AN ANALYSIS OF FARMS SIZE CHANGE IN MICHIGAN

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ABSTRACT

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by Donald J. Epp

This study is an analysis of the process of changing farm size. The necessity of expanding farm size has come to be regarded as an economic necessity by most people associated with agriculture. Yet, little is known of the actual process by which farms change size or what factors influence the farmer's decision. The need for such knowledge becomes increasingly acute as new policy proposals are made for changes in the institutional setting for agriculture.

Data from 310 farms in the Michigan Township Extension Experiment were used for this study. The total acres in the farm operation served as the indicator of size. Two important discoveries were made that are masked by presently available data. First, it was found that 70 percent of the farmers changed the size of their operations during the five years of the study period (1953-1958). This differs from the frequently made assumption that the land factor is fixed over fairly long periods in most farms. Second, it was found that nearly one-third of the farms got smaller--an action contrary to the generally accepted belief of increasing farm size.

This study elaborates on the above findings by identifying the factors which influenced farmers' decisions to change farm size and by indicating those characteristics which might reveal the process by which farmers increased or decreased the number of acres farmed. Using the Chi-square test for independence, twelve factors were tested for their

association with the decision to change farm size. Seven factors were found to have a statistically significant relationship with changes in farm size. These were total acres operated, the machinery investment per acre, and the price of the land, (all measured as they existed at the starting date of the study), the tenure arrangement, the operator's satisfaction with farming as an occupation, the educational level of the operator, and the change during the study in the amount of off-farm work. The remaining five factors which were found not to have a significant relationship to changes in farm size were the age of the operator, the operator's opinion as to whether the opportunities in farming were increasing or decreasing, the value of the total assets of the farmer, the net farm income of the operator, and the total months of off-farm work performed by the operator.

When the process of farm size change is determined by studying the differences in measurements made at given points of time, such as a comparison of data from censuses, it appears that the number of large farms increases, and the number of small farms decreases. This gives the impression that all farms are getting bigger. However, when viewed continuously over a period of time, it is apparent that some farms increase in size and some decrease in size. These changes are partially offsetting. Thus, the net changes in farm size understate the true magnitude of farm size adjustment.

AN ANALYSIS OF FARMS SIZE CHANGE IN MICHIGAN

By

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CHAPTER I

INTRODUCTION

This study is an analysis of the process of changing farm size. Most people associated with agriculture are aware of the rapid growth in the size of farms. The large farm has come to be regarded as an economic necessity for a farm operator. A quick review of the recent editions of farm magazines will reveal the emphasis placed on increasing the number of acres farmed to obtain an adequate income for the farm family. Even the reports of the Census of Agriculture contain a comment on the changes in farm size.

> One of the most dramatic changes in agriculture during the past 30 years has been the rapid increase in farm size. In 1959 the average farm size in the United States was 303 acres, or nearly twice as large as the average size in 1930. The growth in farm size was especially rapid in the fifties. Between 1950 and 1959 average farm acreage increased by 40.5 percent, only slightly less than the increase during the previous 50 years.[1]

Yet our knowledge of this phenomenon is very limited. The Census shows that the average size of farms is increasing. It also shows that small farms are a decreasing proportion of the total number of farms. In Michigan, farms that are less than 100 acres in size constituted 55.7% of all farms in 1950 yet they were only 49.9% of a smaller total number of farms in 1959. At the same time those farms which were 260 acres or more in size were becoming more numerous and constituted an increased

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[1]U.S., Bureau of the Census Census of Agriculture: 1959, V, Part 6, Chapter 2, "A Graphic Summary of Farm Tenure," p. 22.

proportion of the farms in the state.[2] But these figures do not tell us whether all farms are getting bigger. It is possible that some farms get smaller while other farms get larger even though the average size increases. Another question which remains unanswered from presently available information is how farmers increased the size of their farms. Did they rent more land or did they buy more land? Again, the Census gives data on the average number of rented and owned acres but it does not reveal whether all farmers increased both rented and owned acres or whether some increased while others decreased their rented land. The important consideration at this point is that averages of large groups can point out significant trends and can give valuable information about certain things; but they are not the complete story. And there are very important reasons for knowing more of the story than we do.

The growth of farm size affects, and is in turn affected by, the land market. This market really has two separate but related parts--one for the purchase, and the other for the rental, of land. Obviously, a farmer who wishes to expand the size of his farm must become involved with one or both parts of this land market. How satisfactory his experience in the market is will depend on whether the type of land he seeks is available to him. This in turn will be influenced by the institutional rules that govern the land market.[3] These same rules will affect the supplier of the land that farmers seek for expanding operations. The rest of our

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[2]See Appendix Table 1.

[3]The institutional rules of the land market determine such things as who may enter the market, what may or may not be exchanged, and which interests of the parties in the market will be supported by the society as a group.

society also has an interest in the working of the land market since it may affect the production of the food and fiber used by everyone. In order to appraise accurately the functioning of the land market rules we need to know what kind of land farmers are seeking. Is it land to rent or land to buy? We also should know where the land offered is coming from. Is it from farms which have gone out of existence and are being divided up or does it come from farms which are becoming smaller? As yet we can only give tentative and somewhat speculative answers to these questions.

Nonetheless, the question concerning the adequacy of the land market rules for our changing society has been given some thought and some provocative suggestions have been offered. Professor Philip Raup has recently turned his attention to the European experience for some possible modifications of our present land tenure arrangements in an attempt to cope with some problems of adjusting agriculture to an industrializing society.[4] He reviews some policies which have been adopted that entail extensive control of the actual transaction in the land transfer process, even to the extent of deciding who shall have access to agricultural land resources. Raup indicates the relevance of European experience for the problems faced by the United States when he states, "European experience underlines the fact that actual parity between agricultural and non-agricultural incomes is unlikely to be achieved without some control over entry into agriculture."[5] In order to properly evaluate

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[4]Philip M. Raup, "Satisfying the Economic Demands for Natural Resources: Some Recent Developments in European Land Policy," Land Use Policy and Problems in the United States, ed. Howard W. Ottoson (Lincoln, Nebraska: University of Nebraska Press, 1963). pp. 379-99.

[5]Ibid., p. 359.

the effect and appropriateness of changes in land marketing policies in the United States it is necessary that we better understand the processes of farm size change occurring with existing economic rules and policies.

Another suggestion for institutional change involves a problem of the land market in areas close to expanding urban areas. Frederick Stocker (as well as others) has suggested that one method of allocating land between competing uses is zoning.[6] Under this framework land would be indicated that should remain as farms and other land would be indicated for development of residential or industrial uses. Thus, zoning would substitute administrative allocation for part of the free market allocation of land use. Again it is necessary to understand the process of farm size adjustments to know what reactions could be expected to such rules. Would farms in the various zoned areas continue to expand or would they get smaller? How much land must be included in the zone that is to remain in agriculture to allow for future expansion? It is essential that some knowledge be gained concerning the processes used to adjust the size of farms.

This section has introduced some of the limits of our understanding. It has also tried to indicate a few of the pressing questions which require that the boundary of our knowledge be extended into these areas. It is the goal of this study to further the understanding of the processes of changing farm size. To accomplish this goal, data from 310 Michigan farms will be examined. Twelve factors thought to be associated with the decision to change the size of a farm will be analysed for significant

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[6]Cf. Frederick D. Stocker, "The Taxation of Farmland," A Place to Live, The Yearbook of Agriculture 1963, (Washington: U.S. Government Printing Office, 1963) pp. 163-165.

relationship with actual farm size changes. The discription of the study and the results of the analysis of factors is found in Chapter II. Chapter III contains a summary of the study and the conclusions drawn from it.

CHAPTER II

THE STUDY AND MAJOR FINDINGS

The Study

The size of a farm can be measured in several ways. Which measure is used depends upon what purpose the information is to serve. If the primary concern is with financing the farm operation then total expenses or total receipts may be the most appropriate measure of size. If the problem concerns family living standards then net farm income might be a better measure of size. The number of livestock animals or the quantity of crops produced may be most meaningful for other problems. Farm size commonly refers to the number of tillable acres operated or the total number of acres in the farm operation.

Several different size measures were available for use in the study. Total number of acres operated was chosen because it best reflected the objectives of the study. As indicated in the introduction, this study is concerned with adjustments that involve social interaction and the institutions which influence this interaction, mainly the land markets. Size adjustments can also be accomplished within the farm firm by adjusting the input and enterprise combinations. While these are important methods of adjusting to changing conditions they were considered to be beyond the scope of this study. It must be noted, however, that these internal adjustments may affect the external adjustment of total acres farmed. An attempt will be made to indicate

those instances where the internal adjustments may provide alternative explanations to those presented by the study.

The information for this study was selected from the data gathered in the Michigan Township Extension experiment which was conducted in five areas of Michigan from 1953 to 1958. These five areas represent four different types of farming commonly found in the lower peninsula of Michigan. The farms from all four areas were studied as one group. Since the study was primarily concerned with the direction and manner of size change rather than the magnitude of the change, it was decided that the differences in average size of farm between the five study areas were not sufficiently large to prevent studying all farms in the area as a group. The percentage change in average size ranged from less than one percent to not quite 11 percent, which again was considered to be similar enough to group all farms together.[1] The location of each farm was retained so that comparisons between areas could be made. Where these comparisons showed a significant difference between areas of the study, this difference has been noted and taken into consideration in the conclusions.

Farms in Kalkaska and Otsego counties were included in the Township Extension experiment to represent the northern Michigan dairy and potato type of farming. Another area represented cash crop farming and farms in Tuscola County were selected for this group. Farms in Lapeer, Calhoun and Ionia counties were selected to represent either southern Michigan dairy farming or southern Michigan dairy and general

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[1] See the data for the townships in Appendix Table 2.

farming.[2] The more intensive types of land use such as the fruit and vegetable areas of Western Michigan were not included in the study.[3]

The Township Extension Experiment was selected as the source of data because it included a wealth of information on a large number of farms which had been studied over a five year period. Such a time span is long enough to give some limited insight into the process of how farm size is adjusted. Since some of the farms had been given an intensive extension program the data were tested to see if this program had influenced the adjustments in farm size. A t-test of the difference in average change in size of the group which received the extension program and the group which did not showed that the difference was not significantly different from zero.

The Frequency of Size Change

Two very important discoveries that are masked by presently available data were made early in the study. First, it was found that a large proportion of the farmers had made some adjustment in the size of their farms during the relatively short period of five years. When considering the study area as a whole, 70 percent of the farmers changed the size of their operations during the study period. Even when the different geographical areas of the study were considered separately

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[2]For the location of the counties included, see Figure 1.

[3]For further information see James Neilson, and William Crosswhite, The Michigan Township Extension Experiment: Changes in Agricultural Production, Efficiency and Earnings, Agricultural Experiment Station Technical Bulletin 274, Michigan State University, (East Lansing, 1959).

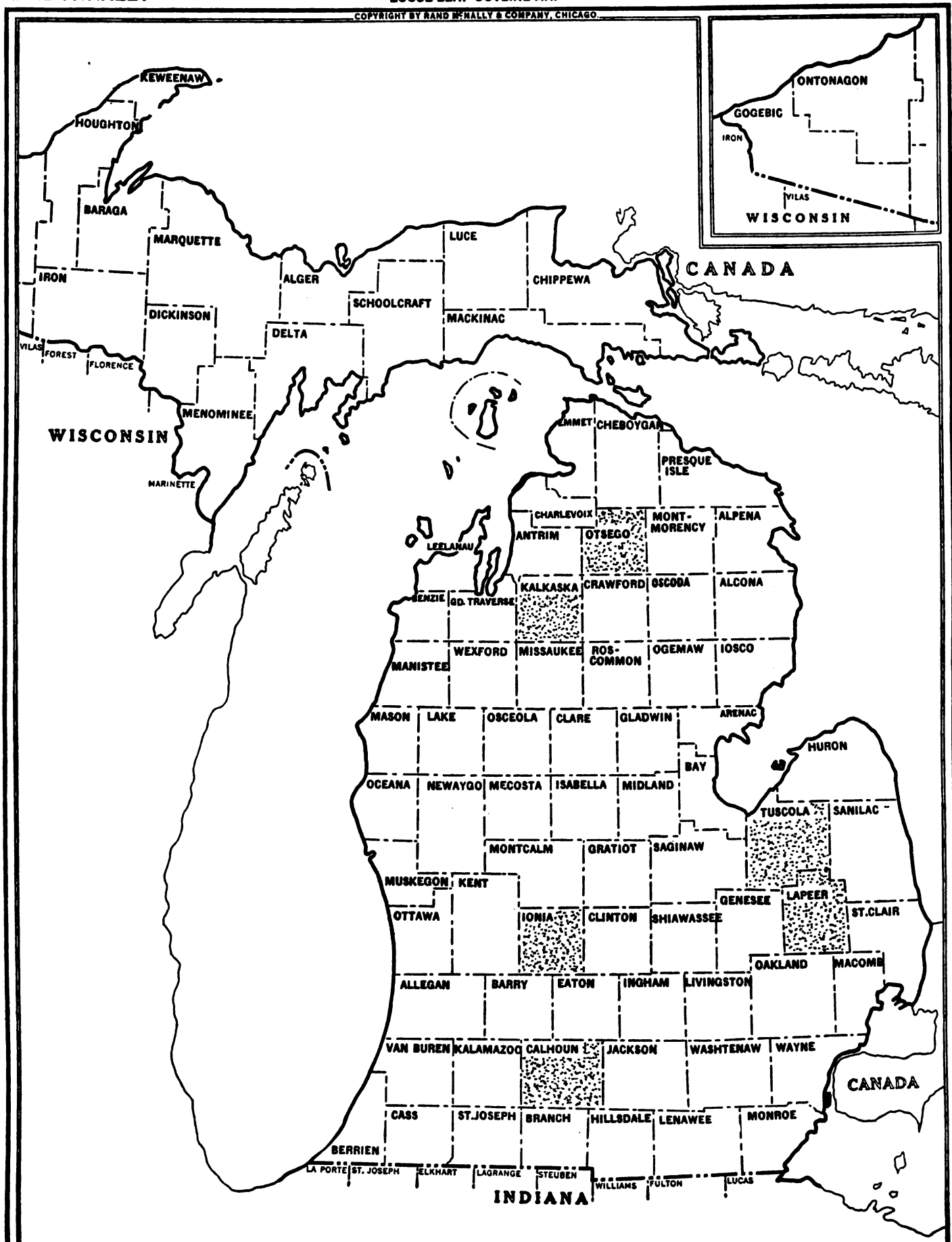

Figure 1. Outline Map of Michigan Showing the Area From Which the Samples Were Drawn

the proportion of farmers changing the size of their operations ranged from 59 percent in the Tuscola County area to 80 percent in the Kalkaska County and Otsego County areas.[4] The importance of these farms is indicated by the fact that they included 64 percent and 84 percent respectively of the land in their areas of the study. The figures indicate a much greater flexibility in the land input in farming operations than might be expected. Perhaps the implicit (sometimes even explicit) assumption that the land input is quite fixed is derived from the widespread use of land as the fixed input in production functions in many of the standard texts in production and land economics.[5] Even though these same authors mention that the land input need not be the fixed input, many people in agriculture consider the land factor to be fixed over fairly long periods in most farms. It is with respect to this assumption that the large number of farmers changing the size of their farms is so significant. The data of this study indicate that the land input is flexible for a large proportion of farmers.

A second major finding of the study was that about one-third of the farms got smaller during the study period. The proportion of farms decreasing farm size ranged from 25 percent in Tuscola County to 38 percent in the Tri-Township areas of Kalkaska and Otsego counties with 31 percent of the farms in the total study decreasing the number of

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[4] See Appendix Table 3.

[5] Cf. Earl O. Heady, Economics of Agricultural Production and Resource Use, (New York: Prentice-Hall, 1952), Ch. 3, and Raleigh Barlowe, Land Resource Economics, (Englewood Cliffs, N.J.: Prentice-Hall, 1958), pp. 117-120.

acres farmed.[6] The preponderance of the advice given farmers by popular farm magazines and by agricultural extension workers is that costs are reduced and family incomes are more adequate if farm size is increased, at least up to certain levels. Some of the reasons given for increasing size are analyzed later in this study. The point of interest here is that in view of the recommendations to farmers to enlarge the size of their farms, why did such a large percent of them do the opposite? To answer this question the study attempted to identify the factors which influenced farmers' decisions to change farm size and to indicate those characteristics which might reveal the process by which farmers increased or decreased the number of acres farmed.

The existing literature does not contain much information on the process of farm size change. The phenomenon of some farms getting smaller while other farms get bigger has not been specifically considered. However, some studies have been made of problems closely related to those of this study and it was thought that some of their conclusions might prove useful in selecting factors to consider. Hoffmann and Heady conducted a study of the process of farm consolidation in southwest Iowa.[7] Their study concerned the decision of one group of farmers to quit farming and another group of farmers to take over the land left by the first group. The decision by the second group

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[6] See Appendix Table 3.

[7] Randall A. Hoffmann and Earl O. Heady, Production, Income and Resource Changes From Farm Consolidation, Agricultural and Home Economics Experiment Station, Research Bulletin 502, Iowa State University, (Ames, 1962).

which enlarged their farm size must have been very similar to the decisions made by farmers in the present study who decided to increase the number of acres farmed. Thus, the factors found to be significant by Hoffmann and Heady were considered to be important to examine with respect to this study. Some of the explanatory variables considered in the Iowa study were, the age and education of the operator, the number of acres farmed, the amount of labor used per year in farm work, the machinery investment per acre, the total amount of capital managed by the operator, the sources of management information used, the production practices employed, and the income received from past farm operations.

A related problem which has received a great deal of attention lately is the problem of farmers leaving farming for non-farm employment. Guither conducted a study of Illinois farmers who quit farming[8] and found the following factors to be important in explaining their decisions: the age of the farmer, the amount of off-farm work done, the farmer's attitude toward farming, the past income from farming, the costs of operating a farm, the tenure status of the operator, the number of acres farmed, and the machinery investment. Hill also found some of these same factors to be important in explaining the movement of farmers off of Iowa farms.[9] Some of the specific variables discussed

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[8] Harold D. Guither, "Factors Influencing Farm Operators' Decisions To Leave Farming," Journal of Farm Economics, XLV (August, 1963), pp. 567-576.

[9] Lowell D. Hill, "Characteristics of the Farmers Leaving Agriculture in an Iowa County," Journal of Farm Economics, XLIV (May, 1962), pp. 419-426.

by Hill were, tenure status of the operator, education of the farmer, size of family, past farm income, and farm costs.

In a study from an earlier period Heady analyzed the pattern of farm size adjustment in Iowa, especially concentrating on the period from 1920-1940.[10] During that period he found that increasing mechanization of farming increased the output which contributed to the decrease in product prices. Mechanization also increased the fixed costs of small farm operations which further contributed to lowering net farm income unless the number of acres in the farm were increased. Other factors which Heady found to influence the pattern of farm size adjustment were the type of farming, the size of the farm and the tenure arrangement.

The data available in the Township Extension experiment were reviewed in light of the above studies and twelve factors were selected for testing. These twelve factors were considered to be most likely to be significant in explaining the process by which farmers in Michigan adjust the size of their farms. The variables selected were, the total acres operated at the beginning of the study, the machinery investment per acre at the start of the study, the tenure status of the operator, the price of farm land, the operator's satisfaction with farming as an occupation, the education of the operator, the change in the amount of off-farm work done, the age of the operator, the operator's opinion as to whether the opportunities in farming were increasing or decreasing,

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[10] Earl O. Heady, Pattern Of Farm Size Adjustment in Iowa, Agricultural Experiment Station, Bulletin 350, Iowa State College, (Ames, 1947).

the value of the total assets of the operator, the net farm income of the farmer, and the total months of off-farm work performed by the operator. The Chi-square test of independence was used to determine the significance of the relation of each variable to the changes made in farm size. The results of these tests are discussed in the next two sections.

Characteristics Which Are Associated With Size Changes

Seven of the twelve factors tested had a statistically significant relationship with changes in farm size. Having established a statistical relationship, these variables were further analyzed to determine how they were related to size change and what this relationship indicated about the process of size change. The seven variables which received this analysis were total acres operated, the machinery investment per acre, and the price of land, (all measured as they existed at the starting date of the study), the tenure arrangement, the operator's satisfaction with farming as an occupation, the educational level of the operator, and the change during the study in the amount of off-farm work done. The results of this analysis are presented below for each variable.

Total Acres Operated at the Beginning of the Study

The general trend in average farm size is up for both the United States and for Michigan. From 1920 to 1959 the average size of farm in the United States more than doubled from 148 acres per farm to 303 acres per farm.[11]

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[11] U.S., Bureau of the Census, Census of Agriculture: 1959, Vol. II, Chapter V, "Size of Farm," p. 369.

While the increase has not been as great for farm size in Michigan as in the United States, the trend has been toward larger farms. The average size of farm in Michigan in 1920 was 97 acres and had increased to 132 acres by 1959.[12]

The total number of acres farmed is generally recognized as having an important influence on the costs and efficiency of farm production. The larger farms can usually make better use of the machinery and labor available and thus, reduce the costs per unit of output. An Iowa study of the efficiency of farms of different sizes conducted by Geoffrey Shepherd has concluded that large farms can reduce average costs and produce greater volumes of product and this results in greater net farm income for the farmer and his family.[13] Another Iowa study related costs per dollar of product for different machinery size combinations to the number of acres farmed. This study by Heady and Krenz indicated that with the capacity of machinery now available, farms in Iowa that contain 320-350 acres have a considerable cost advantage over smaller farms.[14]

A study by R. H. Blosser at the Ohio Agricultural Experiment Station indicated that machinery costs per acre decline significantly

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[12] U.S., Bureau of the Census, Census of Agriculture: 1959, Vol. I, part 13, "Michigan," p. 4.

[13] Geoffrey Shepherd, "Are Big Farms More Efficient Than Small Ones?" Iowa Farm Science, XVI, Nos. 3-4, (Sept.-Oct., 1961), p. 44.

[14] Earl O. Heady, and Ronald D. Krenz, "How Big Will Our Farms Get?" Iowa Farm Science, XVI, No. 5, (November, 1961), pp. 52-53.

as the hours of annual use increase.[15] This indicates that farmers can reduce the machinery costs per acre by increasing the number of acres covered and thus, increasing the use of the machines. Similar results were found for Michigan conditions by Leonard Kyle in a study of 101 farms in the Michigan Mail-in Record Project.[16]

In a previous study of the production data for the farms in the cash crop farming region of the present study (Tuscola County) W. R. Bolger indicated that more acres were needed for the optimum use of the labor and machinery available.[17] Bolger applied the Cobb-Douglas analysis to the data to obtain an estimate of the marginal value product of the various inputs. When he compared the marginal value product of land to the marginal factor cost of land at the beginning of the study, Bolger found that the marginal product exceeded the marginal cost by an amount sufficient to warrant the conclusion that farmers should use more land.

The increasing average size of farm and the extensive public distribution of the recommendations on increased farm size to reduce costs per unit of output led to the anticipation of increases in farm size in the present study. While farms large enough to make efficient

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[15] R. H. Blosser, "Greater Use Slashes Machinery Costs," Better Farming Methods, (March, 1964), pp. 32-33.

[16] Leonard Kyle, "A Major Problem: Machinery Costs," Michigan Farm Economics, February, 1964, Michigan State University Cooperative Extension Service, (East Lansing, 1964).

[17] William Ross Bolger, "A Partial Evaluation Of The Michigan Township Extension Program In Denmark Township Over The Period 1953 to 1958, Using Cobb-Douglas Analysis," (unpublished M.S. dissertation, Department of Agricultural Economics, Michigan State University, 1959), p. 61.

use of machinery and labor were not expected to increase size as often as small farms, it was considered unlikely that reductions in farm size would be significant for any size of farm.

The Chi-square test was used to determine whether the size of a farm at the beginning of the study period had a significant relationship to the changes in size during the next five years. The farms were classified into five size groups according to total number of acres operated when the study began. They were also classified into five categories according to the changes made in total acres operated during the study period. These two classifications were combined in a two-way table as shown in Table 4 in the Appendix. The hypothesis tested by the Chi-square test is that the columns are independent of the rows. To test this hypothesis the expected number of observations in each cell is assumed to depend on the column total and the row total of which the cell is a part. The Chi-square test evaluates the difference between the expected number of observations in each cell and the actual number of observations. A standard statistical table of Chi-square values indicates the probability of obtaining a critical value as large as the one obtained in the test given the degrees of freedom.[18]

The hypothesis tested was that farms would increase in size regardless of original size but that this tendency would be more pronounced among farms that were smaller initially. The analysis of the data did not support this hypothesis although the Chi-square test

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[18]For a discussion of the procedures used to calculate the critical values see Wilfrid J. Dixon, and Frank J. Massey, Jr., Introduction to Statistical Analysis, (2d ed., New York: McGraw-Hill, 1957), pp. 224-226.

indicated a very significant relationship between farm size and changes in farm size.[19] The relationship shown by the data was that farms which are small initially do tend to increase in size but that farms which are large tend to get smaller.

Having already divided the farms into five groups with approximately the same number of farms in each group, a more detailed study was made of the first, third, fourth, and fifth[20] of these quintiles to determine how size adjustments were made.[21]

The fifth quintile (containing the smallest farms) showed less tendency to adjust farm size than did the other three quintiles. Only 55.6% of the fifth quintile changed size while 74.6% of the third quintile and 83.3% of the first quintile changed size. Of those farms in the fifth quintile that did change size, only 11.5% decreased size. This result was expected since these farms were very small to begin with, ranging from the smallest farms of 40 acres to farms of 134 acres. Many of these farms are of the minimum size to be classified as farms for purposes of the study.

Of the farms in the first quintile (the largest farms in the study) 34.8% increased in size but 48.5% decreased in size. The large proportion decreasing size was not anticipated when formulating the hypothesis concerning the relation between size and changes in size. Many of the

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[19] See Appendix Table 4.

[20] Originally only the first, third and fifth quintiles were studied, but the fourth quintile was later added to check trends noted in the smaller size groups.

[21] See Appendix Table 5.

farms in this quintile which reduced size -- an action contrary to that hypothesized -- were very big farms. They were able to reduce the number of acres operated by a large amount and still remain bigger than the average size of all farms at the end of the study. From available data there is no way of determining whether these farms continued to get smaller or whether they stayed at about average size for all farms. Based on the observed size changes during the study of farms in the middle size groups one could as likely expect these farms to get bigger during the next five years as to continue getting smaller.[22] However, it is indicated below that much of the size adjustment involves the use of rented acres. Large farms which had already reduced the number of rented acres might be expected to be less inclined to further reduce size. Further research on the long-run changes in size is needed.

To better determine how the size adjustments were made each of the four quintiles studied were analyzed to determine whether owned or rented land was used to make the size adjustments. Those farmers in the quintile with the largest farms who increased the size of their farms used several methods with about equal frequency. The methods most often used were increasing rented acres only and increasing both rented and owned acres.[23] The farmers in this group with the largest farms who reduced the size of their farms most often accomplished this reduction by decreasing the number of rented acres.

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[22]See Figure 2 in the Summary

[23]See Appendix Table 5, First Quintile.

The farmers who operated farms in the third, fourth and fifth quintiles (middle size to smallest farms) showed a definite preference for using rented acres to adjust the size of their operations. The proportion of those in each of these three quintiles who increased farm size solely by renting more acres ranged from 34.6% to 41.7%.[24] The proportion of farmers in these three quintiles who reduced farm size by decreasing solely the number of acres rented was also large -- in some cases over half of the farmers used this method. However, the small number of farmers with small farms who decreased size makes these proportions less meaningful. It can be concluded that farmers did make greater use of rented rather than owned acres for adjusting the size of their farms. The importance of having rented land in the farm operation at the beginning of the study is a related question that is discussed in a later section concerned with tenure arrangements.

Machinery Investment Per Acre

The literature cited in the preceeding section on farm size indicated that one of the reasons for the trend toward larger farms was to make more efficient use of modern farm machinery and thus, to reduce the costs per unit of output. The effect of machinery investment on changes in farm size was examined by testing the hypothesis that farmers with high machinery investment per acre would increase farm size more often than those with low machinery investment. It was considered possible that farmers with a low machinery investment per acre might be

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[24] See Appendix Table 5, Third, Fourth and Fifth Quintiles.

able to reduce farm size somewhat without increasing per unit costs but no definite incentives for such acreage reductions were postulated.

The analysis of the data showed that machinery investment per acre was significantly related to changes in farm size.[25] Farms with a high machinery investment per acre increased in size more frequently than did farms with low machinery investments. Half of the farmers with over fifty dollars per acre of machinery enlarged their operations while only 39% of those farmers with less than twenty dollars of machinery per acre enlarged the size of their farm. The influence of machinery investment per acre was important in size reductions, too, with 43% of those farmers with less than twenty dollars per acre of machinery reducing size while only 15% of those with fifty dollars or more machinery decreased size.

When trying to relate the influence of machinery investment to changes in farm size it is necessary to consider some possible explanations for the investment in machinery prior to the study. A high investment in farm machinery per acre could be caused by the expensive nature of machinery used in farming today. Even the minimum investment is large and would result in high per acre investments for small farms. However, it is also possible that the high investment per acre in machinery reflects a prior decision of the operator to continue farming as his occupation. Additional land to farm is not always immediately available but machinery investments may be made with the intention of expanding

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[25] See Appendix Table 6.

acres operated at the first opportunity. In such a case the high machinery investment per acre prior to expanding and the increase in size may both be part of a previous decision. If such is the case the results of this portion of the study are not surprising.

There are two different groups of farmers who might have low machinery investments per acre at the beginning of the study. One group would be those farmers who had already been able to acquire a larger farm to operate and this had reduced their per acre investment. Some of the farms in the study were large enough in 1953 that they could reduce total acres operated without increasing per unit costs to any significant degree. These farms would be able to fit into the pattern of farm size adjustment and its relation to machinery investment just discussed.

Another group of farmers who might have low machinery investments per acre are those farmers who have decided to supplement their farm earnings with off-farm work. The relationship between size changes and off-farm work is discussed in a later section but the relevant point here is the implication for machinery investment of such a decision. Having decided that farming is not going to be the only source of family income, the farmer is less inclined to build up his machinery investment. The present machinery may be repaired rather than replaced or may be traded for smaller sizes in anticipation of future reductions in the number of acres farmed. Either of these actions would result in a low machinery investment per acre at the beginning of the study. The subsequent decline in number of acres operated would be the result of a decreased emphasis on the farm as a source of family income.

Tenure Arrangement

One of the relationships hypothesized to underlie this study was that rented land is a more easily varied input in a farm operation than is owned land. This hypothesis was partially verified in the section on farm size where it was indicated that farm size adjustments were more often accomplished by using rented land. There is a further facet of this relationship which concerns the influence of having rented acres in the farm operation prior to changing farm size. Does the fact that a farmer rents land now affect the probability that he will change the size of his farm in the near future? Some partial answers to this question can already be given from what has been shown previously. The preference for using rented acres to increase or decrease farm size indicates that a farmer who does not now rent land could not use this method for reducing the size of his farm, if such were his desire. Does this mean that farmers who did not rent any land at the beginning of the study reduced farm size less often than those who did rent land initially?

To answer this question the farms in the study were divided into three groups. Those farms where all of the land was owned were called owner or full owner farms. Those where part of the land was owned and part rented were called part owner farms. The third group consisted of those farms where all of the land was rented. This group was called tenant farms. These three groups were analyzed for statistical differences in the changes made in the size of farm. It was found that the size adjustments made by the tenant tenure class were not statistically different from those

made by the entire group of farms studied;[26] but the differences in the adjustments made by the owner and part owner tenure groups were highly significant.[27] This finding indicates that having rented land in the farm operation does not significantly influence farm size adjustments (since tenants have only rented land) but that having rented land and owned land results in adjustments that are different from those of the group as a whole, as well as different from those adjustments made by farmers who owned all of their land.

One of the differences between the part owner and full owner groups was the proportion of the farmers making changes in the size of their farms. Full owners made no change in the size of their farms in 45% of the cases while only 13% of the part owners remained on the same size farm. Most of this difference in proportions changing size was due to the difference in the proportions of each group reducing size. Only 13% of the owners decreased the size of their farms while 50% of the part owners did so. The proportions who increased the size of their farms was about the same with 41% of the owners and 37% of the part owners increasing farm size. The results of this comparison are consistent with those found in the section on farm size where greater flexibility, particularly for decreases in size, was associated with rented land.

The total size of farm has already been discussed as a significant factor in determining changes in farm size. The large farms have a larger proportion decreasing size than small farms. When the average size of

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[26] See Appendix Table 7.

[27] See Appendix Table 8.

owner and part owner farms are considered it can be seen that their size adjustments are consistent with those found in the previous section on farm size. The average size of part owner farms in 1953 was 255 acres while the average size of owner farms was 198 acres.

The process of farm size change can be better understood by examining the farms which changed tenure group from 1953 to 1958. Of those farmers who were full owners in 1953 and increased the size of their farms by 1958, 53% became part owners indicating that they had rented some land in 1958. Rented land was also used for size reductions as is indicated by the fact that 43% of the part owners who reduced farm size were full owners in 1958. These findings support the contention that adjustment of rented land is the principal method used in making size changes.

Price of Land

The price of land may be associated with changes in farm size for several reasons. First, it may be that the low priced land is marginal land that shifts in and out of agricultural production. Such land might also be the first to be disposed of when a farmer reduces farm size. For these reasons farms containing this marginal land would be expected to be involved in size changes more often than would farms containing only the higher priced land.

A second possible relationship between land price and size changes is closely related to the first. It seems reasonable that farms composed of high quality land are more attractive to heirs of the farm and that these farms are actively farmed by the heirs more often than farms consisting of lower quality land. Thus, the lower priced land would enter

the land market more often during inter-generation transfers than would higher priced land. As the heirs adjusted the size of the farm during their operations, it is also likely that the better quality land would be retained in the unit and adjustments would involve the lower priced land.

The third reason why land price might be related to farm size changes is capital rationing -- either external or internal. If a farmer has a limited amount of money to spend on land, either through his own preferences concerning debt or through limits placed by others on the amount he can borrow, he may be limited in his choice of land to buy to the low priced land. It was shown above that a certain number of acres may be needed to reduce the machinery costs of production. Combining this need for a certain minimum number of acres with a limited amount of capital with which to buy land would dictate that the farmer seek only relatively cheaper land. The lack of significance between the value of a farmer's assets and his decisions concerning size adjustments, which is discussed in a later section of this chapter, raises some doubt as to the importance of capital rationing in the farmer's decisons. However, there is insufficient evidence to rule out the possibility that capital rationing may contribute to more frequent adjustment involving lower priced land.

The only information available which could be used to test the hypothesis concerning land prices was the farmer's estimate of the price of his land at the beginning of the study. It would have made a better test if the price of the land added or subtracted from the farm had been available. However, it was necessary to use the average price of land in

the farm as an indication of the price of land involved in the changes in size. This limitation applies to all data on land prices.

The statistical analysis showed that the price of land was significantly related to changes in farm size,[28] but that there was no significant difference between increases and decreases in size with regard to land price.[29] This analysis indicates that when the study area is considered in its entirety the percent of lower priced land involved in changes in farm size is greater than the percent of higher priced land.

However, there was a sizable difference between the land prices in the different townships in the study. The Tri-Township area of Kalkaska and Otsego counties had no land priced over $100 while in Denmark Township in Tuscola County all of the land was priced at more than $100.[30]

To test the effect of the geographical distribution of land values, the farms in each township area were divided into two groups of approximately equal size representing the higher and lower land prices in the township. The size changes made by the farms in each group were analyzed by use of the Chi-square test.[31] In the case of two townships, Denmark and Odessa, the size changes made by the farmers with higher priced land were not significantly different from the changes made by those who farmed lower priced land. However, in the other three areas the differences

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[28]See Appendix Tables 9 and 10.

[29]See Appendix Table 11.

[30]See Appendix Table 12.

[31]See Appendix Table 13.

in the kind of adjustments in size made by the farmers operating higher priced land were significantly different from those made by operators of lower priced land. In all three of these townships the low priced land was involved in significantly more decreases in size and significantly fewer increases in size than was the higher priced land. In the cases of Newton Township and Tri-Township there was also a larger proportion of the lower priced land that was involved in changes in size than expected.

The reasons for the differences between township areas in the study could not be explained by the information available. The results do indicate that within some geographical areas the lower priced land is used more often for making adjustments in size than is the higher priced land. These results would be consistent with any of the explanations given in the opening portion of this section.

Satisfaction With Farming

The preceeding sections of this report discussed characteristics of the farm business that are related to changes in the size of the farm. The next three sections are concerned with some characteristics of the farm operator that were found to be significantly related to changes in farm size.

When considering a farmer's satisfaction with farming as an occupation as compared with other occupations, it was expected that a satisfied farmer would be likely to increase size while a dissatisfied farmer would be seeking other work and possibly reducing the size of his farm. A feature of this particular variable that should be recognized is that the farmers in this study all were active farmers during the entire study period. It would be expected that those farmers with a strong dissatisfaction

with farming would have moved to other occupations. A high proportion of very dissatisfied farmers would be considered unusual.

The statistical analysis of the data in the study confirms the theoretical expectations.[32] Most farmers expressed satisfaction with farming as an occupation.[33] The proportions of this group increasing or decreasing size were not significantly different from that of all farmers in the study. Those farmers who expressed neither satisfaction nor dissatisfaction with farming made more changes in size than statistically expected, especially increases in size.

As hypothesized, the percentage of farmers decreasing size was largest among those farmers who were dissatisfied with farming as an occupation. This group also had the largest proportion of farmers who did not change size and the smallest proportion of farmers who increased size. All of these results are in keeping with the hypothesis that a dissatisfied farmer does not expand the size of his farm. Even though the relationship is not highly significant from a statistical viewpoint it does indicate that attitude influences decisions concerning size change.

The usefulness of these results is limited by a lack of data concerning farmers' attitudes in most areas. The type of data necessary for this study is not gathered on a regular basis but rather, is the result

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[32] See Appendix Table 14.

[33] Each farmer in the study was asked to select one of the five choices indicating that he was 1) very well satisfied, 2) pretty well satisfied, 3) neither satisfied nor dissatisfied, 4) not very well satisfied, or 5) not at all satisfied with farming as an occupation. For this analysis responses 1) and 2) were grouped together and called satisfied while responses 4) and 5) were grouped together and called dissatisfied.

of specific studies. By indicating the relationship between attitude and size change it is hoped that future studies may be guided in the selection of the relevant questions.

Education

Education plays an increasingly important role in the life of Americans today. This is true in the non-agricultural sectors of our society where greater skills and knowledge are required and in agriculture where the advances of science have resulted in increased rewards for those with the ability to apply new techniques.

The effect of the educational level of the operator on his decision concerning changes in farm size cannot be definitely hypothesized. There are at least two different influences on the size change decision which may be attributed to educational differences. First, the person with more schooling will have more opportunities for employment in other occupations than will the person with fewer years of schooling. If a person has some college training it usually means that he has been away from the home community and has had a chance to see the opportunities in occupations other than farming. On the basis of these influences it would be expected that farmers with more years of education completed would tend to reduce farm size and shift to other occupations, at least on a part-time basis. Those farmers with fewer years of schooling would be expected to increase their farm size since they would have fewer alternative opportunities.

A second influence of education that runs counter to the trend just discussed results in a different hypothesis. The better training received by those who complete more years of schooling may enable them to make a better living from farming. The fact that they stayed in school

longer may also indicate a higher level of ability than that of those who quit school earlier. This combination of higher ability and more training may mean that the better educated farmers earn better incomes from farming and would be less inclined to seek work in other occupations than less trained farmers. Consideration of this influence leads to the hypothesis that farmers with more education tend to increase farm size and those with less schooling tend to reduce farm size.

The statistical analysis of the data in this study indicated a significant relationship between educational level and changes in farm size but it did not clearly support one hypothesis and reject the other.[34] Those farmers who completed eight or less years of school had a larger proportion making some change in farm size which included a larger percentage increasing farm size than was true for the study as a whole. A large proportion of those who attended high school but did not graduate also changed farm size. However, this group had the largest percentage of farmers decreasing farm size with nearly half of the group making such a decrease in size. Those farmers who graduated from high school had the smallest percentage reducing size (25%) and a large percentage who increased size (42%). The farmers who had some schooling beyond high school were about evenly divided between increases, decreases, and no changes in farm size.

The data give support to the first hypothesis discussed above. Farmers with low levels of education, less than eight years, tend to increase farm size, presumably from lack of opportunity for non-farming

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[34] See Appendix Table 15.

jobs. There is also support given to the second hypothesis since farmers who graduate from high school also tend to increase farm size. Since the high school diploma would enable these farmers to find work elsewhere if they so desired, it is probably safe to assume that these farmers believe that they have the ability to make a good living in farming. Those farmers who attended high school but did not graduate showed the only definite tendency to reduce farm size. Nearly half of this group had off-farm jobs to supplement their farm income and about 20% of them worked from 10 to 12 months per year at these off-farm jobs. Both of these proportions are higher than for most other educational groups.

The analysis of the data in the study indicates that the hypotheses originally proposed are not mutually exclusive. There is indication that lack of a minimum level of education may prevent shifting to other occupations but that higher levels of education may train farm youths well enough that they feel their income opportunities are sufficient in farming. In both cases the effect of educational level is closely related to off-farm work. The use of non-farm jobs to supplement farm income is discussed in the next section but it is important to note the connection between these two variables, each of which is significantly related to changes in farm size.

Change in Amount of Off-farm Work

Industrial and other non-agricultural employment is widely dispersed in Michigan. Most cities and many small towns in southern Michigan have industrial plants which provide a source of non-farm employment quite close to home for farm people. The convenience of these off-farm jobs means that farmers do not have to quit farming entirely in order to take a job

in a factory but can continue to farm when not working in town. The extent to which southern Michigan farmers have taken advantage of these opportunities can be seen from the large proportion of part-time farmers in this area.[35]

A priori one would expect a farmer to reduce the amount of time spent farming as he increased the amount of off-farm work. This reduction in time spent farming could be accomplished by adjusting the combination of enterprises, reducing the total acres operated, or a combination of both methods. It was hypothesized that increases in off-farm employment would be associated with decreases in farm size. A decrease in off-farm work associated with an increase in farm size would also be consistent with the hypotheses.

The statistical analysis of the data in the study confirmed that changes in off-farm employment are significantly related to changes in farm size.[36] The relationship shown in the data was the same as that hypothesized. Those who decreased the number of months of off-farm employment tended to increase the size of their farms while those who increased the amount of off-farm employment tended to decrease farm size. This relationship was particularly strong in the case of those decreasing off-farm work. Of this group, 53% increased farm size and 16% decreased size. The relationship was not so pronounced in the group of farmers

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[35]Ralph A. Loomis, Dean E. McKee, and James T. Bonnen, "The Role of Part-time Farming In Agricultural Adjustment In Southern Michigan," Quarterly Bulletin of the Michigan Agricultural Experiment Station, XLIV, No. 4, Michigan State University, (East Lansing, 1962), p. 645. Forty percent of the 362 farmers in their study were part-time farmers.

[36]See Appendix Table 16.

who increased the number of months of off-farm employment. One-third of this group increased farm size and 37% decreased size. The proportion of this latter group who increased size was somewhat larger than expected. It may be due to the large proportion of farmers already engaged in off-farm work at the beginning of the study who made small increases in the amount of off-farm work while increasing farm size by a small amount.

The relationship between changes in off-farm work and changes in farm size is particularly useful for better understanding the process of farm size adjustment. With the large proportion of part-time farmers in southern Michigan changes in the amount of off-farm work can give an indication of the probable effect on farm size. This will allow more accurate prediction of the changes in size of farm in Michigan. This relationship is also useful in explaining how it is possible for farmers to reduce the size of their farms at a time when farm prices and farm incomes are generally low. The availability of off-farm work gives farmers who do not want to continue farming full-time the opportunity to make reductions in farm size as well as the opportunity to quit farming entirely.

Characteristics Which Are Not Associated With Size Changes

Five of the factors which were originally hypothesized to be related to changes in farm size were found to not be significantly related when analyzed statistically. These factors were age of the operator, the operator's opinion as to whether the opportunities in farming were increasing or decreasing, the value of the total assets of the farmer, the net income of the operator, and the total months of off-farm work performed

by the operator. These factors are briefly discussed in this section.

Age - When developing hypotheses it was felt that the age of the farmer would be important in size change decisions primarily from the family labor standpoint. Young farmers were considered to be more likely to increase farm size to make better use of the increases in family labor as their children grew up. Another consideration was that young farmers would expand farm size as they acquired the capital necessary to buy more machinery and land. On the other hand, older farmers were expected to reduce the size of their farms as their children left home and as the farmer reached retirement age.

The average age of those decreasing size in the study was not significantly different from the average age of those increasing size.[37] The Chi-square test also failed to reject the hypothesis that age groups were independent of size change categories.[38] When discussing the effects of age on size changes it is important to remember that farmers who quit farming during the five-year study period were not included in the study. All farmers included were actively farming at the conclusion of the test. Thus, it is possible that those older farmers who felt the need to reduce the amount of work done moved off the farm rather than decreasing the size of farm. If such were the adjustment made these farmers would not appear in this study. This possibility requires further research beyond that possible in the present study.

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[37] See Appendix Table 17, Part A.

[38] See Appendix Table 17, Part B.

One possible explanation for the older farmers not showing the anticipated decline in farm size is that they have sons who are going to take over the farm when the present farmer retires. To test this possibility the farmers in the 55 - 64 year age group and those in the 65 years and over age group were divided into three groups according to family characteristics. These three groups were those with children at home, those with all children having moved away from home, and those with no children.[39] The differences in size changes made by these three groups were not significantly different in the 55-64 age group. There were not enough farmers in the 65 and over group to do a statistical analysis but observation of the two-way table for this group (Appendix Table 18) does not indicate any striking differences.

Opportunities in farming - The operators who thought that the opportunities in farming were increasing were hypothesized to be more likely to increase farm size than those who believed that opportunities in farming were decreasing. The statistical analysis of the data did not indicate that there was any relationship between opinion concerning opportunities and size changes.[40]

Value of assets - Another relationship tested was that between total value of the farmer's assets and changes in farm size. The hypothesis was that farmers with greater total value of assets would be more likely to increase farm size and less likely to decrease size than would farmers with a lesser value of assets. The statistical analysis

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[39] See Appendix Table 18.

[40] See Appendix Table 19.

of this relationship did not indicate any significant difference.[41]

Income - It was thought at the start of the study that income received from the farm operations would be significantly related to decisions concerning changes in farm size. The data available did not substantiate this hypothesis.[42] However, the farm income data available was quite limited for purposes of this study. The only information concerning the net farm income of the farms for the period prior to the study was the net farm income in 1953. It would be expected that farmers consider the income experience of more than one year when making decisions about the future size of their farm. For this reason it would have been desirable to have an average farm income for several years preceding the study. While the data available did not indicate a significant relationship between net farm income and changes in farm size, a final evaluation of this relationship must await more satisfactory data.

Amount of off-farm work - The amount of off-farm work done was hypothesized to influence the changes made in farm size. Farmers who spent more time in off-farm employment were expected to expand farm size less often than were farmers who had little or no off-farm employment. The statistical analysis showed that total amount of off-farm employment was not significantly related to changes in farm size.[43] Even though the changes made in off-farm work are negatively related to changes in farm size, as was shown in a preceding section, this relationship is independent of the amount of off-farm work done.

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[41] See Appendix Table 20.

[42] See Appendix Table 21.

[43] See Appendix Table 22.

CHAPTER III

SUMMARY AND CONCLUSIONS

Summary

The preceding two sections have included an examination of the factors which were significantly related to changes in size and those which were not significantly related. To summarize the material contained in this study it might be helpful to look at a different arrangement of the twelve factors tested. The twelve variables contain personal characteristics of the farmer, characteristics of the farm business, and two variables concerned non-farm business.

The personal characteristics of the farmer were his age, the level of education attained and his attitude toward farming. The age of the farmer did not have any significant relationship to size adjustments but the education of the farmer was significantly related to size changes. A small amount of schooling appeared to restrict the farmer to a farm job and those with more than high school education apparently had the ability and desire to make a success of farming and thus, expanded farm size. The attitude of the farmer toward farming was expected to have an effect on his size change decisions and two different measures of attitude were used in this study. The farmer's opinion as to whether the opportunities in farming were increasing or decreasing was not significantly related to size changes but his satisfaction with farming was important in understanding the size adjustments made. Almost half of the farmers in this study thought that opportunities were decreasing in farming and

this opinion was held by about the same proportion of farmers who increased as decreased farm size. When considering satisfaction with farming (which was significantly related to size change) it is important to remember that farmers who were extremely dissatisfied with farming would be expected to quit farming and would not be included in this study.

There were six factors studied that were related to the farm business. The net income from farming was not a significant variable, but as has been previously indicated, this may be due to the data being limited to only one year. Another business variable that was not significantly related to size adjustments was the value of the assets owned by the farmer. However, a part of those assets, the machinery investment, was a significant variable. The importance of machinery investment in the farm size decision may be attributed to the reduction in costs as machinery is used more hours to cover more acres. The size of the farm at the start of the study was an important variable in determining size changes. The larger than average farms showed a noticeable tendency to get smaller. Also involved in the size adjustment decision was the price of the land. The lower priced land in most areas was used for size changes significantly more often that was the higher priced land in the same areas. The final characteristic of the farm business that was considered was the tenure arrangement. It was found that the adjustments in size made by tenants were not significantly different from those made by the group as a whole but that the adjustments made by part owners were different from those made by full owners.

There were two variables considered which concerned the non-farm employment of the farmer. These two variables were the amount of off-farm work done and the change in the amount of off-farm work done by the

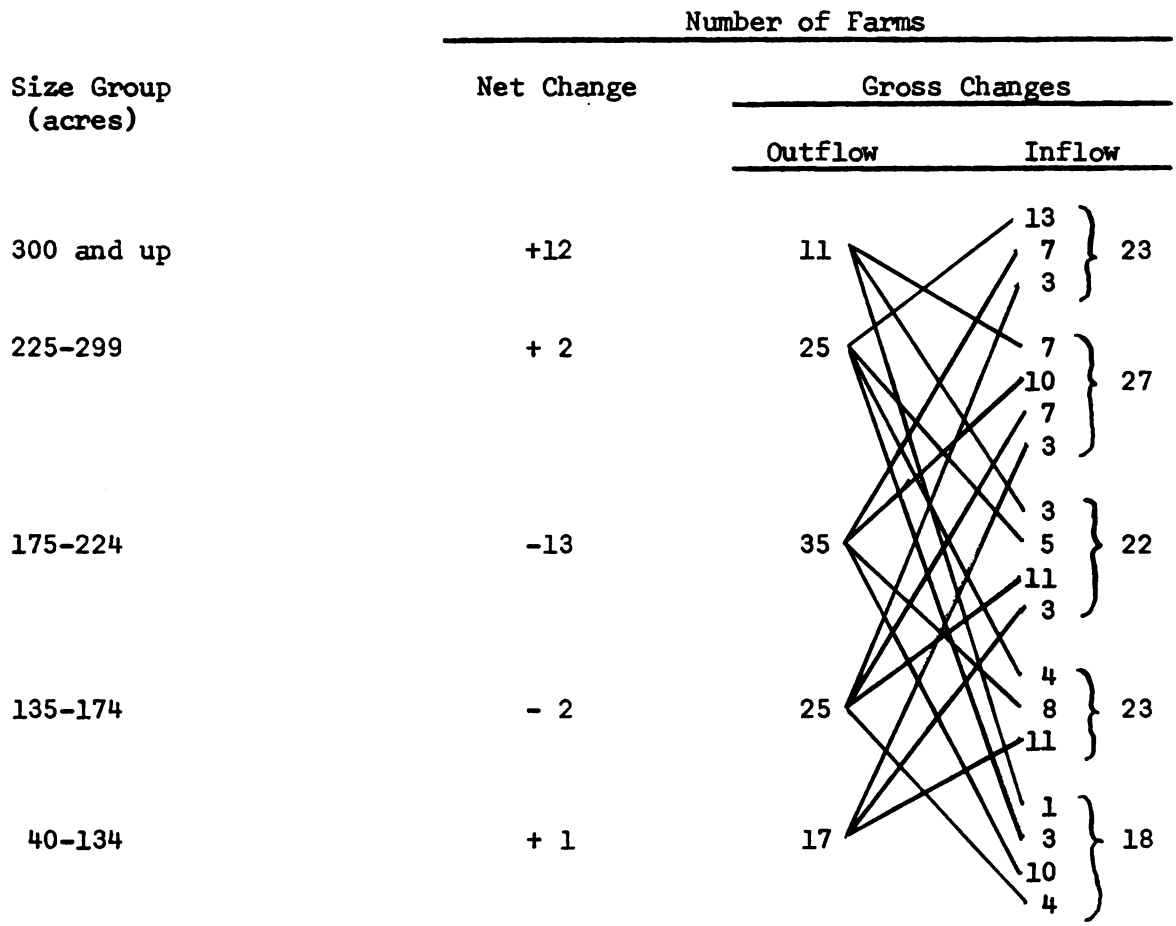
farmer. The study showed that the amount of off-farm work done was not significantly related to size changes but that there was a significant relationship between the changes made in the size of the farm and the changes made in the amount of off-farm work done.

This study of the process of farm size adjustments began by indicating the lack of adequate information in census calculations and from other currently available sources. By taking individual farms and analysing the adjustments made by each, a better understanding was gained about the actual changes made and what influenced the decisions to make these adjustments. Some indication of the additional information gained by this study can be seen in Figure 2.

In Figure 2 the farms in this study were divided into the five size groupings used to form the quintiles in the discussion of farm size. The second column of the chart shows the net change in the number of farms in each size category during the study. This is similar to the information available in the census. It is interesting to note that the larger size groups increased in number of farms and the smaller size groups generally decreased in number of farms. This is the same trend as noted in the Census data. However, the next two columns of Figure 2 show information not usually available. That is, they show the gross movements of farms between size groups. The gross outflow for each size group is the number of farms that were in that size group at the beginning of the study but which changed size sufficiently during the study period to be in a different size group at the end of the study. The arrows show the patterns of size shifts in the gross movements which resulted in the net figures shown in the first column. It is readily apparent from the arrows on the chart that there is a great deal of size adjustment taking place, much more than the net changes would indicate.

Figure 2

Net and Gross changes in the number of farms in different size groups during the study period.



While it was not the purpose of this study to analyze specific farm policy measures, it is perhaps appropriate to discuss some of the general implications of this study. At several points reasons were given to explain a reduction in farm size in Michigan. This study has shown the phenomenon of smaller farms to have the basis for being a permanent feature of Michigan agriculture rather than a special case in a particular short-run setting. Any proposal to regulate the size of farms must be flexible enough to permit part-time farmers to reduce the size of their farms below the minimum profitable size for a full-time operation. Those areas of southern Michigan where non-farm employment, especially industrial work, is available can expect that the number and proportion of small farms will not decrease in the foreseeable future and might possibly increase. If we consider part-time farming to be a desirable arrangement, then the institutional setting, be it the land market or legal provisions, should encourage these adjustments.

For policy decisions requiring an estimate of the future structure of agriculture in Michigan this study indicates several significant trends. There is likely to be less change in the size of farms in the areas of the state having high land values, such as the Saginaw Valley, than in areas having low land values. What adjustments are made could be expected to be primarily expansions in size.[1] For those areas of Michigan with low average land values this study indicated that adjustments in farm size will be more common. The farming areas north of the Bay City-Muskegon line can expect both larger and smaller farms as adjustments are made,

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[1]Cf. John R. Brake, Farm Adjustments in the Michigan Thumb - A Projection, Agricultural Experiment Station Research Report Number 2, Michigan State University (East Lansing, Mich.).

especially if efforts to attract industry into this area are successful in increasing the amount of non-farm employment available.

Another policy implication is connected with the trend to smaller farms in the areas of part-time farming. Even though part-time farmers live in rural areas they are closely associated with city dwellers at work. Their regular trips to town for work give a closer contact with city conveniences, such as good roads, schools, utilities, and other government services. A long-time association between rural and city dwellers may lead to increased demands for these better services in rural areas. Perhaps the primary implication of this study is that any policy should allow for flexibility in farm size adjustments due to the different pressures on farm size changes.

Additional Study Needed

At several points it was indicated that additional information was needed to accurately appraise the process of farm size adjustment. Due to the lack of time or space in this study or to the unavailability of data, our knowledge is incomplete in several important areas. This section will indicate some of these problems for further study and show their relation to the results of this study.

One question which this study was unable to answer concerned the adjustments made by large farms. Do the large farms which got smaller during the study period continue to get even smaller or do they remain at a size that is about average for the area as a whole? The answer to this question would give some indication as to whether farms make wide variations in size or whether there is a tendency to move toward the average size for the group. The answer to this question would involve studying

farms at short intervals, such as the five year period of this study, over a much longer period, say fifteen or twenty years.

Another problem which could not be handled adequately by this study was the influence of farm income on the size adjustment decision. It is the thought of this author that if the income experience of a longer time period than one year is considered it will have a significant relationship to the changes in farm size. A five to seven year period would probably be most desirable.

A further study which would improve our understanding of the processes of adjustment made on farms would be an inquiry into the timing of adjustments in machinery investment and changes in acres operated. If a farmer decides that he is going to enlarge his farm, does he buy more and bigger machinery and then acquire more land, or does he get the additional acres first and then add the machinery, or is there no definite tendency in this matter? This question is related to the significance of machinery investment per acre in explaining farm size adjustments in this study. Once again this is a case where we know the average values but do not understand the processes which underlie these averages.

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APPENDIX

Table 1: The number of farms in Michigan, by size in 1950, 1954, and 1959[a]

Size Group (acres)	1950 Number	1950 Percent	1954 Number	1954 Percent	1959 Number	1959 Percent
1 -10	8,669	5.6	7,964	5.7	3,545	3.2
10-49	35,032	22.5	31,113	22.4	23,225	20.8
50-69	12,072	7.8	10,387	7.5	8,427	7.5
70-99	30,845	19.8	25,849	18.6	20,580	18.4
100-139	24,686	15.9	20,811	15.0	16,924	15.1
140-179	17,580	11.3	15,718	11.3	13,024	11.6
180-219	9,557	6.1	9,215	6.6	8,128	7.3
220-259	5,954	3.8	6,178	4.4	5,728	5.1
260-499	8,822	5.7	10,031	7.2	10,338	9.2
500-999	1,155	0.7	1,423	1.0	1,690	1.5
1000 and up	217	0.1	233	0.2	208	0.2
Total	155,589	100.0	138,922	100.0	111,817	100.00

[a]According to U. S., Bureau of the Census, Census of Agriculture for 1950, 1954 and 1959.

Table 2: The average size of farms in each township in the study with the average size of farms in the same county, changes in average size of farms in each township between 1953 and 1958, and changes in average size of farms in each county between 1954 and 1959.

County (census)[a] or Township (study)	Average Size of Farms 1954 1953	1959 1958	Change in Size Acres	Percent
Calhoun County	132	152	+20	+15.2
Newton Township	233	234	+ 1	+ 0.4
Ionia County	137	147	+10	+ 7.3
Odessa Township	214	228	+14	+ 6.5
Lapeer County	123	129	+ 6	+ 4.9
Almont Township	232	231	- 1	- 0.4
Tuscola County	113	132	+19	+16.8
Denmark Township	175	189	+19	+10.8
Kalkaska County	190	213	+23	+12.1
Tri-Township	323	350	+27	+ 8.4
State	118	132	+14	+11.9
Entire study area	228	239	+11	+ 4.8

[a]From U. S. Census of Agriculture for year given.

Table 3: The number of farms in the study in each township distributed by changes made in farm size during the study period. (Percentage figures are the percent of the farms in each township which made the indicated change in size.)

Change in Total acres during the study period	Townships: Tri-Township (Kalkaska County)	Newton (Calhoun County)	Odessa (Ionia County)	Almont (Lapeer County)	Denmark (Tuscola County)	Total
Increased	42%-20	32%-17	46%-33	42%-27	34%-25	39%-122
No change	21%-10	36%-19	26%-19	23%-15	41%-30	30%- 93
Decreased	38%-18	32%-17	28%-20	34%-22	25%-18	31%- 95
Total	100%-48	100%-53	100%-72	100%-64	100%-73	100%-310

$X^2 = 10.458$

degrees of freedom = 8

Level of significance[a] = 30% 20%

Critical values[a] = 9.52 11.03

[a]In this table and all subsequent tables the critical values are either the values in the Chi-square table which bracket the calculated Chi-square value or are the critical value at the one percent level of significance when the calculated Chi-square value exceeds the table value at the one percent level.

Table 4: The number of farmers making changes in acres operated distributed by number of acres operated at the beginning of the study (1953)

Total acres - 1953	Change in Total Acres during the Study Period					
	Increased		No change	Decreased		Total
	1 - 64 acres	65 acres or more		65 acres or more	1 - 64 acres	
300 - 1187	11 35%	12	17%-11	18 48%	14	100%-66
225 - 299	12 39%	11	25%-15	11 36%	10	100%-59
175 - 224	16 38%	9	26%-17	10 36%	14	100%-66
135 - 174	11 41%	13	40%-23	2 19%	9	100%-58
40 - 134	17 44%	10	44%-27	0 11%	7	100%-61
Total	67 39%	55	30%-93	41 31%	54	100%-310

$X^2 = 40.412$

degrees of freedom = 16

Level of significance = 1%

critical values = 32.00

Table 5: Farms in selected size quintiles (based on 1953 total acres operated) distributed by method of changing farm size during the study period.

First Quintile - largest farms
(300-1187 acres)

	Number	Percent	Number	Percent
Increase in size	23	34.8		
Increase owned acres only			4	17.4
Increase rented acres only			6	26.1
Increase both			6	26.1
Increase owned acres and decrease rented acres			5	21.7
Decrease owned acres and increase rented acres			2	8.7
No change in size	11	16.7		
No change in either owned or rented acres			9	81.8
Increase owned acres and decrease rented acres			2	18.2
Decrease owned acres and increase rented acres			0	--
Decrease in size	32	48.5		
Decrease owned acres only			7	21.9
Decrease rented acres only			11	34.4
Decrease both			5	15.6
Decrease owned acres and increase rented acres			2	6.2
Increase owned acres and decrease rented acres			7	21.9
Total	66	100.0		

Table 5: cont.

	Third Quintile (175-224 acres)			
	Number	Percent	Number	Percent
Increase in size	26	38.8		
Increase owned acres only			5	19.2
Increase rented acres only			9	34.6
Increase both			5	19.2
Increase owned acres and decrease rented acres			4	15.4
Decrease owned acres and increase rented acres			3	11.5
No change in size	17	25.4		
No change in either owned or rented acres			14	82.4
Increase owned acres and decrease rented acres			2	11.8
Decrease owned acres and increase rented acres			1	5.9
Decrease in size	24	35.8		
Decrease owned acres only			4	16.7
Decrease rented acres only			14	58.3
Decrease both			1	4.2
Decrease owned acres and increase rented acres			0	--
Increase owned acres and decrease rented acres			5	20.8
Total	67	100.0		

Table 5: cont.

	Fourth Quintile (135-174 acres)			
	Number	Percent	Number	Percent
Increase in size	24	41.4		
Increase owned acres only			7	29.2
Increase rented acres only			10	41.7
Increase both			2	8.3
Increase owned acres and decrease rented acres			3	12.5
Decrease owned acres and increase rented acres			2	8.3
No change in size	23	39.6		
No change in either owned or rented acres			22	95.6
Increased owned acres and decreased rented acres			1	4.3
Decreased owned acres and increased rented acres			0	--
Decrease in size	11	19.0		
Decrease owned acres only			5	45.4
Decrease rented acres only			4	36.4
Decrease both			0	--
Decrease owned acres and increase rented acres			0	--
Increase owned acres and decrease rented acres			2	18.2
Total	58	100.0		

Table 5: cont.

Fifth Quintile - smallest farms
(40-134 acres)

	Number	Percent	Number	Percent
Increase in size	27	44.3		
Increase owned acres only			6	22.2
Increase rented acres only			11	40.7
Increase both			3	11.1
Increase owned acres and decrease rented acres			3	11.1
Decrease owned acres and increase rented acres			4	14.8
No change in size	27	44.3		
No change in either owned or rented acres			25	92.6
Increase owned acres and decrease rented acres			1	3.7
Decrease owned acres and increase rented acres			1	3.7
Decrease in size	7	11.5		
Decrease owned acres only			1	14.3
Decrease rented acres only			4	57.1
Decrease both			1	14.3
Decrease owned acres and increase rented acres			1	14.3
Increase owned acres and decrease rented acres			0	--
Total	61	100.0		

Table 6: The number of farmers making changes in acres operated distributed by machinery investment per acre at the beginning of the study (1953)

Machinery Investment Per Acre - 1953	Change in Total Acres during the Study Period			
	Increased	No change	Decreased	Total
$19 and less	39%-27	19%-13	43%-30	100%-70
$20 - 29	34%-26	38%-29	29%-22	100%-77
$30 - 39	39%-33	30%-25	31%-26	100%-84
$40 - 49	42%-19	31%-14	27%-12	100%-45
$50 and over	50%-17	35%-12	15%-5	100%-34
Total	122	93	95	310

$X^2 = 13.0856$

degrees of freedom = 8

Level of significance = 20% 10%

critical values = 11.03 13.36

Table 7: The number of farmers making changes in acres operated distributed by whether operator owned any land or not at the beginning of the study (1953)

Ownership of land in 1953	Change in Total Acres during the Study Period			
	Increased	No change	Decreased	Total
Own some land (owner or part owner)	111	86	87	284
Rent all land (tenant)	11	7	8	26
Total	122	93	95	310

$X^2 = .1579$

degrees of freedom = 2

Level of significance = 95% 90%

critical values = .10 .21

Table 8: The number of farmers making changes in acres operated distributed by owner, part owner, and tenant tenure classes at the beginning of the study (1953)

	Change in Total Acres, during the Study Period			
1953 Tenure class	Increased	No change	Decreased	Total
Owner	41%-62	45%-68	13%-20	100%-150
Part owner	37%-49	13%-18	50%-67	100%-134
Tenant	42%-11	27%-7	31%-8	100%-26
Total	39%-122	30%-93	31%-95	100%-310

$X^2 = 55.591$

degrees of freedom = 4

Level of significance = 1%

critical values = 13.28

Table 9: The number of farmers who decreased, increased, or held constant the number of acres operated distributed by the price of the land they farmed at the beginning of the study (1953)

	Changes in Total Acres during the Study Period					
Price of Land, dollars per acre 1953	Increased		No change	Decreased		Total
	1 - 64 acres	65 acres or more		65 acres or more	1 - 64 acres	
0-99	25	17	20	13	22	97
100-199	33	26	39	21	18	137
200-299	4	5	22	4	9	44
300 and up	5	7	12	2	5	31
Total	67	55	93	40	54	309

$X^2 = 21.378$

degrees of freedom = 12

Level of significance = 5% 1%

critical values = 21.03 26.22

Table 10: The number of farmers who changed or did not change acres operated distributed by price of the land that they farmed at the beginning of the Study (1953)

Price of land Dollars per acre 1953	Change in Total Acres during the Study Period: Changed Size (either increase or decrease)	No Change in Size	Total
0-99	77	20	97
100-199	98	39	137
200-299	22	22	44
300 and up	19	12	31
Total	216	93	309

$X^2 = 13.8158$

degrees of freedom = 3

Level of Significance = 1%

critical values = 11.34

Table 11: The number of farmers who increased or decreased the number of acres operated distributed by the price of the land they farmed at the beginning of the study (1953)

Price of land, Dollars per acre 1953	Change in total acres during the study period: Increased 65 acres and over	Increased 1 - 64 acres	Decreased 1 - 64 acres	Decreased 65 acres and over	Total
$0 - 99	13	22	25	17	77
$100 - 199	21	18	33	26	98
$200 - 299	4	9	4	5	22
$300 and over	2	5	5	7	19
Total	40	54	67	55	216

$X^2 = 8.5327$

degrees of freedom = 9

Level of Significance = 50% 30%

critical values = 8.34 10.66

Table 12: The number of farms in the study in each township distributed by the average value of the land in the farm at the beginning of the study (1953)

Price of land, dollars per acre, 1953	Townships: Tri-Township (Kalkaska County)	Newton (Calhoun County)	Odessa (Ionia County)	Almont (Lapeer County)	Denmark (Tuscola County)	Total
$0 - 99	48	24	23	13	0	108
$100-199	0	26	43	48	10	127
$200-299	0	0	6	3	36	45
$300 and over	0	3	0	0	27	30
Total	48	53	72	64	73	310

Table 13: The number of farmers increasing, decreasing, or making no change in the size of their farm distributed by township and by price of land within each township.

Denmark Township (Tuscola County)

1953 Price of land, dollars per acre	Change in total acres during the study period			
	Increased	No Change	Decreased	Total
$0-299	52%-13	67%-20	67%-12	62%-45
$300-500	48%-12	33%-10	33%-6	38%-28
Total	100%-25	100%-30	100%-18	100%-73

$X^2 = 1.482$

degrees of freedom = 2

level of significance = 50% 30%

critical values = 1.39 2.41

Odessa Township (Ionia County)

1953 Price of land, dollars per acre	Change in total acres during the study period			
	Increased	No Change	Decreased	Total
$0-149	79%-26	68%-13	60%-12	71%-51
$150-300	21%-7	32%-6	40%-8	29%-21
Total	100%-33	100%-19	100%-20	100%-72

$X^2 = 2.188$

degrees of freedom = 2

level of significance = 50% 30%

critical values = 1.39 2.41

Table 13: cont.

Almont Township (Lapeer County)

1953 Price of land, dollars per acre	Change in total acres during the study period			
	Increased	No Change	Decreased	Total
$0-149	44%-12	60%-9	77%-17	59%-38
$150-249	56%-15	40%-6	23%-5	41%-26
Total	100%-27	100%-15	100%-22	100%-64

$X^2 = 5.327$

degrees of freedom = 2

level of significance = 10% 5%

critical values = 4.60 5.99

Newton Township (Calhoun County)

1953 Price of land, dollars per acre	Change in total acres during the study period			
	Increased	No Change	Decreased	Total
$0-124	47%-8	37%-7	76%-13	53%-28
$125-500	53%-9	63%-12	24%-4	47%-25
Total	100%-17	100%-19	100%-17	100%-53

$X^2 = 5.914$

degrees of freedom = 2

level of significance = 10% 5%

critical values = 4.60 5.99

Table 13: cont.

Tri-Township (Kalkaska and Otsego Counties)

1953 Price of land, dollars per acre	Change in total acres during the study period			
	Increased	No Change	Decreased	Total
$0-49	55%-11	50%-5	89%-16	67%-32
$50-100	45%-9	50%-5	11%-2	33%-16
Total	100%-20	100%-10	100%-18	100%-48

$X^2 = 6.495$

degrees of freedom = 2

level of significance = 5% 2%

critical values = 5.99 7.82

Table 14: The number of farmers making changes in acres operated distributed by levels of satisfaction with farming as an occupation. (Percentage figures show percent of those in each satisfaction level making each type of size change.)

	Change in Total Acres during the Study Period			
Satisfaction with farming as an occupation	Increased	No Change	Decreased	Total
Satisfied	39%-90	29%-67	31%-72	100%-229
Neither satisfied nor dissatisfied	62%-10	12%-2	25%-4	100%-16
Not Satisfied	32%-14	34%-15	34%-15	100%-44
Total	39%-114	29%-84	31%-91	100%-289

$X^2 = 5.056$

degrees of freedom = 4

level of significance = 30% 20%

critical values = 4.88 5.99

Table 15: The number of farmers making changes in acres operated distributed by highest school grade completed by the operator. (Percentage figures show the percent of each educational level group who made changes in size.)

School grade completed by the operator	Changes in Total Acres during the Study Period			
	Increased	No Change	Decreased	Total
Less than 8 yrs.	48%-12	20%-5	32%-8	100%-25
Completed 8 years	38%-32	35%-30	27%-23	100%-85
Attended High School but did not graduate	30%-13	21%-9	49%-21	100%-43
Graduated from High School	42%-47	32%-36	25%-28	100%-111
Schooling beyond High School	38%-16	28%-12	33%-14	100%-42
Total	120	92	94	306

$X^2 = 10.9151$

degrees of freedom = 8

level of significance = 30% 20%

critical values = 9.52 11.03

Table 16: The number of farmers making changes in acres operated distributed by changes in number of months of off-farm work performed by the farmer. (Percentage figures show percent of each category of change in off-farm work making each change in total acres.)

	Change in Total Acres during the Study Period			
Change in number of months of off-farm work, 1953-58	Increased	No Change	Decreased	Total
Decrease	53%-30	32%-18	16%-9	100%-57
No change	39%-59	30%-46	31%-48	100%-153
Increase	33%-33	29%-29	37%-37	100%-99
Total	39%-122	30%-93	30%-94	100%-309

$X^2 = 9.154$

degrees of freedom = 4

level of significance	10%	5%
critical values =	7.78	9.49

Table 17:[a] The age of the operator compared with the changes made in acres operated during the study period.

Part A

Average age of those farmers increasing the size of their farm = 44.5*

Average age of those farmers decreasing the size of their farm = 42.8*

Average age of those farmers making no change in the size of their farm = 46.4

*The difference between these average ages is not significantly different from zero, according to the t-test.

Part B

Number of farmers making changes in acres operated distributed by age of the operator at the beginning of the study (1953). (Percentage figures show the percent of farmers in each size change group whose age is in the group indicated.)

	Change in Total Acres during the Study Period			
Age of farmer, 1953	Increased	No Change	Decreased	Total
Less than 30 years	7%-8	4%-4	8%-8	6%-20
30-44 years	47%-57	43%-40	49%-47	46%-144
45-54 years	26%-32	25%-23	28%-27	26%-82
55-64 years	16%-19	22%-20	12%-11	16%-50
65 and over	5%-6	6%-6	2%-2	5%-14
Total	100%-122	100%-93	100%-95	100%-310

[a]It is important to keep in mind that the data does not include any farmers who quit farming during the study period.

Table 18: The number of farmers over age 55 at the beginning of the study who increased, decreased or made no change in the size of their farm distributed by the presence of children in the family at the beginning of the study (1953).

	Change in Total Acres during the Study Period			
Farmers age 55-64	Increased	No Change	Decreased	Total
With children at home	58%-11	55%-11	45%-5	54%-27
All children away from home	26%-5	35%-7	45%-5	34%-17
No children	16%-3	10%-2	9%-1	12%-6
Total	100%-19	100%-20	100%-11	100%-50

$X^2 = 1.148$

degrees of freedom = 4

level of significance = 90% 80%

critical values = 1.06 1.65

	Change in Total Acres during the Study Period			
Farmers age 65 and over	Increased	No Change	Decreased	Total
With children at home	50%-3	50%-3	0%-0	43%-6
All children away from home	33%-2	0%-0	50%-1	21%-3
No children	17%-1	50%-3	50%-1	36%-5
Total	100%-6	100%-6	100%-2	100%-14

Table 19: The number of farmers making changes in acres operated distributed by operator's opinion concerning the opportunities to do the things they would like to do in farming. (Percentage figures are the percent of farmers in each size change group who hold the indicated opinion concerning opportunities in farming.)

	Change in Total Acres during the Study Period			
Opinion concerning opportunities in farming	Increased	No Change	Decreased	Total
Opportunities are increasing	42%-47	35%-28	35%-31	37%-106
No change in opportunities	11%-12	17%-14	19%-17	15%-43
Opportunities are decreasing	48%-54	48%-39	46%-41	47%-134
Total	100%-113	100%-81	100%-89	100%-283

$X^2 = 3.613$

degrees of freedom = 4

level of significance = 50% 30%

critical values = 3.36 4.88

Table 20: The number of farmers making changes in acres operated distributed by the value of the assets of the operator's family on January 1, 1954.

	Change in Total Acres during the Study Period			
Value of assets of operator's family, January 1, 1954	Increased	No Change	Decreased	Total
Less than $30,000	17	12	12	41
$30,000-59,999	24	13	18	55
$60,000 and over	16	14	12	42
Total	57	39	42	138

$X^2 = 1.1315$

degrees of freedom = 4

level of significance = 90% 80%

critical values = 1.06 1.65

Table 21: The number of farmers making changes in acres operated distributed by net farm income received in 1953.

1953 Net Farm Income	Change in Total Acres during the Study Period					
	Increased		No Change	Decreased		Total
	65 acres and over	1 - 64 acres		1 - 64 acres	65 acres and over	
Net loss	2	5	13	5	4	29
$1-2,999	15	26	38	26	24	129
$3,000-7,999	16	18	31	29	18	112
$8,000 and over	8	5	11	6	10	40
Total	41	54	93	66	56	310

$X^2 = 9.672$

degrees of freedom = 12

level of significance = 70% 50%

critical values = 9.03 11.34

Table 22: The number of farmers making changes in acres operated distributed by the number of months of off-farm work performed in 1953.

1953 Months of off-farm work	Change in Total Acres during the Study Period					
	Increased		No Change	Decreased		Total
	1 - 64 acres	65 acres or more		65 acres or more	1 - 64 acres	
0	42	27	54	25	39	187
1-6	17	22	31	14	10	94
7-12	8	6	8	2	5	29
Total	67	55	93	41	54	310

$X^2 = 9.2336$

degrees of freedom = 8

level of significance = 50% 30%

critical values = 7.34 9.52