple partial correlation coefficient (0.5406) was statistically significant at the $\alpha = .05$ probability level. The partial regression coefficient was significant at the $\alpha = .05$ significance level. The standard partial regression coefficient was ranked number two which is very high, and the variable entered the regression equation second in importance.

The signs of the coefficients were positive as expected indicating that those counties which had "high" average off-farm income figures for farm families also had a "high" percentage of farm families living off their farm.

It was concluded from these results that this variable was an important determinant in explaining the inter-county variation in off-farm residence of farm operators.

Iowa

There are 99 counties considered in this analysis. Table 5 indicates that R^2 is only .341, meaning that the entire model does less well than in California.

Table 5. Criteria for Determining Significant Independent Variables, Iowa, 1964

Independent Variable	Simple Partial Correlation Coefficient	Multiple Regression Coefficient ¹	Standard Partial Regression Coefficient ²	Order in Which Variables Entered the Equation ³
X ₁ (Type of Farm)	-0.489283**	-0.057784** (0.012192)	-0.666072 (2)	1
X ₂ (Sales of Farm)	-0.155103*	-0.044692* (0.031475)	-0.457654 (3)	2
X ₃ (Tenancy)	-0.018055	-0.020918 (0.040856)	-0.139427 (6)	6
X ₄ (Non-Commercial Farms)	-0.230433**	-0.020008 (0.073849)	-0.088193 (7)	7
X ₅ (Off-Farm Work)	0.207632**	0.071362 (0.059380)	0.349715 (4)	3
X ₆ (Remoteness)	-0.026446	-0.254052	-0.739538 (1)	5

Table 5. Continued

Independent Variable	Simple Partial Correlation Coefficient	Multiple Regression Coefficient ¹	Standard Partial Regression Coefficient ²	Order in Which Variables Entered the Equation ³
X ₇ (College Education)	0.284922**	0.009182 (0.058109)	0.017372 (8)	8
X ₈ (Average Off-Farm	0.183087**	0.033437* (0.029117)	0.169924 (5)	4

The Coefficient of Determination (R^2) is .341.

* Denotes statistical significance of coefficient of .10 probability level.

** Denotes statistical significance of coefficient of .05 probability level.

¹ The numbers in parentheses are standard errors of regression coefficients.

² The number in parentheses is the rank of each coefficient according to magnitude.

³ The numbers indicate the order in which each variable entered the regression model.

Determination of significant variables

As was the case with California, each variable was analyzed separately and the results are reported in Table 5.

Percent of farm operators in group I type farms (dairy, poultry livestock feeding) (X_1)

All four tests for significance indicate that this variable was of important explanatory significance in this analysis. The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked second, in relation to the others, and this variable was the first in order of importance to enter the regression equation.

The computer output did show some intercorrelation between this variable and variable X_7 . However, this intercorrelation proved to be of little significance. Variable X_7 had little or no effect on variable X_1 when X_7 was left out of the stepwise regression.

The signs of the coefficients were negative as expected. This suggests that those counties with a "high" percentage of farm operators engaged in dairy, poultry, and livestock feeding operations tend to have a "low" percentage of farm families residing off the farm.

Percent of farm operators with
gross farm sales over \$10,000
(X_2)

All of the criteria used to determine significance indicate that this variable is of some explanatory importance in this analysis. The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .10$ probability level. The standard partial regression coefficient ranked third in relation to the others, and the variable was second in order of importance to enter the regression equation.

The computer output also showed that there was some intercorrelation between variable X_2 and variables X_3 , X_4 , and X_5 . This could mean either that the explanatory power of variable X_2 could be suppressed by the influence of the other variables or that what significance appears to exist properly belongs to the collinear variables.

A careful study of the computer output showed that the partial regression coefficient for variable X_2 was highly significant at the $\alpha = .05$ probability level before the inclusion of variables X_3 and X_4 . Variable X_5 , however, appeared to strengthen the significance of the partial regression coefficient for variable X_2 . Prior to variable X_5 entering the regression model, the value of the partial regression coefficient and calculated "t" value for variable X_2 was -0.0244755 and -2.88317 respectively. After the inclusion of variable X_5 , the value of the

partial regression coefficient and calculated "t" value rose to -0.0451448 and 03.17704. In both cases, however, the coefficient is significant at the .05 probability level.

The inclusion of variables X_3 and X_4 , however, had an opposite effect on the significance of the partial regression coefficient of variable X_2 . With the inclusion of variable X_3 , the value of the partial regression coefficient and calculated "t" value for variable X_2 dropped to -0.0408897 and -1.46296 respectively. As can be seen, the partial regression coefficient and calculated "t" value for variable X_2 dropped considerably with the inclusion of variable X_3 . Then with the inclusion of variable X_4 , the value of the partial regression coefficient and calculated "t" value dropped even lower to -0.0388897 and -1.42236. Based on these results, it was concluded that the indicators probably had more significance than the complete computer output actually showed and, therefore, the explanatory power of variable X_2 had been suppressed by the presence of multicollinearity.

The signs of the coefficients, however, were negative and contrary to the hypothesized sign. The agricultural situation in Iowa seems to provide a logical explanation for the negative sign. In Iowa, we find agriculture to be very homogeneous compared to most other states. The farms are relatively large and prosperous

with farm operators who engage in agriculture pretty much full time.

The agricultural census showed that in 1964 every county in the state of Iowa had better than 90 percent of all farm operators living on the farm. Roughly 60 to 70 percent of all farm operators in each county reported gross farm sales in excess of \$10,000. Therefore, it might well be that farmers with large gross farm sales are full-time operators and live on the farm in Iowa.

Percent of farm operators
who are managers and
tenants (X_3)

All four criteria used to determine significance indicate that this variable was not important in this analysis. The simple partial correlation coefficient and partial regression coefficient were both nonsignificant at the $\alpha = .10$ probability level. The standard partial regression coefficient ranked sixth, in relation to the others, and the variable was sixth in importance to enter the regression equation.

The signs of the coefficients were negative. This suggests that counties with a "high" percentage of farm operators who are managers and tenants had a tendency to have a "low" percentage of farm operators living off the farm.

There was also evidence of considerable multicollinearity between this variable and variables X_2 , X_4

and X_5 . An analysis of the computer output showed that the inclusion of variables X_2 and X_5 into the regression model had little effect on the partial regression coefficient of variable X_3 . And, since the effect of variable X_4 on the partial regression coefficient of variable X_3 was so small, it was decided to overlook the interaction among the variables.

Based on these results, it was concluded that variable X_3 was of little importance in explaining the variation in off-farm residence among counties in Iowa.

Percent of farm operators operating
"other" farms (part-time, part retirement
and abnormal (X_4))

This variable gave somewhat contradictory results making it necessary to check for multicollinearity. The simple partial correlation coefficient was significant at the $\alpha = .05$ significance level, however, the partial regression coefficient was not significant at the $\alpha = .10$ probability level. The standard partial regression coefficient ranked seventh, in relation to the others, and the variable entered the regression equation seventh, or second to last, in importance.

Variable X_4 was found to be intercorrelated with variables X_2 , X_3 , and X_5 . However, since variable X_4 did not enter the regression model until after variables X_2 , X_3 , and X_5 , it was almost impossible to accurately assess the effects of this multicollinearity between the

variables. Nonetheless, it was assumed that the inter-correlation among the variables did have some effect on the significance of the partial regression coefficient, and, therefore, the explanatory power of this variable might have been suppressed.

The signs of the coefficients were negative which is of some interest. This negative sign suggests that the effect of part-retirement farmers outweighs the effect of part-time farmers. Therefore, in Iowa those counties with a "high" percentage of part-retirement farmers had a tendency to have a "low" percentage of off-farm residence.

On the basis of these results, it was concluded that variable X_4 did have some influence on off-farm residency in Iowa even though it was probably quite weak.

Percent of farm operators
working off the farm 100 days
or more (X_5)

All tests for significance, except the partial regression coefficient, indicate that this variable had some influence on the dependent variable in this analysis. The simple partial correlation coefficient was significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked fourth, in relation to the others, and the variable entered the regression model third in importance.

The partial regression coefficient was the only indicator that gave contradictory results. This

inconsistency, however, can be explained by looking at the multicollinearity between variable X_5 and X_2 , X_3 , X_4 , and X_8 . The partial regression coefficient for variable X_5 was highly significant at the $\alpha = .05$ probability level before the inclusion of variables X_3 , X_4 , and X_8 . Variable X_2 entered the regression model before variable X_5 making it difficult to determine the effect of X_2 on variable X_5 . However, since variable X_5 had no effect on variable X_2 it was assumed that the effect of the two variables was reciprocal.

Prior to variable X_3 entering the regression model, the value of the partial regression coefficient and calculated "t" value for variable X_5 was 0.0813739 and 1.86283 respectively. With the inclusion of variable X_3 into the regression model, the value of the partial regression coefficient and calculated "t" value for variable X_5 rose to 0.08219305 and 1.87275. The partial regression coefficient for variable X_5 was still significant at the $\alpha = .05$ level at this stage. The next variable to enter the regression model was X_4 . With the inclusion of variable X_4 , the partial regression coefficient and calculated "t" value for variable X_5 dropped to 0.07195369 and 1.22071. And, with the inclusion of variable X_8 , the partial regression coefficient and calculated "t" value for variable X_5 dropped even lower to 0.0713629 and 1.20179. Based on these results, it was concluded that

the partial regression coefficient for variable X_5 did have more significance than was actually shown in the complete computer output. Therefore, the explanatory power of variable X_5 had been suppressed.

The signs of the coefficients were positive as expected. This suggests that those counties with a "high" percentage of farm operators working off the farm 100 days or more tend to have a "high" percentage of farm operators living off the farm.

Taking all of these results into consideration, it was concluded that variable X_5 did have a significant impact on off-farm residence and was therefore an important determinant in the analysis.

County contains a community with a population of 10,000 or more or county boundaries are within 30 miles of such a city or town (X_6)

Variable X_6 was rated non-significant by all indicators except for the standard partial regression coefficient. The simple partial correlation coefficient and the partial regression coefficient were both non-significant at the $\alpha = .10$ probability level. The standard partial regression coefficient ranked first, in relation to the others, and the variable entered the regression model fifth in importance.

The signs of the coefficients were negative as expected. This suggests that counties which have a town or

city with population of 10,000 or more, or whose county boundaries are within 30 miles of such a town or city tend, although weakly, to have a "low" percentage of farm operators living off the farm.

Since there was no multicollinearity present among the independent variables, it was concluded that this variable was not of statistical significance in the analysis.

Percent of farm operators
with one or more years
of college (X_7)

This variable also gave conflicting results particularly with respect to the partial correlation coefficient. The simple partial correlation coefficient was significant at the $\alpha = .05$ probability level. The partial regression coefficient was not significant even at the $\alpha = .10$ probability level. The standard partial regression coefficient ranked last, in relation to the others, and the variable entered the regression model last in order of importance.

The computer output showed that there was some intercorrelation between this variable and variable X_1 . An analysis of this interaction showed that the significance of the partial regression coefficient for variable X_7 had been understated. It was, therefore, concluded that the explanatory power of this variable had been suppressed.

The signs of the coefficients were positive as expected. This suggests that those counties with a "high" percentage of college-educated farmers tend to have a "high" percentage of farm families residing off the farm.

Based on these results, it was concluded that variable X_7 did have some importance in this analysis, although the results are admittedly ambiguous.

Average income of all persons in farm household from sources other than farm operated (X_8)

All four indicators show that this variable does have some importance in this analysis. The simple partial correlation coefficient is significant at the $\alpha = .05$ probability level. The partial regression coefficient was significant at the $\alpha = .10$ probability level. The standard partial regression coefficient was ranked fifth, in relation to the others, and the variable entered the regression model fourth in order of importance.

The computer output showed some intercorrelation between this variable and variable X_5 . However, the partial regression coefficient and calculated "t" value for variable X_8 were largely unaffected.

The signs of the coefficients were positive as expected. This suggests that counties with a "high" percentage of farm families with high average off-farm incomes tend to have a "high" percentage of farm families living off the farm.

On the basis of these results, it was concluded that average off-farm family income was a significant variable and that it did help explain part of the inter-county variation in the percent of farm operators living off the farm.

Kansas

There were 105 counties in the Kansas analysis. Table 6 indicates that the complete list of variables explains about 61 percent of the inter-county variation in off-farm residence in Kansas.

Determination of Significant Variables

The same procedures are followed as previously employed with California and Iowa.

Percent of farm operators in group I type farms (Dairy, poultry, and livestock feeding) (X_1)

Only one test for significance indicated that this variable was important. The simple partial correlation coefficient was significant at the $\alpha = .05$ probability level. The other indicators indicated that variable X_1 was not a significant variable. The partial regression coefficient for this variable was non-significant even at the $\alpha = .10$ significance level. The standard partial regression coefficient ranked eighth, or last, in relation to the others, and variable X_1 was seventh in order of

Table 6. Criteria for Determining Significant Independent Variables, Kansas, 1964

Independent Variable	Simple Partial Correlation Coefficient	Multiple Regression Coefficient ¹	Standard Partial Regression Coefficient ²	Order in Which Variables Entered the Equation ³
X ₁ (Type of Farm)	-0.354763**	-0.036787 (0.058555)	-0.047855 (8)	7
X ₂ (Sales of Farm)	0.645561**	0.361714** (0.061749)	0.055146 (6)	1
X ₃ (Tenancy)	-0.563688**	-0.214781** (0.124361)	-0.146555 (3)	2
X ₄ (Non-Commercial Farms)	-0.585456**	-0.413160** (0.159223)	-0.423001 (1)	4
X ₅ (Off-Farm Work)	0.448877**	0.056513 (0.183331)	0.049405 (7)	8
X ₆ (Remoteness)	-0.332868**	-2.813102** (1.568973)	-0.135701 (5)	5

Table 6. Continued

Independent Variable	Simple Partial Correlation Coefficient	Multiple Regression Coefficient ¹	Standard Partial Regression Coefficient ²	Order in Which Variables Entered the Equation ³
X ₇ (College Education)	0.423983**	0.270347** (0.145563)	0.144363 (4)	6
X ₃ (Average Off-Farm Income)	0.397340**	0.294973** (0.064403)	0.349190 (2)	3

The Coefficient of Determination (R^2) is .614.

* Denotes statistical significance of coefficient at .10 probability level.

** Denotes statistical significance of coefficient at .05 probability level.

¹ The numbers in parentheses are standard errors of regression coefficients.

² The number in parentheses is the rank of each coefficient according to magnitude.

³ The numbers indicate the order in which each variable entered the regression model.

importance to enter the regression model.

Once again the data must be checked for multicollinearity. A careful study of the computer results showed that there was some intercorrelation between variable X_1 and X_8 . However, since variable X_8 entered the regression model before X_1 , it was not possible to see what happened to the partial regression coefficient of variable X_1 as variable X_8 entered the regression equation. Nonetheless, it was clear from the computer results that variable X_1 did have a slight effect on the partial regression coefficient of variable X_8 . It was concluded from these results that the significance of the partial regression coefficient for variable X_1 might have been affected by the inclusion of variable X_8 and, therefore, the explanatory power of variable X_1 could have been slightly suppressed.

The signs of the coefficients were negative as expected. This suggests that those counties with a "high" percentage of farm operators operating dairy, poultry, and livestock feeding enterprises tend to have a "lower" but still statistically significant percentage of farm operators residing off the farm.

Percent of farm operators with
gross farm sale over
\$10,000 (X_2)

Three of the four criteria used to determine significance indicate that variable X_2 was an important

factor in this analysis. The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .05$ probability level. This variable was first in importance to enter the regression model. And the standard partial regression coefficient ranked sixth, in relation to the others.

The signs of the coefficients were positive as expected. This suggests that in Kansas those counties with a "high" percentage of farm operators with gross farm sales over \$10,000 tend to have a "high" percentage of farm families residing off the farm.

From these results, it was concluded that variable X_2 was, in fact, a very important determinant of off-farm residence of farm families.

Percent of farm operators
who are managers and
tenants (X_3)

All four tests for significance indicate that this variable was an important determinant in this analysis. The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked fourth, in relation to the others, and this variable was second in order of importance to enter the regression model.

The signs of the coefficients were negative indicating that those counties with a "high" percentage

of farm operators who are managers and tenants tend to have a "low" percentage of farm families living off the farm.

Based on these findings, it was concluded that variable X_3 was a very important variable in this analysis and that it had a great influence on the trend toward increasing off-farm residence of farm families.

Percent of farm operators operating "other" farms (part-time, part retirement and abnormal) (X_4)

All four criteria used to determine significance indicate that variable X_4 is very important in this analysis. The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked first, in relation to the others, and variable X_4 was fourth in order of importance to enter the regression model.

The signs of the coefficients were negative. These signs suggest that in Kansas the effect of part-retirement farmers on off-farm residence outweighs the effect of part-time farmers. This negative sign means that those counties with a "high" percentage of part-retirement farmers tend to have a "low" percentage of farm families living off the farm.

On the basis of these results, it was concluded that variable X_4 had a significant influence on the

dependent variable.

Percent of farm operators working
off the farm 100 days or more
(X_5)

This variable gave contradictory results. The simple partial correlation coefficient was significant at the $\alpha = .05$ probability level. However, the other indicators did not confirm these results. The partial regression coefficient was non-significant at even the $\alpha = .10$ probability level. The standard partial regression coefficient ranked seventh, in relation to the others, and this variable entered the regression equation last.

The computer output was examined for multicollinearity among the independent variables. There was some intercorrelation between this variable and variables X_2 , X_3 , and X_6 . The inclusion of these three variables, X_2 , X_3 , and X_6 , had a definite effect on the significance of the partial regression coefficient for variable X_5 . It was concluded on the basis of these findings that the partial regression coefficient for variable X_5 had been understated in the complete model.

The signs of the coefficients were positive as expected. This suggests that those counties which have a "high" percentage of farm operators working off the farm 100 days or more tend to have a "high" percentage of farm families residing off the farm.

It was concluded from these results that this variable was of some importance in this analysis, although its significance was a bit questionable.

County contains a community with a population of 10,000 or more or county boundaries are within 30 miles of such a town or city (X_6)

All criteria used to determine significance indicate that variable X_6 was of some explanatory importance. The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked fifth, in relation to the others, and this variable was fifth in order of importance to enter the regression model.

The signs of the coefficients were negative as expected. This suggests that those counties which have a community with population of 10,000 or more, or whose county boundaries are within 30 miles of such a town or city tend to have a "low" percentage of farm operators living off the farm.

Since at least two of the criteria pointed to the fact that this variable was significant, and the other two were not importantly contradictory, it was concluded that variable X_6 was an important determinant in explaining inter-county variation in the percent of off-farm residence of farm operators in Kansas.

Percent of farm operators with
one or more years of college
(X_7)

All of the indicators showed that this variable was an important factor in this analysis, although entry into the model came toward the end. The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked fourth, in relation to the others, and this variable was sixth in order of importance to enter the regression model.

The signs of the coefficients were positive as expected. This suggests that those counties with a "high" percentage of college-educated farm operators tend to have a "high" percentage of farm families living off the farm.

From these results, it was concluded that variable X_7 did have an important effect on the dependent variable.

Average income of all persons
in farm household from sources
other than farm operated (X_8)

All four tests for significance indicate that this variable was very important in this analysis. The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked second, in relation to the others, and the variable entered the regression model third in order of importance.

The signs of the coefficients were positive as expected indicating that those counties with "high" average off-farm family income figures tend to have a "high" percentage of farm families residing off the farm.

Based on these results, it was concluded that variable X_8 had a strong influence on off-farm residence of farm families.

Texas (West)

Texas is a large state with a heterogenous agriculture. The regression model with nine independent variables (the conventional eight plus race) was tried for the entire state. The results were disappointing. The reason was not hard to find. Texas is divided into two sections. The East is part of the old cotton belt, built around plantation agriculture. The West is a livestock economy, with ranching and livestock feeding predominating. The decision was made to divide the state into these two sections and run the regression analysis for each. The fit of the analysis turned out to be much better.

There were 72 counties analyzed in the West. R^2 was .314, a bit disappointing but better than for the state as a whole.

Determination of Significant Variables

The same procedures are followed as previously

employed with California, Iowa, and Kansas. The results are presented in Table 7.

Percent of farm operators in group
I type farms (Dairy, poultry and
livestock feeding) (X_1)

Table 7 reveals that all tests for significance indicate that this variable was an important factor in this analysis. The simple partial correlation coefficient was significant at the $\alpha = .10$ probability level. The partial regression coefficient was significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked fourth, in relation to the others, and this variable was fourth in order of importance to enter the regression model.

The signs of the coefficients were negative as expected. This suggests that those counties with a "high" percentage of farm operators operating dairy, poultry, and livestock feeding enterprises tend to have a "low" percentage of farm operators living off the farm.

Based on these results, it was concluded that variable X_1 was an important determinant in explaining inter-county variation in the percent of farm operators living off the farm.

Percent of farm operators with
gross farm sales over \$10,000
(X_2)

Three of the four tests for significance indicate

Table 7. Criteria for Determining Significant Independent Variables, West Texas, 1964

Independent Variable	Simple Partial Correlation Coefficient	Multiple Regression Coefficient ¹	Standard Partial Regression Coefficient ²	Order in Which Variables Entered the Equation ³
X ₁ (Type of Farm)	-0.124184*	-0.132789** (0.066079)	-0.305229 (4)	4
X ₂ (Sales of Farm)	0.169778*	0.110681 (0.133829)	0.204936 (6)	7
X ₃ (Tenancy)	-0.047927	-0.008376 (0.126997)	-0.057717 (9)	9
X ₄ (Non-Commercial Farms)	0.007457	0.193525 (0.290983)	0.196014 (1)	5
X ₅ (Off-Farm Work)	0.007457	0.193525 (0.294372)	0.196014 (7)	8
X ₆ (Remoteness)	0.205875**	-4.474089 (4.231314)	-0.129385 (3)	6

Table 7. Continued

Independent Variable	Simple Partial Correlation Coefficient	Multiple Regression Coefficient ¹	Standard Partial Regression Coefficient ²	Order in Which Variables Entered the Equation ³
X ₇ (College Education)	0.347559**	0.362112** (0.174900)	0.358203 (3)	3
X ₈ (Average Off-Farm Income)	0.363646**	0.095609* (0.057564)	0.215424 (5)	1
X ₉ (Non-White Population)	-0.329720**	-6.828615** (2.151675)	-0.390155 (2)	2

The Coefficient of Determination (R^2) is .314.

* Denotes statistical significance of coefficient at .10 probability level.

** Denotes statistical significance of coefficient at .05 probability level.

¹ The numbers in parentheses are standard errors of regression coefficients.

² The number in parentheses is the rank of each coefficient according to magnitude.

³ The numbers indicate the order in which each variable entered the regression model.

that this variable was not important in this analysis. The simple partial correlation coefficient was the exception. The simple partial correlation coefficient was significant at the $\alpha = .10$ probability level. The partial regression coefficient was non-significant even at both the $\alpha = .10$. The standard partial regression coefficient ranked sixth, in relation to the others, and this variable was seventh, or second to last, in order of importance to enter the regression model.

The signs of the coefficients were positive as expected. This suggests that the weak relationship was at least in the expected direction. Those counties with a "high" percentage of farms with gross farm sales over \$10,000 tend to a "higher" percentage of farm families residing off the farm.

The computer output showed that there was some intercorrelation between this variable and variables X_4 and X_5 . The inclusion of variables X_4 and X_5 might have had some effect on the significance of the partial regression coefficient for variable X_2 . Therefore, it was concluded that the partial regression coefficient for variable X_2 might have had more influence than revealed in the analysis and that the explanatory power of variable X_2 could have been suppressed.

On the basis of these results, this variable was considered to have some importance, although probably quite weak.

Percent of farm operators who
are managers and tenants
(X_3)

This variable was rated non-significant by all four indicators. Considering that there was no intercorrelation among the independent variables, it was concluded that variable X_3 was not an important variable in this analysis and that it did not help explain inter-county variation in the percent of farm operators residing off the farm.

Percent of farm operators
operating "other" farms (part-time,
part retirement and abnormal) (X_4)

All, but one, of the criteria used to determine significance indicate that this variable was of some importance in this analysis. The simple partial correlation coefficient was the only indicator that did not confirm the results of the other indicators. The simple partial correlation coefficient was non-significant even at the $\alpha = .10$ probability level. On the other hand, the partial regression coefficient was significant at the $\alpha = .05$ level. The standard partial regression coefficient ranked first, in relation to the others, and this variable was fifth in order of importance to enter the regression model.

This inconsistency between the indicators may be explained by multicollinearity among the independent

variables. The computer output showed that there was considerable intercorrelation between this variable and variables X_2 and X_5 . An analysis of this interaction between these variables indicated that the partial regression coefficient for X_4 was affected by the inclusion of variables X_2 and X_5 .

Prior to variable X_2 entering the regression model, the partial regression coefficient and calculated "t" value for variable X_4 was -0.1828224 and -1.74225 respectively. With the inclusion of variable X_2 , the partial regression coefficient and calculated "t" value for variable X_4 rose to -0.3454449 and -1.74824 . Then, with the inclusion of variable X_5 , the partial regression coefficient rose to -0.4853384 while the calculated "t" value dropped to -1.66789 . As can be seen, the partial regression coefficient was affected by the inclusion of variables X_2 and X_5 , but the level of "t" was not significantly changed. The regression coefficient was significant at the .05 level in all cases. Thus, the significance of the regression coefficient can hardly be attributable to multicollinearity.

The signs of the coefficients were negative which indicates that the effect of part-retirement farmers on off-farm residence outweighs the effect of part-time farmers.

On the basis of these results, it was concluded

that variable X_4 was of questionable importance in explaining off-farm residence of farm operators.

Percent of farm operators working
off the farm 100 days or more
(X_5)

All of the criteria used to determine significance indicate that this variable is not important in this analysis. The simple partial correlation coefficient and partial regression coefficient were both non-significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked seventh, in relation to the others, and this variable was eighth, or second to last, in order of importance to enter the regression model. The signs of the coefficients were positive as expected, but they were not significant.

County contains a community
with population of 10,000 or
county boundaries are within
30 miles of such a town
or city (X_6)

The simple partial correlation coefficient was the only indicator to point out that variable X_6 had some importance. The simple partial correlation coefficient was significant at the $\alpha = .05$ probability level. The other indicators did not confirm the results of the partial correlation coefficient. The partial regression coefficient was non-significant even at the $\alpha = .10$ level. The standard partial regression coefficient ranked eighth, in

relation to the others, and this variable was sixth in order of importance to enter the regression model.

Before deciding whether or not this variable was significant, the computer output was checked for the possible existence of multicollinearity between this variable and one or more of the other variables. There was some intercorrelation between this variable and variable X_2 . An analysis of this interaction revealed that the partial regression coefficient for variable X_6 was significant at the $\alpha = .10$ probability level before variable X_2 entered the regression model.

Prior to variable X_2 entering the regression model, the partial regression coefficient and calculated "t" value for variable X_6 was -5.383882 and -1.30346 respectively. With the inclusion of variable X_2 , the partial regression coefficient and calculated "t" value for variable X_6 dropped to -4.906051 and -1.17894. It was, therefore, concluded that the significance of the partial regression coefficient for variable X_6 had been understated and that the explanatory power of variable X_6 had been suppressed due to multicollinearity.

The signs of the coefficients were negative as expected. This suggests that those counties in West Texas with a community of population of 10,000 or more, or whose county boundaries are within 30 miles of such a town or city could be expected to have a "low" percentage of farm

operators living off the farm.

On the basis of these results, it was concluded that variable X_6 was of some importance in this analysis.

Percent of farm operators with
one or more years of college
(X_7)

All of the criteria used to determine significance indicate that this variable was an important factor in this analysis. The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked third, in relation to the others, and variable X_7 was third in order of importance to enter the regression model.

The signs of the coefficients were positive as expected. This suggests that those counties with a "high" percentage of college-educated farm operators could be expected to have a "high" percentage of farm operators residing off the farm.

From these results, it was concluded that variable X_7 was of significant importance in explaining inter-county variation in the percent of farm operators living off the farm.

Average income of all persons in
the farm household from sources
other than farm operated (X_8)

This variable also was considered to be an import-

ant determinant. The simple partial correlation coefficient was significant at the $\alpha = .05$ probability level. The partial regression coefficient was significant at the $\alpha = .10$ probability level. The standard partial regression ranked fifth, in relation to the others, and the variable was first in order of importance to enter the regression model.

The signs of the coefficients were positive as expected. This suggests that those counties with a "high" percentage of farms with high average farm family incomes from off-farm sources tended to have a "high" percentage of off-farm residence of farm families.

Since all four criteria indicated that variable X_8 was an important factor in the analysis, it was concluded that variable X_8 played an important part in explaining inter-county variation in off-farm residence.

Percent of farm operators who
are non-white (X_9)

Percent of non-white farm operators was rated by all four indicators to be of significant importance in this analysis. The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked second, in relation to the others, and this variable was second in order of importance to enter the regression model.

The signs of the coefficients were negative as expected. This sign of the coefficients is very interesting besides being very important. It suggests that as the percentage of non-white farm operators rises, the tendency to live off the farm falls. This means that the non-white farmers are living on the farm. It could be because of low incomes. It could be tradition, and it could be because of discrimination in the cities.

Texas (East)

There were 170 counties analyzed in the East. R^2 was .562, a bit better than for West Texas and also better than the state taken as a whole.

Determination of Significant Variables

The same procedures are followed as previously employed with California, Iowa, Kansas and West Texas. The results are presented in Table 8.

Percent of farm operators in group
I type farms (dairy, poultry and
livestock feeding) (X_1)

Three out of four indicators showed that this variable was of some importance in this analysis. The simple partial correlation coefficient was the only criterion which did not confirm the results of the other indicators. The simple partial correlation coefficient was non-significant at the $\alpha = .10$ probability level.

Table 8. Criteria for Determining Significant Independent Variables, East Texas, 1964

Independent Variable	Simple Partial Correlation Coefficient	Multiple Regression Coefficient ¹	Standard Partial Regression Coefficient ²	Order in Which Variables Entered the Equation ³
X ₁ (Type of Farm)	-0.032215	-0.120409** (0.042454)	-0.206888 (4)	5
X ₂ (Sales of Farm)	0.486303**	0.220545** (0.057253)	0.574812 (3)	4
X ₃ (Tenancy)	-0.237651**	-0.041551 (0.059294)	-0.045690 (8)	8
X ₄ (Non-Commercial Farms)	-0.647788**	-0.752656** (0.089000)	-1.834068 (1)	1
X ₅ (Off-Farm Work)	0.522955**	0.479024** (0.118443)	0.768162 (2)	2
X ₆ (Remoteness)	-0.228427**	-1.533157 (1.341534)	-0.062315 (7)	7

Table 3. Continued

Independent Variable	Simple Partial Correlation Coefficient	Multiple Regression Coefficient ¹	Standard Partial Regression Coefficient ²	Order in Which Variables Entered the Equation ³
X ₇ (College Education)	0.416702**	0.199006** (0.094676)	0.156364 (6)	6
X ₃ (Average Off-Farm Income)	0.253622**	0.019961 (0.035725)	0.041891 (9)	9
X ₉ (Non-White Population)	-0.171030**	-0.129642** (0.043735)	-0.181630 (5)	3

The Coefficient of Determination (R^2) is .562.

* Denotes statistical significance of coefficient at .10 probability level.

** Denotes statistical significance of coefficient at .05 probability level.

¹ The numbers in parentheses are standard errors of regression coefficients.

² The number in parentheses is the rank of each coefficient according to magnitude.

³ The numbers indicate the order in which each variable entered the regression model.

The partial regression coefficient was significant at the $\alpha = .05$ significance level. The standard partial regression coefficient ranked fourth, in relation to the others, and the variable was fifth in order of importance to enter the regression model.

The inconsistency between correlation and regression coefficients may be explained by the presence of multi-collinearity among the independent variables. In checking the computer output for intercorrelation among the variables, considerable interaction was found between variable X_1 and variable X_3 . An analysis of this interaction showed that the inclusion of variable X_3 into the regression model had a serious effect on the significance of the partial regression coefficient for variable X_1 . This interaction could have unduly increased the apparent significance of the regression coefficient for variable X_1 . Therefore, the real explanatory power of variable X_1 might well be quite small.

The signs of the coefficients were negative as expected. This suggests that to some extent those counties in East Texas which have a "high" percentage of farm operators engaged in dairy, poultry, and livestock feeding operations could be expected to have a "low" percentage of farm operators residing off the farm. But, based on the evidence of the model, it was concluded that variable X_1 had only weak significance in the analysis.

Percent of farm operators with
gross farm sales over
\$10,000 (X_2)

All four criteria used to determine significance indicate that this variable was an important factor in the analysis. The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked third, in relation to the others, and the variable was fourth in order of importance to enter the regression model.

The signs of the coefficients were positive as expected. This indicates that those counties in East Texas with a "high" percentage of farm operators with gross farm sales over \$10,000 tend to have a "high" percentage of farm families residing off the farm.

It was concluded from these results that variable X_2 was an important determinant of off-farm residence patterns in East Texas.

Percent of farm operators
who are managers and
tenants (X_3)

Three of the four criteria used to determine significance indicate that variable X_3 is not significant in this analysis. The only indicator that did not confirm these results was the simple partial correlation coefficient which was significant at the $\alpha = .05$ probability

level. The partial regression coefficient was non-significant even at the $\alpha = .10$ probability level. The standard partial regression coefficient ranked eighth, in relation to the others, and this variable was eighth in order of importance to enter the regression model.

There was some interaction between this variable and variables X_1 and X_2 . An analysis of this interaction, however, revealed that the inclusion of variables X_1 and X_2 did not have any important effect on the significance of the partial regression coefficient for variable X_3 . Therefore, it was concluded that the significance of the partial regression coefficient for variable X_3 could not have been seriously understated and as a result the explanatory power of this variable X_3 could not have been suppressed due to this multi-collinearity.

Percent of farm operators operating
"other" farms (part-time, part
retirement and abnormal) (X_4)

All of the criteria used to determine significance indicate that this variable was of highest importance in this analysis. The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked first, in relation to the others, and the variable was first in order of importance to enter the regression model.

The signs of the coefficients were negative. This

suggests that the effect of part-retirement farmers on off-farm residence outweighs the effect of part-time farmers. The negative sign is interesting because it means that those counties with a "high" percentage of part-retirement farmers could be expected to have a "low" percentage of farm families living off the farm.

Percent of farm operators
working off the farm 100
days or more (X_5)

This variable was also highly important in this analysis by all four criteria. The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked second, in relation to the others, and this variable was second in order of importance to enter the regression model.

The signs of the coefficients were positive as expected. This suggests that those counties with a "high" percentage of farm operators working off the farm 100 days or more could be expected to have a "high" percentage of farm families living off the farm.

From these results, it was concluded that variable X_5 was the second most important factor in this analysis and that it had a significant impact on off-farm residence patterns in Eastern Texas.

County contains a community with a population of 10,000 or more, or county boundaries are within 30 miles of such a town or city (X_6)

The simple partial correlation coefficient was the only indicator to point out that variable X_6 was of some importance. The other indicators, however, did not confirm these results. The simple partial correlation coefficient was significant at the $\alpha = .05$ probability level. The partial regression coefficient was non-significant at even the $\alpha = .10$ probability level. The standard partial regression coefficient ranked seventh, in relation to the others, and this variable was seventh in order of importance to enter the regression model.

Even though the regression coefficient for X_6 was not significant the signs of the coefficients were negative as expected. Since there was no significant interaction between this variable and any of the others, it was concluded from the results that this variable was not an important determinant in the analysis.

Percent of farm operators with one or more years of college (X_7)

The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .05$ probability level. The other indicators, however, do not strongly confirm these results. The

standard partial regression coefficient ranked sixth, in relation to the others, and the variable was sixth in order of importance to enter the regression model.

The signs of the coefficients were positive as expected. This suggests that those counties with a "high" percentage of college-educated farmers tend to have a "high" percentage of farm operators residing off the farm.

Since there was not much multi-collinearity present among the independent variables, it was decided that the significance of the first two indicators more than offset the other two. On the basis of these results, it was concluded that this variable was of some importance in the analysis.

Average income of all persons
in the farm household from sources
other than farm operated (X_8)

The simple partial correlation coefficient was the only indicator that showed variable X_8 to be of some importance in this analysis. The other indicators, however, did not confirm these results. The simple partial correlation coefficient was significant at the $\alpha = .05$ probability level. The partial regression coefficient was non-significant at the $\alpha = .10$ probability level. The standard partial regression coefficient ranked ninth, or last, in relation to the others, and this variable was ninth, or last, in order of importance to enter the regression model.

The computer output showed that there was some intercorrelation between this variable and variable X_7 . An analysis of this interaction showed that the inclusion of variable X_7 into the regression model appeared to have a significant effect on the partial regression coefficient for variable X_3 . It was, therefore, concluded that the significance of the partial regression coefficient for variable X_3 may have been understated and as a result the explanatory power of this variable might have been suppressed due to this multi-collinearity.

The signs of the coefficients were positive as expected. This indicates that those counties which have a "high" percentage of farm families with high average off-farm family incomes tend to have a "high" percentage of farm families living off the farm.

Based on these results and keeping in mind the multi-collinearity, it was concluded that variable X_3 might well have had some importance, although in all probability quite weak.

Percent of farm operators who
are non-white (X_9)

All four of the criteria used to determine significance indicate that this variable was very important in this analysis. The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .05$ probability level. The standard partial

regression coefficient ranked fifth, in relation to the others, and this variable was third in order of importance to enter the regression model.

The signs of the coefficients were negative as expected. This indicates that those counties with a "high" percentage of non-white farm operators could be expected to have a "low" percentage of farm operators residing off the farm.

Based on these results, it was concluded that variable X_9 was a very important determinant in the analysis.

Utah

There are 28 counties for Utah. The complete model explains 41.7 percent of the variation in off-farm residence among counties.

Determination of Significant Variables

The same procedures are followed as previously employed with California, Iowa, Kansas, and Texas. The results are presented in Table 9.

Percent of farm operators in group
I type farms (dairy, poultry, and
livestock feeding) (X_1)

All of the criteria used to determine significance indicate that variable X_1 was not an important variable in this analysis. The simple partial correlation coefficient

Table 9. Criteria for Determining Significant Independent Variables, Utah, 1964

Independent Variable	Simple Partial Correlation Coefficient	Multiple Regression Coefficient ¹	Standard Partial Regression Coefficient ²	Order in Which Variables Entered the Equation ³
X ₁ (Type of Farm)	-0.143138	-0.454742 (0.507474)	-0.404723 (5)	6
X ₂ (Sales of Farm)	0.010408	0.266557 (0.597640)	0.130755 (6)	9
X ₃ (Tenancy)	-0.097964	-1.524063* (1.062443)	-0.472483 (3)	5
X ₄ (Non-Commercial Farms)	-0.099342	-1.092130 (1.076793)	-0.071228 (8)	7
X ₅ (Off-Farm Work)	0.174686	0.776328 (0.993662)	0.406657 (4)	8
X ₆ (Remoteness)	-0.449903**	-31.620172** (9.366154)	-0.953854 (1)	1

Table 9. Continued

Independent Variable	Simple Partial Correlation Coefficient	Multiple Regression Coefficient ¹	Standard Partial Regression Coefficient ²	Order in Which Variables Entered the Equation ³
X ₇ (College Education)	0.120336	0.470407 (0.412753)	0.023486 (9)	2
X ₈ (Average Off-Farm Income)	0.069424	0.779273* (0.482575)	0.501387 (2)	3
X ₉ (Mormon Population)	0.155588	0.727699 (0.318163)	0.082984 (7)	4

The Coefficient of Determination (R^2) is .417.

* Denotes statistical significance of coefficient at .10 probability level.

** Denotes statistical significance of coefficient at .05 probability level.

¹ The numbers in parentheses are standard errors of regression coefficients.

² The number in parentheses is the rank of each coefficient according to magnitude.

³ The numbers indicate the order in which each variable entered the regression model.

and partial regression coefficient were both non-significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked fifth, in relation to the others, and this variable was sixth in order of importance to enter the regression model.

A review of the computer output showed that there was considerable intercorrelation between this variable and variables X_3 , X_4 , X_5 , X_8 , and X_9 . An analysis of this interaction showed that the partial regression coefficient for variable X_1 was enhanced by the inclusion of variables X_4 and X_5 . Variables X_3 , X_8 , and X_9 entered the regression model before variable X_1 making it quite difficult to assess the effect that these variables could have had on each other. There was, however, evidence that the simple partial correlation coefficient had been suppressed due to multi-collinearity. It was concluded that the significance of the simple partial correlation coefficient and partial regression coefficient had been understated and as a result the explanatory power of variable X_1 had been suppressed due to intercorrelation.

The signs of the coefficients were negative as expected. This suggests that those counties with a "high" percentage of farm operators engaged in dairy, poultry, and livestock feeding operations tend to have a "low" percentage of off-farm residence of farm families.

From these results, it was concluded that

variable X_1 was of some importance, although it was probably quite weak.

Percent of farm operators with gross farm sales over \$10,000 (X_2)

This variable was rated non-significant by all four criteria. The simple partial correlation coefficient and partial regression coefficient were both non-significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked sixth, in relation to the others, and this variable was ninth, or last, in order of importance to enter the regression model.

Although the coefficients were not statistically significant, the signs of the coefficients were positive as expected. This means that those counties with a "high" percentage of farmers with gross farm sales over \$10,000 tended to have a "high" percentage of farm families residing off the farm.

Since the computer output did not show any multicollinearity problems between this variable and any of the others, it was concluded that this variable was of only negligible importance in the analysis.

Percent of farm operators who are managers and tenants (X_3)

All but one of the criteria used to determine significance indicate that this variable may be of some

importance in this analysis. The only indicator that did not confirm the results of the other indicators was the simple partial correlation coefficient which was non-significant at even the $\alpha = .10$ probability level. The partial regression coefficient, however, was significant at the $\alpha = .10$ probability level. The standard partial regression coefficient ranked third, in relation to the others, and the variable was fifth in order of importance to enter the regression model.

Because of ambiguous results, it was necessary to check for multi-collinearity among the independent variables. The computer output showed that there was some intercorrelation between this variable and variables X_4 and X_5 . However, an analysis of this interaction revealed that the significance of the partial regression coefficient for variable X_3 is not significantly different with or without X_4 and X_5 in the model.

Prior to variable X_4 entering the regression model, the partial regression coefficient and calculated "t" value for variable X_3 was 1.4936820 and 1.59565 respectively. With the inclusion of variable X_4 , the partial regression coefficient and calculated "t" value dropped to 1.422429 and 1.51933. And, with the inclusion of variable X_5 , the partial regression coefficient and calculated "t" value for variable X_3 dropped even lower to 1.4102941 and 1.37776. In all three cases, the regression

coefficient is significant only at the $\alpha = .10$ level. It is evident, at best, that the variable has only marginal significance.

The signs of the coefficients were negative. This suggests that those counties with a "high" percentage of farm operators who are managers and tenants tend to have a "low" percentage of farm families living off the farm.

Percent of farm operators operating "other" farms (part-time, part retirement, and abnormal) (X_4)

All of the criteria used to determine significance indicate that this variable was not important in this analysis. The simple partial correlation coefficient and partial regression coefficient were both non-significant at the $\alpha = .10$ probability level. The standard partial regression coefficient ranked eighth, in relation to the others, and this variable was seventh in order of importance to enter the regression model.

From these results, it was concluded that variable X_4 did not have any importance in the analysis.

Percent of farm operators working off the farm 100 days or more (X_5)

The standard partial regression coefficient was the only indicator that indicated variable X_5 might be of some importance in this analysis, and then only

marginally. The other indicators, however, did not confirm these results. The simple partial correlation coefficient and partial regression coefficient were both non-significant at the $\alpha = .10$ probability level. The standard partial regression coefficient ranked fourth, in relation to the others, and the variable was eighth, or second last, in order of importance to enter the regression model. The signs of the coefficients were positive as expected.

Since there was not much multi-collinearity among the independent variables, it was concluded that this variable was not an important factor in the Utah analysis.

County contains a community with a population of 10,000 or more or county boundaries are within 30 miles of such a town or city (X_6)

All of the criteria used to determine significance indicate that this variable was of highest importance in this analysis. The simple partial correlation coefficient and partial regression coefficient were both significant at the $\alpha = .05$ probability level. The standard partial regression coefficient ranked first, or highest, in relation to the others, and this variable was first in order of importance to enter the regression model.

The signs of the coefficients were negative as expected. This suggests that those counties with a community of population 10,000 or more, or whose county

boundaries are within 30 miles of such a town or city could be expected to have a "low" percentage farm families living off the farm.

On the basis of these results, it was concluded that variable X_6 was the most important variable in the Utah analysis and that it did have a significant impact on off-farm residence patterns.

Percent of farm operators with
one or more years of
college (X_7)

All of the indicators, except one, indicate that this variable was not important in this analysis. The simple partial correlation coefficient and partial regression coefficient were both non-significant at the $\alpha = .10$ probability level. The standard partial regression coefficient ranked ninth, or last, in relation to the others, and the variable was second in order of importance to enter the regression equation. Except for X_6 and possibly X_9 none of the other variables seem to have much explanatory significance, so the fact that X_7 came into the model as the second variable should not be considered too important. The signs of the coefficients were positive as expected, however.

Average income of all persons
in farm household from sources
other than farm operated (X_8)

Three out of four criteria used to determine

significance indicate that this variable was of some importance in this analysis. The simple partial correlation coefficient was only .07 and not significant. The partial regression coefficient was significant at the $\alpha = .10$ probability level. The standard partial regression coefficient ranked second, in relation to the others, and this variable was third in order of importance to enter the regression model.

This inconsistency between indicators may be explained by the presence of intercorrelation among the independent variables. The computer output showed that there was significant interaction between this variable and variable X_5 . An analysis of this interaction revealed that the partial regression coefficient for variable X_3 was significant at the $\alpha = .05$ probability level prior to the inclusion of variable X_5 into the regression model. Before variable X_5 entered the model the partial regression coefficient and calculated "t" value for variable X_3 was 0.86297840 and 1.30236 respectively. With the inclusion of variable X_5 into the regression model, the partial regression coefficient and calculated "t" value for variable X_3 dropped to 0.75980905 and 1.51082. As can be seen, the partial regression coefficient for variable X_3 decreased considerably as a result of variable X_5 .

The signs of the coefficients were positive as expected. This means that those counties with a "high"

percentage of farms with high average off-farm income tend to have a "high" percentage of farm families residing off the farm.

Based on these results, X_8 is of ambiguous importance with the simple correlation coefficient contradicting the other indicators.

Percent of farm operators
who are Mormon (X_9)

This variable was rated important by two indicators. The partial regression coefficient was significant at the $\alpha = .05$ significance level and the variable was fourth in order of importance to enter the regression model. Even the simple correlation coefficient was sizable at .16, but because of the small sample size was not significant. The standard partial regression coefficient ranked seventh in relation to the others.

There was some intercorrelation between this variable and variable X_1 and X_{14} . An analysis of this interaction showed that the significance of the partial regression coefficient for variable X_9 had been seriously affected as result of variables X_1 and X_{14} entering the regression model. The effect of X_9 was even strengthened when X_1 and X_{14} were eliminated in the step-wise.

The signs of the coefficients were positive as expected. The positive sign is very important because it supports the hypothesis that Mormon families tend to live

off the farm in greater proportion than do Mormon families. This means that those counties which have a "high" percentage of Mormon farm operators can be expected to have a "high" percentage of farm families living off the farm.

SUMMARY AND CONCLUSIONS

Statement of The Problem

Farm families depending upon agriculture for all or part of their livelihood are establishing residence off the farm in increasing proportion. In 1940, only 5.4 percent of farmers reporting residence location for census enumerators indicated that they lived off the farm. By 1954 this figure had risen to 6.2 percent, by 1959 to 7.6 percent and by 1964 to 9.5 percent.

Gardner's study attempts to find out what factors are responsible for this recent trend, to make projections of off-farm residence ten and thirty years hence, and to explore the implications for resource-use planning, public policy, and institutional and community development in rural areas.

This study also was undertaken to determine which factors are related to differences in off-farm residence patterns among counties in each of the five states studied.

Primary Objective and Procedure

The primary objective of this study was to determine which independent variables account for the inter-county variation in the percent of farm operators

living off the farm in each of the five states considered. Forward step-wise regression was used in each state analysis. Those variables which were thought to be important in affecting off-farm residence patterns were regressed against the percent of farm operators living off the farm. Included in this group of variables were type of farm, farm sales, tenancy, non-commercial farm, off-farm work, remoteness, college education, and average off-farm income. Other variables which could be expected to influence off-farm residence in some states were also considered. These variables were percent of Mormon farm operators, which was used only in the Utah analysis, and percent of non-white farm operators, which was used in both the West Texas and East Texas analyses.

The criteria used to determine the significance of the independent variables were the simple partial correlation coefficients, the partial regression coefficients, rank of the standard partial regression coefficients, and the order in which each of the independent variables entered the regression model.

Results

The results for each regression analysis are summarized in Tables 10, 11, and 12. Using these tables, it was possible to determine those variables which appear to be responsible for the inter-county variation in the

Table 10. Simple Partial Correlation Coefficients Between Off-Farm Residence and Eight Independent Variables for Various Populations of Counties in California, Iowa, Kansas, Utah, West Texas and East Texas, 1964

Coefficient	California	Iowa	Kansas	West Texas	East Texas	Utah
r_{YX_1}	-0.286**	-0.489**	-0.355**	-0.124*	-0.032	-0.143
r_{YX_2}	0.575**	-0.155*	0.646**	0.170*	0.486	0.010
r_{YX_3}	-0.413**	-0.018	-0.564**	-0.048	-0.238**	-0.098
r_{YX_4}	-0.506**	-0.230**	-0.585**	-0.072	-0.648**	-0.099
r_{YX_5}	-0.531**	0.208**	0.449**	0.007	0.523**	0.175
r_{YX_6}	-0.172	-0.026	-0.333**	-0.206**	-0.228**	-0.450**

Table 10. Continued

Coefficient	California	Iowa	Kansas	West Texas	East Texas	Utah
r_{YX_7}	0.431**	0.285**	0.424**	0.348**	0.417**	0.120
r_{YX_8}	0.541**	0.188**	0.398**	0.364**	0.254**	0.069
r_{YX_9}				-0.330**	-0.171**	0.156

* Denotes statistical significance of coefficient at .10 probability level.

** Denotes statistical significance of coefficient at .05 probability level.

X_1	Type of Farm	X_6	Remoteness
X_2	Sales of Farm	X_7	College Education
X_3	Tenancy	X_8	Average Off-Farm Income
X_4	Non-Commercial Farms	X_9	Mormon Population Non-White Population
X_5	Off-Farm Work		

Table 11. Multiple Regression Coefficients Showing Effects of Eight Independent Variables on Off-Farm Residence for Various Populations of Counties in California, Iowa, Kansas, Utah, West Texas, and East Texas, 1964

Coefficient	California	Iowa	Kansas	West Texas	East Texas	Utah
a	8.726516	12.675434	9.550066	13.275162	40.522629	-32.355682
b ₁	-0.119970 (0.071742)	-0.057784** (0.012192)	-0.036787 (0.058555)	-0.132789** (0.066079)	-0.120409** (0.042454)	-0.454742 (0.507474)
b ₂	0.064265 (0.172429)	-0.044692* (0.031475)	0.361714 (0.061749)	0.110681 (0.133829)	0.220545** (0.057253)	0.266557 (0.597640)
b ₃	-0.302130** (0.077459)	-0.020918 (0.040856)	-0.214781** (0.124361)	-0.008376 (0.126997)	-0.041551 (0.059294)	-1.524068* (1.062443)
b ₄	-0.032217 (0.214425)	-0.020008 (0.073349)	-0.413160** (0.159223)	-0.485333** (0.290988)	-0.752656** (0.089000)	-1.092130 (1.076798)
b ₅	-0.193470 (0.196973)	0.071362 (0.059380)	0.056513 (0.183331)	0.193525 (0.294372)	0.479024** (0.118443)	0.776328 (0.993662)
b ₆	-0.763412 (2.591500)	-0.254052 (0.350354)	-2.813102** (1.568973)	-4.474089 (4.231314)	-1.533157 (1.341584)	-31.620172** (9.866154)
b ₇	0.168828** (0.093418)	0.009132 (0.058109)	0.270347** (0.145563)	0.362112** (0.174900)	0.199006** (0.094676)	0.470407 (0.412743)

Table 11. Continued

Coefficient	California	Iowa	Kansas	West Texas	East Texas	Utah
b_8	0.107792** (0.054711)	0.038487* (0.029117)	0.294973** (0.064408)	0.095609* (0.057564)	0.019961 (0.035725)	0.779273* (0.482575)
b_9				-6.828615** (2.151675)	0.129642** (0.043735)	0.727699** (0.318163)
R^2	.681	.341	.614	.417	.314	.562
Order of variables removed from step-wise regression	X_6, X_4, X_5 X_1, X_7, X_3	X_7, X_4, X_3 X_6, X_8, X_5	X_5, X_1, X_7 X_6, X_4, X_8	X_8, X_9, X_7 X_1, X_4, X_6	X_4, X_5, X_9 X_2, X_1, X_7	X_6, X_7, X_8 X_9, X_3, X_1
	X_8, X_2	X_2, X_1	X_3, X_2	X_2, X_5, X_3	X_6, X_3, X_8	X_4, X_5, X_2

* Denotes statistical significance of coefficient at .10 probability level.

** Denotes statistical significance of coefficient at .05 probability level.

Numbers in parentheses are standard errors of regression coefficients.

Table 12. Summary Results of Relationships Between Off-Farm Residence and Eight Explanatory Variables, 1964

	California	Iowa	Kansas	West Texas	East Texas	Utah
X ₁ (Type of Farm)	yes (yes)	yes (yes)	? (yes)	yes (yes)	yes (no)	? (no)
X ₂ (Sales of Farm)	yes (yes)	yes (yes)	yes (yes)	? (yes)	yes (yes)	no (no)
X ₃ (Tenancy)	yes (yes)	no (no)	yes (yes)	no (no)	no (yes)	yes (no)
X ₄ (Non-Commercial Farm)	? ^c (yes)	? (yes)	yes (yes)	yes (no)	yes (yes)	no (no)
X ₅ (Off-Farm Work)	? (yes)	yes (yes)	yes (yes)	no (no)	yes (yes)	no (no)
X ₆ (Remoteness)	no ^b (no)	no (no)	yes (yes)	yes (yes)	no (yes)	yes (yes)
X ₇ (College Education)	yes (yes)	? (yes)	yes (yes)	yes (yes)	yes (yes)	no (no)

Table 12. Continued

	California	Iowa	Kansas	West Texas	East Texas	Utah
X_8 (Average Off-Farm Income)	yes (yes)	yes (yes)	yes (yes)	yes (yes)	? (yes)	yes (no)
X_9 (Mormon Population)						yes (no)
(Non-White Population)				yes (yes)	yes (yes)	

The word, yes or no, not bounded by parenthesis is the conclusion yielded by the regression analysis, whereas the word in parenthesis states whether or not the simple correlation coefficient is significant.

- a If yes, independent variable is unambiguously significant.
- b If no, independent variable is unambiguously non-significant.
- c ?, independent variable is of questionable significance.

percent of farm operators residing off the farm in each of the states. As can be seen from Table 12, almost all variables turned out to be important in more than one state. Some were important in all states while others were important only in certain states.

Significant variables

Variable X_1 was found to be clearly significant in three states, and the indicators gave ambiguous results in the remaining two. Variable X_8 was probably significant in all five states. This is particularly important because it suggests that type of farm and average off-farm income are both highly important in explaining off-farm residence patterns in the states analyzed.

Variable X_2 was unambiguously significant for California, Iowa, Kansas, and East Texas; and probably was for West Texas, but not for Utah. X_4 was clearly significant only for Kansas and East Texas, but yielded ambiguous results for California, Iowa, and West Texas. Once again, X_4 failed for Utah. Variable X_5 was significant for Iowa, Kansas, and East Texas, and was of at least probable importance for California. It failed for West Texas and Utah. X_7 worked for all except Utah and perhaps Iowa.

Variable X_3 , percent of farm operators who are managers and tenants, was found to be a significant variable only in the California, Kansas, and ambiguously

for Utah and East Texas. It was not significant in the other states.

Variable X_6 was found to be significant only in Kansas, West Texas, and Utah, the remote states studied.

Percent of Mormon farm operators, which was used only in the Utah analysis, turned out to be probably important.

Percent of "non-white" farm operators, which was used in the two Texas analyses, was also found to be important in the study.

Non-Significant variables

It is important to discuss possible reasons why certain variables were not found to be significant in various states. It is also important to emphasize that conclusions made in this study are pertinent only to the five states studied.

As you recall from Table 12, variables X_2 , X_4 , X_5 , and X_7 were not significant in the Utah analysis. These results may be explained by looking at some of the characteristics of the state of Utah, particularly the influence that the Mormon Church had on residence patterns within the state.

Historically, Utah was settled by Mormons who came West largely to escape religious persecution. A unique feature of Mormon settlements in the United States was the

establishment of residences in town and with farms located nearby, patterned after agricultural settlements in Europe. The main reason for this type of settlement was that their social, cultural, and educational activities, as well as religious rites, were closely tied to the local church and town living was much more convenient than living on the farm. The point is that this influence seems to be dominant in explaining residence patterns even today, since none of the other variables are statistically significant.

Percent of farm operators who are managers and tenants (X_3) was not significant variable in Iowa and Texas. However, there appears to be good justification for these results.

As was pointed out earlier, Iowa is characterized by very large and prosperous farms with farm operators who engage in agriculture pretty much full time. Since the farms are of this nature, it is quite possible that farm operators regardless of tenure live on the farm in order to adequately manage the large enterprises. As a result we would logically expect this variable not to be significant.

Texas residence patterns were influenced by racial factors. As a rule, rural black people have lower incomes and levels of education than white people. This may explain the fact that proportionately more live on the

farm. It may also be true that discrimination against the minority farm population had a great deal of influence on where farm people lived and may discourage minorities from moving off the farm into town. Since a high percentage of the managers and tenants were also in minority groups, we might expect these families to live on the farm rather than off. As can be seen, other factors appear to outweigh the effect of this variable since variable X_3 is not found to be important in the Texas analyses.

Variable X_6 (remoteness from urban centers) was not found to be significant in the California, Iowa, and East Texas analyses. There seem to be logical explanations in each case as to why they were not important.

California has a very high percentage of its farms located near large towns and cities. Almost all of the counties in California have cities with populations in excess of 10,000. And since these towns and cities tend to reach way out into the hinterlands with their services, it is not necessary for the farmers to move off the farm.

In Iowa, the farms tend to be quite large and prosperous with farmers who engage in agriculture pretty much full time. The farms are also contiguous and are located reasonably close to a county seat, most of which are over 10,000 people. It is therefore plausible that X_6 would seem to have little influence on off-farm residence.

In Texas, we find that X_6 was important in the West Texas analysis but not in East Texas. This should have been expected. The reason may well be explained along the same lines as California. West Texas, for example, is less densely populated with fewer counties containing towns or cities with population of 10,000 or more or whose county boundaries are within 30 miles of such a town. As a result, the costs of living on the farm are much less in East Texas than in West Texas due to the availability of these cities.

Conclusions

One can conclude from the results of this study that all of the independent variables used in the analyses had a significant impact on off-farm residence patterns in one or more of the five states studied.

Some of the variables were not significant in certain states, but in most cases there were plausible explanations. It was concluded that variables X_1 , X_2 , X_4 , X_5 , X_7 , X_3 , and X_9 had most influence on the whole on off-farm residence patterns and, as a result, explained much of the inter-county variation in the percent of farm families living off the farm.

Variables X_3 and X_6 were considered to be of lesser importance, although they also contributed in some states.

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