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AN ANALYSIS OF FACTORS INFLUENCING FARM FAMILY RESIDENCE LOCATION

by

Larry Keith Bond

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

of

DOCTOR OF PHILOSOPHY

in

Economics

Approved:

UTAH STATE UNIVERSITY
Logan, Utah

1972

ACKNOWLEDGMENTS

I would like to ackowledge with gratitude the assistance and quidance given me by Dr. B. Delworth Gardner, while serving as my major professor and adviser during the course of this study. Special thanks are also extended to Dr. James B. McDonald, Dr. Herbert H. Fullerton, and Dr. Darwin B. Nielsen for the counsel and service rendered me while serving on my advisory committee. Dr. Rex L. Hurst also provided valuable assistance in the use of computer programs.

It is recognized and appreciated that through the personal efforts of Dr. B. Delworth Gardner the funds were obtained for this study.

Finally, to my wife Lois, I extend my sincere gratitude for her patience and encouragement during my graduate studies.

Larry K Bond

Larry Keith Bond

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ABSTRACT

An Analysis of Factors Influencing Farm

Family Residence Location

by

Larry Keith Bond, Doctor of Philosophy

Utah State University, 1972

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

Census data reveal that the percentage of farm operators in the United States that live off-farm is increasing. It has been suggested that this may be due largely to a shifting of residence off-farm. An analysis of factors influencing residence of farm families has been done at the national level. In addition, a cross section analysis of county data within states has been attempted. However, a purely local analysis is needed to pick up the variation obscured by aggregate data. The purpose of this study is to identify and evaluate variables that might be expected to influence residence location, and to determine to what extent residence shifting is actually occuring.

A theoretical model was developed to facilitate identification of variables that might be expected to influence place of residence of farm families. The model utilizes the concept of utility and postulates causal relationships between certain independent variables and farm family residence. No attempt is made to estimate parameters that establish a statistical relationship between independent variables and utility since utility is nonquantifiable. Rather, the model is uti-

lized to logically deduce what variables might be expected to differentially affect residence on- and off-farm. The statistical tests of significance of the variables consists of determining whether there is a significant difference between on- and off-farm residers with respect to the variables in question. In order to meet the data demands of the study, a random sample of farm families living on- and off-farm were interviewed.

Two basic procedures were used in analyzing the data. Initially, all variables were tested individually by analysis of variance and independence chi-square tests. Next, the variables were entered into a discriminant function to ascertain if there was some linear combination of all variables taken compositely that successfully discriminates between on- and off-farm residers. The ability of the functions to accurately predict group membership was encouraging, suggesting possible future use in identifying farm families most likely to shift residence.

Despite the fact that the percentage of farm operators residing off-farm in the two counties under study has been increasing, this study failed to reveal a trend to shifting residence off-farm. Rather, it appears that the increase is largely a result of farm operators entering agriculture from the off-farm sector. It is recognized, however, that Utah may not be typical of the nation as a whole, and residence shifting may be taking place in many areas of the United States.

In conclusion, definite statements regarding the influence of the variables, that showed significance, on residence shifts would be hazardous since very little shifting has occured. Interpretations must be couched within the framework of different patterns of living due to

residence location rather than a framework of residence shifts due to different patterns of living. In other words, the analysis has more relevance to residence choice than to residence shifts.

(128 pages)

I. INTRODUCTION

The changing composition of the American rural population is an established fact and has been the subject of much research.[1] Urban families are moving to the "country" to escape the noise and congestion of the city, while the migration of people from the farm to urban centers continues. The net result is a decrease in rural population relative to that classified as urban, although in absolute terms the rural population is increasing also. In 1969, less than 30 percent of all Americans were classed as rural residents, compared to 60 percent in 1900 and 95 percent in 1790.

Of notable interest also is another more recent trend which may have far-reaching implications. Census data imply that many families that depend on farming for all or part of their livelihood are establishing residences off-farm (Gardner, 1969). If, in fact, farm people are leaving the farm as a place of residence, what are their reasons for moving into town and will the trend continue? Answers to these questions must be obtained before adequate social and economic planning can be done in both urban and rural areas. That is, answers to these questions will increase the probability that scarce land, capital, and human resources will be optimally allocated in the interest of all Americans.

A first step toward finding these answers is to make a detailed

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[1] Some of the more recent studies are the following: Advisory Commission on Intergovernmental Relations (1968), Beale (1969), Bogue and Beale (1964), and statements by Dale Hathaway and Senator Fred R. Harris--Senate Subcommittee on Government Research (1968).

analysis of the census data. This will be followed by a theoretical conceptualization of the phenomenon of shifting rural residence and an identification of the factors influencing it. The implications of the conceptual model will then be empirically tested.

National Trends in Farm Operator Residence

Census data were used to tabulate numbers of farm operators living on- and off-farm for various census years since 1940 (Table 1).[2] The estimated number of on-farm residers in 1964 is about half the number estimated for 1940 (Table 1, row 4). The decrease over the entire period is monotonic with the largest absolute decrease between 1954 and 1959 census years. Of course, most of this large decline over the 25-year period resulted from farmers leaving agriculture altogether. Some of the decrease, however, could be attributable to the fact that farm operators moved their residences off-farm but remained in agriculture.

In absolute numbers, the estimates indicate that there has been relatively little change over the period in operators living off-farm (Table 1, row 5). The figure in 1940 was approximately 329,000 and was up to 341,000 in 1945, probably reflecting the fact that many farm operators moved off-farm to take part-time jobs to assist the war effort. The year 1950 shows a substantial decline from 1945, but this is probably attributable to the unique characteristic of the 1950 census. The 1950 enumeration took place in April, whereas in other years it was done in November-December. Many farmers that maintain two residences, one in town and one on the farm, especially those in the South, were already in their fields by April. A detailed study of census data sug-

[2] Data for Table 1 were prepared by Gardner (1969).

Table 1. Residence of farm operators in the United States, Cache County, and Sanpete County for census years 1940-64.

	1940	1945	1950	1954	1959	1964
United States						
1. Number reporting living on-farm (thousands)	5,506	5,460	4,982	4,392	3,231	2,770
2. Number reporting living off-farm (thousands)	314	337	268	290	266	291
3. Number not reporting residence (thousands)	277	62	132	100	207	93
4. Estimated number living on-farm (thousands)[i]	5,768	5,519	5,107	4,486	3,422	2,854
5. Estimated number living off-farm (thousands)[i]	329	341	275	296	282	300
6. Estimated percent living off-farm[ii]	5.4	5.8	5.1	6.2	7.6	9.5
7. Estimated numbers shifting residence off-farm (thousands)[iii]		25	-38	52	53	60
Cache County						
1. Number reporting living on-farm	1,862	2,069	1,866	1,842	1,407	1,236
2. Number reporting living off-farm	324	154	166	258	221	361
3. Number not reporting residence	67	4	53	84	176	56
4. Estimated number living on-farm[i]	1,919	2,073	1,915	1,916	1,559	1,279
5. Estimated number living off-farm[i]	334	154	170	94	245	374
6. Estimated percent living off-farm[ii]	14.8	6.9	8.2	12.3	13.6	22.6
7. Estimated numbers shifting residence off-farm		-176	26	-84	43	38

Table 1. Continued

	1940	1945	1950	1954	1959	1964
Sanpete County						
1. Number reporting living on-farm	510	859	826	971	590	359
2. Number reporting living off-farm	813	724	646	372	323	437
3. Number not reporting residence	103	7	98	20	86	15
4. Estimated number living on-farm[i]	550	863	881	985	646	366
5. Estimated number living off-farm	976	727	689	378	353	445
6. Estimated percent living off-farm[ii]	61.5	45.7	43.9	27.7	35.4	54.9
7. Estimated number shifting residence off-farm[iii]		-361	-29	-220	76	158

Source: U.S. Census of Agriculture

i Those not reporting residence were distributed among on-farm residence and off-farm residence by the same percentage in these groups as those who did report residence.

ii $\frac{\text{Row 2}}{\text{Row 1} + \text{Row 2}}$

iii The following is an explanation of how these figures were estimated. It was assumed that operators living off-farm left agriculture at the same rate as those living on-farm. The rate of decline between 1940 and 1945 for example was 3.9 percent for the U.S. as a whole. Had there been no shifting of operator residence from farm to off-farm, therefore, it might be expected that there would have been 329 − (329 x 0.039) = 316,000 operators living off-farm in 1945. In fact, 341,000 lived off-farm. Under the assumptions above, then 25,000 must have moved from residences on the farm to residences off the farm.

gests that many of these farm operators who reported on-farm residency in April likely would have reported off-farm residency had the census been taken in November-December as usual, since by this time they would have moved back to their nonfarm homes.

The fact that the total number of operators living off-farm in 1964 was about the same as in 1940 deserves comment. On the surface it would appear that the trend might be for many on-farm operators to leave agriculture altogether (accounting for the large diminution of on-farm residers over time) while off-farm operators remain in agriculture since their number is reasonably stable. It may be, however, that off-farm operators are leaving agriculture at about the same rate as on-farm operators but the trend is obscured by a change in the composition of the off-farm group. That is, those leaving agriculture from off-farm residence could be almost completely offset by operators entering agriculture as off-farm residents or by operators entering the off-farm group from the on-farm group. It is assumed that the latter reason prevails.

How many operators are shifting residence off-farm between census years? Unfortunately, those who move, if in fact a shift is occuring, cannot be identified from information contained in the census. It is possible, however, to roughly estimate the number who move to off-farm residences (Table 1, row 7). These estimates were obtained in the following way.

It is assumed that operators living off-farm leave agriculture at the same rate as those having on-farm residences. The total number of farm operators in the U.S. declined by 3.9 percent between 1940 and 1945. Accordingly, applying this rate to off-farm residers, we might

have expected 316,000 in 1945 had there been no residence shifts. Instead, actually 341,000 lived off-farm. This implies about 25,000 shifted residence from the farm to town. Empirical analysis should test the reasonableness of the assumptions used to develope these data.

The negative figure (-38,000) in 1950 implies a shift from off-farm to on-farm residence. This figure, however, probably reflects the enumeration problem with the 1950 census, alluded to above, rather than a real residence movement off-farm. With the exception of 1950, the trend over time is for greater numbers of operators to shift residence off-farm.

The data strongly suggest that those operators who live off-farm are not in the process of abandoning agriculture altogether. They are just as viable as a group in agriculture as the on-farm residers as indicated by the fact that their farm incomes, on the average, are greater and they have expanded farm size over time just as rapidly as the on-farm group (Gardner, 1969).

The time trends of operator residence can be easily seen in the percentages of farm families living off-farm (Table 1, row 6). The 5.4 to 9.5 percent increase from 1940 to 1964 is a significant increase. It takes on greater meaning when one realizes that this is a national average and some states have a much higher percentage of off-farm residency. Utah, which ranked highest in the percent of farm operators living off-farm in 1964, had 26.3 percent off-farm residence compared to 17.2 percent in 1954.[3] This is an increase of 9.1 percentage points in just 10 years. Texas, which ranked fourth in 1964, showed 21.4 percent compared to 12.6 percent in 1954. When viewed on a county

[3]Source: United States Census of Agriculture.

basis, several Texas counties reported over 60 percent of the farm operators living off-farm in 1964, while several counties in Utah exceeded 50 percent for the same year. Data with respect to residence of farm operators in Cache and Sanpete Counties of Utah are given in Table 1. The estimated percent residing off-farm has increased steadily in Cache County since 1945 and in Sanpete County since 1954. The 1969 census, already taken but not compiled and analyzed, will be watched with interest to ascertain if the county, state, and national trends have continued since 1964.

Review of Literature

In recent years the changing residence patterns in the U.S. have sparked an interest among sociologists and economists and concern among persons involved in planning for the future. Marion Clawson (1966) has probed the area of rural settlement patterns. Briefly, he suggests that more and more farm operators will shift residence from the farm to urban centers or at least will establish residence nearer to larger towns, because of the advantages in purchasing farm inputs, home supplies for consumption, and other services. Present-day farm families purchase more of their consumptive items than did their ancestors. Fresh vegetables and milk are less frequently produced on the farm than in the past. Farmers must deal with governmental agencies more and more regarding farm programs. Such agencies tend to locate in larger towns, generally the county seat. Consolidation of schools force rural children to spend more time on buses, with the consequent loss of opportunity to participate in many extracurricular activities. All of these factors suggest advantages of living in or near to larger

towns than many present-day farm families now live. It is not only a matter of quantity of goods and services available, but quality also.

A number of studies have been made in regards to labor mobility, place-to-place migration, off-farm migration, etc. Very little has been done, however, by way of actual analysis of the phenomenon of shifting residence of farm families. Possibly the first attempt at analyzing the factors influencing residence shifts of farm families was done by Gardner (1969). He approached the problem on a national level. Using regression analysis, he tested the hypothesis that residence location was influenced by such factors as type of farm, gross sales, farm tenure, and condition of the farm dwelling. Clifford (1971) continued where Gardner left off by doing a cross section analysis of county data within states. The present study will bring the empirical testing down to the local level by analyzing the variation of selected variables within counties.

The theoretical framework upon which this study is based treats time as a cost of consumption as well as a cost of production. Although time receives no special treatment, it is somewhat unique. It may, therefore, be worthwhile to review the works of others giving similar treatment to time. The basic concept is similar to that used by Becker (1965) in his article dealing with the allocation of time. He said that due to the secular decline in the work week, "...the allocation and efficiency of nonworking time may now be more important to economic welfare than that of working time...." In his model he treated consumption as the production of utility, with time being a principal factor in the production function.

Since Becker's pioneering article, others have used the notion of

time as a cost of consumption. Johnson's (1966) article entitled, "Travel Time and The Price of Leisure" concludes that "...the typical individual attempts to maximize utility by economizing on the use of time as well as his use of money, and that leisure and work are distinct choice variables in the decision process." Linder (1970) was in the process of writing a book entitled, "The Harried Leisure Class" when Becker's article was published. Their basic approach was the same. Linder suggests that economists have ignored the fact that consumption requires time. He argues that they have conveyed the idea, "...that the use of time off the job is a noneconomic phenomenon and that economic growth results in the decreasing scarcity of time." Moreover, he states that if time is a scarce resource, which it surely must be, then "...it must be subject to the economic laws that prevail in the economist's universe." That is, time must be allocated in such a way as to maximize utility. Such is the role of time in the theoretical framework of this study. However, it is only one of several factors that must be optimally allocated to achieve a maximization of utility.

Harris, Tolley, and Harrell (1968) developed a model which attempted to explain residence site choice using, among other variables, a variable they referred to as amenity. In other words, they suggested that people place a value on surroundings and this in turn influences the price of home sites; and that "...the household maximized satisfaction from consumption of amenity, lot size, leisure, and all other goods...," subject to certain constraints, one of which is a time constraint. This is similar to the consideration given to environmental factors in this study. That is to say, an environmental factor such as "the wide open spaces" may satisfy a need or a want and, thus, yields utility.

In summary, an analysis of factors influencing residence shifts of farm families has been done at the national level. In addition, a cross section analysis of county data within states has been attempted. However, a purely local analysis is needed. This is to be done within the framework of a utility model. Historically, the time costs of consumption have been ignored. The point of departure, as far as the model is concerned, is that time, as a scarce resource, is treated as a cost of consumption.

Statement of Problem

Demographers predict growth in the total population of the U.S. New schools, hospitals, roads, and other public expenditures must be planned for now to accommodate this increasing population. A problem lies in knowing where to build these facilities. Investments in facilities that are underused after a few years, because of shifting residence patterns,are costly to society and an effort must be made to increase the probability that such facilities will be built in the "best" location.

Although the total migration problem needs to be thoroughly probed, it is beyond the scope of this study. Only the alleged shifts in residence of farm families will be investigated. An understanding of the factors which influence residence location of farm families would be helpful to policy makers and planners at all levels of government as well as to decision makers in private industry. It is recognized, however, that the entire population of a given area must be considered when decisions are made. The purpose of this study is to theoretically determine the factors that influence residence location of farm families

and test them empirically. Gardner (1969) has done it using aggregate census data at the national level, and Clifford (1971) has done a cross section analysis of county data within states. However, there are variables that appear a priori to have causal significance that Gardner and Clifford were unable to test because of the nature of the data with which they were working. Hence, a purely local analysis is needed.

Procedure and Methodology

A theoretical model was developed to facilitate identification of variables that might be expected to influence place of residence of farm families. The model utilizes the concept of utility and postulates causal relationships between certain independent variables and farm family residence. No attempt is made to estimate parameters that establish a statistical relationship between the independent variables and utility since utility is nonquantifiable. Rather, the model is utilized to logically deduce what variables might be expected to differentially affect residence on- and off-farm. That is, specific variables are deduced from the model by examination of each of the production functions within the framework of relevant constraints, at the same time relying upon a basic knowledge of both the theory of the firm and the theory of the household.

The empirical data were taken from samples of farm families from Cache and Sanpete Counties in Utah. These counties were chosen for several reasons. First, it was necessary to select counties with a sufficiently large farm population to ensure that an adequate sample of off-farm residents could be obtained. Secondly, it seemed desirable to select counties having at least some differences in production patterns

and enterprises. Thirdly, it seemed appropriate to choose counties having different economic structures. The existence of a city the size of Logan, coupled with the presence of a university, makes Cache County different than Sanpete County where the largest town has a population of less than 2,000.

Lists of all persons engaged in farming were obtained from County Agricultural Stabilization and Conservation (ASC) offices, and hence, included operators of noncommercial farms as defined by the Census Bureau.[4] Two samples were taken from each county--a sample from among those who live on the farm and one from among those who live in town. Data pertaining to the 1970 calendar year were obtained through personal interviews.

Two basic procedures were used in analyzing the data. Initially, each variable was tested individually to ascertain if there was a significant difference in the data obtained from farm families living on-farm as compared to those from farm families who live off-farm. Next, all variables were entered into a discriminant function to determine if there was some linear function of the variables that successfully discriminates between on-farm and off-farm residers. The data for each county were analyzed separately then aggregated and analyzed col-

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[4]Commercial operators are defined as those with annual sales of farm produce of at least $2500. and those with sales less than $2500. provided the operator is under age 65 and did not work off the farm 100 days or more. There was no way of readily distinguishing between commercial and noncommercial operators from these lists. However, since the census data discussed earlier include all farm operators, it seemed approriate to do so in the analysis. Noncommercial farm operators are a part of the total group and the same implications for resource allocation and planning for the future apply. Moreover, the influences of many of the variables of the model are not restricted to commercial operators alone.

lectively. Next, the exact same procedures were followed in analyzing the data after all noncommercial farm operators had been excluded from the samples.

A third step in the empirical testing was a demand analysis of diversion activities such as movies, concerts and plays, swimming, bowling, etc., to test the hypothesis that farm families who live on farms consume less of these items than do farm families who live in towns. The rationale behind this hypothesis is that time and travel costs increase the price of consumption, and as the distance to the place of consumption increases the quantity demanded goes down. A complication of this aspect of the study was that some farm families live in towns which have none of these recreational facilities, and thus must travel farther to consume these items than do some on-farm residents.

II. A MODEL FOR ANALYZING RESIDENCE LOCATION

Residence site choice embodies more than mere decision-making based on costs. It involves subjective evaluation of future gains and losses in utility from various alternatives. Traditionally, in a scientific sense, economists have been concerned with measurable costs in predicting the behavior of rational, utility-maximizing, decision-makers. In this sense, decision-makers do not choose. As Buchanan (1969) puts it, "...they behave predictably in response to objectively-measurable changes in their environment." The researcher has no alternative but to rely on objectively measurable data. In the strictest sense, a subjective model cannot be tested. The theoretical model used in this study serves only as a guide to identifying variables which the farm family subjectively evaluates in making a residence site choice. Thus, only indirect tests of the model are possible. That is, only hypotheses based on objectively measurable data, as they relate to the subjective model, can be tested.[5]

A basic assumption is that farm households are simultaneously both producers and consumers. Thus, regardless of whether they live on or off the farm, they make both production and consumption decisions. Hence, both the theory of the firm and the theory of the household are relevant and must be incorporated into the model. Assuming rational

[5]A model does not have to be empirically tested to be useful. Models are a result of "...a desire to be more systematic in tracing theoretical relationships (Beach, 1957)." Their usefulness comes in shedding light on the topic in question. As Roberts (1969) puts it, his model "...only serves to provide insight to the problems of a dynamic society and also through which more meaningful questions can be raised."

behavior, scarce resources will be allocated among competing consumptive and productive activities in such a way as to maximize utility. One such variable that deserves special attention is time, since time is considered a basic resource in both consumptive and productive activities of the model.[6]

In traditional production theory, time, as a factor of production, enters the production function indirectly in terms of an opportunity cost. An hour of labor time, if utilized in one enterprise, cannot be used in another. The theory of the household, however, has historically overlooked time as an opportunity cost of consumption.[7] Time is utilized in activities necessary to sustain life (eating and sleeping) and other activities, such as working, going to a movie, reading, etc. Thus, for any given time period, an individual can increase consumption time of a particular activity only at the expense of one or more other activities. Hence, there is a direct opportunity cost attached to time as a basic resource of consumption.

Farming is relatively free of institutional constraints on the number of hours a farm operator can work. Hence, the operator is "free" to allocate his time among the various productive and consumptive activities facing him.[8] It should be emphasized, however, that it is the farm household and not just the farm operator that is the utility-maximizing entity of this model. Thus, the farm household employs time, labor, capital, and management resources in three basic production

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[6]This approach was taken by Becker (1965) in his article dealing with the allocation of time.

[7]For a very recent exception, read Linder (1970).

[8]There may be institutional restrictions on the number of hours he or other members of his family can work in off-farm employment.

activities if consumption can be considered as production of utility:

1) Consumption items that directly enter the consumption function and thus produce utility are produced by combining time and quantities of commodities (goods and services, both tangible or intangible, whether market allocated or provided by nature). Let the quantity of the i^{th} such consumption item be denoted Z_i (i=1,...m), where

$$Z_i = \sum_{k=1}^{q} z_{ik}$$

and z_{ik} represents the consumption item i for each of the k members of the household. The logic of breaking the Z_i down into individual family member components stems from the variation in tastes, preferences, and needs among members of the family. Each member consumes a different "bundle" of goods although some items may be consumed in equal amounts by several or all members of the household.

2) Time and other resources are combined in order to produce farm products. Let the quantity of the j^{th} product be denoted Y_j (j = 1,...n).

3) Time and other resources are combined to produce income by working off the farm. Let W denote household income from off-farm employment where:

$$W = \sum_{k=1}^{q} w_k \quad (k = 1,...q)$$

and w_k represents the income of the k^{th} member of the household.[9]

Assumptions

The farm family is assumed to choose those options available to it which will maximize utility. One such option is whether to live at the farm or in town.

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[9]The justification for breaking household income down in this manner is that in some families more than one member may work and wage rates will not likely be equal for all members of the family. Moreover, income is not only a function of the wage rate but also a function of time worked, and the productivity of time may also vary among members of the household. Later discussions of time inputs and the opportunity cost of time will make this justification more apparent.

Let perfect competition in both factor and commodity markets be assumed. That is, there is free mobility of resources, products are homogeneous, and decisions are made under conditions of certainty since farm families, as both producers and consumers, are assumed to have perfect knowledge of costs as well as prices. Moreover, a short run production function is assumed in which the supply of land and capital (both fixed and operating) is constant. Thus, changes in output must be accomplished by changes in the usage of variable inputs. Time spent in work and consumption is variable and is subject to diminishing marginal returns (utility) in both types of activities. It is assumed, moreover, that work and consumption can be strictly separated so that production functions are independent and no utility is derived from work on the farm apart from the income recieved. That is, it is the income from work and not the work itself which yields utility.

Production Functions

The production function for consumption items which directly enter the utility function can be expressed as follows:

$$z_{ik} = f_{ik}(x_{ik}, e_{ik}, T^{c}_{ik}) \qquad \begin{matrix}(i = 1,\ldots m)\\(k = 1,\ldots q)\end{matrix} \quad . \quad . \quad (1)$$

where x_{ik} is a matrix of market goods,[10] e_{ik} is a matrix of collective goods or non-market goods, hereinafter referred to as environmental

[10] In the case of consumer durables, the x refers to the services yielded by the goods.

goods,[11] and T^c_{ik} is a matrix of time inputs used in producing the utility of the i^{th} consumption item.[12] Not all members of the family will have identical consumption patterns. Moreover, not all consumption items will require all three components. Hence, it seems appropriate to express each with double subscripts. With respect to the time element, the matrix T^c_{ik} applies to both market and environmental goods. Each member of the household combines market and/or environmental goods with time to produce other basic commodities that directly enter the utility function. Expressing T^c_{ik} as a matrix of time inputs allows the differentiation of time according to the time of day or time of week as well as according to each individual member of the family. The reason for this is that some activities are engaged in during the day and others at night, and some on weekends and others during the week. Moreover, not all activities may be engaged in by every member of the household. In short, the opportunity cost of time differs according to time of day and time of week and among the different members of the family. For simplicity, it is assumed that the x_{ik}, e_{ik}, and T^c_{ik} can be aggregated over the individuals to yield family parameters in these same variables. Thus, the summation of z_i over k in (1) yeilds the aggregate production

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[11] Environmental goods refers to both the collective goods provided by nature, which are usually considered as being available in the "country", and public goods and services provided by public expenditures at the various levels of government and which may be quite different if one lives in town rather than on the farm. Such goods are treated separately from market goods since no market price is involved; however, in some cases there may be a consumption outlay.

[12] The superscript c refers to time used in consumption to differentiate time used in this way from time utilized in production on the farm (T^p_j) and work off the farm (T^w_k).

function for the household

$$Z_i = f_i(x_i, e_i, T_i^c), \tag{1a}$$

which is the relevant production function of the model for basic consumption items.

The production function for farm products is

$$Y_j = g_j(\bar{L}_j, \bar{C}_j, T_j^p) \qquad (j = 1,\ldots n) \tag{2}$$

where $\bar{L}_j$ is a vector of land inputs, $\bar{C}_j$ is a vector of capital inputs, and T_j^p is a vector of time inputs (includes labor and management) used in the production of the various j's. (The bars above L and C denote the supply of these inputs is fixed, which seemed appropriate for the problem at hand.) The vector T_j^p is the sum of the time inputs of each member of the family in the production of the various j's.

The possibility of joint products should now be evident, since the activities of consumption and production can, in some cases, be carried on simultaneously. A consumption activity, such as watching a sunset, can be engaged in at the same time one is plowing a field. Thus, time becomes a factor in the joint production of a basic consumption item (which enters the utility function directly) and a farm commodity. If joint products are considered important, they could easily be handled in the model by summation of the utilities of the joint products (Mishan, 1969).

The production function for off-farm work is

$$w_k = w_k(\bar{w}_k, T_k^w) \qquad (k = 1,\ldots q) \tag{3}$$

where $\bar{w}_k$ is a vector of net wage rates for off-farm work,[13] and T_k^w is a vector representing total expenditure of time in off-farm employment by each member of the household. Vectors instead of scalars are used since in some cases more than one member of the household engages in off-farm work. Moreover, wage rates are likely to differ among individuals of the same family. Since the production function for off-farm work has been viewed separately for each member of the household, the aggregate function can be obtained by summing (3) over k which yields

$$W = W(\bar{w}, T^W) \tag{3a}$$

where $\bar{w}$ is a weighted average wage rate for the family, where the weights are the hours spent by each family member working off the farm.

Maximization of Utility

The production functions for the three basic production activities of the farm household are (1a), (2), and (3a). Following the assumption that farm households are utility maximizers, the utility function to be maximized is:

$$U = U(Z_1,\ldots Z_m) = U(f_1,\ldots f_m) = \bar{U}(x_1,\ldots x_m;\ e_1,\ldots e_m;\ T_1^c,\ldots T_m^c) \tag{4}$$

subject to a resource constraint

$$h(Z_1,\ldots Z_m) = Z \tag{5}$$

where h is an expenditure function of Z_i and Z is the bound on consumption resources.

Recalling production function (1a), consumption items are expressed

[13] Expenses consequent to off-farm work may include such items as babysitting and travel expense.

as functions of market goods, environmental goods, and time, Hence, Z can be broken down into three component constraints. In some circumstances the environmental constraint can be accepted as a given if the individual family is powerless to alter the supply. In this case

$$E = \bar{E} \quad . \tag{6}$$

Often those environmental goods peculiar to "country living" are "free" to those who live in the country. Some of these also can be consumed by urban dwellers at the expense of taking a trip to the country. If time and income constraints are relevant for environmental goods, they should be incorporated in the constraints as shown below. Likewise, some public goods which are a characteristic part of urban life are not as cheaply consumed by rural residents. For example, the public library, city parks, museums, etc., are open to anyone, but those who live out of town must incur expense, both in time and travel, to consume these items.

The market goods constraint can be written as

$$\sum_{i=1}^{m} P_i^x x_i = \left(\sum_{j=1}^{n} Y_j P_j^y - \sum_{j=1}^{n} Y_j C_j\right) + T^w \bar{w} - \sum_{i=1}^{m} P_i^e e_i \tag{7}$$

where P_i^x is a vector of unit prices of x_i, P_j^y are the market prices of the Y_j, C_j are the unit costs of producing the Y_j, P_i^e is a vector of unit prices (expenses) associated with consuming environmental goods, and e_i are the environmental goods which have a consumption expense associated with them. In other words, the market goods constraint is equal to net farm income plus net off-farm income of the farm family less what is spent in consuming environmental goods. In this framework, market goods and environmental goods should be considered together and

equation (7) can be rearranged into a total goods constraint of the form

$$\sum_{i=1}^{m} (P_i^x x_i + P_i^e e_i) = (\sum_{j=1}^{n} Y_j P_j^y - \sum_{j=1}^{n} Y_j C_j) + T^w \bar{w} \quad . \tag{7a}$$

The time constraint can be written as

$$T = \sum_{i=1}^{m} T_i^c + \sum_{j=1}^{n} T_j^p + T^w \tag{8}$$

where T is the total time available for consumption, farm work and off-farm work. Since sleep and other activities necessary to sustain life are considered as consumption items, T equals maximum total man-hours available to the household per relevant time period.

The production functions for basic consumption items (1a) can be written in equivalent form as

$$\begin{aligned} T_i^c &\equiv t_i^c Z_i \\ x_i &\equiv a_i Z_i \\ e_i &\equiv b_i Z_i \end{aligned} \tag{9}$$

where t_i^c is a vector of time inputs per unit of Z_i, a_i is a vector of inputs of market goods, and b_i is a vector of inputs of environmental goods per unit of Z_i. That is, t_i^c is a functional parameter relating T_i^c to Z_i and a_i and b_i are functional parameters relating x_i and e_i respectively to Z_i.

While it appears that the problem at hand is to maximize the utility function (4) subject to the multiple constraints (6), (7), and (8) and to the production relations (9), it is easily shown that the problem can be reduced to the maximization of (4) subject to a single

constraint. Since the environmental goods are either present or not present, the physical constraint (6) is unimportant for these goods. When present, the time constraint (8) and an income constraint may be important.

Let the time constraint (8) be rewritten in equivalent form as

$$T^W = T - \sum_{i=1}^{m} T_i^c - \sum_{j=1}^{n} T_j^p \tag{10}$$

recalling from equation (1a) that T_i^c includes time spent consuming environmental goods as well as market goods. Substituting the equivalent of T^W from (10) into the goods constraint (7a) yields

$$\sum_{i=1}^{m} (P_i^x x_i + P_i^e e_i) = (\sum_{j=1}^{n} Y_j P_j^y - \sum_{j=1}^{n} Y_j C_j) + (T - \sum_{i=1}^{m} T_i^c - \sum_{j=1}^{n} T_j^p)\overline{w} \tag{11}$$

where the e_i represents only those environmental goods which have a travel expense associated with their consumption and the P_i^e represents the travel expense of the i^{th} good. Those environmental goods which have no costs whatsoever associated with their consumption can be omitted since the only relevant constraint is time and T_i^c in (11) includes time spent consuming environmental as well as market goods. When equation (11) is re-arranged and values from (9) are substituted into it, the result is a single constraint of the form

$$\sum_{i=1}^{m} (P_i^x a_i + P_i^e b_i + t_i^c \overline{w}) Z_i + \sum_{j=1}^{n} T_j^p \overline{w} = (\sum_{j=1}^{n} Y_j P_j^y - \sum_{j=1}^{n} Y_j C_j) + T\overline{w} \tag{12}$$

Equation (12) can be interpreted as follows: The sum of the price of goods and the consumption time per unit of Z_i plus the opportunity cost of time spent in on-farm work is equal to net income from farm production plus money income that would be received if all available time were

expended in off-farm work. That is, the amount of resources (both time and goods) available for production and consumption activities on the left are constrained by the amount of resources on the right.

To simplify handling of the constraint, let

$$\phi_i \equiv P_i^x a_i + P_i^e b_i + t_i^c \bar{w} \tag{13}$$

so that the total resource constraint (12) can be expressed as

$$\sum_{i=1}^{m} \phi_i Z_i + \sum_{j=1}^{n} T_j^p \bar{w} = \left(\sum_{j=1}^{n} Y_j P_j^y - \sum_{j=1}^{n} Y_j C_j\right) + T\bar{w} \tag{14}$$

Letting $Z = (Z_1, \ldots Z_m)'$ and $\phi = (\phi_1, \ldots \phi_m)$, the Lagrangean associated with this maximization problem becomes

$$L(Z,\lambda) = U(Z) + \lambda\left[\left(\phi Z + \sum_{j=1}^{n} T_j^p \bar{w}\right) - \sum_{j=1}^{n} Y_j P_j^y - \sum_{j=1}^{n} Y_j C_j - T\bar{w}\right] \tag{15}$$

In order to yield a maximum, a necessary first order condition is that

$$\frac{\partial L}{\partial Z} = \frac{\partial U}{\partial Z} + \lambda\left[\frac{\partial \phi}{\partial Z} \cdot Z + \phi\right] = 0 \tag{16}$$

where λ is the marginal utility of money income.

Annual Utility and Choice of Residence

It seems desireable to incorporate a temporal dimension to the analysis. This is accomplished by assuming that total utility (U) is an annual quantity based on planned consumption.[14] Utilities in

[14] This does not imply that tastes are expected to remain unchanged over time. The only implication is that the household decision-maker plans as if he knows the manner in which they will change. A change in circumstances or desires may cause the decision-maker to revise his utility index and choose another time horizon.

each time period are assumed to be independent. The household can vizualize a flow of (U's) over some relevant time horizon which is discounted back to the present for decision making purposes.[15] The result is a present value of the flow of annual utilities, U^*, defined as

$$U^* = \sum_{t=1}^{h} \frac{U_t}{(1+r)^t} \tag{17}$$

where h is the relevant time horizon and r is the rate of discount.

The household decision-maker is assumed to evaluate the flow of utilities from residence both on- and off-farm, in much the same manner as described by McFadden (1967) in the evaluation of development programs, and choose the residence location yielding the highest present value of utility.

Factors Affecting Farm Residence

Thus far, attention has been focused on the framework within which residence of farm households can be analyzed. The production functions and constraints suggest broad categories of variables that influence the utility function either directly or indirectly. From these broad categories of variables, other more specific variables can be logically deduced. Residence location is not explicitly recognized as a factor influencing utility. However, it seems obvious that many factors, which do exert an influence, impose differential effects upon the utility function depending upon whether one lives in town or on the farm.

Economic theory suggests that consumer demand is influenced by income, tastes and preferences, and prices. Consumption costs are

[15] For examples of discounting utility, see Gale (1967), McFadden (1967), and Radner (1967).

assumed to include time as well as monetary costs in this study. Each of the factors influencing demand may themselves be influenced by other variables. Tastes and preferences, for example, are influenced by such things as age, size of family, background, attitudes, etc. On the farm production side, the conditions prevailing on the farm have an influence on production activity, which in turn may affect the utility function. Examples are the type of farm and capital investment.

Deductively, each variable is evaluated within the framework of the model to determine its potential relevance. To qualify for empirical testing, each variable must be capable of imposing differential effects on the farm family's utility function depending upon whether the family lives in town or on the farm. It should be pointed out that the set of variables selected for this study is not unique in the sense that anyone studying through the model would identify the exact same set of variables. Nevertheless, many of the variables would be the same. The identification of some variables, however, presupposes at least some knowledge of agriculture.

The next step is to specify a set of hypotheses relating selected variables to the utility function either as a component of the function itself or as a constraining influence. That is, the differential effects imposed by the variables upon the utility function, as a result of residence location, will be postulated. Each variable will be presented within a framework of costs, where costs are construed broadly as being time and monetary costs. Focus is given to those factors that can be controlled by the household rather than those which are exogenously imposed from without. This is by choice rather than because of any limitation of the model, since any imposed shifts of exogenous

variables (such as prices) could be analyzed within the framework of the model.

It is assumed that the farm family maximizes utility. The goal is to hypothesize, in a general way, the possible differences in the various consumption and production activities, that lead to a utility maximum, of on-farm families as compared to off-farm families. To put it another way, an examination of the production functions for consumption, farm production, and off-farm work is expected to suggest some basic differences based on residence location. Any factor that affects the demand or supply of inputs to the production functions should be a candidate for empirical testing.

Production function for consumption

The majority of the variables to be proposed have their main influence on the consumption production function. Some, however, may logically influence more than one production function. The Z_i, including the "goods" and "time" components, and the specification of the production of utility (f_i) will be determined largely by tastes and preferences, the income and time constraints on consumption, the availability or lack of various kinds of goods and services, and the prices and time costs of acquiring and consuming these commodities.

Farm tenure. Consumption is influenced by farm tenure for at least three reasons, a priori. First, pride of ownership might be expected to produce a desire to be in close physical proximity with that which one owns. Thus, the desire to own land is assumed to be positively associated with the desire to live on it. Satisfaction or utility is derived from fulfillment of this desire. A second reason is directly related to the insecurity associated with rental arrangements.

Most rental agreements, being of short duration, do not provide the security of tenure necessary to allow people to sink funds into long-lived investments such as housing on the farm which they rent. To do so would likely result in loss of investment and would not represent an optimum allocation of scarce capital. Thirdly, land operated by part owners and tenants is often more scattered than that operated by full owners. In such cases, travel costs may be minimized where a home situated in town is more centrally located to the farm operation than one located out of town. For these reasons, it is hypothesized that tenants and part owners will live in town in greater proportions than full owners.

Age of operator. There is reason to expect a positive correlation between age of the operator and off-farm residence on the one hand and a negative correlation on the other. With older couples, whose children have all moved away, the need or desire for neighbors to associate with may be an incentive to move to town. In addition, the aged may require more frequent medical attention, the costs of which increase as the distance from town increases. In fact, the costs of travel for any reason whatever are greater the older and more incapacitated one becomes. On the other hand, the older operators have probably had little or no college education, which would have had an influence on their life style as shall be discussed more fully later. Suffice it to say at this point that older farm couples have likely never experienced anything but farm life and, therefore, may not realize the opportunities forgone by living on-farm. Their consumption habits would not likely change much and, therefore, their utility may not increase appreciably and may even decrease as a result of shifting residence.

In fact, as a rule, the older one gets, the more set in his way of life he becomes, and the harder it is to change. Even moving into a new house next to their old house on the farm is disruptive to some, resulting in a degree of disutility. In addition, older couples will have fewer children that "demand" educational and recreational services, the costs of which are cheaper when the family lives in town rather than on-farm. Thus, the constraining influences on utility would not be diminished much by moving into town. It is expected, therefore, that the advantages of remaining on the farm outweigh the advantages that would tend to pull them off the farm. Therefore, it is hypothesized that the older operators will tend to live on-farm while the younger ones will tend to live in town, other things being equal.

Educational attainment of operator. The majority of present-day Utah residents, of working age, have graduated from high school. Many have attended college or university. Their years at college have no doubt had an influence on their life style. There is often more exposure to cultural activities, a wider variety of sports, and more opportunities for belonging to organized groups such as clubs, fraternaties, and service organizations at college than at high school. Hence, it is expected, and there is agreement among many sociologists, that the years one spends at college have a greater influence on life style than those spent in high school. Thus, many of the consumption items to which one is accustomed, as a result of having attended college, are more expensive, in terms of monetary as well as time costs, when living on-farm rather than in town. It is, therefore, hypothesized that farm operators who live off-farm have had more college education than those who live on-farm.

Educational attainment of wife. The hypothesis associated with this variable is the same as for the preceding variable. That is, it is expected that wives of farm operators who live in town will have attended more years of college than those living on the farm.

Background of wife. Girls who are reared in the city are often accustomed to a different style of life than they can expect if they live on the farm after getting married. While some can adjust very easily to farm life, many cannot. The thought of being "isolated" and having to help with the farm work may be a repellant to farm life, even though the present-day farm house is as "modern" as a home in the city. Moreover, the availability of consumption items to which she may be accustomed is crucial, since on-farm residence would increase the monetary and time costs of consuming these items. Therefore, it is hypothesized that the larger proportion of farm families, where the wife was reared in the city, will live off-farm.

Number of school-age children. Rural families have traditionally been larger than urban families. Several hypotheses have been offered to explain this phenomenon, but they are not germane to this study. Cognizance of this phenomenon, however, is important in formulating a meaningful hypothesis since it has a direct bearing on the expected findings. There is reason to expect on-farm families to be larger because traditionally rural families have been larger. But on the other hand, there are reasons for expecting off-farm families to be larger, especially if the off-farm group is composed of families who have recently moved from the farm.

Due to the consumption of educational services and related activities, church related activities, music lessons, etc., it may be cheaper

for the farm operator to commute to the farm from a home in town that to take the children to town for the many different reasons in addition to making other necessary trips to town for household shopping, farm business, etc. Such increased time and travel costs associated with on-farm living impose additional constraints on the family's utility function. Thus, it is expected, a priori, that the farm families with the largest number of school-age children will be more likely to move to town. Of course, the off-farm sample may be composed of both families who have moved from the farm and those who have always lived in town. Thus, if the off-farm sample is comprised mainly of families that have moved off the farm, one might expect significantly more school-age children per family than in on-farm families. On the other hand, the sample for the off-farm group may be comprised mostly of farm families that have never lived on the farm. If such is the case, it is expected that off-farm families will have fewer school-age children than on-farm families.

Net income. Let it be assumed that most consumption items are available only in town. The time and travel costs of living on the farm constrain consumption below the level that would be possible if one lives in town. The family that moves to town faces a lower set of prices, due to decreased time and travel costs of consumption, and hence, is able to achieve a higher indifference curve. Moreover, let it be assumed that most consumptive goods are superior goods so that expenditure will increase with income, and that not only the quality of consumption items but the quantity as well likewise increases. It follows that the larger volume of consumption must be associated with more trips to town. Therefore, in absolute terms, the higher the income,

the greater the time and monetary savings from moving into town. It is hypothesized, therefore, that a larger proportion of farm families with higher levels of income will reside in town where the costs of consumption of most commodities are cheaper.

Off-farm income. Census data for Utah indicate that a large proportion of farm operators, commercial as well as noncommercial, work off-farm either part or full time. In addition, the wives of many farm operators also engage in off-farm employment. Daily travel to and from work impose additional constraints (both time and monetary) on the consumption function of on-farm residents. Total travel time and expense may very well be less if the family lives in town near the place of employment and makes the necessary trips to the farm. This would especially be true for the types of farms that do not require continuous supervision such as some livestock enterprises. It is hypothesized, therefore, that off-farm income, as a percent of total net income of husband and wife, will be positively correlated with off-farm residence.

Farm housing. Housing represents a major consumption expenditure. The expected marginal costs of providing "adequate" housing is largely a function of the age and condition of the house as well as the availability of good water, electricity, and possibly telephone services. Many agricultural areas were settled over 100 years ago and housing is often old and in poor condition. In such cases, the cost of abandoning the farm house in favor of one in town is much less than if the house is modern and in a good state of repair. It is expected that, ceteris paribus, the probability of a family moving from the farm to town would be higher the older and more dilapidated the farm dwelling.

Remoteness and conditions of travel. Time and travel costs of living on the farm are positively related to remoteness of the farm and travel conditions that increase the difficulty of travel, and thereby impose additional constraints on the consumption function. One would expect, a priori, that the greater the distance from the farmstead to town the greater the likelihood that the family would live in town, especially if the type of farm does not require year-round presence of the operator.

Church activity. Church participation is one of the many consumption activities requiring the use of time as a resource. In addition, a monetary outlay is sometimes necessary. The farther one lives from church, the greater the time and monetary costs of consumption and consequent constraining effects on their utility function. It is expected that farm families desiring to be active in their church would choose to live in town where time and travel costs of consuming this item are less than they would be if they lived on the farm. This brings up a question. Does this variable actually influence farm families to move into town, or will newly married couples who desire to be very active establish residence in town right from the beginnining? Unfortunately, the answer is not known. It is possible to live on the farm and still be active but the cost is greater. These costs increase as children get old enough to become actively involved. Thus, the number of school-age children could be an important consideration as previously discussed. Nevertheless, regardless of whether the off-farm samples are comprised mainly of families that have always lived in town or of families that have moved off the farm, it is expected that off-farm residents will generally be more active in church.

Environmental preference. The production function for consumption specifies environmental factors (e_i) as a factor in producing utility. This seems logical. However, selecting a variable or variables representing environment, that can be empirically tested, is no easy task. Two variables are proposed to serve as proxies for environmental preference. One respresents an attitude and is treated as a categorical variable, while the other is quantifiable.

Some parents prefer to rear their children in the country where there are more chores for children than normally are available in the city. It is widely believed that, besides teaching them responsibility, it keeps them out of trouble. Therefore, the attitude of the parents concerning the importance of having farm chores for the children to do will be used as a proxy for environmental preference. It is hypothesized that, in comparing farm families residing on-farm with farm families living in town, a difference in attitude toward farm chores will be evident. Specifically, it is expected that a smaller proportion of the families (parents) living in town will feel it important to have farm chores for children to do.

The other variable that might be used to reflect environmental preference is the number of years the farm has been in the family. It is assumed that a certain amount of joy and satisfaction (utility) is derived from living on the "old homestead". In other words, there may be sentimental value attached to the farm. A suggested proxy for sentimental value is the number of years (generations) the farm has been in the family. Thus, a positive correlation between the number of years the farm has been in the family and on-farm residence is expected.

Production function for farm products

Some of the variables mentioned under consumption may also exert an influence on the production function for farm products, especially those where time, as a scarce resource, is involved. For example, the farther the farm is from town, the more time is expended in going to and from town for the various reasons, including off-farm employment. This may result in a "different" allocation of factors than would be the case if the family lived near to or in town. However, only those variables which influence the utility function mainly via their effects on the production function for farm products will be discussed under this subheading.

Farm type. Some farm enterprises utilize labor and management fairly constantly throughout the year while others are strictly seasonal. For example, livestock enterprises would tend to require a more even allocation of labor throughout the year than crop enterprises. On the other hand, many livestock feeding enterprises are becoming highly mechanized, which reduces labor requirements considerably. However, routine health checks of livestock are still a necessary part of good management. Dairy and egg enterprises require substantial daily labor inputs on a scheduled basis. Off-farm residence may prove costly in terms of time and travel costs as well as quality of management, ultimately exerting constraining influences on the utility function. It is, therefore, hypothesized that the type of farm is correlated with residence location. To be more specific, it is expected that dairy farmers and egg producers will live on the farm. Farmers engaged in other livestock enterprises may tend to live on the farm also, while the greater

proportion of farm operators living off-farm will be primarily engaged in crop enterprises.

Acres irrigated. This variable is closely related to farm type, but it seems sufficiently important that it can logically be treated separately. Irrigation agriculture, in the absence of mechanized irrigation systems, requires steady doses of labor inputs on a seasonal basis. The water has to be checked and set every few hours around the clock. Hence, time and travel costs as well as quality of management may be influenced by residence location. Therefore, it is expected that farm operators having a large number of acres to be irrigated will tend to live on-farm, while a large proportion of the operators who live in town will have fewer acres under irrigation.

Capital-labor ratio. The variable just previously discussed may well be influenced by the capital-labor ratio. That is, irrigation agriculture has recently been using more mechanized irrigation systems which permit more hours away from the farm than previously. In addition, many livestock feeding enterprises are becoming highly mechanized, which reduces labor requirements considerably. Since mechanization generally tends to be a substitute for labor, resulting in a relaxation of the time constraint, perhaps a fruitful hypothesis would be that farm residence would be higher on those farms having a "low" capital-labor ratio.

A Recapitulation of the Model

In light of the theoretical framework presented in this chapter, the following variables seem to be a priori relevant in explaining residence location:

X_1 = Farm tenure

X_2 = Age of operator

X_3 = Years of college of operator

X_4 = Years of college of wife

X_5 = Background of wife

X_6 = Number of school-age children

X_7 = Net income

X_8 = Off-farm income as a percent of total net income

X_9 = Farm housing

X_{10} = Remoteness and conditions of travel

X_{11} = Church activity of operator

X_{12} = Church activity of wife

X_{13} = Attitude concerning farm chores for children

X_{14} = Sentimental value of farm (years the farm has been in the family)

X_{15} = Farm type

X_{16} = Acres irrigated

X_{17} = Capital-labor ratio

An empirical specification of these variables will be presented in the next chapter along with the results of tests of significance.

III. EMPIRICAL TESTS

Data for this study were collected from two types of farm families: those who live on-farm and those who live in town. A problem was encountered in classifying some farm operators into these residence types since many live in small towns or at the outer edge of larger towns, but have all or part of their farm land extend out from their home. While many in this category considered themselves as on-farm residents, they were originally classified as off-farm residents. The justification for doing this was that since they live in a town their life style was assumed to be different than if they live out of town. On the other hand, many small towns in these counties have very little to offer in the way of services. In this regard, living in a small town is not so very different from living on a farm out of town. In either case, travel to a larger urban center is necessary for most consumptive needs. It, therefore, seemed appropriate to reclassify the farm operators, using the concept of a service center as the criterion for classification,[16] and analyze the data again, comparing the results with those of the original analysis. Since the theoretical model specifies market

[16] A minimum set of services desirable for most shopping needs was established similar to that developed by Borchert and Adams (1963). Those towns meeting this criterion were designated as service centers. Farm families living in service centers were classified as off-farm residents. All others were classified as on-farm residents. In Cache County, Logan, Smithfield, and Hyrum qualified as service centers. Mt. Pleasant, Ephraim, Manti, and Gunnison were designated as service centers in Sanpete County. None of the other towns provided for complete "minimum convenience" shopping (eating place, bank, hardware store, drug store, and gas station) much less a minimum of four specialty shops.

goods as a factor in producing utility, the availability of such goods would seem to be an important consideration. Viewed in this light, the latter classification would appear to be more appropriate and might, therefore, result in more variables being statistically significant than under the original classification.

The inclusion of noncommercial operators in the sample deserves comment. No distinction between commercial and noncommercial operators is made by the Census Bureau in reporting residence of farm operators. Hence, the estimates of the numbers of operators shifting residence off the farm, as presented in Table 1, were based on census data for all operators. The assumptions upon which these estimates were based could not be adequately tested if noncommercial operators were excluded from the samples. Moreover, the influences of many of the variables of the model are not restricted to commercial operators alone, and noncommercial operators may have as much or more reason to shift residence as commercial operators. However, as a matter of interest, an analysis of data pertaining only to commercial operators was performed. Since the reliability of the results may be questioned due to very small sample sizes for the off-farm groups, the results of this particular analysis will be presented in a separate sub-section rather than make direct comparisons with the results of the initial analyses of each variable.

Analytical Methods

Initially, seventeen variables were selected to be tested, each having an independent hypothesis associated with it, based on the theoretical framework presented earlier. That is, the data for each

variable for on-farm residents were hypothesized to be significantly different from the data for off-farm residents. Analysis of variance and independence chi-square tests were used to test for significant differences. Each variable was tested separately for each of the two counties. The data were then aggregated and tested again. Finally, the model was empirically tested by means of discriminant function analysis. This was done for each county separately as well as for the aggregated data.

The procedure for presenting the results of the analyses will be as follows: First, a review of the basic hypothesis associated with a particular variable will be presented, followed by the results of the test under both residence classifications. If the results are not those expected, a possible explanation will be offered. After all variables have been discussed, the results of the discriminant analyses will be presented. Finally, the results of the analysis of data pertaining only to commercial farms will be discussed. In regards to statistical significance, the term "significant" will denote statistical significance at the 0.05 probability level, while the term "highly significant" will denote significance at the 0.01 probability level. All chi-square values for one degree of freedom have been corrected for continuity.

Independent analysis of each variable

Statistical hypotheses are usually worded in terms of "no difference" or "independence", depending upon the type of test used. The discussions which follow, however, will be presented in terms of expected differences in keeping with the hypotheses postulated in the theoretical chapter.

Farm tenure. Farm operators were classified as full owners, part owners, or tenants and the data analyzed by means of a contingency table. It was hypothesized that full owners would live on-farm in greater proportion than would tenants and part owners. The chi-square values, as shown in Table 2, are not significant for either county nor for the aggregate data. Despite the insignificance, tenants in Cache County all live off the farm as expected. There were only two tenants in the Sanpete County samples--one living on-farm and one off-farm. A reclassification of the data, according to the revised definition of on-farm-off-farm residence, failed to improve the significance of this variable (Table 3). Possibly the percentages of tenant operators in these two counties are too small to really test this variable since there were only five in the two counties combined. However, this does not explain why full owners and part owners were fairly evenly distributed between the on-farm and off-farm groups in both counties. Early settlement patterns may be partially responsible. Many settlers established residence in towns right from the beginning. Generally, the descendents of these early settlers have established residence in town also, and commute to the farm as did their ancestors. As farms are divided among sons and daughters in succeeding generations, many farms become smaller and smaller. Operators must either rent or buy additional land to maintain a viable economic unit. Moreover, when farms are divided among several children, there usually are not enough houses to go around. In some cases, children grow up and get married before they find out if they are going to get part of the farm. Unless they have enough money to buy a parcel of land they will likely rent

Table 2. Contingency tables of selected variables with resulting chi-square values.

	Cache County		Sanpete County		Aggregate Data	
	On-farm	Off-farm	On-farm	Off-farm	On-farm	Off-farm
Farm tenure						
Full owner	24	24	33	27	57	51
Part owner	26	22	16	22	42	44
Tenant	0	4	1	1	1	5
χ^2	4.33		1.55		3.05	
Background of wife						
Farm	32	31	30	41	62	72
City	18	19	20	9	38	28
χ^2	0.00		4.86*		1.83	
Operator holds church position						
Yes	36	29	32	33	68	62
No	14	21	18	17	32	38
χ^2	1.58		0.00		0.55	
Wife holds church position						
Yes	42	35	35	34	77	69
No	8	15	15	16	23	31
χ^2	2.03		0.00		1.24	

Table 2. Continued

	Cache County		Sanpete County		Aggregate Data	
	On-farm	Off-farm	On-farm	Off-farm	On-farm	Off-farm
Attitude concerning chores for children						
Very important	48	46	49	46	97	92
Fairly important	2	2	1	4	3	6
Not important	0	2	0	0	0	2
χ^2	2.04		0.84		3.13	
Farm type						
Crop	11	14	4	2	15	16
Dairy	26	16	18	3	44	19
Other livestock	13	20	28	45	41	65
χ^2	4.23*		15.34**		15.39**	

*Significant at 5 percent level.
**Significant at 1 percent level.

Table 3. Contingency tables of selected variables with resulting chi-square values after reclassification.

	Cache County		Sanpete County		Aggregate Data	
	Rural-farm	Urban-farm	Rural-farm	Urban-farm	Rural-farm	Urban-farm
Farm tenure						
Full owner	39	9	47	13	86	22
Part owner	37	11	29	9	66	20
Tenant	2	2	2	0	4	2
χ^2	2.15		0.63		0.69	
Background of wife						
Farm	48	15	53	18	101	33
City	30	7	25	4	55	11
χ^2	0.10		1.00		1.20	
Operator holds church position						
Yes	54	11	53	12	107	23
No	24	11	25	10	49	21
χ^2	2.01		0.83		3.33	
Wife holds church position						
Yes	63	14	57	12	120	26
No	15	8	21	10	36	18
χ^2	1.96		1.96		4.67*	

Table 3. Continued

	Cache County		Sanpete County		Aggregate Data	
	Rural-farm	Urban-farm	Rural-farm	Urban-farm	Rural-farm	Urban-farm
Attitude concerning chores for children						
Very important	74	20	77	18	151	38
Fairly important	3	1	1	4	4	5
Not important	1	1	0	0	1	1
χ^2	0.96		7.07*		7.21*	
Farm type						
Crop	19	6	4	2	23	8
Dairy	38	4	21	0	59	4
Other livestock	21	12	53	20	74	32
χ^2	7.83*		7.61*		13.40**	

*Significant at 5 percent level.
**Significant at 1 percent level.

or build a house in town. After once becoming settled in town, many remain there after acquiring part or all of the family farm.

In conclusion, it appears that this variable is not relevant, at least for Utah. Early settlement patterns as well as the strong feeling that everyone should own a parcel of land no doubt contribute to the problem. Perhaps in another area, where there are more tenant farmers, this variable might prove more significant.

Age of operator. A positive correlation between age of the operator and on-farm residence was expected. The mean age, as presented in Table 4, is higher for off-farm operators for both counties; however, the differences are not significant. A reclassification failed to bring about any significance as can be seen from Table 5, although it resulted in the mean age of on-farm operators in Sanpete County being greater than for off-farm operators as hypothesized. A reason for expecting on-farm operators to be older was that they were assumed to be set in their patterns of living and any major shifting of residence would likely come from younger operators. However, there is virtually no shifting of residence in these two counties. Even excluding the noncommercial farm operators, which eliminates some of those over 65 years of age, failed to improve the significance of this variable, as shall be discussed more fully in a later section.

Years of college for operator. Since college life is expected to have an influence on life style, it was hypothesized that farm operators living off-farm would have more college education than those living on-farm. This variable is significant, in the expected direction, for both counties and for the aggregate data as well. A reclassification resulted in a greater spread between the mean years of college education

Table 4. Means, standard deviations, and F-values[i] of selected variables.

		Cache County		Sanpete County		Aggregate Data	
		On-farm	Off-farm	On-farm	Off-farm	On-farm	Off-farm
Age of operator	$\bar{X}$	51.56	53.10	53.46	53.74	52.51	53.42
	S	10.50	13.29	12.82	12.74	11.70	12.96
	F	0.41		0.01		0.27	
Years of college for operator	$\bar{X}$	0.90	1.70	0.78	1.50	0.84	1.60
	S	1.49	2.36	1.47	1.95	1.48	1.25
	F	4.12*		4.33*		8.47**	
Years of college for wife	$\bar{X}$	0.60	1.50	0.84	0.98	0.72	1.24
	S	1.05	1.84	1.42	1.48	1.25	1.68
	F	9.00**		2.33		6.16*	
Number of chool-age children	$\bar{X}$	2.68	1.32	1.64	1.76	2.16	1.54
	S	2.27	1.72	1.76	2.03	2.09	1.88
	F	11.39**		0.10		4.86*	
Net income	$\bar{X}$	8,956.80	10,850.00	7,624.00	9,274.36	8,290.40	10,062.18
	S	3,779.41	5,819.93	5,432.39	5,567.92	4,703.70	5,721.53
	F	3.72		2.25		5.72*	
Off-farm income	$\bar{X}$	29.56	52.60	29.94	32.74	29.75	42.67
	S	37.62	39.07	37.12	36.25	37.18	38.80
	F	9.02**		0.15		5.80*	
Remoteness	$\bar{X}$	7.64	7.12	6.08	6.76	6.86	7.07
	S	3.72	7.08	2.72	4.41	3.33	5.07
	F	0.21		2.38		0.34	

Table 4. Continued

		Cache County		Sanpete County		Aggregate Data	
		On-farm	Off-farm	On-farm	Off-farm	On-farm	Off-farm
Years farm has been in family	$\bar{X}$	45.18	46.36	38.76	37.88	45.77	38.32
	S	30.40	35.80	28.11	27.92	33.04	27.87
	F	0.03		0.02		2.97	
Acres Irrigated	$\bar{X}$	103.40	72.82	119.74	140.68	111.57	106.75
	S	103.2	95.67	127.35	142.87	115.62	125.68
	F	2.36		0.60		0.08	
Capital-labor ratio	$\bar{X}$	307.86	283.92	182.26	276.20	245.06	280.06
	S	323.72	344.75	186.37	370.25	270.26	355.94
	F	0.13		2.57		0.61	

*Significant at 5 percent level.
**Significant at 1 percent level.
[i]Error degrees of freedom equals 98 for counties and 198 for aggregate data.

Table 5. Means, standard deviations, and F-values[i] of selected variables after reclassification.

		Cache County		Sanpete County		Aggregate Data	
		Rural-farm	Urban-farm	Rural-farm	Urban-farm	Rural-farm	Urban-farm
Age of operator	$\bar{X}$	51.47	55.36	54.58	50.14	53.03	52.75
	S	11.75	12.40	13.45	9.11	12.68	11.08
	F	1.84		2.12		0.02	
Years of college for operator	$\bar{X}$	1.03	2.27	0.97	1.73	1.00	2.00
	S	1.57	2.93	1.59	2.21	1.57	2.58
	F	7.06*		3.21		10.14**	
Years of college for wife	$\bar{X}$	0.85	1.77	0.83	1.18	0.84	1.48
	S	1.38	1.95	1.37	1.68	1.37	1.82
	F	6.39*		1.00		6.36*	
Number of school-age children	$\bar{X}$	2.24	1.14	1.71	1.68	1.97	1.41
	S	2.19	1.58	1.96	1.64	2.09	1.62
	F	4.87*		0.00		2.75	
Net income	$\bar{X}$	9,532.56	11,218.18	7,903.44	10,384.09	8,718.00	10,801.14
	S	4,884.21	5,180.52	5,269.93	6,130.16	5,129.82	5,624.70
	F	1.99		3.53		5.42*	
Off-farm income	$\bar{X}$	34.92	62.91	30.42	34.59	32.67	48.75
	S	38.34	38.29	36.60	36.96	37.42	39.85
	F	9.15**		0.22		6.15*	
Remoteness	$\bar{X}$	8.09	4.86	7.96	2.50	8.03	3.68
	S	4.60	7.96	4.22	1.74	4.40	5.82
	F	5.92*		34.92**		28.77**	

Table 5. Continued

		Cache County		Sanpete County		Aggregate Data	
		Rural-farm	Urban-farm	Rural-farm	Urban-farm	Rural-farm	Urban-farm
Years farm has been in family	$\bar{X}$	47.64	43.45	40.31	31.27	43.93	37.36
	S	30.35	40.50	28.35	25.49	29.49	34.00
	F	0.28		1.82		1.58	
Acres irrigated	$\bar{X}$	91.31	76.77	125.58	144.64	108.44	111.70
	S	97.68	110.35	133.96	140.77	118.12	129.90
	F	0.36		0.41		0.03	
Capital-labor ratio	$\bar{X}$	299.00	284.86	188.10	375.05	243.55	329.95
	S	352.63	257.70	188.41	502.69	287.23	397.39
	F	0.03		7.31**		2.59	

*Significant at 5 percent level.
**Significant at 1 percent level.
[1]Error degrees of freedom equals 98 for counties and 198 for aggregate data.

for on-farm and off-farm operators in both counties. However, the variable is no longer significant for Sanpete County due to a larger standard deviation. The possibility exists that the main influence of this variable is on the original choice of residence at the time of marriage rather than on a subsequent decision to shift residence. In fact, in the absence of a sufficient number in the sample that did shift residence this would appear to be the case.

It may be interesting to note that farm operators in Cache County have attended more years of college than those in Sanpete County. A possible explanation is that Sanpete County has only a two-year college. A young man just out of high school is old enough to provide valuable assistance to the farm operation. Those living near a college can attend while still living at home. In addition to helping with the farm work, the out-of-pocket costs of education are less than if he has to leave home. Many may not be able to leave home to continue beyond the second year because of limited finances or because they are needed on the farm. In Cache County, however, a student can attend four or more years while still living at home. In other words, the opportunity cost as well as the out-of-pocket cost of finishing college may be less in Cache County than in Sanpete County.

Years of college for wife. The hypothesis associated with this variable is the same as for the previous variable. It is expected that wives living in town will have more education than those living on-farm. The influence on life style may be even more pronounced for the wife. As expected, wives living in town have had more years of college education than those living on-farm when looking at mean values only. The variable is significant for Cache County and for the aggre-

gate data; however, it is not significant for Sanpete County. The reclassification did not alter the results as can be seen by comparing Tables 4 and 5.

A question arises at this point. Why is this variable significant for Cache County but not for Sanpete County? Perhaps the fact that Sanpete County is essentially a rural county with no town having a population over 2,000 has something to do with it. The contrast between on-farm and off-farm life would not be so great as in Cache County. Thus, residence location would not affect life style as much as might be expected in Cache County.

In conclusion, it appears that this variable may have some causal significance. However, as with the preceding variable, it may be more relevant to residence choice than residence shifts.

Background of wife. This variable was analyzed by means of a contingency table, with the wife either having a farm background or a city background. There is virtually no difference in the background of the wife for the two residence classifications in Cache County. As Table 2 indicates, the differences noted for Sanpete County and for the aggregate data are opposite to those expected, but significantly so only for Sanpete County. After reclassification, the variable was insignificant on all counts as can be seen from Table 3.

Possibly, the insignificant results for Cache County and the unexpected difference in Sanpete County stems directly from the manner in which the question was asked on the questionnaire. The wife was merely asked if she came from a farm background. No doubt many were reared in small rural towns. In fact, Sanpete County is essentially a rural area, with the population of the largest town just under 2,000.

If the county had at least one town the size of Logan the results may not have been opposite to what was expected. Furthermore, if the definition of an off-farm background had been confined to being reared in a larger city like Salt Lake or Ogden the variable may have had more explanatory power.

Number of school-age children. It was hypothesized that, ceteris paribus, a positive correlation between the number of school-age children and off-farm residence shifts would be noted. Thus, if the off-farm sample was comprised mainly of families who had moved off the farm, the number of school-age children per family would be significantly higher than for on-farm families. On the other hand, if little or no shifting of residence has occurred, on-farm families would be expected to have more children.

This variable is significant for Cache County and the significance carries over into the aggregate data. On-farm residents have significantly more school-age children than off-farm residents. The results conform to the hypothesis since virtually no residence shifting has occurred. The off-farm sample in Sanpete County was also comprised almost exclusively of families that have always lived in town. However, there is no difference in the number of children. The reclassification did not alter the results although it did bring about a diminution of the differences. It must be concluded that the hypothesis relating residence shifts to the number of school-age children cannot be properly tested with these data since little residence shifting has occurred.

Net income. It was hypothesized that a larger proportion of farm families with higher levels of income would reside in town. While the

average net income from all sources is higher for off-farm residents in both counties, the differences are not significant. The difference is significant for the aggregate data, however, due to greater statistical power resulting from a larger sample size. The reclassification did not alter the results in any way. Recall that the hypothesis was based on the idea that, ceteris paribus, farm families with higher levels of income would be those more apt to move into town. However, little residence shifting is occurring. This may partially explain why this variable is not significant for either county.

Off-farm income. The F-values in Table 4 indicate this variable is significant for Cache County and for the aggregate data, in keeping with the hypothesis that farm families living off the farm earn a larger proportion of their net income from off-farm sources. The variable is not significant for Sanpete County although the difference is in the predicted direction. The reclassification of the data did not alter the results. The fact that the variable is significant for Cache County but not for Sanpete County may be revealing. Off-farm income, as a percent of total net income, of families living on the farm in these two counties is about the same. The big difference is with off-farm families. Possibly there are more job opportunities in Cache County due to the presence of the university and the larger population. It is recognized that such opportunities are available to on-farm and off-farm residents alike. Also, some on-farm residents live closer to major sources of employment within both counties than many who live in service centers. In addition, many even work outside of the county in which they live which may also result in the distance to work being less for many on-farm residents than for many off-farm

residents. These reasons may partially explain the lack of significance in Sanpete County. Moreover, these reasons may very well diminish the importance of this variable in the residence site choice.

Farm housing. It was hypothesized that the age, condition, and relative maintenance costs of farm housing would have an influence on decisions pertaining to residence shifts. The questionnaire was designed to ascertain the age and conditions of the farm house. In the case of off-farm residents, the data were based on the age and condition at the time the family moved into town. Insufficient data were obtained to draw any conclusions. To be specific, only five farm families, who now live off the farm, had ever lived on the farm. That is, almost all of the off-farm residents interviewed have always lived in town. This was surprising. The reasons influencing these five families to move will be presented in a subsequent section.

Remoteness and conditions of travel. As stated in the hypothesis, the greater the distance to town and the greater the probability of adverse travel conditions, the greater the likelihood of the farm family moving to town, other things being equal. It became apparent while interviewing operators that almost all farm residences were located on a paved road, with the remaining few being not far off the pavement. This, coupled with the knowledge that winter travel conditions, in these two counties, are seldom very bad for long, seemed reason to suspect that this variable was not as important as originally thought.

The fact that there are many small towns in both counties presented another problem. It did not seem appropriate to measure distance from the farm to the nearest town in every case, even if the town was

the place of residence, or where those living on farms went to church. Many of the small towns have hardly any services to speak of other than a church, a corner store, and perhaps a gas station. The majority of the farm families travel to several towns for their various needs. The problem was deciding which distance figure to use. Table 13 in a later section summarizes the frequency of trips to town by on-farm residents for various reasons. Shopping and farm business headed the list in both counties. In most cases shopping and farm business were done in the larger towns. Thus, it seemed more appropriate to base the remoteness factor on the distance to a larger town. These towns are referred to as service centers.

This variable is not significant for either county (Table 4). The farms of on-farm residents are about the same distance from a service center as those of off-farm residents. The variable became significant on all counts after reclassification of the data; however, the difference was opposite to what was hypothesized (Table 5). Most farms have been in the family for at least one generation and some for several generations. Many early settlers established residence in town and acquired farms nearby. In fact, it was necessary that their farms be fairly close because their mode of travel was slow. Some of these towns have since grown into larger towns offering a wide variety of services while many have remained small. Farm families living in these larger towns are classified as off-farm residents under the new classification. However, those living in smaller towns are now a part of the on-farm group. It seems only natural that these towns would be farther from a service center than the farms of many families that live in service centers. This partially explains why the variable is signi-

ficant after reclassification but in the opposite direction to what was expected. The prevalence of paved roads and the absence of severe travel conditions coupled with this fact would suggest that this variable has little influence on residence shifts in these two counties. If farm families had to travel to a service center to attend church as well as for all their other needs then this variable might show more relevance. As it is, they travel to more than one town for their various needs, some of which are only short distances from their farm.

Church activity. Originally it was thought that a variable reflecting church activity of the farm operator and his wife might be of sufficient importance to merit inclusion in the model. The thinking was that church participation is another of the many consumption activities requiring time as a resource. It was expected that farm families desiring to be "active" in their church would choose to live in town where the time and travel costs of consuming this item are less than they would be if they lived on the farm. However, it became apparent that there are Latter-day Saint (Mormon) chapels in every little community in the counties being studied. In fact, there are chapels in rural areas where there are no communities as such. Hence, the difference in the availability of church activities to on-farm residents as opposed to off-farm residents is not as great as originally supposed. This coupled with the knowledge that farm families in Utah are predominately Mormon, seemed reason to suspect that this variable was not as important in a residence site choice as initially hypothesized.

Both the farm operator and the wife were asked if they held a church position. As can be seen from Table 2, no significances are

noted for the operator or the wife. The variable became significant at the aggregate level for the wife after reclassification. Wives living on the farm appear to be more active than those living in service centers.

What explanation can be offered for the unexpected results? In retrospect, it would appear that the author's strong agricultural and religious background overshadowed economic reasoning in formulating the hypothesis. What may very well be the case is that church is located more favorably to on-farm families than other possible substitutes, many of which may exist only in larger towns. This would mean the relative price of church as opposed to other substitute activities might be lower for on-farm residers than for off-farm residers. In addition, it might well be that the younger, better educated, and wealthier people, on the average, have a lesser preference for church activities vis-a-vis substitutes than do older, more conservative people.

Attitude concerning farm chores. The attitude of farm operators (and their wives) with respect to having farm chores for their children to do, was chosen as one of the proxies for environmental preference. Farm couples were asked whether they felt it very important, fairly important, or not very important to have chores and other work for their children to do. While more on-farm residents than off-farm residents indicated that they felt it very important, the variable was not significant for either county. After reclassification the variable became significant for Sanpete County and the significance carried over into the aggregate data. However, the expected cell frequencies are too low in some cases to give reliable results. Perhaps the fact that

service centers in Cache County are larger than those in Sanpete County is in some way responsible for the lack of significance in Cache County. That is, there may be more opportunity for employment for teenagers as well as more organized activities for children in the larger towns of Cache County than in Sanpete County. Hence, the young people in Logan and the other service centers in Cache County have more opportunity to keep occupied without having farm chores to do than those of Sanpete County.

Sentimental value of farm. The number of years the farm has been in the family was chosen as a proxy for sentimental value. Assuming that living on the old "homestead" yields a certain amount of utility, a positive correlation between the number of years (generations) the farm has been in the family and on-farm residence was expected. This variable was not significant for either county either before or after reclassification (Tables 4 and 5). A possible explanation for the lack of significance is that almost all of the off-farm residents, under both classification, have always lived in towns. Hence, sentimental value could be tied more to ownership of the old "homestead" rather than residence on it. This variable appears to have little relevance for purposes of this study.

Farm type. It was hypothesized that farm operators having dairy or other livestock enterprises that require close supervision would live on the farm, while crop farmers would tend to live off the farm. The farms were classified into three categories: (1) crop, (2) dairy, and (3) other livestock, depending upon which enterprise yielded the largest proportion of net farm income. As can be seen from Table 2, this variable is significant for both counties and for the aggregate

data. In both counties, dairy operators tend to live on the farm while operators whose net farm income is derived mostly from other livestock tend to live off the farm. The large number of off-farm operators that raised turkeys accounted for this great difference in Sanpete County. As the table indicates, the off-farm category includes quite a few dairy farmers, especially in Cache County. The reclassification resulted in all dairy farmers in Sanpete County and most in Cache County being placed in the on-farm group. The variable is still unambiguously significant after reclassification and appears to be relevant to residence choice.

Acres irrigated. In the absence of a mechanized irrigation system, the number of acres irrigated was hypothesized to be positively correlated with on-farm residence. This variable is not significant for either county (Table 4). It may be interesting to note that only 28 percent of the on-farm operators in Cache County have sprinkler systems compared to 26 percent of off-farm operators. Not one of the operators interviewed had a mechanized irrigation system that moves itself. None of the operators included in the Sanpete County samples had a sprinkler system. A reclassification failed to bring about any significance in this variable (Table 5). The prevalence of paved roads coupled with the fact that off-farm operators under both classifications live fairly close to their farms would suggest that this variable is not very relevant to residence choice in these two counties.

Capital-labor ratio. Since capital can be substituted for labor in some instances, it was hypothesized that farm operators who live in town would have a higher capital-labor ratio than those who live on the farm. The data for this variable reflect crop machinery and equip-

ment mostly since none of the farm operators interviewed had mechanized feeding systems for livestock. Most of the turkey raisers had feed wagons and self-feeders and the value of these was included in the valuation figures for capital.

Reference to Table 4 reveals that this variable is not significant for either county. The reclassification, however, did result in significance for Sanpete County (Table 5). Moreover, the off-farm group showed the highest capital-labor ratio as expected. A detailed examination of the data reveals that the extremely high capital investment of three operators, each operating a combination cow-calf and feeder enterprise, was responsible for the significance. The variable was not significant when the data for these three operators were excluded.

In conclusion, a word of caution seems appropriate. Very few operators kept a list of their machinery, much less a valuation sheet. Furthermore, their estimates of labor input could have had a serious bias. Therefore, there is reason to question the reliability of the data used in calculating the capital-labor ratio. Although this variable has not been adequately tested, there is still reason to believe it has some relevance to residence site choice.

Discrimant function analysis

The original intention was to enter all 17 variables, as listed in Chapter II, in a discriminant function. However, two variables could not be used in this phase of the analysis. The variable representing farm housing was to be based on data pertaining to the farm dwelling at the time the family moved off the farm. However, only 5

of the 100 families living in towns had ever lived outside of town. Therefore, this variable could not be used because of the small sample size. The variable representing the attitude of parents towards farm chores could not be used since there were no responses for one of the specified attitudes. If a code level is specified for a dummy variable and there are no, or only a few observations having that code level, it introduces linear dependency into the resulting matrix.

The model tested by means of discriminant analysis is comprised of only the 15 variables listed below:[17]

X_1 = Farm tenure

X_2 = Age of operator

X_3 = Years of college for operator

X_4 = Years of college for wife

X_5 = Background of wife

X_6 = Number of school-age children

X_7 = Net income

X_8 = Off-farm income

X_{10} = Remoteness

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[17]An alternative to using all the variables is to use only those that show significance when tested by means of analysis of variance or independence chi-square. While this may seem more logical, it presents several problems. For example, variables that show significance before classification may not show significance afterwards. Moreover, variables that are significant in one county may not be significant in another. To try and compare any differences in discriminating power would be difficult unless the same set of variables is used in each case. Dr. Rex Hurst suggested that it would be in order to include all variables in the discriminant function since there is no perfect criterion for statistically selecting the "best" variables. Therefore, all variables, for which adequate data are available, were used. However, separate analyses were performed using only those variables showing significance after reclassification, with the results appearing in Appendix A.

X_{11} = Church activity of operator

X_{12} = Church activity of wife

X_{14} = Years farm has been in the family

X_{15} = Farm type

X_{16} = Acres irrigated

X_{17} = Capital-labor ratio

Variables X_1, X_5, X_{11}, X_{12}, and X_{15} were treated as categorical variables.

The purpose of this type of analysis is to ascertain if there is some linear function of these 15 variables, taken compositely, that successfully discriminates between on- and off-farm data. A computer program written by Hurst (1971) was used in this analysis, in which the trace of the matrix ($W^{-1}A$) is used as a statistic to measure discriminating power, where

W = error variance-covariance matrix

A = group variance-covariance matrix

Where only a single variable is involved, the trace approaches the F ratio.

A step-wise mode was chosen in which all variables are entered and deleted one at a time on the basis of their contribution to the trace. That is, the variable contributing the least to the composite trace value is deleted first, and so on until the variable contributing most to the composite trace is the only variable remaining. The purpose of this step of the discriminant analysis is to provide a means of scaling down the model similar to the use of the multiple correlation coefficient (R^2) in step-wise least square regression

analysis.[18] However, unlike the multiple correlation coefficient, the trace cannot be taken by itself as an indication of the "fit" of the model. All that can be said is that the higher the trace value, the better the "fit"; whereas, a value of one of the multiple correlation coefficient is taken to mean a perfect correlation. The deletion orders and the trace values are presented in Appendix A.

A comment concerning possible correlation between independent variables seems appropriate, since all 15 variables were used. Farrar and Glauber (1967) point out that econometricians accept least squares coefficient estimates as "best linear unbiased" since the expectation of the error term is zero regardless of the degree of multicollinearity. Assuming this is the case, the coefficient estimates in the discriminant function would be unbiased.[19]

The only real test of a discriminant function is its ability to predict group membership. In other words, discriminating power is measured by the percentage of observations properly classified. Table 6 summarizes the predictive accuracy of the model both before and after reclassification. By way of explanation, 84 percent of the on-farm residents of Cache County, under the original classification were

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[18] A word of caution is in order. Waite (1971) says, "The lack of a one-to-one correspondence makes omitting variables because of a small drop in trace, risky." Where the variable, of a set of variables, which contributes most to the trace is used in a univariate discriminant function, it may sometimes yield fewer correct group predictions than another variable of the same set.

[19] This assumes that the matrix can be properly inverted. In a personal conversation with Dr. Rex Hurst, he expressed the opinion that there should be no computational problems as long as there was no r-value greater than 0.90. The highest was 0.753 as shown in Appendix B.

Table 6. Percent of on-farm and off-farm residents correctly classified by discriminant functions both before and after reclassification.

	On-farm Group		Off-farm Group		Overall Accuracy	
	Before	After	Before	After	Before	After
Cache County	84%	86%	52%	68%	68%	82%
Sanpete County	80%	86%	66%	91%	73%	87%
Aggregate Data	86%	85%	46%	77%	66%	83%

placed in the on-farm group by the resultant discriminant function. Sixteen percent were mistakenly placed in the off-farm group. Only 52 percent of the off-farm residents in Cache County were correctly placed while the remaining 48 percent were mistakenly placed in the on-farm group. As can be seen from the table, the functions were more successful in placing the on-farm residents than the off-farm residents by a considerable margin in every case under the original classification. This suggests that the off-farm samples were more heterogeneous than the on-farm samples. In other words, the data for many of the residents in the off-farm groups appear to be more similar to those in the on-farm groups.

The reclassification of the data increased the discriminating power significantly in almost every case, with the greatest improvement occurring in the off-farm groups. The coefficients of the discriminant functions for the reclassified data are given in Appendix A.

What does all this mean? The improved accuracy of the discriminant functions in classifying farm families after the data were reclassified seems to suggest that living in a very small rural town is not much different than living on the farm. At least, when looking at the variables used in this model, farm families living in small towns have a lot in common with on-farm residents. In fact they have more in common with on-farm residents than with farm families living in service centers. This is evident from the increase in discriminating power for the on-farm groups after reclassification but even more so from the substantial increase in accuracy of placement in the off-farm groups.

The majority of one's activities are consumptive in nature. Many consumption activities, as well as other types of activities, require the input of market goods which are not always available in smaller towns. It would, therefore, seem more appropriate to distinguish farm families as rural-farm and urban-farm rather than on-farm and off-farm, with the distinction being based on the availability of some minimum set of goods and services.

Analysis of data for commercial farms

Recall that data for this study were collected by random sampling of all farm operators. All noncommercial operators, according to the definition given in footnote number 4, were then excluded and the data again analyzed under both residence classifications. This resulted in approximately a 40 percent reduction in sample size for both Cache and Sanpete Counties. The operators eliminated were not confined primarily to those over age 65. Some younger operators earning a very high proportion of their net income from off-farm sources were also excluded.

Tables 7 and 8 contain the results of the independent analysis of each variable under the original classification, while the results of the analysis after reclassification are presented in Tables 9 and 10. Since it was concluded earlier that the reclassification data are more appropriate for this study, the major part of the discussion which follows will deal with Tables 9 and 10. Comparisons will be made with Tables 3 and 5. It is left for the reader to compare the results with Tables 7 and 8.

A word of caution is offered at this point. After excluding all

Table 7. Contingency tables of selected variables with resulting chi-square values-Commercial farms.

	Cache County		Sanpete County		Aggregate Data	
	On-farm	Off-farm	On-farm	Off-farm	On-farm	Off-farm
Farm tenure						
Full owner	14	12	18	20	32	32
Part owner	21	14	12	15	33	29
Tenant	0	1	1	0	1	1
χ^2	1.55		1.20		0.13	
Background of wife						
Farm	20	17	17	30	37	47
City	15	10	14	5	29	15
χ^2	0.04		6.21**		4.68*	
Operator holds church position						
Yes	24	15	20	24	44	39
No	11	12	11	11	22	23
χ^2	0.62		0.01		0.07	
Wife holds church position						
Yes	28	19	24	25	52	44
No	7	8	7	10	14	18
χ^2	0.33		0.07		0.67	

Table 7. Continued

	Cache County		Sanpete County		Aggregate Data	
	On-farm	Off-farm	On-farm	Off-farm	On-farm	Off-farm
Attitude concerning chores for children						
Very important	34	25	30	31	64	56
Fairly important	1	1	1	4	2	5
Not important	0	1	0	0	0	1
χ^2	1.36		0.63		2.70	
Farm type						
Crop	6	6	2	1	8	7
Dairy	20	13	14	3	34	16
Other livestock	9	8	15	31	24	39
χ^2	0.52		12.82**		10.00**	

*Significant at 5 percent level.
**Significant at 1 percent level.

Table 8. Means, standard deviations, and F-values[i] of selected variables--Commercial farms.

		Cache County		Sanpete County		Aggregate Data	
		On-farm	Off-farm	On-farm	Off-farm	On-farm	Off-farm
Age of operator	$\bar{X}$	51.54	51.52	51.16	53.71	51.36	52.76
	S	10.81	12.52	11.05	12.81	10.84	12.63
	F	0.00		0.74		0.45	
Years of college for operator	$\bar{X}$	0.89	1.22	0.68	1.83	0.79	1.56
	S	1.30	2.08	1.42	2.05	1.35	2.07
	F	0.61		6.84*		6.38*	
Years of college for wife	$\bar{X}$	0.63	1.37	0.81	1.26	0.71	1.31
	S	1.06	1.74	1.45	1.63	1.25	1.67
	F	4.32*		1.39		5.26*	
Number of school-age children	$\bar{X}$	2.60	1.26	1.74	1.89	2.20	1.61
	S	2.23	1.77	1.69	2.19	2.02	2.03
	F	6.59*		0.09		2.66	
Net income	$\bar{X}$	9,671.14	11,451.85	8,496.77	10,676.23	9,119.55	11,014.00
	S	3,744.36	6,410.41	6,291.61	5,769.96	5,094.33	6,018.47
	F	1.88		2.15		3.71	
Off-farm income	$\bar{X}$	11.49	31.59	8.84	16.86	10.24	23.27
	S	22.89	29.49	16.93	24.65	20.20	27.63
	F	9.15**		2.31		9.36**	
Remoteness	$\bar{X}$	7.29	8.85	5.65	7.34	6.52	8.00
	S	3.87	8.07	2.65	5.50	3.43	6.72
	F	1.02		2.44		2.52	

Table 8. Continued

		Cache County		Sanpete County		Aggregate Data	
		On-farm	Off-farm	On-farm	Off-farm	On-farm	Off-farm
Years farm has been in family	$\bar{X}$	48.43	54.15	41.42	39.60	45.14	45.94
	S	30.63	33.87	31.84	25.83	31.16	30.23
	F	0.48		0.07		0.02	
Acres irrigated	$\bar{X}$	111.83	92.85	143.39	172.71	129.00	137.94
	S	116.41	110.91	151.25	158.18	134.11	144.16
	F	0.42		0.41		0.13	
Capital-labor ratio	$\bar{X}$	352.06	333.07	154.74	317.00	259.38	324.00
	S	362.74	418.56	99.62	417.47	288.54	414.58
	F	0.04		4.45*		1.06	

*Significant at 5 percent level.
**Significant at 1 percent level.
[i]Error degrees of freedom equals 60 for Cache County, 64 for Sanpete County, and 126 for aggregate data.

Table 9. Contingency tables of selected variables with resulting chi-square values after reclassification--Commercial farms.

	Cache County		Sanpete County		Aggregate Data	
	Rural-farm	Urban-farm	Rural-farm	Urban-farm	Rural-farm	Urban-farm
Farm tenure						
Full owner	23	3	28	10	51	13
Part owner	29	6	22	5	51	11
Tenant	1	0	1	0	2	0
χ^2	0.55		0.85		0.60	
Background of wife						
Farm	31	6	33	14	64	20
City	22	3	18	1	40	4
χ^2	0.01		3.34		3.20	
Operator holds church position						
Yes	34	5	35	9	69	14
No	19	4	16	6	35	10
χ^2	0.01		0.10		0.25	
Wife holds church position						
Yes	42	5	40	9	82	14
No	11	4	11	6	22	10
χ^2	1.24		1.21		3.35	

Table 9. Continued

	Cache County		Sanpete County		Aggregate Data	
	Rural-farm	Urban-farm	Rural-farm	Urban-farm	Rural-farm	Urban-farm
Attitude concerning chores for children						
Very important	50	9	50	11	100	20
Fairly important	2	0	1	4	3	4
Not important	1	0	0	0	1	0
χ^2	0.54		6.88*		7.35*	
Farm type						
Crop	12	0	2	1	14	1
Dairy	30	3	17	0	47	3
Other livestock	11	6	32	14	43	20
χ^2	8.69*		6.77*		13.76**	

*Significant at 5 percent level.
**Significant at 1 percent level.

Table 10. Means, standard deviations, and F-values[i] of selected variables after reclassification--Commercial farms.

		Cache County		Sanpete County		Aggregate Data	
		Rural-farm	Urban-farm	Rural-farm	Urban-farm	Rural-farm	Urban-farm
Age of operator	$\bar{X}$	51.32	52.78	53.43	49.40	52.36	50.67
	S	11.44	12.35	12.78	8.48	12.10	9.98
	F	0.12		1.32		0.40	
Years of college for operator	$\bar{X}$	1.02	1.11	0.94	2.47	0.98	1.96
	S	1.49	2.67	1.57	2.33	1.52	2.49
	F	0.02		8.69**		6.13*	
Years of college for wife	$\bar{X}$	0.89	1.33	0.88	1.60	0.88	1.50
	S	1.38	1.73	1.44	1.84	1.40	1.77
	F	0.75		2.53		3.39	
Number of school-age children	$\bar{X}$	2.17	1.11	1.78	1.93	1.98	1.63
	S	2.15	1.90	2.02	1.79	2.09	1.84
	F	1.93		0.07		0.59	
Net income	$\bar{X}$	10,484.72	10,222.22	8,932.71	12,100.00	9,723.63	11,395.83
	S	5,146.62	5,190.80	5,879.09	6,285.47	5,546.06	5,855.10
	F	0.02		3.26		1.74	
Off-farm income	$\bar{X}$	16.70	41.11	12.41	15.40	14.60	25.04
	S	25.29	33.05	22.68	17.92	24.02	27.15
	F	6.55*		0.22		3.51	
Remoteness	$\bar{X}$	8.28	6.11	7.75	2.47	8.02	3.83
	S	4.85	11.08	4.32	1.55	4.58	6.89
	F	1.00		21.41**		13.24**	

Table 10. Continued

		Cache County		Sanpete County		Aggregate Data	
		Rural-farm	Urban-farm	Rural-farm	Urban-farm	Rural-farm	Urban-farm
Years farm has been in family	$\bar{X}$	50.45	53.67	42.80	32.47	46.70	40.42
	S	30.82	32.18	29.87	28.48	30.45	31.35
	F	0.08		1.53		0.82	
Acres irrigated	$\bar{X}$	100.87	119.44	151.90	193.20	125.89	165.54
	S	106.63	155.01	156.08	148.52	134.99	152.04
	F	0.20		0.83		1.60	
Capital-labor ratio	$\bar{X}$	339.06	371.67	171.37	476.80	256.83	437.38
	S	401.47	283.95	133.84	578.13	311.70	483.94
	F	0.05		12.41**		5.20*	

*Significant at 5 percent level.
**Significant at 1 percent level.
[1]Error degrees of freedom equals 60 for Cache County, 64 for Sanpete County, and 126 for aggregate data.

noncommercial farms and then reclassifying the data according to the new definition of on-farm-off-farm residence, the off-farm samples were quite small, being 9 and 15 for Cache and Sanpete Counties respectively. In some cases the expected cell frequencies are less than five, thus, casting suspicion on the results. It was not possible to perform a meaningful discriminant analysis with such small sample sizes.

Comparison is first made between Tables 3 and 9 which contain only categorical variables. Farm tenure was not significant before noncommercial farms were excluded and is not significant afterwards. The variable representing background of the wife is still not significant. Regarding church activity, it is insignificant on all counts for both the husband and the wife, whereas, it was significant at the aggregate level for the wife before noncommercial farms were excluded. The variables representing attitude towards farm chores and farm type show the same significance as before.

Next, Tables 5 and 10, which contain only quantitative variables, are compared. The age of the operator is still not significant. Apparently the proportion of operators over sixty-five that were excluded was about the same for the on-farm group as the off-farm group. Some change was noted for the variable representing the educational attainment of the operator. It is no longer significant for Cache County but it resulted in the off-farm operators of Sanpete County having significantly more college education than on-farm operators where no significance was noted before. Off-farm wives in Cache County showed significantly more years of college in Table 5, whereas, when looking only at commercial farms no significance was

noted in either county. The variable representing the number of school-age children is insignificant on all counts when looking only at commercial farms, whereas, on-farm families in Cache County had significantly more than off-farm families when looking at the original sample.

Exclusion of the noncommercial farms did not bring about any significance in the variable representing net income (Table 10). As can be seen in Table 5, the only significance was for the aggregate data. A look at the mean values may be of interest. It appears that a significant number of low income on-farm residents of Cache County were excluded since the average net income increased after exclusion of noncommercial farms. However, the mean value for net income of the off-farm group in Cache County decreased, suggesting that it was mostly high income operators earning under $2500. net income from the farm that were excluded. In Sanpete County the average net income for both on-farm and off-farm residents increased. This, coupled with the fact that the mean age of operators for both groups also decreased suggests that those excluded were primarily partially retired farmers over age 65.

It was expected that exclusion of noncommercial farm operators would affect the results of the variable representing off-farm income as a percent of total net income. It did. The variable is no longer significant for either county. Previously it was significant for Cache County and for the aggregate data with off-farm residents earning significantly more net income from off-farm sources. This seems to confirm the conclusion reached in the previous paragraph that at least in Cache County, it was mainly high income families earning most of

their income from off-farm sources that were excluded. Another point is of interest. The mean values for off-farm income as a percent of total net income of both on- and off-farm families were drastically reduced for both counties as a result of excluding noncommercial farms. This also suggests that low net farm income rather than age of the operator was responsible for the exclusion of many of the noncommercial farms.

A change was noted for remoteness. This variable was unambiguously significant before exclusion of noncommercial farms but not significant for Cache County afterwards. It is interesting to note that for both counties, there is not much difference in the mean distance from farm to service center for the on-farm groups. There is an increase, however, in the mean distance for the off-farm group in Cache County. It appears that the farms of noncommercial operators are generally closer to their place of residence (service center) than those of commercial operators. Possibly some of these are hobby farmers. It could be that some of the noncommercial operators living on farms and in small towns are also hobby farmers. However, it appears, upon examination of the questionnaires for the noncommercial operators living on farms, that several were bonafide farmers at one time. It may be that some found they could not make a decent living solely from the farm and sought off-farm employment to supplement their income.

Regarding the years the farm has been in the family, the variable is still insignificant on all counts after exclusion of noncommercial farms. Not much change is noted in the capital-labor ratio. Initially it was significant only for Sanpete County. Now the significance for Sanpete County has increased some, resulting in a carryover of the

significance into the aggregate data. The change was due largely to a substantial increase in the capital-labor ratio for off-farm residents.

It is difficult to assess the value of excluding all noncommercial operators from the samples. Part of the difficulty comes from the fact that the sample sizes for the off-farm groups were quite small after excluding noncommercial farms. It is not certain how much reliability can be placed on the results. On the other hand, many of the variables pertain as much to farm families operating noncommercial farms as to those operating commercial farms. It would seem that there is value in comparing the characteristics of all on-farm residents with all off-farm residents engaged in farming. In fact, farm residents living on the farm and operating noncommercial farms may be among those most likely to shift residence off the farm.

Supplementary Analyses

In the process of collecting data relating specifically to the hypotheses, other information was obtained. For example, data pertaining to the consumption of diversionary activities, number of trips to the farm and to town, attitudes regarding school consolidation, and other information relating to residence location were put in the questionnaires. Although not included in the empirical tests of the model for one reason or another, much of the additional data seems of sufficient interest to merit comment. The discussions which follow will be based on reclassified data, where appropriate, unless otherwise specified.

Consumption of diversion activities

Data with respect to the consumption of diversion activities were obtained. That is, farm families were asked to estimate annual attendance at movies, plays and concerts, athletic events, and their participation in other recreational activities such as bowling, swimming, golf, etc. Assuming that rural-farm residents have to travel farther to "consume" these goods than urban-farm residents it is hypothesized that they will "consume" less because it costs them more. However, some rural-farm residents live closer to a theater, and possibly other places of diversion, than some urban-farm residents because not all service centers have these facilities.[20] As an aid to interpreting the results of the analyses, the distance to the place of consumption of each of the four types of diversion activities will also be analyzed. If distances are significant, then more confidence might be placed in the consumption statistics.

Only 58 percent of the farm families had children living at home. To examine the average consumption of diversion activities of children and the family as a whole, does not tell the entire story. It, therefore, seems appropriate to not only analyze the data in terms of the entire sample but to also analyze the data for a reduced sample, excluding all data for families without children. Table 11 relates to the entire sample while Table 12 pertains only to families with children.

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[20] In Sanpete County, Mt. Pleasant, Ephraim, Manti, and Gunnison were designated as service centers. However, not all of these towns have facilities for each of the activities mentioned. There is a movie theater and a swimming pool in each town. Ephraim is the only town with a bowling alley. A golf course is presently being built between Manti and Gunnison. It may be that these four towns, none of which is very large, in effect operate as one town.

Table 11. Means[i], standard deviations, and F-values of variables relating to diversion activities of farm families after reclassification.

		Cache County		Sanpete County		Aggregate Data	
		Rural-farm	Urban-farm	Rural-farm	Urban-farm	Rural-farm	Urban-farm
Total annual movies of parents	$\bar{X}$	8.41	10.09	5.13	7.91	6.77	9.00
	S	1.25	10.46	6.81	7.89	5.13	9.23
	F	0.33		2.66		1.72	
Average annual movies per family member	$\bar{X}$	5.75	5.56	6.58	9.18	6.17	7.37
	S	5.74	6.21	7.75	9.14	6.81	7.94
	F	0.02		1.79		0.99	
Distance to movies	$\bar{X}$	8.56	3.91	5.90	1.50	7.23	2.70
	S	7.17	3.28	4.71	2.15	6.19	3.00
	F	8.73**		17.98**		22.01**	
Total annual plays & concerts of parents	$\bar{X}$	3.15	6.64	4.10	6.55	3.63	6.59
	S	4.56	9.16	4.92	6.74	4.75	7.95
	F	6.06*		3.56		9.59**	
Average annual plays and concerts per family member	$\bar{X}$	1.58	3.36	2.09	2.78	1.84	3.07
	S	2.00	4.20	2.77	2.60	2.42	3.47
	F	7.84**		1.10		7.27**	
Distance to plays and concerts	$\bar{X}$	6.47	3.27	7.28	1.73	6.88	2.50
	S	7.33	3.33	12.54	2.25	1.02	2.91
	F	3.95		4.25*		7.83**	
Total annual athletics of parents	$\bar{X}$	10.83	18.82	5.92	10.18	8.38	14.50
	S	13.90	21.78	13.40	11.38	13.83	17.72
	F	4.93*		7.53**		12.20**	

Table 11. Continued

		Cache County		Sanpete County		Aggregate Data	
		Rural-farm	Urban-farm	Rural-farm	Urban-farm	Rural-farm	Urban-farm
Average annual athletics per family member	$\bar{X}$	6.25	8.84	3.33	5.60	4.79	7.22
	S	7.49	10.66	6.59	5.08	7.18	8.41
	F	1.67		2.23		3.62	
Distance to athletic events	$\bar{X}$	7.71	2.68	3.86	0.86	5.78	1.77
	S	7.61	3.12	8.39	1.25	8.21	2.52
	F	9.11**		2.77		10.18**	
Total annual recreation of parents	$\bar{X}$	5.21	11.27	2.71	7.50	3.96	9.39
	S	10.99	22.18	12.00	24.09	11.54	2.30
	F	3.15		1.66		4.63*	
Average annual recreation per family member	$\bar{X}$	4.21	6.92	2.77	9.90	3.49	8.41
	S	6.06	10.47	4.92	12.40	5.55	11.44
	F	0.24		16.77**		15.80**	
Distance to recreation	$\bar{X}$	6.49	2.00	5.90	1.04	6.19	1.52
	S	9.32	2.98	8.21	1.84	8.76	2.49
	F	4.93*		7.53**		12.20**	

*Significant at 5 percent level.
**Significant at 1 percent level.
[i]Refers to number of times attended or miles to place of attendance.

Table 12. Means[i], standard deviations, and F-values of variables relating to diversion activities of farm families with children after reclassification.[ii]

		Cache County		Sanpete County		Aggregate Data	
		Rural-farm	Urban-farm	Rural-farm	Urban-farm	Rural-farm	Urban-farm
Average annual movies per child	$\bar{X}$	9.71	10.60	15.84	22.25	12.65	16.95
	S	7.83	11.50	13.63	15.48	11.32	14.75
	F	0.08		1.97		2.28	
Average annual movies per family member	$\bar{X}$	7.57	8.53	10.34	15.17	8.88	12.15
	S	5.78	7.53	8.22	8.17	7.14	8.41
	F	0.21		3.26		3.48	
Distance to movies	$\bar{X}$	9.94	5.10	7.80	2.42	8.92	3.63
	S	6.09	2.77	3.43	2.57	5.10	2.94
	F	5.99*		25.48**		21.83**	
Average annual plays and concerts per child	$\bar{X}$	1.27	2.80	1.84	2.67	1.53	2.73
	S	1.77	4.73	2.33	1.61	2.06	3.31
	F	3.18		1.32		4.58*	
Average annual plays and concerts per family member	$\bar{X}$	1.76	4.13	2.37	3.79	2.05	3.94
	S	2.07	5.34	2.94	2.43	2.52	3.92
	F	5.75*		2.34		7.94*	
Distance to plays and concerts	$\bar{X}$	6.94	3.30	9.68	2.75	8.24	3.00
	S	6.55	3.30	15.18	2.63	11.49	2.89
	F	2.91		2.45		4.47*	
Average annual athletics per child	$\bar{X}$	5.71	6.60	4.20	8.00	5.00	7.36
	S	6.76	10.48	5.20	6.03	6.29	8.16
	F	0.12		4.09*		2.23	

Table 12. Continued

		Cache County		Sanpete County		Aggregate Data	
		Rural-farm	Urban-farm	Rural-farm	Urban-farm	Rural-farm	Urban-farm
Average annual athletics per family member	$\bar{X}$	7.52	9.24	3.86	7.77	5.79	8.44
	S	7.82	10.74	4.59	4.83	6.72	7.89
	F	0.35		6.68*		2.59	
Distance to athletics	$\bar{X}$	9.04	3.30	4.57	1.25	6.92	2.18
	S	7.06	3.30	6.39	1.54	7.08	2.65
	F	6.26*		3.15		9.50**	
Average annual recreation per child	$\bar{X}$	7.78	12.00	5.77	19.42	6.83	16.05
	S	8.68	12.53	7.28	14.08	8.07	13.63
	F	1.68		21.23**		17.27**	
Average annual recreation per family member	$\bar{X}$	6.23	10.32	4.32	18.15	5.33	14.59
	S	6.61	12.92	5.53	11.42	6.17	12.48
	F	2.20		35.40**		25.49**	
Distance to recreation	$\bar{X}$	8.94	3.30	10.14	1.92	9.51	2.55
	S	10.03	3.30	8.75	2.15	9.41	2.76
	F	3.06		10.30**		11.72**	

*Significant at 5 percent level.
**Significant at 1 percent level.
[i]Refers to number of times attended or miles to place of attendance.
[ii]Sample sizes are as follows: Cache County rural-farm = 49, urban-farm = 10; Sanpete County rural-farm = 46, urban-farm = 12; Aggregate rural-farm = 95, urban-farm = 22.

Still another way of looking at the consumption of diversion is to hypothesize a functional relationship between consumption and selected variables and perform regression analyses. For each of the four diversion activities, it is hypothesized that consumption is a function of distance, net income, and age of the operator, recognizing that this is not strictly an on-farm-off-farm analysis since some families living on-farm live closer to places of diversion than some off-farm families. Two sets of regressions were run for each county and for the aggregate data; one for the entire sample and one for the sample comprised only of the families with children living at home. The regression coefficients, t-values, and multiple correlation coefficients, for regressions showing some statistical significance, are found in Appendix C.

Each of the four types of activities will be discussed in turn without restating the hypothesis or alluding to the fact that some urban-farm families live farther from the places of consumption than do some rural-farm families.

Movie attendance. The variable representing total annual movie attendance of the parents is not significant for either county or for the aggregate data, as shown in Table 11. Furthermore, the average annual attendance per family member failed to show any significance. However, the distance to the movie theater is highly significant in every case. Although rural-farm residents generally live farther from the theater than urban-farm residents, there does not appear to be any significant difference in movie attendance. Moreover, when the data were analyzed only for families with children, there still was no significant difference in attendance. The added time and travel costs,

incurred by rural-farm families, apparently does not influence their consumption of this good. On the other hand, there may be more substitutes for movies available to urban-farm families.

The only regressions that showed significance were average annual movie attendance per family member in Cache County and total annual movie attendance of parents in Sanpete County. Relevant statistics are given in Appendix C. With regards to per capita consumption of movies in Cache County, all coefficients have significant t-values except the one representing net income. The sign of the coefficient for age of the operator is negative as expected. That is, movie attendance per family member decreases as the age of the operator increases. What is surprising is the positive sign for the coefficient representing distance to the theater. It appears that movie attendance increases with distance.

With respect to movie attendance of parents in Sanpete County, the t-values for all coefficients are significant. The signs of the coefficients are as expected except for the one representing distance. That is, a positive correlation between distance and movie attendance is noted, suggesting that movies are looked upon as an inferior good with the income effect outweighing the substitution effect.

Plays and concerts. Urban-farm residents in Cache County appear to attend more plays and concerts than on-farm residents (Table 11). Annual attendance of parents is significant at the 0.05 level while annual attendance per family member is significant at the 0.01 level. However, the difference in distance is not significant. When analyzed only for families with children there did not appear to be any difference in the results for Cache County (Table 12). The per capita consumption

is still significantly higher for urban-farm residents. A partial explanation may be that urban-farm families are more aware of such things as plays and concerts than on-farm families, whereas, rural- and urban-farm residents are equally aware of movies since theaters are generally open most days of the week. Hence, urban-farm residents could substitute plays and concerts for movies more readily than rural-farm residents because of their increased awareness of such presentations. The fact that movie attendance is not significantly higher for urban-farm residents even though they live closer to the theater seems also to suggest that they have substitutes for movies. The variable is not significant when analyzed in terms of children alone.

In Sanpete County, none of the results is statistically significant. No matter how attendance at plays and concerts is viewed, the differences in consumption by rural-farm residents are not significantly different than for urban-farm residents. This may be partly due to the limited number of such presentations in Sanpete County. Snow College at Ephraim presents a few plays and concerts each year, but nothing like the number presented at Utah State University.

In looking at aggregate data, urban-farm residents do attend significantly more plays and concerts than rural-farm residents. Moreover, they live significantly closer than families residing on the farm. Only the average annual consumption per child, for families having children at home, does not show significance.

None of the regressions showed any significance when looking at the multiple correlation coefficients, although the t-value for the coefficient representing distance was significant for Cache County and for the aggregate data.

What conclusions can be drawn from all this? Any attempt to link the consumption of plays and concerts with distance to the place of consumption for Cache and Sanpete County residents separately would appear hazardous. However, when viewed in the aggregate, there does appear to be a possible relationship.

An additional comment may be in order. Recall that movie attendance of parents living on farms in Cache County was not significantly different than for urban-farm residents even though the urban-farm residents live closer to the theater. It was suggested that perhaps off-farm residents have better substitutes for movies. Urban-farm residents in Cache County attend significantly more plays and concerts than rural-farm residents. This would suggest the possibility that urban-farm residents substitute plays and concerts for movies. Perhaps the fact that urban-farm operators, as well as wives, have attended more years of college is in some way related to this phenomenon. Moreover, the presence of a university makes such activities readily available to those who are aware of up-coming presentations.

Athletic events. Farm operators and wives were asked how many times a year they attended athletic events. The children were asked how many times a year they participated in athletic events. Hence, the consumption figures per family member is a combination of attendance on the part of the parents and participation on the part of the children.

When looking at all farm families, the attendance of parents at athletic events is significantly higher for urban-farm residents than for rural-farm residents for both Cache County and for the aggregate data. Moreover, distance is significant for Cache County and the

aggregate data (Table 11). No significance is noted for Sanpete County. No differences for either county are noted when consumption is viewed on a per capita basis. When looking only at farm families with children there are no significant differences in consumption for Cache County nor for the aggregate data but distances are significant (Table 12). Children in Sanpete County who live in larger towns participate more in athletic events than children who live on the farm. Furthermore, when looking at the average annual consumption per family member, urban-farm residents in Sanpete County consume significantly more than do rural-farm residents. However, the difference in distance is not significant.

Multiple correlation coefficients are not significant for any of the regressions. However, t-values for the coefficients representing distance are significant.

Other recreational activities. Farm families were asked to estimate the number of times a year that they participated in bowling, golf, swimming, etc. The sum of these represents the annual consumption of recreation. The only significance noted for parents was for the aggregate data. Urban-farm couples consume significantly more recreation than rural-farm couples (Table 11). When looking at the average per family member, there is no difference for Cache County but the variable is highly significant for Sanpete County and the aggregate data. Distance is significant in all cases.

After excluding all families without children, the consumption data for recreation for children and per family member was analyzed. No significance in consumption or distance is noted for Cache County. However, consumption differences and the distance differences are

highly significant for Sanpete County and for the aggregate data.

As with most other diversion activities, the regressions are not significant.

Trips to town

On-farm residents were asked to estimate the average number of trips made to town per week for broad categories of reasons, excluding trips to work if they worked off the farm.[21] In most cases, more than one town was involved. They went to church in the nearest town while other needs, such as shopping and farm business, quite often took them to other towns. This question was designed for a strict on-farm-off-farm classification, hence, only those who actually live on the farm answered the question. As can be seen from Table 13, the frequency of trips for shopping and farm business was greater than for any other single reason. An estimated 65 shopping trips and 87 farm business trips are made in a typical week by the 50 on-farm families in Cache County. These two categories represent about 48 percent of the total trips to town. Looking at total trips for all reasons, on-farm residents in Cache County make an average of 6.18 trips to town in a typical week. On-farm residents of Sanpete County make an estimated 9.44 trips per week per family. Shopping and farm business are responsible for over 50 percent of these trips.

Trips to the farm

The counterpart of the previous question was to ask farm families that live in towns to estimate the average number of trips they make

[21]Figures were arrived at by having the family estimate the average number of trips per week by season then averaging for the entire year.

Table 13. Totals, means[i], and standard deviations for trips to town per week for various reasons, and a comparison with weekly trips to the farm.[ii]

		Cache County	Sanpete County	Aggregate Data
Household shopping	ΣX	65.00	115.00	179.00
	$\bar{X}$	1.28	2.19	1.79
	S	0.70	2.30	1.79
School Activities	ΣX	32.00	34.00	66.00
	$\bar{X}$	0.64	0.68	0.66
	S	1.18	2.00	1.64
Church Activities	ΣX	59.00	67.00	126.00
	$\bar{X}$	1.18	1.34	1.26
	S	1.38	1.52	1.45
Music Lessons	ΣX	19.00	23.00	42.00
	$\bar{X}$	0.38	0.46	0.42
	S	0.79	0.85	0.83
Farm Business	ΣX	87.00	144.00	231.00
	$\bar{X}$	1.74	2.88	2.31
	S	1.61	2.95	2.43
Recreation	ΣX	30.00	59.00	89.00
	$\bar{X}$	0.60	1.18	0.89
	S	0.49	2.86	2.14
Other	ΣX	18.00	22.00	40.00
	$\bar{X}$	0.36	0.44	0.40
	S	1.14	1.38	1.25
Total for all Reasons	ΣX	309.00	472.00	781.00
	$\bar{X}$	6.18	9.44	7.81
	S	3.61	9.45	7.30

		On-Farm	Off-Farm	On-Farm	Off-Farm	On-Farm	Off-Farm
Total Trips to Town (farm)	$\bar{X}$	6.18	9.80	9.44	12.94	7.81	11.37
	S	3.61	5.43	9.45	7.73	7.30	6.83
	F	15.42**		4.11*		12.69**	

[i] Means found by dividing the total trips by sample size of 50 for counties and 100 for aggregate data.

[ii] Based on the original classification.

to the farm per week. Those in Cache County average 9.80 trips to the farm per week, while those in Sanpete County average 12.94 trips. As can be seen from Table 13, off-farm residents in both counties make significantly more trips to the farm per week than on-farm residents make to town. This is possibly due to the fact that most farm operators have livestock of some kind that they check on or feed at least once a day.

One wonders how many trips would be made to town in a typical week by the off-farm residents if they were living on the farm. The fact that off-farm residents in Cache County have fewer school-age children would seem to dispel the idea that they would make more trips if they lived on the farm. Moreover, there is no significant difference in the number of school-age children per family in Sanpete County. It would appear that less money would be spent in travel if the off-farm families moved to the farm. There must be other advantages of living in town that outweigh this pecuniary disadvantage.

Reasons given for moving off-farm

A main objective of this study was to learn something about the reasons for the alleged trend to off-farm residence. It was hoped that a sizable number of off-farm residents in the samples had shifted residence so that selected variables, thought to be important in residence shifts, could be tested. However, only two farm operators in Cache County and three in Sanpete County had ever lived on the farm. All the other off-farm operators had lived in town all their married lives, and most of them since they were born. One of the two in Cache moved off the farm 8 years ago at the age of 51 to let his son live on

the farm. The other is presently a professor at Utah State University. He and his family lived on their farm only during the summers up until 10 years ago. Now they live in town the year-round. The farm is located in Box Elder County and there is no electricity on the farm.

Of the 3 families in Sanpete County that moved into town, one moved 25 years ago when the operator was 34 years of age. The house was old and in need of repair and there was no electricity and no telephone. The farm is located 5 miles from their present home. Another moved into town 5 years ago from a farm 9 miles away. The operator was age 66 at the time. They wanted to let their married daughter live in the farm house. The other operator moved 23 years ago at the age of 40. He had been in partnership with his brother and when they split up he had no place to live.

Since only a very few farm families actually shifted residence off-farm, a definite pattern of reasons for shifting cannot be established. It does appear that two of the five that moved off the farm may have been influenced by reasons related to inadequate housing on the farm. It was hypothesized in Chapter II that the age and condition of farm housing would influence decisions regarding place of residence.

What conclusions can be drawn from these results? Recall that the census data for Cache and Sanpete Counties, as presented in Table 1, indicate an increase in the percentage of off-farm residency. The data were interpreted as being indicative of a trend to shifting residence off the farm. However, the data collected for this study do not show this. The samples should surely have picked up any shifting of residence since 1959. It may be that the extension of town limits of towns like Lewiston, to include a large number of surrounding farms,

has resulted in more operators reporting off-farm residence. While this is possible it does not seem probable. Still there has to be some explanation. Perhaps the assumption that off-farm operators leave agriculture at the same rate as operators living on the farm is not reasonable. It may be that operators living on the farm are leaving agriculture at a greater rate than those living off the farm. Moreover, an increasing number of off-farm residents may be entering agriculture. There appears to be strong evidence of this from the data collected for this study. Operators were asked how many years they had been farming their own farm. In both counties, the number of operators living in urban centers that had farmed for 10 years or less is double the number living on farms that have farmed 10 years or less. Based on these samples, twice as many urban-farm residents are entering agriculture as rural-farm residents. Although several operators were in their early twenties when they became operators, there was an insufficient number to establish a definite pattern. A larger sample might reveal that the younger generation farm operators are generally establishing residence off-farm right from the beginning. As it stands now, all that can be said is that there appears to be more evidences that the increasing percentage of off-farm residence in Cache and Sanpete Counties is due to an increasing number of operators entering agriculture as off-farm residents rather than a shift of residence from farm to town.

Reasons for wanting to move off the farm

Very few off-farm residents had ever lived on the farm, as discussed earlier. However, those living on-farm were asked if they were

considering shifting their residence into town. In Cache County, not one single farm family was considering moving to town. Two on-farm families in Sanpete County have considered shifting residence. One of these is an older couple who want to retire and let their son take over the farm. The other family has talked about moving into town and "relax" a little. The operator is 56 years old and there are 2 children still living at home.

It appears that no big shift of residence from farm to urban centers will take place in the near future in Cache and Sanpete Counties. On-farm families are apparently content to live on the farm for the present. Extension agents and personnel in ASC offices in several other counties in Utah were asked about residence shifts. Indications are that there has been very little shifting during the past 20 years and very little is expected in the near future.

Reasons for not moving to town

Farm families living on-farm were presented with several reasons which might explain why they preferred to live on the farm. They were asked to rate the reasons according to importance. Many checked only one reason while others did not answer the question clearly. Therefore, the data for some could not be used. Table 14 reflects only those that gave unambiguous answers. As can be seen, the main reason Cache and Sanpete County residents gave for not moving to town was that they just didn't care for city life. Other reasons were the desire to provide chores for the children and the sentimental value of the farm. In Sanpete County these same reasons appear to be important but many checked "other" reasons as well.

Table 14. Reasons given for not moving into town and frequency of response for each reason.[i]

	Farm Has Sentimental Value	Children Need Chores To Do	Don't Care For City Life	Cheaper to Own a House on the Farm	Other
Cache County					
1st or main reason	5	2	14	1	5
2nd reason	2	7	3	4	2
3rd reason	5	3	2	2	1
Totals	12	12	19	7	8
Sanpete County					
1st or main reason	0	3	17	4	14
2nd reason	6	8	0	1	0
3rd reason	3	1	2	1	2
Totals	9	12	19	6	16

[i]Respondents were asked to rate the reasons in order of importance. Some checked only one reason while others checked two or three reasons.

Those considering moving to the farm

Farm families living in town were asked if they were giving serious thought to moving out to the farm. It appears that more farm families want to move to the farm than move off the farm. Whether they will actually move is another question. There were six families in Cache County and six in Sanpete County that have considered moving. The main reason given is the desire to provide the children with definite responsibilities and to be closer to work. All 12 families have children, averaging 4 per family.

Consolidation of schools

There is probably little doubt as to what was expected with regard to an opinion poll on this subject. Rural-farm residents, including those in small communities, were expected to be against the consolidation of county schools. In fact, residents of small communities may be more firmly opposed to consolidation than on-farm residents. Children living on the farm must ride the bus regardless, whereas, children living in communities with schools will only have to ride the bus if their school is closed down.

It was not surprising that this variable was insignificant in Cache County. Many respondents said they were originally against consolidation but they like it now. This is no doubt partially responsible for the lack of significance. In Sanpete County, however, this was a very hot issue at the time the data were collected. Despite this fact, the variable was not significant. A possible explanation is that some of the service centers will lose schools. Only one of the four largest towns, which were designated as service centers, will

Table 15. Contingency tables and resulting chi-square values relative to attitude towards consolidation of schools--reclassified data.

	Cache County		Sanpete County		Aggregate Data	
	Rural-farm	Urban-farm	Rural-farm	Urban-farm	Rural-farm	Urban-farm
Consolidation of schools						
In favor	54	15	14	8	68	23
Against	12	5	51	9	63	14
No opinion	12	2	13	5	25	7
χ^2	1.03		4.71		1.22	

have a high school. Another will get the junior high school. There is even talk of closing down some of the elementary schools with possibly two of the service centers being without an elementary school. This no doubt accounts for the fact that 41 percent of the urban-farm residents were against consolidation.

Conclusions

Very few farm families are moving off the farm. Since there is no evidence of a trend to shifting residence off the farm in these counties, definite statements regarding the relevance of the variables used in this study to analyze residence shifts would be hazardous. Interpretations of the results must be couched within the framework of different patterns of living due to residence location rather than a framework of residence shifts due to different patterns of living. In other words, the analysis has more relevance as it pertains to residence choice rather than to residence shifts.

Census data for Cache and Sanpete Counties reveal an increase in the percentage of farm operators residing off-farm. It appears that this is due in part to an increased number of operators entering agriculture from the off-farm sector rather than a trend to shifting residence off the farm. During the past 10 years twice as many farm operators entered agriculture from the off-farm sector in these two counties as from the on-farm sector.

Despite the lack of evidence of a trend to off-farm residence in Utah, an off-farm migration may yet start in the future. There appears to be distinguishing characteristics of rural-farm families, including the type of farm operated, that tend to set them apart from farm

families living in the larger urban centers. The variables reflecting these characteristics may be helpful in predicting residence shifts in a trend yet to begin in some areas. Moreover, these variables may prove useful in studying residence shifts in areas where such shifts are actually taking place. However, a word of caution is offered. Residence patterns of farm families in Utah may not be typical of the nation as a whole due to the fact that Mormon pioneers tended to settle in towns rather than on farms. Nevertheless, there is reason to expect the variables to be just as relevant, or perhaps more so, for other areas as for Utah.

Regarding classification of farm operators by residence type, it appears more appropriate to place those living in larger urban centers in one group and those living in small towns and on farms in the other group. Thus, residence classifications would be rural-farm and urban-farm rather than on-farm and off-farm.

Both the individual analysis of relevant variables and discriminant analysis appear useful. The isolation of families with "non-normal" characteristics for a particular group is simple with discriminant analysis. The discriminant function would place families in either the on- or off-farm group. Those that are misplaced would be those most suspect of shifting residence in the future. A further test of the discriminant functions resulting from this study would be to collect data from areas where shifts are occurring and enter the data into one of the functions appearing in Appendix A. While the results may prove very promising, the determination of discriminant functions for each geographical area of study should be considered.

The predictive accuracy of the discriminant functions was generally

greater when all variables were included, than when only "significant" variables, as determined by analysis of variance and independence chi-square tests, were used (Table 24). However, the predictive ability of the discriminant functions using only "significant" variables was acceptable and should be considered, especially if research is carried out under a limited budget.

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APPENDIXES

Appendix A

Discriminant Functions

Programs used

The analysis was performed using 4 of 7 individual programs written by Hurst (1971) for discriminant function analysis and classification. These were:

1. (MACRDT)- Multivariate analysis of variance--completely randomized design with transformations.
2. (SDF) - Stepwise discriminant function with optional subsets.
3. (ODF) - Orthogonal discriminant function.
4. (DFS) - Discriminant function scores.

The first program is used to perform multivariate tests on equality of group dispersions and group centroids. Error and treatment variance-covariance matrices are produced and stored for further use.

The next phase is a stepwise discriminant analysis which uses basic computations predpared by MACRDT. The trace of the matrix $(W^{-1}A)$ is used as an indication of discriminating power, where

W = error variance-covariance matrix

A = group variance-covariance matrix .

Given a specific model, the variable contributing the least to the composite trace is the first to be deleted. Dummy variables are treated as subsets and all dummy variables pertaining to a particular categorical variable are deleted as a subset. Tables 16 and 17 show the deletion orders for the original data and for the reclassified data respectively.

Table 16. Deletion orders of variables and resulting composite trace values.[i]

Cache County		Sanpete County		Aggregate Data	
Variable	Composite Trace	Variable	Composite Trace	Variable	Composite Trace
Capital-labor ratio	42.32	Age of operator	40.45	Operator holds Church position	45.75
Years college of operator	42.32	Years farm has been in family	40.44	Capital-labor ratio	45.72
Background of wife	42.32	Years college of wife	40.33	Remoteness	45.65
Years farm has been in family	42.31	Operator holds church position	40.09	Age of operator	45.45
Net income	42.28	Wife holds church position	39.45	Acres irrigated	45.30
Farm type	42.24	Off-farm income	39.14	Years college of wife	44.80
Age of operator	41.77	Acres irrigated	38.46	Years farm has been in family	44.06
Acres irrigated	41.21	Capital-labor ratio	38.12	Wife holds church position	43.19
Remoteness	40.30	Farm tenure	37.84	Farm tenure	41.98
Operator holds church position	39.62	Number of school-age children	36.84	Off-farm income	40.05
Farm tenure	38.50	Remoteness	34.85	Number of school-age children	37.14

Table 16. Continued

Cache County		Sanpete County		Aggregate Data	
Variable	Composite Trace	Variable	Composite Trace	Variable	Composite Trace
Wife holds church position	35.97	Years college of operator	31.95	Years college of operator	34.56
Years college of wife	32.30	Background of wife	28.53	Background of wife	30.44
Off-farm income	23.91	Net income	23.41	Net income	26.17
Number of school-age children	11.39	Farm type	17.76	Farm type	17.50

[i]The composite trace values are values after the preceding variable(s) has been deleted. In other words, it is the composite trace for a model comprised of the variable opposite the trace value and all variables following it.

Table 17. Deletion orders of variables and resulting composite trace values after reclassification.

Cache County		Sanpete County		Aggregate Data	
Variable	Composite Trace	Variable	Composite Trace	Variable	Composite Trace
Background of wife	55.00	Off-farm income	75.25	Years farm has been in family	93.98
Years farm has been in family	54.77	Acres irrigated	75.24	Number of school-age children	93.96
Number of school-age children	54.43	Years college of wife	75.23	Operator holds church position	93.82
Acres irrigated	53.57	Years farm has been in family	75.22	Age of operator	93.00
Operator holds church position	52.11	Operator holds church position	75.14	Off-farm income	91.80
Net income	50.58	Capital-labor ratio	75.00	Farm tenure	90.01
Farm tenure	48.91	Number of school-age children	74.44	Years college of wife	87.92
Years college of operator	46.42	Farm tenure	73.64	Acres irrigated	85.39
Wife holds church position	42.87	Years college of operator	72.83	Capital-labor ratio	81.70
Farm type	39.51	Wife holds church position	71.75	Background of wife	78.68

Table 17. Continued

Cache County		Sanpete County		Aggregate Data	
Variable	Composite Trace	Variable	Composite Trace	Variable	Composite Trace
Capital-labor ratio	35.91	Age of operator	68.73	Wife holds church position	74.39
Age of operator	31.22	Net income	66.19	Net income	69.71
Off-farm income	25.64	Background of wife	59.01	Farm type	61.47
Remoteness	17.07	Farm type	52.28	Years college of operator	45.99
Years college of wife	6.39	Remoteness	34.92	Remoteness	28.77

[i]The composite trace values are values after the preceding variable(s) has been deleted. In other words, it is the composite trace for a model comprised of the variable opposite the trace value and all variables following it.

Discriminant functions were obtained by program ODF, again using computations prepared by MACRDT. The output consists of the weighting coefficients, group centroids, and variance of discriminant function scores (Tables 18-23).

The final phase of the analysis is the calculation of discriminant function scores using program DFS. The score of the i^{th} observation is given by the solution of:

$$\begin{bmatrix} X^*_{11} & \cdots & X^*_{1m} \\ \vdots & & \vdots \\ X^*_{n1} & \cdots & X^*_{nm} \end{bmatrix} \begin{bmatrix} b_1 \\ \vdots \\ b_m \end{bmatrix} = \begin{bmatrix} Z_1 \\ \vdots \\ Z_n \end{bmatrix}$$

where X^*_{ij} is the standard normal deviate of the j^{th} variable of the i^{th} observation, n is the number of observations, m is the number of variables, and b_j is the weighting coefficient. The score (Z_i) is compared with the centroids for each group and the observation placed in one of the groups on the basis of two different criteria. One is a chi-square criterion and the other uses a Baysian approach. The chi-square criterion, which was chosen for this study, yields the same results as the Baysian criterion when sample sizes for each group are equal. In testing a derived function against new data, the chi-square criterion is the simplest to use. All that is necessary is to compute the score (Z_i) and find the absolute difference between the score and each of the group centroids. The observation is placed in the group yielding the smallest absolute difference. For example, suppose new data are used with the coefficients given in Table 18 and a score of -0.95, for a particular observation, is computed. The absolute difference between

-0.95 and each of the centroids, as given at the end of Table 18, is computed. Since the difference is smallest for the rural-farm group, the observation is placed in that group.

Table 18. Coefficients for discriminant function after reclassification--Cache County.

	Code For Dummy Variable	Coefficients
Farm tenure		
Full owner	0	
Part owner	1	-0.1979845
Tenant	2	0.547919
Age of operator		0.03478722
Years college of operator		0.2061209
Years college of wife		0.3287032
Background of wife		
City	0	
Farm	1	-0.09673834
Number of school-age children		-0.1150884
Net income		0.00004920668
Off-farm income		0.01664765
Remoteness		-0.1318789
Operator holds church position		
No	0	
Yes	1	0.2619733
Wife holds church position		
No	0	
Yes	1	0.3798997
Years farm has been in family		-0.003321214
Farm type		
Dairy	0	
Crop	1	-0.1332592
Other livestock	2	-0.4876942
Acres irrigated		-0.001714355
Capital-labor ratio		0.001003389
Centroids: Rural-farm = 1.818051		Urban-farm = 4.088289
Variance for discriminant scores = 1.608063		

Table 19. Coefficients for discriminant function after reclassification--Sanpete County.

	Code For Dummy Variable	Coefficients
Farm tenure		
Full owner	0	
Part owner	1	0.1202633
Tenant	2	0.2124093
Age of operator		0.008717396
Years college of operator		-0.07206376
Years college of wife		0.008139748
Background of wife		
City	0	
Farm	1	0.4447975
Number of school-age children		-0.07237503
Net income		-0.00003742097
Off-farm income		0.0002604937
Remoteness		0.2166453
Operator holds church position		
No	0	
Yes	1	-0.05104635
Wife holds church position		
No	0	
Yes	1	-0.2125293
Years farm has been in family		0.001254007
Farm type		
Dairy	0	
Crop	1	0.7494688
Other livestock	2	-0.2749285
Acres irrigated		0.0001414213
Capital-labor ratio		-0.0003726487
Centroids: Rural-farm = 1.696967		Urban-farm = -0.2596759
Variance for discriminant scores = 1.608063		

Table 20. Coefficients for discriminant function after reclassification--Aggregate data.

	Code For Dummy Variable	Coefficients
Farm tenure		
Full owner	0	
Part owner	1	-0.3742309
Tenant	2	0.04709994
Age of operator		0.0151067
Years college of operator		0.2821581
Years college of wife		0.2224168
Background of wife		
City	0	
Farm	1	-0.2979655
Number of school-age children		-0.04084596
Net income		0.00009082249
Off-farm income		0.00769792
Remoteness		-0.255518
Operator holds church position		
No	0	
Yes	1	0.1882526
Wife holds church position		
No	0	
Yes	1	0.3896065
Years farm has been in family		-0.0008713703
Farm type		
Dairy	0	
Crop	1	-0.5821524
Other livestock	2	-0.2155899
Acres irrigated		-0.002546998
Capital-labor ratio		0.001309732
Centroids: Rural-farm = -0.06122375		Urban-farm = 2.542303
Variance for discriminant scores = 2.475229		

Table 21. Coefficients for discriminant function using only significant variables after reclassification--Cache County.

	Code For Dummy Variable	Coefficients
Years college of operator		0.1533005
Years college of wife		0.3619557
Number of school-age children		-0.3505137
Off-farm income		0.01557393
Remoteness		-0.04605182
Farm type		
Dairy	0	
Crop	1	-0.7488406
Other livestock	2	-0.3993766
Centroids: Rural-farm = -2.145426		Urban-farm = 0.740716
Variance for discriminant scores = 3.29659		

Table 22. Coefficients for discriminant function using only sigfificant variables after reclassification--Sanpete County.

	Code For Dummy Variable	Coefficients
Remoteness		-0.2917732
Farm type		
Dairy	0	
Crop	1	-0.9412512
Other livestock	2	0.1700383
Capital-labor ratio		0.001233581

Centroids: Rural-farm = -1.811588 Urban-farm = 0.4497768

Variance for discriminant scores = 1.545068

Table 23. Coefficients for discriminant function using only significant variables after reclassification--Aggregate data.

	Code For Dummy Variable	Coefficients
Years college of operator		0.1770099
Years college of wife		0.1800852
Net income		0.00006250382
Off-farm income		0.007655746
Remoteness		-0.03724882
Wife holds church position		
No	0	
Yes	1	0.571561
Farm type		
Dairy	0	
Crop	1	-0.7794407
Other livestock	2	0.02410073
Centroids: Rural-farm = -0.9401462		Urban-farm = 1.053724
Variance for discriminant scores = 2.040573		

Table 24. A comparison of the ability of discriminant functions using all variables in placing rural-farm and urban-farm residents in the proper group with discriminant functions using only "significant" variables-reclassified data.

	Rural-farm Group		Urban-farm Group		Overall Accuracy	
	All Variables	Significant Variables	All Variables	Significant Variables	All Variables	Significant Variables
Cache County	86%	82%	68%	77%	82%	81%
Sanpete County	86%	86%	91%	86%	87%	86%
Aggregate Data	85%	82%	77%	75%	83%	81%

Appendix B

Partial Correlation Coefficients

The partial correlation coefficients were calculated in order to ascertain the degree of multicollinearity present. These were computed from the variance-covariance matrix of each group. Thus, for each area, such as Cache County, there is a set of correlation coefficients for rural-farm data and another for urban-farm data. The correlation coefficients were examined for the original classification. However, since the degree of multicollinearity present was no more serious than for the reclassified data, it seems sufficent to present the correlation coefficients for the reclassified data only (see Tables 25 through 30).

Table 25. Partial correlation coefficients for reclassified data--Cache County rural-farm.

	Age of Operator	Yrs.College of Operator	Yrs.College of Wife	No.School-Age Children	Net Income	Off-Farm Income	Remoteness	Acres Irrigated	Capital-Labor Ratio
Age of Operator	1.000	-0.110	-0.064	-0.560	-0.308	-0.244	-0.026	-0.087	-0.175
Yrs. College of Operator		1.000	0.512	0.123	0.156	0.089	-0.049	0.120	-0.227
Yrs. College of Wife			1.000	0.017	0.312	-0.046	0.135	-0.008	-0.198
No. School-Age Children				1.000	-0.073	0.136	-0.061	0.314	-0.037
Net Income					1.000	-0.048	0.148	-0.001	0.192
Off-Farm Income						1.000	-0.089	-0.278	-0.070
Remoteness							1.000	-0.207	0.263
Acres Irrigated								1.000	-0.048
Capital-Labor Ratio									1.000

Table 26. Partial correlation coefficients for reclassified data--Cache County urban-farm.

	Age of Operator	Yrs. College of Operator	Yrs. College of Wife	No. School-Age Children	Net Income	Off-Farm Income	Remoteness	Acres Irrigated	Capital-Labor-Ratio
Age of Operator	1.000	-0.091	-0.018	-0.398	-0.333	-0.281	0.070	0.045	-0.228
Yrs. College of Operator		1.000	0.670	-0.121	0.486	0.462	0.602	-0.286	0.257
Yrs. College of Wife			1.000	-0.236	0.482	0.292	0.498	0.065	-0.145
No. School-Age Children				1.000	-0.230	-0.015	-0.135	-0.127	0.098
Net Income					1.000	0.744	0.481	0.042	0.078
Off-Farm Income						1.000	0.251	-0.252	-0.019
Remoteness							1.000	-0.231	0.265
Acres Irrigated								1.000	-0.024
Capital-Labor Ratio									1.000

Table 27. Partial correlation coefficients for reclassified data--Sanpete County rural-farm.

	Age of Operator	Yrs. College of Operator	Yrs. College of Wife	No. School-Age Children	Net Income	Off-Farm Income	Remoteness	Acres Irrigated	Capital-Labor Ratio
Age of Operator	1.000	-0.345	-0.155	-0.615	-0.241	-0.232	0.194	-0.005	-0.328
Yrs. College of Operator		1.000	0.398	0.169	0.179	0.230	0.002	0.015	0.510
Yrs. College of Wife			1.000	0.088	0.068	0.083	-0.048	0.048	0.085
No. School-Age Children				1.000	0.147	0.098	0.159	0.099	0.212
Net Income					1.000	0.047	-0.002	0.298	0.204
Off-Farm Income						1.000	0.090	-0.275	0.389
Remoteness							1.000	0.057	-0.061
Acres Irrigated								1.000	0.044
Capital-Labor Ratio									1.000

Table 28. Partial correlation coefficients for reclassified data--Sanpete County urban-farm.

	Age of Operator	Yrs. College of Operator	Yrs. College of Wife	No. School Age Children	Net Income	Off-Farm Income	Remoteness	Acres Irrigated	Capital-Labor Ratio
Age of Operator	1.000	-0.237	-0.061	-0.753	-0.190	-0.001	0.338	0.010	-0.042
Yrs. College of Operator		1.000	0.553	0.355	0.442	-0.469	0.112	0.535	0.027
Yrs. College of Wife			1.000	0.263	0.421	-0.098	-0.114	0.543	0.339
No. School-Age Children				1.000	0.201	-0.062	-0.308	0.236	0.017
Net Income					1.000	-0.238	-0.257	0.714	0.518
Off-Farm Income						1.000	-0.094	-0.436	-0.256
Remoteness							1.000	0.019	-0.035
Acres Irrigated								1.000	0.645
Capital-Labor Ratio									1.000

Table 29. Partial correlation coefficients for reclassified data--Aggregate rural-farm.

	Age of Operator	Yrs. College of Operator	Yrs. College of Wife	No. School-Age Children	Net Income	Off-Farm Income	Remoteness	Acres Irrigated	Capital-Labor Ratio
Age of Operator	1.000	-0.236	-0.112	-0.590	-0.285	-0.242	0.084	-0.018	-0.236
Yrs. College of Operator		1.000	0.455	0.145	0.168	0.159	-0.024	0.055	0.033
Yrs. College of Wife			1.000	0.050	0.184	0.017	0.048	0.023	-0.093
No. School-Age Children				1.000	0.055	0.125	-0.024	0.169	0.066
Net Income					1.000	0.010	0.074	0.149	0.211
Off-Farm Income						1.000	-0.005	-0.277	0.092
Remoteness							1.000	-0.061	0.151
Acres Irrigated								1.000	-0.036
Capital-Labor Ratio									1.000

Table 30. Partial correlation coefficients for reclassified data--Aggregate urban-farm.

	Age of Operator	Yrs. College of Operator	Yrs. College of Wife	No. School-Age Children	Net Income	Off-Farm Income	Remoteness	Acres Irrigated	Capital-Labor Ratio
Age of Operator	1.000	-0.112	0.006	-0.561	-0.233	-0.062	0.142	-0.040	-0.130
Yrs. College of Operator		1.000	0.628	0.067	0.458	0.103	0.493	0.079	0.095
Yrs. College of Wife			1.000	-0.028	0.451	0.165	0.374	0.249	0.125
No. School-Age Children				1.000	-0.005	-0.096	-0.169	0.122	0.060
Net Income					1.000	0.231	0.271	0.407	0.363
Off-Farm Income						1.000	0.222	-0.412	-0.194
Remoteness							1.000	-0.184	-0.085
Acres Irrigated								1.000	0.456
Capital-Labor Ratio									1.000

Appendix C

Regressions For Consumption of Diversion Activities

Only the results of regressions yielding significant coefficients of multiple correlation will be given. A forward step-wise regression method was used. In those cases where significance was indicated before all variables were included, the coefficients and relevant statistics will be presented for the "incomplete" model(s) as well. Sigficance at the 5 percent level is denoted by a single asterisk, while a double asterisk indicates significance at the 1 percent level.

Average annual movie attendance per family member-Cache County

The sample used in this regression includes all families, whether or not children were living at home. The correlation coefficient was significant after the first variable, representing mileage to the theater, had entered the regression. The relevant statistics are as follows:

$$F = 26.04^{**} \qquad R^2 = 0.2099^{*} \qquad \bar{R}^2 = 0.1938 \ .$$

The resulting coefficients and t-values are:

	Coefficients	t-values
	B_o = 2.7515	
Mileage to theater:	B_1 = 0.3930	5.10^{**}

The variable representing age of the farm operator was the next to

enter, resulting in the following statistics and coefficients:

$F = 19.05^{**}$ $R^2 = 0.2820^{*}$ $\bar{R}^2 = 0.2529^{*}$

		Coefficients	t-values
	B_o =	10.1773	
Mileage to theater:	B_1 =	0.3395	4.48^{**}
Age of operator:	B_2 =	-0.1342	3.12^{**}

The variable representing net family income was the last to enter but the t-value for the coefficient was not significant.

Total annual movie attendance of parents-Sanpete County

The coefficient of multiple correlation was not significant until all variables had entered the regression. The variables are listed below according to their order of entry.

$F = 12.94^{**}$ $R^2 = 0.2879^{*}$ $\bar{R}^2 = 0.2582$

		Coefficients	t-values
	B_o =	6.0957	
Net income:	B_1 =	0.0005	3.89^{**}
Mileage to theater:	B_2 =	0.4563	3.34^{**}
Age of operator:	B_3 =	-0.1194	2.35^{*} .

VITA

Larry Keith Bond

Candidate for the Degree of

Doctor of Philosophy

Dissertation: An Analysis of Factors Influencing Farm Family Residence Location

Major Field: Economics

Biographical Information:

Personal Data: Born at Ramah, New Mexico, September 9, 1935, son of Charles Merlin and Lois Russell Bond; married to Lois Bullock; four children- Cindy, Janine, Shauna, and Keith.

Education: Attended elementary school in Ramah, New Mexico; graduated from Ramah High in 1953; received Bachelor of Arts degree from Brigham Young University in 1960 with a major in Animal Husbandry and minors in Agricultural Economics and Spanish; received Master of Science degree from University of Arizona, with a major in Agricultural Economics, in 1963.

Professional Experience: 1964 to 1965, Economic Analyst for Alberta Wheat Pool, Calgary, Alberta; 1966-68, District Agriculturist for Alberta Department of Agriculture, Lethbridge, Alberta; 1968-72, research assistant, Utah State University.