EMPIRICAL TESTING OF A FARM FIRM GROWTH THEORY

Frederick J. Rafeld and Edgar T. Shaudys*

INTRODUCTION

Researchers in agricultural economics have become increasingly concerned with the effects of structural and technical changes in agriculture upon the size of the farm firm. These researchers not only want to understand firm growth in order to make suggestions for necessary changes in social institutions but also to advise the managers of farm firms.

Recent farm firm growth research studies were conducted using empirically based mathematical programming models to explore growth and to test hypotheses concerning the influence of various economic factors upon growth. For examples, see [3, 6, 7]. Growth in these studies is a function of the assumptions of the particular programming model.

The present study developed a theory of farm firm growth and tested its validity, using empirical data. The main objectives were to isolate the specific factors, including human factors, which contribute to growth and to determine the quantitative relationships of these factors to growth.

THE RESEARCH HYPOTHESIS

The basic hypothesis was that farm firm growth is a function of personal characteristics, situational characteristics, and of the growth strategies employed. This hypothesis is based upon previous research and upon economic, managerial and social psychological theories.

A farm firm was defined as a farming operation controlled and operated by one manager and, as used in this study, management includes entrepreneurship. Size of each firm was determined on both January 1, 1962 and January 1, 1967 and was defined as the constant dollar value of all the production resources controlled. Growth was defined as increase in the size of the firm. Thus, farm firm growth comprised the increase in constant dollar value of total resources controlled (owned or leased) by each manager from January, 1962 to January, 1967.

The specific personal characteristic variables considered were operator age; operator attitudes toward credit use, risk acceptance, innovation and business orientation; operator education and management ability; and the relative importance of a growth goal. The main situational variables were production efficiency, firm size, and the availability of additional land, labor and capital. The amount of capital available was assummed to be a function of farm income, amount of borrowed money and family size. The strategy variables were methods used by the operators to achieve growth.

EXPERIMENTAL DESIGN

A random sample of 62 southwestern Ohio cash grain-hog farm operators were interviewed in August 1967. The sample included farmers who: (1) were between 30 and 50 years of age, (2) had a gross farm income exceeding $10,000 each year of the study period, (3) had less than $4,000 of family income from nonfarm sources in any year, and (4) received over half of this gross farm income from the sale of cash grain and hogs. The sample was restricted to farm firms with only one manager.

MEASUREMENT OF SPECIFIC VARIABLES[1]

Growth

As stated earlier, size and growth were defined in

*Frederick J. Rafeld is assistant professor of Agricultural Economics and Agribusiness at Louisiana State University and Edgar T. Shaudys is Professor of Agricultural Economics at Ohio State University. Research was conducted cooperatively between the Ohio State University and the Economic Research Service, U. S. Department of Agriculture.

[1]For further details see [8].

terms of the constant dollar value of all resources controlled. These resources included land, buildings, machinery and equipment, labor, livestock, feed, supplies and other assets (cash or fairly liquid assets). A constant dollar value for these items was determined either by using the same value for a unit of the resource in both 1962 and 1967 (e.g. same land value per acre) or by deflating the 1967 dollar investment to 1962 equivalents by the U. S. Index of Wholesale Prices (e.g. machinery investment). All resource values were determined for January 1, 1962 and January 1, 1967, except for labor, which was the annual amount used during 1962 and 1967, and land, which was the acreage operated in these years.

Attitudes

Attitudes were measured through the use of psychological scales. For further information on attitude measurement see [2]. Several statements, relating to each attitude, were presented to each respondent. He responded to each statement with strong agreement, weak agreement, indecision, weak disagreement or strong disagreement. Each response was assigned a numerical score. After eliminating inconsistent and unreliable statements, the final scale score for each respondent was determined by summing the numerical values of the responses to the remaining statements for each scale. This resulted in a score for each individual which permitted evaluation of his attitude relative to the attitudes of other farm operator respondents.

Farm Management Ability

Farm management ability was measured by obtaining answers to a series of management related questions. The response to these questions were scored and the inconsistent and unreliable questions eliminated. The final score for each respondent was the sum of his scores on the acceptable questions. This score for each respondent was used to determine his managment ability relative to the management ability of other respondents.

Measurement of Goals

A ranking of the following goals was made for each of the respondents in the study: (1) growth, (2) efficiency, (3) community recognition through activities, (4) community recognition because of farming ability, and (5) family considerations. The paired comparison ranking procedure was used to determine the ranking of goals for each individual. Each of the five goals was paired with every other goal (resulting in ten pairs) and the respondent was asked to choose which goal of each pair had been more important during the previous five years. The ranking of the goals was determined by counting the total number of times each goal was chosen over the other goal in a pairing and ranking of the respective totals. The goal with the highest total was the first ranked goal [1, 5].

Growth Strategies

The growth strategies used by the sample farmers were isolated by asking what changes they made in the quantities of the various production resources used during the study period. For example, did the operator rent or purchase any additional land? Changes of this type were isolated for land, labor, machinery and equipment, livestock and buildings and improvements. These changes were classified by acquisition method used (rent, purchase, or other methods), and by acquisition method used and type of resource acquired (rent land, purchase land and so forth).

THE EMPIRICAL TEST

"Fast" Versus "Slow" Grower Comparisons

The data for the farm operations were arrayed on the basis of the amount of growth occurring during the study period (1962-1967). Two groups were created by dividing the array at the median value. The upper portion of the array was identified as "fast growers" and the lower portion as "slow growers." A "t" of chi-square statistic was computed comparing the means or sums of each variable for the two groups. The means or sums for selected variables and the significance levels of the "t" of chi-square are shown in Table 1.

The comparison of the personal characteristics of the two groups revealed that the fast growing operators were younger, possessed a more positive attitude toward the use of credit, and more frequently ranked growth as their most important goal. Their willingness to use credit was substantiated by nearly $10,000 greater debt than farmers in the slow growth group.

There were no statistically significant differences between the two groups in (1) production efficiency as measured by corn yield per acre and pigs weaned per litter, (2) firm size in 1962, (3) family labor availability, (4) farm income in 1962, (5) debt in 1962, and (6) net worth in 1962.

However, there were some significant situational differences between the two groups. Significantly, fewer of the "fast growers" reported additional land available for lease or purchase. This may be interpreted to mean that they had acquired most of the land they knew to be available. These "fast growers" also had a larger size family and a lower percentage equity. Family size may be an incentive for growth because of consumption needs but need not be a

TABLE 1. MEANS AND SUMS[a] OF SELECTED VARIABLES FOR FAST AND SLOW GROWERS, SAMPLE FARMS, 1967

Variable	Unit	Mean or Sum[a] Fast 25[b]	Mean or Sum[a] Slow 24[b]
Personal			
1. Age	year	38.7[c]	42.1[c]
2. Credit use attitude	scale	9.6[c]	8.4[c]
3. Risk acceptance attitude	scale	19.0	18.3
4. Innovation attitude	scale	29.9	28.7
5. Business orientation attitude	scale	37.8	37.2
6. Education	year	12.2	11.9
7. Management ability	scale	15.6	13.7
8. Growth goal ranked first or tied for first	number	15.[d]	4.[d]
Situational			
9. Corn yield per acre	bushel	93.9	91.0
10. Pigs per litter	pig	7.9	7.9
11. Total assets controlled, 1962	dollar	151,441.0	157,252.0
12. Net Worth, 1962	dollar	28,404.0	40,890.0
13. Additional land available, 1962-1967	number	4.[d]	12.[d]
14. Number of children at home, 1967	number	2.7[e]	1.7[e]
15. Sons, 9 to 15 in 1962	number	.2	.5
16. Farm income, 1962[f]	dollar	4,309.0	5,383.0
17. Farm debt, 1962	dollar	15,065.0	5,126.0
18. Percentage equity, 1962	percent	72.0[d]	90.7[d]
Growth Strategies			
19. Rent land	number	13.	6.
20. Purchase land	number	12.	9.
21. Other land strategies	number	1.	2.
22. Purchase livestock	number	4.	3.
23. Other livestock strategies	number	6.	4.
24. Rent machinery and buildings	number	7.	2.
25. Purchase machinery and buildings	number	25.	21.
26. Purchase full-time hired labor	number	3.[c]	0.[c]
Growth and Size			
27. Change in total resources, 1962-67	dollar	81,946.0[e]	7,001.0[e]
28. Change in net worth, 1962-67	dollar	30,170.0[e]	11,753.0[e]
29. Change in farm income[f], 1962-67	dollar	6,075.0[d]	2,936.0[d]

[a]The values for variables 8, 13 and 19 to 26 are the sum total of farmers responding as indicated.

[b]Only 49 of 62 respondents would release sufficient information on their operations so that the necessary values could be calculated.

[c]Difference significant at the .10 level of probability.

[d]Difference significant at the .05 level of probability.

[e]Difference significant at the .01 level of probability.

[f]Sum of farm income reported on IRS Form 1040F and farm income subject to capital gains on IRS Form 1040D.

source of additional productive labor (See variables 14 and 15, Table 1). The lower equity was indicative of greater risk taken and was also consistent with the younger age of the "fast growers." The only strategy variable found to be significantly different between the two groups was the hiring of full-time labor.

The fast growing operators actually expanded firm size by an average of $74,945 more than the slow growers. In addition, their net worths increased an average of $30,170 compared to $11,753 for the slow growers. To the farm operator, an important measure of success is farm income. The fast growers increased their incomes an average of $6,075, compared to $2,936 for the slow growers, a difference of $3,139. Because their 1962 incomes were less, the net result was that the fast growers had about $2,100 greater income in 1966 than the slow growers.

Regression Analysis

Regression procedures were also used to determine the importance of the personal, situational and strategy variables in explaining farm firm growth and to estimate a function which could be used to predict growth. Many regression models were investigated and nonsignificant variables eliminated until the model presented here was isolated.

This regression model was estimated using zero-one "dummy variables" for the growth strategy variables. Some respondents used combinations of strategies and, thus, classes of strategy combinations were also needed. For further details on dummy variables see [4]. An additional requirement was that one dummy variable be deleted to eliminate matrix singularity. This means that there was a dummy variable for each strategy or combination of strategies. Each respondent was coded "one" for the strategy (or combination) he used and "zero" for all others.

The model isolated consisted of nine independent variables and had an R^2 of .608 (significant at the .01 level of probability). The estimated function was:

$$Y = -90{,}725 + \underset{(7{,}169)}{16{,}398\,X_1} + \underset{(2{,}709)}{5{,}034\,X_2}$$

$$\underset{(1{,}567)}{-3{,}024\,X_3} + \underset{(5{,}485)}{6{,}442\,X_4} + \underset{(4{,}922)}{13{,}674\,X_5}$$

$$\underset{(22{,}165)}{-44{,}718\,X_6} - \underset{(26{,}490)}{58{,}656\,X_7} - \underset{(22{,}181)}{82{,}733\,X_8}$$

$$\underset{(36{,}060)}{-102{,}030\,X_9}$$

where:

Y = change in total resources controlled, 1962-1967 (i.e. growth)

X_1= years of formal education

X_2= credit attitude

X_3= innovation attitude

X_4= children at home

X_5= number of times the growth goal was chosen in preference to another goal (maximum of four)

X_6= rent and purchase strategy combination

X_7= purchase and other strategy combination

X_8= purchase only strategy

X_9= other strategies only (mainly inheritance and internal expansion of numbers).

Variables X_6 to X_9 were dummy variables and the deleted dummy variable was the rent, purchase and other strategy combination.

All of the coefficients, except that for the children variable, were significant at the .10 level of probability or less. The positive influences of education, credit use attitude, number of children, and the growth goal seem logical and were consistent with the group comparison results. It should be noted that a first place goal ranking (where the goal variable had a value of four) would have a + $54,696 effect upon growth. The negative influence of the innovation scale is interpreted to mean that the innovator takes risks which, during this particular period, resulted in decreased growth relative to the operator who is not quite as innovative. The predominance of personal variables should be noted.

The coefficients of the dummy variables are interpreted as the deviations of the strategy classes from the deleted class – the use of a combination of renting, purchasing and other strategies. The coefficient effect occurs only if that particular strategy was used. Only one strategy category can be used per operator because the operator has a "one" for only one dummy variable and a "zero" for all others.

It is possible to rank the growth strategy (dummy variable) classes, based upon the size of the regression coefficients. This ranking may be interpreted as the relative importance of the various growth strategies. The differences between coefficients is an estimate of the differences in the effect of the various strategy classes upon growth. From the ranking of the strate-

gies in the model presented above, the importance of renting to growth is evidenced by the smaller negative coefficient. Renting in combination with other strategies was more important to growth than the purchase or other strategy classes.

IMPLICATIONS

This study isolated several factors associated with growing farm firms. Both group comparison and regression procedures indicated that operators who had growth as an objective, who were willing to use credit, and who had larger families, achieved a greater amount of growth than other farmers in the sample. Other personal, situational, and growth strategy variables were also important.

However, the small number of significant factors which were isolated is disappointing since it is intuitively obvious that many more of the variables included in the hypothesized growth theory are important considerations with respect to growth. This lack of statistical significance for many variables may be due to the methodology used rather than a weakness in the theory itself. Further research, using this approach, should be conducted, but the empirical testing procedure should be carefully reconsidered. Three areas, in particular, need attention. First, the sample criteria and sample size should be reconsidered; a larger sample and/or different sampling criteria could result in different answers. Second, the measurement methods should be improved or discarded and new procedures developed; such factors as attitudes, management ability and personal goals are particularly difficult to measure. Third, other analytic techniques and statistical tests should be investigated; some may be uncovered which are more suitable for investigations of this type.

Farm firm growth is a very complex research topic. This study exemplifies the difficulties and complexities involved. The authors feel that this study was worthwhile because of the additional insight gained. However, extensive research is needed before the growth phenomena will be fully understood.

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