



Merchant and Dealer Credit in
AGRICULTURE

DATA FROM THE 1960 SAMPLE SURVEY OF AGRICULTURE

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CHAPTER VII. ANALYSIS OF VARIATION IN THE USE OF
MERCHANT-DEALER CREDIT

As preceding chapters have shown, the degree to which farm operators were indebted to merchants and dealers was found to be related to such characteristics as their age and the size and type of their farms. Here, the study of these relationships is continued through use of multiple regression techniques. As in the preceding analysis that used cross-classification, the primary goal is to quantify the net relationships--net in the sense that the influence of other characteristics was taken into account. However, the regression method extends the previous analysis by permitting simultaneous consideration of more characteristics and by yielding a statistical measure of the relative importance of each characteristic.

The regression study was divided into the following three phases, each concerned with one aspect of indebtedness to merchants and dealers: (1) the likelihood that a farm operator had merchant-dealer debt, (2) the likelihood that an operator owed non-real-estate debt only to merchants and dealers, and (3) the proportion that an operator's debt to merchants and dealers was of his total non-real-estate debt. Each analysis sought to determine which farm characteristics were significantly related to the aspect of indebtedness being investigated and to find the nature of the net relationships that were significant.

Three characteristics--type of farm, size of farm as measured by the value of farm products sold, and age of operator--exhibited significant relationships (at a probability level of .05) in each of the analyses conducted. Three other characteristics that often figure in discussions of merchant-dealer credit--the geographic location, tenure, and race of the operator--were significant in some but not all of the analyses. Because of the interest in these factors, however,

the results obtained in each instance are presented in the material that follows.

Among the other characteristics tested, the use of production contracts and the amount of off-farm income received by the farm family were not found significantly related to any of the aspects of merchant-dealer indebtedness that were examined. Three additional characteristics--the length of time that the operator had farmed his present place, the amount of off-farm work he engaged in, and the per acre value of the land and buildings on the farm he operated--were found significant only in the analysis of the likelihood that the operator had merchant-dealer debt.

A second measure of size of farm, the value of the land and buildings, was tested and found significant in each analysis, as either an alternative or a complement to the value of farm products sold. However, only the latter characteristic is used in the results presented here, as the information gained by using both measures in the same analysis did not appear to compensate for the greater difficulty in interpreting the results.

Probability That a Farmer Had Merchant-Dealer Debt

As compared with the average for all farmers, those in certain groups were significantly more or less likely to have been indebted to merchants and dealers at the time of the Survey. Significant net differences were found among some of the classes of each of the characteristics listed in the accompanying tabulation.

The characteristics are listed in descending order of the degree to which variation in each characteristic was related to the variation in indebtedness remaining after the influence of the other characteristics listed was accounted for. The proportion of the latter variation that was "explained" by the characteristic is shown as the measure of importance, technically known as the coefficient of partial determination (partial R^2). A measure of the statistical significance

<u>Characteristic</u>	<u>Importance (Partial R²)</u>	<u>Significance^{1/} (F-ratio)</u>
Age of operator.....	.0109	24.49**
Value of farm products sold..	.0102	23.01**
Type of farm.....	.0093	14.90**
Tenure of operator.....	.0051	18.89**
Years on farm.....	.0044	6.99**
Off-farm work.....	.0036	8.03**
Per acre value of farm.....	.0029	8.04**
Geographic area.....	.0013	7.39**
Race of operator.....	.0012	6.53**

$$R^2 = .098$$

$$\bar{R}^2 = .095$$

$$F = 30.33 ** (40 \text{ and } 11,104 \text{ degrees of freedom})$$

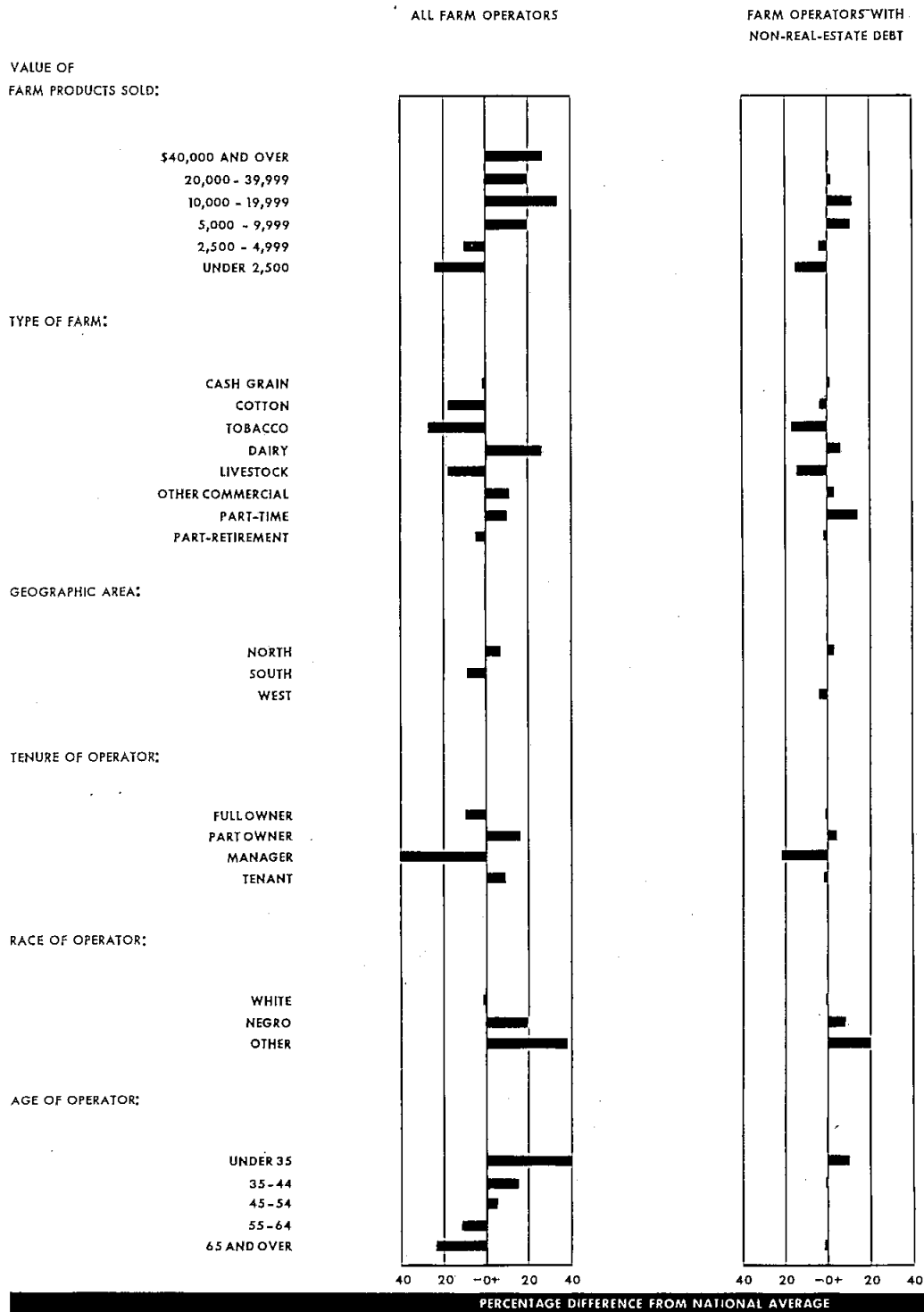
of the relationship (F-ratio) is also shown, together with an indication of whether the relationship can be considered significant at either the .01 or .05 probability levels. The results shown are intended only as a rough guide to significance, however, because complications arising from stratification and clustering in the sample were ignored in the calculations, except that each observation was weighted by the inverse of the sampling rate used in its stratum.

For each class of each characteristic, the analysis also produced an estimate of the net effect that membership in that class had on the probability that the operator had merchant-dealer debt. These results, expressed as percentage differences from the national average probability (.28), are shown in the first column of Chart 1.

^{1/} In this table and in similar tables that follow, two asterisks (**) are used to show that the F-ratio indicates that the net relationship was significant at a probability level of .01. (This statement is interpreted to mean that the chances are less than 1 in 100 that there was actually no relationship.) A single asterisk (*) indicates significance at a probability level of .05, and the absence of an asterisk by the F-ratio indicates that the net contribution of the characteristic was not significant at that probability level in the particular type of analysis conducted.

Net Relationships Between Selected Characteristics and the Probability That an Operator Had Debt to Merchants and Dealers

1



ALL FARM OPERATORS

FARM OPERATORS WITH
NON-REAL-ESTATE DEBT

YEARS ON FARM:

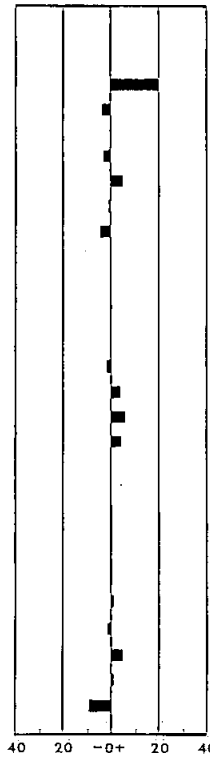
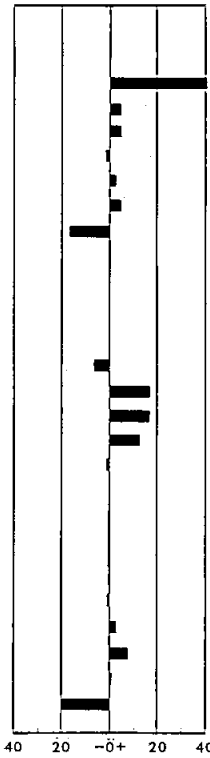
- UNDER 2
- 2 - 4
- 5 - 9
- 10 - 14
- 15 - 19
- 20 - 29
- 30 AND OVER

OFF-FARM WORK (DAYS PER YEAR):

- NONE
- 1 - 49
- 50 - 99
- 100 - 199
- 200 AND OVER

PER ACRE VALUE OF FARM:

- UNDER \$75
- 75 - 149
- 150 - 299
- 300 - 449
- 450 AND OVER



PERCENTAGE DIFFERENCE FROM NATIONAL AVERAGE

The greater variations were found among age classes and among different size and type groupings. The likelihood of having merchant-dealer debt was lowered by advancing age, by operation of a small farm rather than either a large or medium-sized farm, and by operation of a cotton, tobacco, or livestock farm as opposed to a dairy or part-time non-commercial farm.

Differences in the tenure status of the farm operators were also prominently related to the probability that merchant-dealer debt was present. Being a part owner or tenant rather than a full owner added considerably to the likelihood of this circumstance, as did being a Negro or other nonwhite operator. Geographic area had a lesser net impact; other characteristics being equal, location in the North slightly increased probability that the operator had merchant-dealer debt, while location in the South reduced it.

The probability was also raised if the farmer had very recently moved to the farm he now operated, and lowered if he had worked the same farm for 30 years or more. In between, there did not appear to be much variation associated with the length of tenure. A part-time job off the farm operated (1 to 199 days per year) was associated with an increased probability as compared with not working off the farm at all or with holding a full-time job off the farm (200 days or more per year).

The per acre value of the farm was included in the analysis as a rough index of quality and intensity of operation. A high value was found to reduce the probability that merchant-dealer credit was being used.

In a second analysis, it was found that farmers who borrowed from merchants and dealers were on the whole less different from other farmer debtors than they were from all farmers as a group, or especially from farmers who were not indebted. A regression of the same nine characteristics on the probability that a farm operator with non-real-estate debt owed at least some of such debt to merchants and dealers produced the results shown in the accompanying table. Compared with the results of the first analysis, these relationships were generally

<u>Characteristic</u>	<u>Importance (Partial R²)</u>	<u>Significance (F-ratio)</u>
Type of farm.....	.0102	8.54**
Value of farm products sold..	.0072	8.40**
Years on farm.....	.0046	3.84**
Age of operator.....	.0036	4.25**
Per acre value of farm.....	.0024	3.51**
Geographic area.....	.0013	3.91*
Tenure of operator.....	.0013	2.44
Off-farm work.....	.0012	1.39
Race of operator.....	.0008	2.48

$$R^2 = .039$$

$$\bar{R}^2 = .032$$

$$F = 5.85 ** (40 \text{ and } 5,824 \text{ degrees of freedom})$$

less pronounced, as is also evident from the smaller magnitude of the estimated net effect of membership in each class, shown in the second column of Chart 1. In fact, three of the characteristics--tenure, off-farm work, and race of operator--were not significant in this analysis.

Among the operators who had non-real-estate debt, the greatest variation in the net probability that this included some merchant-dealer debt was found related to differences in the type and size of the farms operated. Operation of a medium-sized farm increased the probability, whereas operation of a very small farm decreased it. Among the type-of-farm differences, operation of a part-time noncommercial farm raised the probability; operation of a tobacco or livestock farm reduced it. Differences among the classes of the other significant characteristics were not pronounced.

Probability That a Farmer Owed Non-Real-Estate Debt Only
to Merchants and Dealers

The Survey found about 270,000 farmers--11 per cent of the national total--who owed non-real-estate debt only to merchants and

dealers. Several analyses were conducted to find the characteristics related to the probability that a farmer was in this category. These used different groups of farmers as the base: (1) all farm operators, (2) farm operators with non-real-estate debt, and (3) farm operators with merchant-dealer debt.

Starting with all farmers, the probability that a farmer had non-real-estate debt to only merchants and dealers was found significantly, but not very importantly, related to the six characteristics listed in the table that follows. The nature of the net relationships

<u>Characteristic</u>	<u>Importance (Partial R²)</u>	<u>Significance (F-ratio)</u>
Type of farm.....	.0040	6.40**
Tenure of operator.....	.0022	8.24**
Age of operator.....	.0016	3.57**
Value of farm products sold..	.0013	2.84*
Geographic area.....	.0010	5.42**
Race of operator.....	.0009	5.02**

$$R^2 = .014$$

$$\bar{R}^2 = .012$$

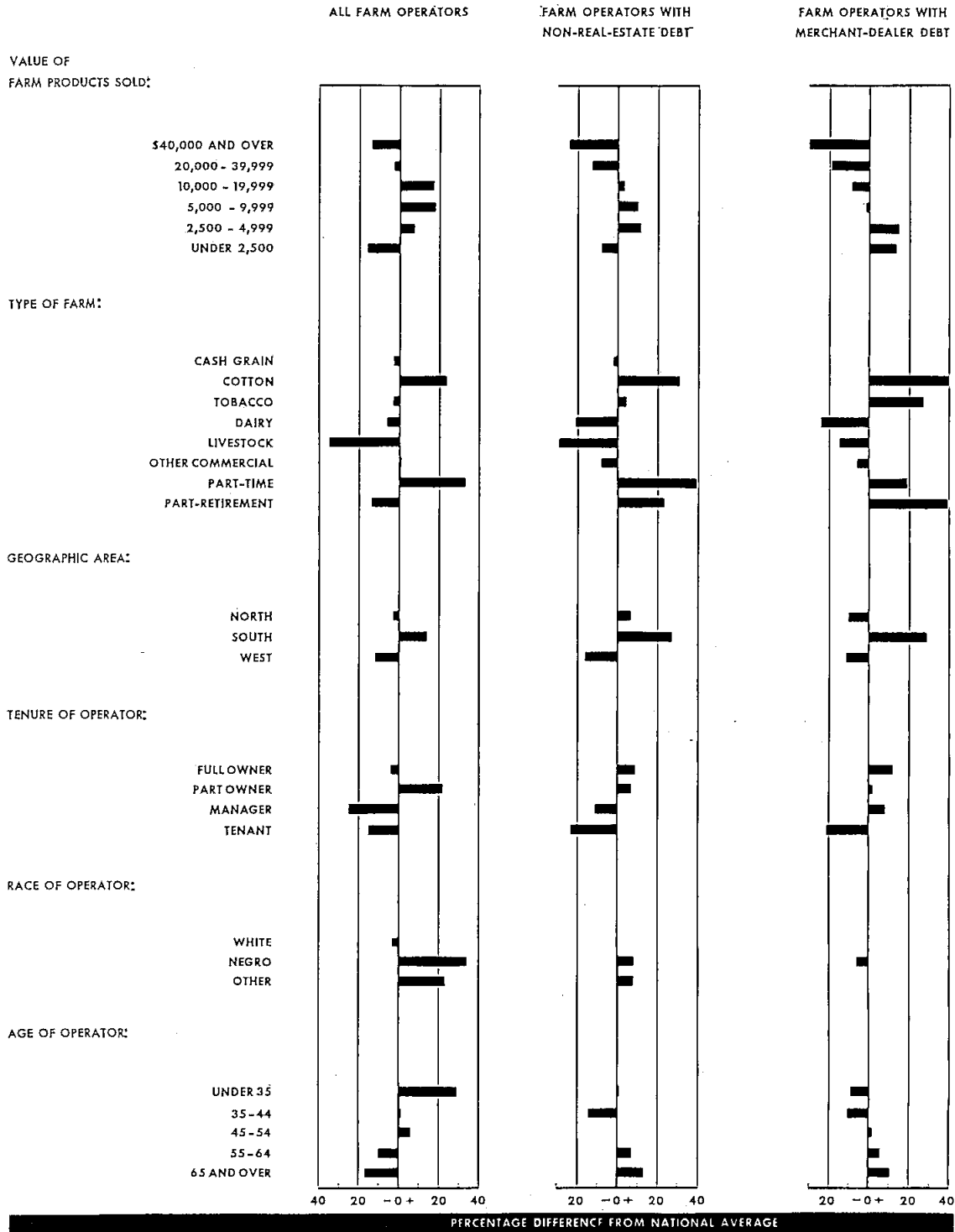
$$F = 6.79 ** (24 \text{ and } 11,120 \text{ degrees of freedom})$$

is illustrated in the first column of Chart 2. The effect associated with each class is in this chart shown as a percentage of the national average probability of .11, and thus even large percentage differences indicate only small absolute differences in the probability.

Among all farm operators, the likelihood that the operator had non-real-estate debt to merchants and dealers only was increased if he operated a medium-sized farm, a cotton or part-time noncommercial farm, or a farm in the South, or if he was a part owner, a Negro or other nonwhite operator, or under 35 years of age. The likelihood was reduced if he had a very large or very small farm, a livestock or part-retirement noncommercial farm, or a farm in the West, or if he was a tenant or over 55 years of age.

Net Relationships Between Selected Characteristics and the Probability That an Operator Had Non-Real-Estate Debt Only to Merchants and Dealers

2



61

The probability that a farmer was using any non-real-estate credit whatsoever was also influenced by some of these characteristics. Thus somewhat different relationships were found for the tendency to use credit from merchants and dealers only, given that the operator was using non-real-estate credit of some kind. Highly significant variations in the probability were found associated with differences in type and geographic location of farm and in tenure of operator, but

<u>Characteristic</u>	<u>Importance (Partial R²)</u>	<u>Significance (F-ratio)</u>
Type of farm.....	.0087	7.31**
Geographic area.....	.0062	18.23**
Tenure of operator.....	.0051	10.02**
Value of farm products sold..	.0026	3.00*
Age of operator.....	.0023	2.72*
Race of operator.....	.0002	.43

$$R^2 = .042$$

$$\bar{R}^2 = .038$$

$$F = 10.76.** \text{ (24 and 5,840 degrees of freedom)}$$

size of farm and age of operator were significant only at the .05 probability level, and no significant differences were found for race. The effect associated with each class of these characteristics is illustrated in the second column of Chart 2, where it is shown as a percentage of the national average probability of .24.

Among these operators with non-real-estate debt, the probability that such debt was owed only to merchants and dealers was increased if the operator had a farm with annual sales of \$2,500 - 10,000, a cotton or noncommercial farm, or a farm in the South, or if he was a full owner, part owner, or over 55 years old. The likelihood of this debt status was decreased if he operated a farm with annual sales over \$20,000 or below \$2,500, a tobacco or dairy farm, or a farm in the West, or if he was a tenant.

The third analysis in this set again dealt with the probability that an operator had non-real-estate debt to merchants and dealers only, but the base was limited to the operators with merchant-dealer debt.

<u>Characteristic</u>	<u>Importance (Partial R²)</u>	<u>Significance (F-ratio)</u>
Type of farm.....	.0150	7.17**
Geographic area.....	.0133	22.16**
Tenure of operator.....	.0106	11.77**
Value of farm products sold..	.0076	5.03**
Age of operator.....	.0062	4.07**
Race of operator.....	.0002	.26

$R^2 = .119$
 $\bar{R}^2 = .112$
 $F = 18.43^{**}$ (24 and 3,286 degrees of freedom)

As in the preceding analysis, five characteristics were significantly related to the likelihood that these operators were using credit only from merchants and dealers, with type of farm, geographic location, and tenure of operator again exhibiting the strongest influence.

Over-all, .40 of the farm operators with merchant-dealer debt had no other non-real-estate debt. The net effect that membership in various classes had on the probability that a farmer was in this group is illustrated in the third column of Chart 2. The probability was increased by operation of a small farm, a cotton, tobacco, or noncommercial farm, or a farm in the South, and was also raised if the operator was a full owner or over 65 years of age. The probability was reduced if the operator had a large farm, a dairy or livestock farm, or a farm in the North or West. It was also lowered if he was a tenant or under 45 years of age.

If one scans across the columns of Chart 2, it becomes evident that the conclusion reached about the kind of operators likely to have had non-real-estate debt only to merchants and dealers depends on the base to which these farmers are compared. For example, among the entire

population of farmers, being a young operator increased the probability of this debt status, whereas being older reduced it. Among the farmers who had non-real-estate debt or merchant-dealer debt, however, greater age increased the probability that the operator had debt only to merchants and dealers. Obviously, in using these results one must be careful to select the analysis most pertinent to the situation being studied.

Ratio of Merchant-Dealer Debt to Total Non-Real-Estate Debt

For those farm operators who had non-real-estate debt both to merchants and dealers and to other sources, it was possible to study the relationships between the farm characteristics and the degree to which the operators used merchants and dealers in meeting their credit needs at the time of the Survey. The distribution of these 555,000 farmers by the percentage that their merchant-dealer debt was of their total non-real-estate debt was as follows:

<u>Merchant-dealer debt as per cent of total non-real-estate debt</u>	<u>Per cent of farmers in class</u>
1 - 10	24
11 - 20	19
21 - 30	13
31 - 40	9
41 - 50	10
51 - 60	7
61 - 70	4
71 - 80	5
81 - 90	4
91 - 99	<u>5</u>
	100

The average of the individual debt ratios was 34 per cent. The analysis found four characteristics significantly related to deviations from this

average, as shown in the tabulation that follows.^{2/} Type and size of farm exhibited the larger net influence, with age and race of lesser importance. The net effects attributable to area and tenure were not

<u>Characteristic</u>	<u>Importance (Partial R²)</u>	<u>Significance (F-ratio)</u>
Type of farm.....	.0124	3.86**
Value of farm products sold..	.0092	3.99**
Age of operator.....	.0076	3.31**
Race of operator.....	.0054	5.86**
Tenure of operator.....	.0032	2.33
Geographic area.....	.0026	2.81

$$R^2 = .064$$

$$\bar{R}^2 = .054$$

$$F = 6.17 ** (24 \text{ and } 2,153 \text{ degrees of freedom})$$

large enough to be significant, but as previously noted, the results obtained are also presented because of the general interest in these factors.

The net effect of membership in a particular class of each characteristic, expressed as a percentage of the national average ratio of .34, is illustrated in Chart 3. Upward influence on the ratio of merchant-dealer debt to total non-real-estate debt was found if the farmer had annual sales between \$2,500 and \$10,000, or operated a cotton, tobacco, or part-time noncommercial farm, or if he was a Negro or other nonwhite operator, or was over 65 years of age. Operation of a dairy, livestock, or part-retirement noncommercial farm exerted a downward influence on the ratio.

^{2/} In the analysis presented, the influence of the characteristics was considered to be additive. Two alternative forms of the relationships, obtained by using the logarithm and square root of the ratio, respectively, were tried and yielded results substantially similar to those presented. Apparently, the proportion of the total variation explained by the surveyed characteristics was so low that the form of the relationship assumed made little difference.

Net Relationships Between Selected Characteristics and the Ratio of Merchant-Dealer Debt to Total Non-Real-Estate Debt Among Operators with Both Merchant-Dealer Debt and Other Non-Real-Estate Debt

3

VALUE OF FARM PRODUCTS SOLD:

- \$40,000 AND OVER
- 20,000 - 39,999
- 10,000 - 19,999
- 5,000 - 9,999
- 2,500 - 4,999
- UNDER 2,500

TYPE OF FARM:

- CASH GRAIN
- COTTON
- TOBACCO
- DAIRY
- LIVESTOCK
- OTHER COMMERCIAL
- PART-TIME
- PART-RETIREMENT

GEOGRAPHIC AREA:

- NORTH
- SOUTH
- WEST

TENURE OF OPERATOR:

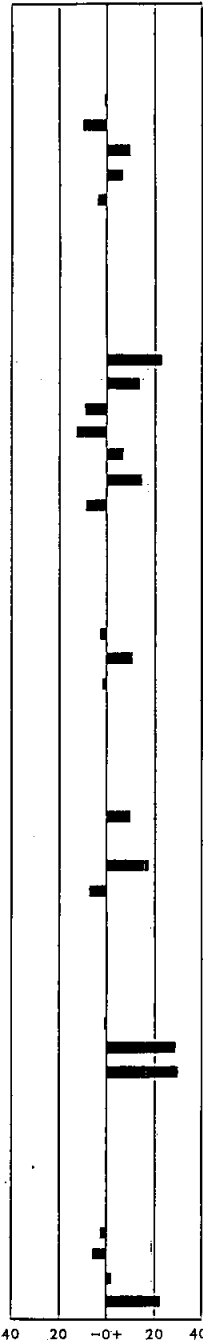
- FULL OWNER
- PART OWNER
- MANAGER
- TENANT

RACE OF OPERATOR:

- WHITE
- NEGRO
- OTHER

AGE OF OPERATOR:

- UNDER 35
- 35-44
- 45-54
- 55-64
- 65 AND OVER



PERCENTAGE DIFFERENCE FROM NATIONAL AVERAGE

66

A Note on the Analytical Technique

The analytical technique employed in this chapter--least-squares multiple regression--permits the simultaneous consideration of many characteristics in a single analysis.^{3/} The relationship found for each characteristic is therefore the one that remains after adjustment is made for the fact that the others also affect the aspect of indebtedness being studied and that there are unequal proportions of farmers with these other characteristics in each of the classes of the characteristic under examination; in other words, it is the "net" relationship found after intercorrelation among the characteristics is taken into account, as contrasted to the "gross" relationship found by simple tabulation of the survey data.

Measuring the Importance of Each Net Relationship

Two kinds of results are obtained from this analytical method. The first, known as the analysis of variance, is designed to measure the proportion of the variation in indebtedness that can be attributed to the net influence of a given farm characteristic and to test whether this proportion is significant in the sense that it is unlikely to have arisen by chance. The procedure is as follows.

First, in each analysis, the proportion of the total variation in indebtedness that can be accounted for by the characteristics included in that analysis is calculated. This figure, which is known as the coefficient of determination (R^2), indicates the importance of all of the relationships taken together.

^{3/} For a more detailed explanation of the methods employed, see Emanuel Melichar, "Factors Related to Farmers' Use of Credit: Least-Squares Analysis of Sample Survey Data," Journal of Farm Economics, December 1965, and Emanuel Melichar, "Least-Squares Analysis of Economic Survey Data," 1965 Proceedings of the Business and Economic Statistics Section, American Statistical Association, (Washington, 1965).

Next, the same type of figure is calculated after one of the characteristics is omitted from the analysis. The difference between these figures is the net contribution of that characteristic toward explaining the variation in indebtedness.

In presenting the results in this chapter, this difference is in each case divided by the proportion of variation that remained unexplained before the inclusion of that characteristic, thereby obtaining the proportion of such variation that was explained by the characteristic. This statistic is the coefficient of partial determination (partial R^2).

Testing for the Significance of Each Net Relationship

The test for the significance of the net contribution of a characteristic is made in a negative manner, in that it is first hypothesized that there is no relationship, and the test then consists of an attempt to reject this hypothesis by showing that the chances are quite high that it is not true. It is customary, in an investigation of this type, to be rather conservative and insist on good odds before declaring that the hypothesis is rejected and that a relationship thus exists. A favorite level of odds is 95 out of 100, in which case it is usually stated that the relationship is significant at a probability level of .05. Naturally, the existence of a relationship can be stated with more confidence if the test shows that the chances are better than this minimum. In reporting results in this chapter, it is therefore also indicated whether the odds were as good as 99 out of 100, in which case it is stated that the relationship is significant at a probability level of .01.

Three implications of this procedure deserve mention. (1) The failure to reject the original hypothesis does not prove that there is no relationship. The insistence on a high probability level for rejection means that there may be a fair chance that a relationship actually does exist in those cases in which the test fails to result in rejection; thus a larger sample might have allowed the hypothesis to

be rejected. Or, the form of the true relationship may be different from the form tested. (2) The test for a significant relationship is divorced from considerations of the existence or direction of cause and effect and therefore provides no substantiation for claims of that nature. (3) There is always a small chance, measured and stated by the probability level used, that the relationship that has been declared significant is actually a result of random variation.

In the analyses reported in this chapter, there are two additional reasons for the exercise of caution in assessing the significance of relationships that are near the borderline of acceptance and rejection. The first is that the test employs formulas that, strictly speaking, are applicable to simple random samples, whereas the actual sampling procedure employed stratification and clustering. (It should be noted, however, that in the analyses conducted the observations were weighted according to the number of farms that each represented in the nation.)

The second consideration applies primarily to the analyses in which probabilities were studied. These analyses violate the requirement known as homoscedasticity, and thus the estimates are not unbiased. A requirement of the significance test--normal distribution of the unexplained variation--is also violated. Because of the large sample sizes, however, the relationships that were important enough to be of interest were also, on the basis of these tests, significant far beyond the usual boundary of acceptance. In these cases, it is thought that refinement of the tests would not have altered the conclusions.

Quantifying the Net Relationships

The second kind of result obtained through the analytical method used is, for each characteristic, a group of summary statistics that describes the net relationship between that characteristic and the aspect of indebtedness that is being investigated. For each class of a characteristic, such as the class of cotton farms in the charac-

teristic called type of farm, the analysis produces an estimate of the net change in indebtedness that is associated with the fact that a farm belongs in that class. Technically, this is the regression coefficient estimated for the "dummy" variable representing that class in the regression equation.

In the charts of this report, these results are shown as percentage differences from the average of the variable being investigated. For example, it was found that .28 of all farm operators were indebted to merchants and dealers at the time of the Survey. The probability that a farmer had such debt, however, was found to be reduced by a net amount of 5 percentage points if the farm was a cotton farm. To aid the comparability of results from different analyses, this net difference associated with cotton farms is reported as a percentage of the average. Thus it is shown as -18 per cent, obtained by dividing $-.05$ by $.28$.

These estimates of the relationships were produced under the assumption that the effects of the various characteristics are additive in nature. For instance, if the net difference associated with the farm being a cotton farm is -18 per cent, and that associated with the farm operator being under 35 years of age is +40 per cent, then the net difference associated with the combination of these two characteristics (a cotton farmer under 35 years of age) is $(-18) + (+40)$, or +22 per cent.

The use of the assumption of additivity means that no provision was made for the possibility of interaction among any two or more of the characteristics. As an example, the technique made no allowance for the possibility that the net difference associated with the farm operator being under 35 years of age might actually depend on the type of farm operated. Various tests of the results, however, appeared to indicate that such interaction as did exist did not substantially affect the results. However, this and the other limitations noted in the data and in the analytical method call for exercise of caution in the use of the findings.