GROWTH OF GROSS INCOME OF AGRICULTURAL FIRMS IN NORTHCENTRAL AND SOUTHCENTRAL KANSAS

by 1264

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I INTRODUCTION

Justification

One of the characteristics of industrial economic life has long been growth and merger of firms. Farming has seen some of this, but on a much lesser scale. Yet, with growing farm-nonfarm interdependence, it is expected that growth in size of production units will continue.

The changes, in terms of number of farm operators and scale of operation, which have occurred in Kansas agriculture have not been short of phenomenal although changes causing growth were probably less noticed than the growth plans of some industries. In 1950, there were 131,194 farms in Kansas while in 1964 the number was 92,439; a reduction of thirty per cent. During this same fifteen year period, acreage per farm increased from 164 to 207; or an increase of twenty-six per cent.[1]

If the present trend toward fewer and larger farms continue, growth, in terms of the quantity of resources used, is and will continue to be a problem of real consequence for the farm firm. Some of the reasons why farm firms must increase their volume of business in order to survive and be in a position to adopt new technology are:

1. Evidence of "price-cost squeeze".
2. Increased capital investment in machinery per farm.
3. Increased technology evidenced in the development of farm machinery suitable to large size farm operations.

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[1] No. of farms and acreages were calculated from data in Kansas State Board of Agriculture, Farm Facts, Topeka, Kansas, 1950 and 1964.

4. Average per capita income for farmers is consistently below the national average per capita income.[2]

A number of studies have been conducted on farm size, where enlarging farm size results in more efficient resource use. Few have been concerned with the growth process itself or how a farm moves from one size to another over a period of years.[3] Increasing the volume of business is necessary for the farmer to maintain an equitable position in society and requires research on the growth process.

Objective

An assumption of this study is that growth in gross income depends upon the existence of productive opportunities which are all the productive possibilities that an entrepreneur can take advantage of. Thus, the primary objective was to identify variables that have a significant influence on increases in gross income. The approach is to identify meaningful statistical relationships among gross income of agricultural firms and productive resources and managerial strategies.

A second objective was to evaluate the difference in the productivity of resources between groups of farms having different rates of growth. The two groups were stratified based on their growth rates and classified as above and below average growth rate.

A third objective was to determine if size of the firm provides economic advantages to the firm growth process.

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[2]Stan Johnson, "A Multi-Period Stochastic Model of Firm Growth," Economics of Firm Growth, Proceedings of GP-2 Ag. Council, Sylvan Lake, S.D., Pub. No. 29, S.D. Ag. Exp. Sta., 1965, p. 84.

[3]R. R. Robinson, "Towards a Growth Theory of the Farm Firm," Farm Management in the West, Problems in Economic Growth, Proceedings of Western Agricultural Research Council, Report 6, Denver, Colo., 1964 and Portland, Oregon, 1965, p. 1.

II REVIEW OF LITERATURE

Definitions

Growth Defined

Many definitions of firm growth can be found in literature. Penrose writes that growth, as used in ordinary discourse, has two different connotations.

> It sometimes denotes merely increases in amount; for example, when one speaks of 'growth in output, export, sales. At other times, however, it is used in its primary meaning of a process of development, akin to natural biological processes in which an interacting series of internal changes leads to increases in size accompanied by changes in the characteristics of the growing object.[4]

For this study, growth was defined as the increase in gross income from 1950 through 1964. A continual changing of resources was needed to achieve this increase. A fundamental element of this definition is that firms do not grow automatically, but in response to human decisions.

Firm Defined

The terms firm and farm are often used interchangably. A firm, as a traditional concept, is an input-output process whereby certain inputs or factors of production are transformed into outputs of salable products.[5] This approach places a heavy reliance on external market forces as determinants of firm survival and growth.

The modern day concept places emphasis upon internal organization and management as primary explanatory variables. Therefore, a firm is defined

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[4]Edith Pilton Penrose, The Theory of the Growth of the Firms, (New York: John Wiley and Sons, Inc., 1959), p. 1.

[5]Robinson, op. cit., p. 38.

in this study as an administrative organization which utilizes a collection of productive resources for the purpose of organizing the use of their own resources and resources acquired from outside the firm for the production and sale of goods.[6]

Growth and Size Differentiated

One cannot help but be concerned with size, whether measured in terms of acres, total investment, gross value of production, etc., when viewing growth of firms. Recent research on growth examines the advantages and disadvantages of employing various combinations of resources. It also explains movements from one size to another in terms of the net advantage of different sizes.[7] Here growth becomes merely an adjustment to the size appropriate to obtain the most efficient combination of given resources.

If the most efficient sized firm is greater than the average size, certainly, economic pressure would cause firms to expand operations or be forced out of business. As expansion occurs, so should gross income, provided productive resources exist.

A later section considers the influence of farm size on the ability of firms to have a higher growth rate in gross income.

Growth in Theory

In theory, the growth of firms is essentially an examination of the changing productive opportunities of firms. Productive opportunities are

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[6]Penrose, op. cit., p. 10.

[7]Warren Bailey, "Necessary Conditions for Growth of the Farm Business Firm," Farm Management in the West, Problems in Economic Growth, Western Agricultural Economics Research Council, Denver, Colo., 1964, and Portland, Oregon, 1965, Report No. 6, p. 35.

all the productive possibilities that its entrepreneurs can take advantage of. In order to find a limit to growth, the productive opportunities of a firm must be shown to be limited in any period.[8]

Necessary Conditions for Growth

Internal limitations imposed on growth will be restricted because a firm does not see opportunities for expansion, is unwilling to act upon them, or is unable to respond to them.[9] For a firm, then, enterprising management is one condition without which continued growth cannot occur. This is one necessary (although not sufficient) condition for growth. A complete list of conditions necessary for growth include the following:[10]

1. Excess managerial capacity. The manager must be capable and willing to take on the duties of a large business.
2. Business is profitable. Cash receipts on the average must exceed cash expenses on the average if reinvestment of earnings can occur.
3. Minimum starting size. The farm business must be large enough to support the farm family and also provide some surplus cash for increasing the resources, unless there is a supplementary nonfarm source of income.
4. Some unused resources. A firm with unused resources that can profitably be employed is definitely in a state of disequilibrium and their use should lead to growth.
5. Added resources procurable. Because growth of a firm may require control over additional resources, then it goes without saying that additional resources must be available to or procurable by the firm.

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[8] Penrose, op. cit., p. 32.

[9] Ibid., p. 33.

[10] Bailey, op. cit., p. 28.

Inducement for Growth

Profit is one motivating force for individuals in our society because of the advantages resulting from increases in income and wealth. Profits of the firm, however, do not confer such advantages unless they are paid out as income and not retained to perpetuate additional growth.[11] Thus, it seems reasonable to assume that the financial and investment decisions of firms are based on a desire for long-run profits. Total profits should increase with every increment of investment that yields a positive return and firms should take advantage of opportunities that they consider profitable.

Growth Problems in Agriculture

Farming for many years was described as a "way of life". This meant that not only were monetary returns important, but so were psychic returns. Thus, growth was of little importance as farms needed only to be large enough to utilize family labor and give, if possible, a reasonable profit.

Recently, agriculture has witnessed an influx of factor-saving technologies which have been labor-saving and capital using or, in other words, there has been a substitution of capital for labor. Labor-saving capital investments have exerted pressure to increase farm size in two ways. First, it has reduced the total amount of labor needed since inelasticity of demand for the product precluded any great expansion in output. Second, the appearance of substantial scale economies associated with having large equipment

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[11] Penrose, op. cit, p. 28.

and using it to capacity on large acreage, have caused increases in size of operation.[12]

Many farms with limited resources have been forced out of farming by the same developments that exerted pressure for expansion of more efficient farms. The smaller units were often not only too small to benefit from labor-saving technologies but also too limited in resources to provide a base for expansion. Even the possibility of maintaining the same absolute level of income with the same scale of operation, the smaller units could not survive as prices have declined because of increased output of the larger and more efficient farms.[13]

The above discussion reveals the changes occurring in agriculture and the realization that growth is necessary for the farmer to maintain reasonable, but rising gross income over time. It is believed that research on growth would indicate that entrepreneurs are not strongly motivated for long-run profit and not enough stress is given to the growth element. This does not mean that all farm managers devote their last ounce of energy to maximizing profit or respond to all existing opportunities.

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[12]Norman K. Whittlesay and Walter R. Butcher, "Technological Change and Growth in Size of Farms, Past and Future," Farm Management in the West, Problems in Economic Growth, Proceedings of Western Ag. Economics Research Council, Report No. 6, Denver, Colo., 1964, and Portland, Oregon, 1965, p. 85.

[13]Ibid., p. 85.

III SOURCE AND CHARACTERISTICS OF DATA

In this study of financial growth of agricultural firms, the records of fifty-eight farm operators belonging to the Farm Management Association provide the data for statistical analysis. The farming area studied is shown in Fig. 1.

The period of 1950 to 1964 was used and regarded as a representative set of years. 1950 was used as a starting point primarily because complete data for all resource categories were not available prior to this time. At the outset of the study of growth, data was available through 1964, thus, this fifteen year period was used.

The period was considered representative as it included years with crop yields above and below average. The same was true for livestock prices. The period between 1952 and 1957 was marked by drought and production for most crops was lowest during this time. It was during this same period that prices received for crops were highest. Livestock prices were low in the period between 1954 and 1957 and again in 1963 and 1964.[14] Therefore, the 1950-1964 period can be regarded as a period of rather typical environmental conditions for agriculture in Central Kansas.

The deletion of records from certain Farm Management Association farms within the areas was necessary for various reasons. First, records of farms which had incomplete data covering the various resource categories for the entire fifteen year period were eliminated. Secondly, farms that had increases in gross income that could be attributed to windfall gains (oil discoveries, inheritance, etc.) were omitted as their growth rate was affected

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[14] Information was obtained from Kansas State Board of Agriculture, Farm Facts, Topeka, Kansas 1950-1964.

by factors other than the productivity of resources for food production. One hundred twenty-one farms kept records for each year, 1950 through 1964, thus 63 farms were deleted for one or more of the above reasons.

To determine the source of farm income, gross income from two sources, crops and supplies, and livestock and supplies were totalled for the fifteen year period. Sixty-two per cent of the income for all farms came from livestock while crops supplied the other thirty-eight per cent. The ratio of income from livestock to income from crops in association one was 69/31 while that of association two was 57/43.

Weather in this region favors the production of wheat, although other cereal crops are grown. Adequate moisture permits reasonable yields of forage and hay and livestock does provide a major source of income on many farms. Annual precipitation was approximately twenty inches in the west and thirty inches in the east.[15] Table 1 summarizes the types of farms as categorized in the Farm Management Association records.

To measure resource quantities and to determine productivity of various resources, it was necessary to classify and aggregate resources. Data available permitted a logical and understandable classification of resources as follows:

1. Capital Managed. This variable combines total working and real estate capital. It is the total investment managed including a value placed on rented land.

2. Working Capital. All assets other than land and buildings are included in this category. A partial list includes livestock inventory, grains and feeds, machinery, and accounts receivables.

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[15]Information was obtained from Kansas State Board of Agriculture, Farm Facts, Topeka, Kansas, 1964.

3. Real Estate Capital. This variable represents the dollar value invested in land and buildings. The value reported may not be the market value of land for the year reported since farm operators do not adjust reported land values each year. The physical quantities of real estate are also used as variables and include acres of land owned and land rented, crop acres, pasture acres and total acres.

4. Livestock Investment. This variable is an estimate of the investment in livestock. It was calculated by subtracting machinery investment from working capital. Thus, it would include nominal amounts of seeds and supplies, and cash and accounts receivables.

5. Number of Men. This variable was in man-equivalent units per year for the farm as a unit. It included operator and unpaid family and hired workers.

6. Gross Income. The dependent variable used was reported gross income. Volume of business or gross income are frequently found measures of size of firm.

Consideration was given to the influence of inflation on growth of gross income. A trend in prices received would influence growth in gross income. Comparison of gross income deflated using the index of prices received with reported gross income showed very little difference. Thus, reported gross income was considered the proper measure of firm size.

TABLE 1. Number of farms by type for all 58 farms and for Associations 1 and 2.[a]

FARM TYPE	All Farms	Assoc. 1 (North-central)	Assoc. 2 (South-central)
Beef	2	2	0
Cowherd	1	0	1
Purchased Beef	2	0	2
Cash Crop-Purch. Lvst.	0	0	0
Cash Crop, Lvst.	29	28	1
Cash Crop	9	0	9
Diary	6	2	4
Hog	0	0	0
Poultry	1	0	1
Sheep	2	0	2
General Lvst.	6	2	4
TOTAL	58	34	24

[a]Source: Farm Management Association records.

IV MODEL FORMULATION

Economic theory provides a logical framework with which the necessarily inexact and incomplete observations of the real world can be apprehended with greater insight. It is a system of logical relations between certain sets of assumptions and the conclusions derived from them.[16]

Analysis of the growth of gross income is an economic interpretation of statistical estimations based on a set of postulates supported by economic theory.

Marginal productivity analysis is used as the theory underlying growth. In using resources to maximize profit in farm production, it is necessary that the marginal value product equal marginal factor cost, and marginal value product be diminishing. These conditions are the basis for maximum growth of gross income.

This chapter will discuss the method used to formulate models and statistical techniques used.

Economic Consideration of Objectives

The primary objective of this study was to identify variables having a significant influence on the growth of gross income. The assumption is that firm growth is limited by the productiveness of its resources.

In economics, production is a function of resources used with limitations imposed by the law of diminishing returns. Analysis of growth assumes that optimum resource allocation must exist during the entire period to achieve maximum growth. That is, factors of production should be allocated

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[16] William S. Vickrey, Microstatics, (New York: Harcourt, Brace and World, Inc., 1964), p. 5.

such that the marginal value product of each factor is equal to the cost of another unit of the factor in the production of all products. An economic limitation to size occurs, assuming profits to be the goal, whenever one of the factors of production cannot be increased.

The degree to which the marginal value products of resources exceed their marginal factor cost indicates an entreprenuer's enterprising ability. Should this difference be continually large, one would assume management was not competent, was not growth conscious, was sacrificing additional returns due to risk and uncertainty, or was maximizing something other than profits.

Also, an analysis of growth lies within a dynamic framework since productive opportunities and factors affecting the productivity of resources and their value are constantly changing. The allocation of resources is based on the acquisition price of additional resources and the salvage value of owned resources. Resources are fixed in an economic sense if the marginal value product of a resource is greater or equal to the salvage value of the resource, and less than or equal to the aquisition value of additional unit of the resource. If the marginal value product is less than the salvage value of the resource the firm will dispose of the resource and if the MVP is greater than the acquisition value, the firm will acquire additional resources. This condition sets the bounds on the adjustment process. Thus it is possible for the MVP to increase or decrease considerably without a corresponding increase or decrease in resource use because the values remain below the acquisition value of additional resources and above the salvage value of owned resources.

Also, in a dynamic framework the expectation of resource returns is important. This study does not relate growth in gross income to the expectations of the entrepreneur.

Methods Used to Formulate Models

Variables used in the estimating equations were selected on what was believed to be a logical input-output relationship. Agricultural production functions usually include the general inputs, capital, labor, and land. These inputs were included in the models as was the age of farm operators and coefficient of variation.

Age was considered an important variable because it is believed that growth objectives differ with various age groups. The coefficient of variation was used to test the notion that farmers sacrifice greater income in the long run for stability of income.

In general, agriculture production functions conform to the law of diminishing returns indicating a curvilinear mathematical function. The important point concerning the use of curvilinear production functions is that increasing or decreasing productivity does not exist unless some of the inputs are fixed thus creating a problem of proportionality between the variables and fixed inputs.

In the analysis of growth, the law of diminishing returns may not apply since all factors are assumed variable if their MVP exceeds the cost of acquiring another unit or is less than its salvage value. Thus, a linear relationship seems plausible since growth considers all resources variable over time.

Multiple linear regression was used to determine which variables had a statistically significant difference on the growth of gross income. The five models used were:

(1) Y = f (Capital managed, no. of men, age, coef. of variation).

(2) Y = f (Working capital, real estate capital, no. of men, age, coef. of variation).

(3) Y = f (Machinery investment, livestock investment, total acres, no. of men, coef. of variation).

(4) Y = f (Machinery investment, livestock investment, crop acres, pasture acres, no. of men).

(5) Y = f (Working capital, land owned, land rented, no. of men).

where Y is total gross income for the period 1950 to 1964 and each of the independent variables is the total quantity of that resource used during the same period.

The marginal value products of resources were estimated by computing the partial derivative of gross income with respect to the particular resource. The coefficients obtained show the change in gross income (Y) per unit change in resources (X_1, X_2,...X_n), and represents production elasticities or productivity levels.[17]

Statistical Techniques

Econometrics consists of the application of mathematical economic theory and modern mathematical statistics to the analysis of numerical data.[18] Tests of significance may be used for testing specific hypotheses which represent economic propositions.

In this study, the "student t" test was used to determine if a given factor influences the level of gross income.[19] The test was applied to estimate the marginal productivity of resources. The null hypothesis was

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[17] For discussion of models see Statistical Appendix.

[18] Gerhard Tintner, Econometrics, (New York: John Wiley & Sons, Inc., 1952), p. vii.

[19] See Statistical Appendix for discussion of t test.

that the resource had an effect on gross income significantly different from zero. If the probability that this should happen by pure chance is very small, say less than five or one percent, it can be said that the parameter in question (marginal productivity of a specific factor) is significant.

A secondary objective was to determine if a statistically significant difference existed between productivity levels of resources of farmers grouped into above and below average growth rates. The same models were used to determine for significant differences in resource productivity as were used to determine factors that influence growth.

In the test for statistically significant differences, the estimated partial regression coefficients of independent variables are compared and the null hypothesis that they are really equal is investigated. It is expected that the alternative hypothesis is accepted indicating that a significant difference does exist for those factors that are significant in influencing gross income.

The third objective was to evaluate if size of the firm provides economic advantages to the firm growth process. The model used was $Y = f(X)$, where Y is the average growth rate of gross income for individual firms over the fifteen year period, and, X is the level of gross income generated for individual firms over the fifteen year period. A chi-square test was used to test the null hypothesis that the growth rate of individual firms was independent of the level of gross income generated by individual firms.

V ANALYSIS AND ECONOMIC INTERPRETATION

Interpretation of the various models is divided into two parts: (1) to determine the factors influencing gross income, and, (2) to explain the growth of gross income for stratified groups and the adjustments made in these groups. Under each part, the statistical results and economic implications of the results will be discussed.

Factors Influencing Gross Income

Statistical Results

Table 2 shows the correlations, means and standard deviations for all thirteen variables used in the study. The correlation between variables gives some indication of the difficulty in estimating the separate influences of each variable if all were included in one equation. This condition exists among several capital items indicating that much of the variation in one variable can be accounted for by variation in the other.

Average annual gross income for all fifty-eight farms was $23,137 with a standard deviation of $11,805. The wide variation of gross income suggests that large and small sized farms are included in the data. The average amount of capital managed was $89,896, total acres per farm was 708, and each farm had an average of 1.83 man-equivalent units of labor.

Table 3 shows the five models. The first model has as one variable all types of capital. In the other models, the capital variable is broken into various subclasses and thus deals more with managerial strategies.

In equation one, total capital managed and labor are highly significant and thus had an effect on changes of gross income significantly different from zero. The fact that total capital had a coefficient of .1259 suggests

TABLE 2. Values and correlations for variables used in regression analysis. 58 Farm Management farms. 1950-1964.

	X(1)	X(2)	X(3)	X(4)	X(5)	X(6)	X(7)	X(8)	X(9)	X(10)	X(11)	X(12)	X(13)	Y
X(1)	1.000	.229	.493	.652	.058	.793	.960	.094	.017	.394	.391	.762	.235	.705
X(2)		1.000	.084	.403	.300	.125	.311	.322	-.396	.275	.430	.026	-.317	.173
X(3)			1.000	.306	.011	.492	.447	.314	.095	-.045	.172	.395	.116	.699
X(4)				1.000	.268	.291	.696	.056	-.048	.284	.727	.273	.454	.354
X(5)					1.000	.060	.066	.211	-.137	-.043	.856	-.005	.669	-.010
X(6)						1.000	.635	.146	.093	.141	.199	.953	.113	.718
X(7)							1.000	.166	-.076	.471	.421	.582	.203	.613
X(8)								1.000	-.251	.180	.191	-.161	-.057	.151
X(9)									1.000	-.237	-.123	.170	.175	-.112
X(10)										1.000	.121	.086	-.083	.187
X(11)											1.000	.143	.720	.182
X(12)												1.000	.130	.670
X(13)													1.000	.059
Means	89896	332	1.83	403	305	30561	61604	9035	40.33	.33	708	21526	376	23137
Sd Dev	45124	305	.76	224	297	17031	30618	5236	8.80	.11	418	17074	397	11805

X(1) = Capital Managed
X(2) = Land Rented
X(3) = No. of Men
X(4) = Crop Acres
X(5) = Pasture Acres
X(6) = Working Capital
X(7) = Real Estate Capital
X(8) = Machinery Investment
X(9) = Age
X(10) = Coef. of Variation
X(11) = Total Acres
X(12) = Livestock Investment
X(13) = Land Owned
Y = Gross Income

TABLE 3. Models used to indicate productivity of independent variables with respect to gross income and used to determine significant variables for 58 Farm Management Association farms.

INDEPENDENT VARIABLE	PARTIAL REGRESSION COEFFICIENT					t VALUES				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 1	Model 2	Model 3	Model 4	Model 5
Constant Term	126040	-66880	-70324	799	-8398	-	-	-	-	-
Capital Managed	0.1259					4.77				
Working Capital		0.2911			0.3389		4.04			5.42
Real Estate Capital		0.0362					0.79			
Machinery Investment			0.0748	0.2118				0.38	1.05	
Livestock Investment			0.3165	0.3326				5.12	5.30	
Crop Acres				5.0019					1.10	
Pasture Acres				-2.32					0.70	
Land Owned					-0.8608					0.35
Land Rented					2.4687					0.77
Total Acres			0.0642					2.22		
No. of Men	7341	7002	7924	6943	7022	5.16	4.93	5.58	4.70	5.08
Age	-3442					2.15				
Coef. of Variation	-34723	167892	265763			0.24	1.14	2.08		
CORRELATION COEFFICIENT	.83	.84	.84	.83	.82	$t_{58\ d.f.}$				

.01 = 2.39 Highly Significant
.05 = 1.67 Significant
.10 = 1.30 Not Significant

that growth possibilities still exist since the return on invested capital exceeds an opportunity cost of capital.

The productivity of labor ($7342) seems to be much higher than an annual wage rate of a farm laborer. This supports the notion that a competent and skilled worker in agriculture on commercial size farms, should receive approximately what his counterpart in the nonagricultural sector receives.

The average age of farm managers was forty in 1950 and was a significant variable explaining changes in gross income. The coefficient indicates that an inverse relation exists between age and gross income. This is consistent with census data. Some possible reasons for this relationship might be:

1. At the time a manager reaches middle age, the family labor which was utilized may not be available, thus causing less emphasis to be placed on growth even though productive opportunities exist.
2. Perhaps the farm manager was growth conscious only to the extent that a comfortable profit was obtained. Upon achieving this level of financial security, he chose to reduce energies exerted to obtain greater income.
3. The growth concept assumes present earnings are reinvested to obtain long-run profit. Thus, there is forfeiture of utility that could be enjoyed from past productive efforts. It seems logical that a manager may wish to forfeit future growth in earnings even though productive opportunities exist as retirement approaches.

The coefficient of variation was included to determine if greater income in the long-run was sacrificed for stability of income. If the farm operators in question are truly growth conscious and striving for long-run profits, one would expect this variable to be quite large. In this model,

which also includes age as a variable, intercorrelation is high between age and the coefficient of variation, and the coefficient of variation is insignificant. Therefore, it is difficult to assess the importance of the coefficient of variation and age when both variables are in the same equation.

The correlation coefficients for all five models were between .82 to .84 which is the amount of variation in gross income that is explained by the independent variables in each model.

Managerial Strategies

In the other four models, total capital was divided into various classes and subclasses. The productivity of various types of capital show how capital was used and thus the strategies managers use to obtain increases in gross income.

Capital managed was classified as working and real estate capital. Working capital was subclassified into machinery and livestock investment. Real estate capital includes total land in terms of crop acres owned or pasture acres owned or in terms of land owned and land rented.

The second equation considers variables of working and real estate capital instead of one total capital variable. Working capital has greater liquidity, as compared to real estate capital, and investments have a more rapid turnover. It is a highly statistically significant factor with a coefficient of 0.29 while real estate capital has a coefficient of 0.04 although it is statistically insignificant.

In the third equation, working capital is classified as machinery investment and livestock investment. The coefficients indicate that livestock investment was more productive than machinery investment and the

livestock investment variable is highly statistically significant and machinery investment is not. An explanation for this result may be that machinery investment may have been more stable than livestock production. Thus, the amount of variance in gross income that is explained by machinery investment would be low.

In place of the dollar value of real estate capital, total acres of land was used as a variable. It was a significant factor although the coefficient was quite low. This is consistent with other studies. Using the "productivity method" or capitalization method to determine land values would suggest that the purchase price of land would be much lower than current market values.

Crop acres and pasture acres were used as variables in the fourth model. Productivity of crop acres was $5.00 while being significant only at the 15 percent level. Pasture acres had a negative effect on gross income but was not a statistically significant variable. The general conclusions from these results are that cash crops are more important to gross income than livestock enterprises using pasture. Also, the negative sign on pasture acres may reflect a quality factor. The fact that the ratio of pasture acres to crop-land acres is about 3 to 4 for the fifty-eight farms, may indicate that land is of a poor quality. The coefficient of variation was omitted from this model but the coefficient for machinery increased as did its level of significance.

The last model examines the productivity of owned and rented land. Although neither category is statistically significant, rented land has a positive productivity while owned land is negative.

Summary

Analysis of the five models shows which resources had a significant influence on changes in gross income. The productivity of various types and classes of resources determined how growth in gross income can occur.

Capital managed and number of men are highly significant explaining variables and have a direct relationship with gross income. Of the two classes of capital, working and real estate, working capital is more significant. The break-down of working capital reveals that livestock investment is highly significant in explaining changes in gross income and its productivity exceeds machinery investment.

Although none of the land categories were significant, crop acres and rented land had positive productivity coefficients while those for pasture acres and land owned were negative. Age was significant and its coefficient indicated that growth in gross income declines as age increases and suggests that long-run profits are not the goal of older farmers. There is evidence that long-run profits are not being maximized for all of the fifty-eight farm management farms since productivity of resources are not being fully exploited. Thus, growth possibilities exist and should occur as farmers take advantage of existing productive opportunities.

Growth of Gross Income

The second objective considers the statistically significant difference between productivity of resources for farms stratified as above and below average growth. A difference in resource productivity between groups would indicate that growth potential is much greater for some farms studied than others.

Results of Stratification

Growth is viewed in terms of annual percentage increase in gross income. The method used to calculate a growth rate was to obtain least squares trend values of gross income for each firm over the fifteen year period, 1950-1964. By using the estimated trend values for 1950 and 1964, the percent change in growth in gross income over the fifteen year period was calculated. The equation used to calculate the average annual percent growth rate is as follows: Annual Growth Rate = $(\hat{Y}_{1964} - \hat{Y}_{1950} / \hat{Y}_{1950}) / 15$. The use of trend values gives a more precise growth rate since it depends on each observation of the period rather than merely the initial and terminal values. The median of the growth rates of fifty-eight farms was determined and farms were grouped as being above and below average in growth.

The annual growth rates ranged from +53% to -4% for individual farms over the fifteen year period. Per farm gross income and percentage yearly changes along with growth rates calculated from the estimated trend values for all farms and stratified groups are given in Table 4. As indicated, the average annual growth rate for all farms is 5.8%, for the twenty-nine above average farms, 11.9%, and for the twenty-nine below average farms, 0.9%.

For comparison, the growth rate of gross national product was calculated for the period 1950-1964. Gross income of the farms under study may be viewed as the total salable output plus nonfarm income; nonfarm income being returns from nonfarm investments, off-farm salary, windfall gains, etc. Only nominal amounts of nonfarm income were included in certain of the farms studied and thus changes in gross income is comparable to changes in GNP which measures total output of all production units in the economy. The calculated growth rate of GNP was 7.3%.[20] This indicates that the

[20]Board of Governors of the Federal Reserve System, Federal Reserve Bulletin, 1951-1965.

TABLE 4. Annual percentage changes in gross income and growth rates by all 58 farms, 29 above average and 29 below average growth farms for the period 1950-1964.[a]

	ALL FARMS	ABOVE AVERAGE GROWTH RATE	BELOW AVERAGE GROWTH RATE
	Gross Income Per Farm	Gross Income Per Farm	Gross Income Per Farm
1950	$20,357	$19,245	$21,469
1951	$21,154	$20,733	$21,575
1952	$20,073	$21,591	$18,556
1953	$17,789	$18,430	$17,149
1954	$20,572	$22,605	$18,539
1955	$15,544	$16,680	$14,407
1956	$18,795	$22,638	$14,953
1957	$19,698	$23,163	$16,233
1958	$24,184	$26,320	$22,047
1959	$23,463	$27,991	$18,935
1960	$26,459	$33,302	$19,617
1961	$30,240	$39,264	$21,217
1962	$30,361	$37,608	$23,113
1963	$30,342	$39,882	$20,802
1964	$33,163	$45,800	$20,525
MEAN	$23,506	$27,683	$19,276
SD. DEVIATION	$ 5,229	$ 8,863	$ 2,551
COEF. OF VAR.	0.22	0.32	0.13
ALPHA	$16,357	$14,619	$18,096
BETA	$ 1,018	$ 1,866	$ 169
GROWTH RATE	5.8%	11.9%	0.9%

[a]Growth rates for the three groups of farms used the estimated least-squares trend values for 1950 and 1964 in the following equation: $(\hat{Y}_{1964} - \hat{Y}_{1950} / \hat{Y}_{1950}) / 15$. $(\hat{Y} = \alpha + \beta X)$ are shown above.

growth rate of the average farm was below the growth rate of the economy, discounting the effects of inflation on GNP.

From Table 4, fluctuations in gross income for all three groups are similar, with the period 1953 to 1957 (in most cases) below the average. The same condition was true for per farm gross income for Kansas farmers, Table 5. The variability of gross income for the above average growth rate group was large as indicated by the standard deviation and the coefficient of variation, Table 4. The coefficient of variation for the above group was 0.32 while for the below group it was 0.13. This provides some evidence that managers that forego stability of income have larger long-term growth.

TABLE 5. Per farm realized gross income and rankings of Kansas farms and farms in study. 1950-1964.[a]

Year	Per Farm Gross Income Kansas Farms	Rank	Per Farm Gross Income 58 Farms Studied	Rank
1950	$ 8,270	12	$20,357	10
1951	9,004	9	21,154	8
1952	9,881	8	20,073	11
1953	8,312	11	17,789	14
1954	8,429	10	20,572	9
1955	7,622	14	15,544	15
1956	8,098	13	18,795	13
1957	7,213	15	19,698	12
1958	11,121	7	24,184	6
1959	11,591	6	23,463	7
1960	12,028	5	26,463	5
1961	13,875	4	30,240	4
1962	14,802	1	30,361	2
1963	14,552	2	30,342	3
1964	14,182	3	33,163	1

[a]Source: Kansas State Board of Agriculture, Farm Facts, Topeka, Kansas, 1950-1964, and Farm Management Association Records.

Means and Variances

The following table shows the means and standard deviations of the variables used in regression equations for farms in the above and below average growth rate groups.

TABLE 6. Means and standard deviation of variables for above and below average growth rate groups for 1950 to 1964.[a]

Independent Variable	Above Ave. Growth Mean	Above Ave. Growth Sd. Dev.	Below Ave. Growth Mean	Below Ave. Growth Sd. Dev.
Gross Income	27,683	13,440	19,276	8,386
Capital Managed	100,967	44,000	78,825	44,217
Land Rented	396	369	267	212
No. of Men	1.90	.97	1.75	.50
Crop Acres	447	250	358	189
Pasture Acres	348	328	261	262
Working Capital	31,945	18,271	29,178	15,895
Real Estate Capital	70,200	30,419	53,008	28,811
Machinery Investment	9,613	3,984	8,457	6,264
Age	38.03	6.48	42.62	10.23
Coef. of Variation	.39	.11	.26	.06
Total Acres	796	477	619	333
Livestock Investment	22,331	18,068	20,720	16,298
Land Owned	400	456	352	335
No. of Farms	29		29	

[a]Source: Farm Management Association Records.

Gross income is greater for the above average growth group by some $7,000 and they use greater quantities of all resources. Standard deviations of quantities of resources used are high for both groups indicating large differences in quantity of resources used by farmers.

Statistical Results

Tables 7, 8, and 9 indicate the productivity of resources for the stratified groups. The same models were used as in the determination of significant growth variables for the total group. The first equation shows that the coefficient for total capital was larger for the above group although additional capital could profitably be employed by both groups. As was expected, the labor coefficients were similar while the reduction in gross income by increases in age was decisively larger for the above growth group. The age of the firm operator in the above average growth rate group was more than five years younger than the age of the other groups manager.

A "t" test used to determine the existence of significant differences indicates that a highly significant difference exists between the two groups for capital managed and age. Although labor was a significant variable influencing growth, in both the above and below growth rate groups, its productivity levels were not significantly different between the two groups.

Capital productivity was significantly different between groups and higher for the above growth groups. Also firms in this group used more capital resulting in a higher growth rate.

Statistically significant variables in the second equation were working capital and labor. Working capital was about three times as productive for the above average growth rate group than for the below average group with values of 0.46 and the other 0.15, respectively.

Significant variables that influence changes in gross income in the other three models were livestock investment, number of men, total acres, working capital and age. With the exception of labor, statistically significant differences existed between coefficients of the two groups

TABLE 7. Models 1 and 2. Used to indicate productivity of independent variables with respect to gross income and used to determine significant differences in 29 above and 29 below average growth groups.

INDEPENDENT VARIABLE	PARTIAL REGRESSION COEFFICIENTS		STANDARD DEVIATION OF B_1 AND B_2 [a]		t VALUE [b]	PARTIAL REGRESSION COEFFICIENTS		STANDARD DEVIATION OF B_1 AND B_2 [a]		t VALUE [b]
	Above	Below	Above	Below	Model 1	Above	Below	Above	Below	Model 2
CONSTANT TERM	272685	156809	-	-	-	-67234	115964	-	-	-
CAPITAL MANAGED	0.1538	0.1131	0.0436	0.0299	2.9708					
WORKING CAPITAL						0.4554	0.1465	0.0822	0.1175	8.7014
REAL ESTATE CAPITAL						-0.0370	0.1179	0.0598	0.0551	32.9574
MACHINERY INVESTMENT										
LIVESTOCK INVESTMENT										
CROP ACRES										
PASTURE ACRES										
LAND OWNED										
LAND RENTED										
TOTAL ACRES										
NO. OF MEN	6554	6719	1986	2332	0.4768	7129	5810	1557	2609	1.2538
AGE	-4899	-1650	3572	1561	3.2565					
COEF. OF VARIATION	-255321	-416559	229420	282164	12.7385	233213	529248	199447	301634	2.8969
CORRELATION COEFFICIENT	.85	.79				.91	.79	t_{28} d.f.	.01 = 2.467 .05 = 1.701 .10 = 1.313	

[a] B_1 is the partial regression coefficient for the above growth group and B_2 is the partial regression coefficient for the below growth group.

[b] t value is the difference between B_1 and B_2 divided by the difference in the standard deviations of B_1 and B_2.

TABLE 8. Models 3 and 4. Used to indicate productivity of independent variables with respect to gross income and used to determine significant differences in 29 above and 29 below average growth groups.

INDEPENDENT VARIABLE	PARTIAL REGRESSION COEFFICIENTS		STANDARD DEVIATION OF B_1 AND B_2 [a]		t VALUE [b]	PARTIAL REGRESSION COEFFICIENTS		STANDARD DEVIATION OF B_1 AND B_2 [a]		t VALUE [b]
	Above	Below	Above	Below	Model 3	Above	Below	Above	Below	Model 4
CONSTANT TERM	-23031	97595	-	-	-	41814	3619	-	-	-
CAPITAL MANAGED										
WORKING CAPITAL										
REAL ESTATE CAPITAL										
MACHINERY INVESTMENT	0.4771	0.0167	0.3355	0.2300	4.3639	0.5309	-0.0126	0.3289	0.2307	5.5346
LIVESTOCK INVESTMENT	0.4560	0.2756	0.0711	0.1024	5.7635	0.4569	0.1999	0.0717	0.0871	14.7701
CROP ACRES						-0.0662	7.5651	5.2710	6.9510	4.5424
PASTURE ACRES						-6.4974	0.4576	3.7428	4.7729	6.7517
LAND OWNED										
LAND RENTED										
TOTAL ACRES	-4.0795	2.3584	2.4500	3.5806	5.6944					
NO. OF MEN	6653	6568	1464	3001	0.0553	5945	6865	1450	3010	0.5897
AGE										
COEF. OF VARIATION	171446	-352329	161742	326019	3.1883					
CORRELATION COEFFICIENT	.92	.76				.92	.76			

$t_{28\ d.f.}$ .01 = 2.467
.05 = 1.701
.10 = 1.313

[a] B_1 is the partial regression coefficient for the above growth group and B_2 is the partial regression coefficient for the below growth group.

[b] t value is the difference between B_1 and B_2 divided by the difference in the standard deviations of B_1 and B_2.

TABLE 9. Model 5. Used to indicate productivity of independent variables with respect to gross income and used to determine significant differences in 29 above and 29 below average growth groups.

INDEPENDENT VARIABLE	PARTIAL REGRESSION COEFFICIENTS		STANDARD DEVIATION OF B_1 and B_2[a]		t VALUE[b]
	Above	Below	Above	Below	Model 5
CONSTANT TERM	51355	-3007			
CAPITAL MANAGED					
WORKING CAPITAL	0.4556	0.2344	0.0720	0.0901	12.2209
REAL ESTATE CAPITAL					
MACHINERY INVESTMENT					
LIVESTOCK INVESTMENT					
CROP ACRES					
PASTURE ACRES					
LAND OWNED	-3.9305	1.7447	2.6511	3.8234	4.8410
LAND RENTED	-3.7885	6.6422	3.3395	6.0475	3.8518
TOTAL ACRES					
NO. OF MEN	6415	5770	1318	2938	0.3981
AGE					
COEF. OF VARIATION					
CORRELATION COEFFICIENT	.91	.73		$t_{28\ d.f.}$	.01 = 2.467 .05 = 1.701 .10 = 1.313

[a] B_1 is the partial regression coefficient for the above growth group and B_2 is the partial regression coefficient for the below growth group.

[b] t value is the difference between B_1 and B_2 divided by the difference in the standard deviations of B_1 and B_2.

with coefficients being larger for the above average growth group in all categories except total acres.

Summary of Statistical Results

Results indicate a large difference in resource productivity and use between the two growth groups. Differences in growth rates between the two groups is explained by the above average growth group using larger quantities of the most productive resources, in particular working capital and livestock investment. Resource productivity on farms in the below average growth group was less and they also used fewer resources.

Resource productivity is necessary for growth. New technology and adjustments in resource use keep resource productivity high permitting a farm operator to use larger quantities of resources resulting in increases in gross income.

Adjustments in Resource Use

Evidence of a lag in resource adjustments by the below average group is shown in Table 10. Percentage increases in resources used by the above growth group were greater for all resource categories and their resources were more productive. This does not conform to the law of diminishing marginal returns which states that as the amount of a variable input is increased, while other inputs and the state of technology are held constant, the marginal value product declines. Using this principle, it is expected that the above average growth group would have lower productivity since more resources were employed to accomplish increases in gross income.

In an analysis of growth, this principle may not apply since all resources are considered variable and the state of technology is changing.

TABLE 10. Adjustments in resource use by percentage increase, periods 1-3, by all farms, and above and below average farms.[a]

RESOURCE CATEGORIES	ALL FARMS (period)			ABOVE AVERAGE (period)			BELOW AVERAGE (period)		
	1	2	3	1	2	3	1	2	3
CAPITAL MANAGED	42	40	100	57	50	137	27	27	63
WORKING CAPITAL	4	41	46	20	52	83	-10	27	18
REAL ESTATE CAPITAL	61	38	123	64	47	142	56	27	100
MACHINERY INVESTMENT	-2	18	15	-1	34	33	-4	1	-2
LIVESTOCK INVESTMENT	15	43	65	25	75	118	7	13	21
CROP ACRES	9	13	23	8	22	32	10	2	13
PASTURE ACRES	39	10	52	43	10	57	33	10	47
LAND OWNED	20	3	34	25	8	41	15	-2	27
LAND RENTED	8	28	38	12	30	45	2	24	27
TOTAL ACRES	20	12	23	21	17	35	19	7	12
NO. OF MEN	-2	6	4	6	14	33	-9	-6	-11

[a]Period 1 refers to a percentage change that the 1950-1954 average is of the 1955-1959 average.

Period 2 refers to a percentage change that the 1955-1959 average is of the 1960-1964 average.

Period 3 refers to a percentage change that the 1950-1954 average is of the 1960-1964 average.

For decreasing marginal returns to exist, some of the inputs must be fixed which alters the proportionality between the variable and fixed inputs. If the marginal value product of a resource exceeds its acquisition cost, it makes sense to increase its usage. Under dynamic conditions, it is possible for resources which could profitably be varied to remain fixed if management is incompetent or if nonpecuniary motivation exists.

Results indicate that managers with high annual increases in gross income were aware of existing productive opportunities and through a more intensive use of resources, growth in gross income was accomplished. The below average growth rate group had lower productivity for resources over the fifteen year period even though the quantity of resources used at the beginning of the period were similar to those used by the above average group.

VI GROWTH AND SIZE RELATIONSHIP

This chapter considers the relationship between size of firms and their growth rates. A firm with a larger gross income should have more money to reinvest and increase future income than a firm with a lesser gross income.

Table 11 shows the relationship between size and growth. The growth rates given in the table are those for individual firms in the above and below growth groups. To determine which farms were large and which were small, average gross income per farm from 1950-1964 was calculated and, the top twenty-nine farms were considered large while the lower twenty-nine considered small. The median value was $20,126. Of the twenty-nine above average growth farms, nineteen were large and ten were small.

A chi-square test of independence was used to determine whether there was any dependency between an individual firm's size and the growth rate of gross income. Hence, the null hypothesis states that a firm's size and growth rate are independent of each other. The test used does not show the degree of dependency but only whether heterogeniety exists. The chi-square value obtained was 4.41.[21] Thus, the null hypothesis would be rejected indicating that size and growth are not independent at the 5% level.

The degree of correlation between growth rates and gross income measures the degree of association in the movements of these two variables.

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[21]See Statistical Appendix for test of homogeniety.

TABLE 11. Size and growth relationship--annual growth rates and average level of gross income and their ranks for the 58 farms.

ABOVE AVE. GROWTH RATE	LEVEL OF GROSS INCOME	RANKS		SIZE		BELOW AVE. GROWTH RATE	LEVEL OF GROSS INCOME	RANKS		SIZE	
		GROWTH	SIZE	LARGE	SMALL			GROWTH	SIZE	LARGE	SMALL
52.7	41336	1	4	X		4.6	21905	30	22	X	
38.6	66652	2	2	X		4.3	14149	31	45		X
37.4	19759	3	30		X	4.3	38065	32	6	X	
29.3	20736	4	27	X		3.8	21607	33	24	X	
26.0	35770	5	7	X		3.8	21284	34	26	X	
20.2	22063	6	21	X		3.5	12134	35	50		X
16.0	13920	7	46		X	3.5	23219	36	20	X	
15.9	21774	8	23	X		3.5	10031	37	57		X
15.8	33110	9	10	X		3.4	23402	38	19	X	
13.0	33798	10	9	X		3.4	13365	39	48		X
12.2	27942	11	13	X		3.4	18325	40	37		X
11.7	20126	12	29	X		3.1	13410	41	47		X
11.4	27560	13	15	X		2.6	16188	42	42		X
11.4	19721	14	31		X	2.5	15549	43	44		X
9.2	41105	15	5	X		2.5	10338	44	56		X
9.0	19256	16	33		X	1.3	18732	45	35		X
8.5	24130	17	18	X		1.3	17010	46	41		X
8.2	20398	18	28		X	1.3	17911	47	39		X
8.0	24462	19	17	X		1.2	19217	48	34		X
7.8	16172	20	43		X	1.1	26953	49	16	X	
7.1	33692	21	8	X		1.1	11138	50	54		X
7.1	66875	22	1	X		0.6	17249	51	40		X
6.7	11947	23	51		X	-0.0	29152	52	12	X	
6.6	18696	24	36		X	-0.6	11006	53	55		X
6.2	25291	25	17	X		-1.5	13065	54	49		X
5.5	21340	26	25	X		-1.8	11711	55	52		X
5.1	11376	27	53		X	-2.1	17958	56	38		X
4.7	27920	28	14	X		-2.6	44428	57	3	X	
4.7	19327	29	32		X	-4.4	33112	58	11	X	

The changes in the variation is in the same direction since the simple correlation coefficient is .40. Using Spearman's rank-difference coefficient of linear correlation, the degree of correlation between growth and size can be determined.[22] It is necessary to rank the growth rates and the level of gross income. The coefficient obtained was .42 and thus is very similar to the simple correlation coefficient.

In summary, it appears that size and growth are dependent and positively correlated although the degree of association is low.

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[22] H. C. Fryer, Concepts and Methods of Experimental Statistics, (Boston: Allyn and Bacon, Inc., 1966), p. 237.

VI SUMMARY AND CONCLUSION

This study was of growth of gross income of farm firms as explained by the use of productive resources. Three objectives were (1) to identify resources that influence growth, (2) to determine if there were significant differences in resource productivities between stratified growth groups, and (3) to consider the relationship between size and growth.

Concerning the first objective, results indicate that capital managed, working capital, livestock investment and number of men are highly statistically significant factors influencing growth. Estimated regression coefficients for the above variables are: $0.13, $0.30, $0.32, and $7,342, respectively. These indicate that resources could be employed more intensively to accomplish additional growth of gross income.

Significant differences in productivity of resources existed between the above and below average growth groups for all variables that had a significant influence on growth of gross income, with the exception of labor. Because of low levels of resource productivity, the below average growth group had a lower growth rate in gross income. The average annual growth rate for the below group was 0.09% while the above group was 11.9%.

To determine size and growth relationships, a chi-square test of independence was used. Results indicate that they are not independent at the five per cent level. In order to determine the degree of dependency, the correlation between size and growth rate was calculated and the coefficient obtained was .40.

Comparing the resource productivity between above and below average growth rate firms and the adjustments in resource usage, certain conclusions can be made concerning the growth process. These include:

1. All managers are not fully exploiting existing productive opportunities as witnessed by the high productivity of various capital items.
2. Entrepreneurs had increased their use of higher return resources resulting in higher growth rates.
3. Above average growth firm managers are able to keep resource productivity levels high while increasing the usage of resources.
4. The vast differences in individual growth rates of farm firms indicates that certain managers are following a well defined growth plan while others are not growth conscious, competent, able to cope with risk and uncertainty, or do not have a large enough base on which to grow.
5. As economic pressures are exerted towards larger and fewer farms, it is logical that firms that have not developed a growth plan may not survive.

APPENDIX A Basic Data

TABLE 12. Resource quantities used by above average growth rate group, 1950-1964.

FARM NO.	GROSS INCOME	CAPITAL MANAGED	WORKING CAPITAL	REAL ESTATE CAPITAL	MACHINERY INVESTMENT	LIVESTOCK INVESTMENT
1	$242585	$626927	$157077	$603056	$ 49196	$107881
2	506982	1885303	1061096	1139536	134840	926256
3	288852	939774	412551	601619	122764	289787
4	326603	772013	195301	601112	82156	113145
5	320100	866458	299666	566792	76311	223355
6	496653	1306013	527690	787921	256440	271250
7	305971	971742	295799	678210	137061	158738
8	366929	1558170	631591	906438	80715	550876
9	616571	2824291	699966	1994749	215751	484215
10	289903	763281	292322	499011	100617	191705
11	379363	1130434	573490	626554	71031	502459
12	361950	1398422	645214	791209	182549	462665
13	418798	1523322	612841	955800	166951	445890
14	296378	1540853	222990	1317863	146819	76171
15	1003137	2547077	881342	1665735	237417	643925
16	999786	3233998	1330036	1903962	49596	1280440
17	301897	1582099	449989	1132110	176307	273682
18	505385	1588529	435724	1152805	190198	245526
19	295821	2441980	558258	1883722	115736	442522
20	170633	459206	134353	324853	81160	53193
21	413409	1286824	500780	786044	187432	313348
22	536556	1438465	399022	1038443	157579	241443
23	419137	1544345	347774	1196571	186631	161143
24	620033	2284745	687466	1597279	210072	477394
25	311040	1586064	292960	1293104	175568	117392
26	280444	1825552	480306	1415246	189851	290455
27	208794	1693169	311475	1381694	225433	86042
28	179200	1237744	151642	1086102	63379	88263
29	330964	993936	307664	609510	112786	194878

TABLE 12 (continued)

FARM NO.	CROP ACRES	PASTURE ACRES	LAND OWNED	LAND RENTED	TOTAL ACRES	NO. OF MEN	AGE	COEF. OF VARIATION
1	5133	1970	$ 444	$6659	7103	22.2	44	.41
2	3851	13225	86	16990	17076	28.2	30	.34
3	7092	2864	2392	7564	9956	19.8	31	.29
4	2861	5269	3594	4536	8130	23.0	35	.42
5	2590	2171	2975	1786	4761	21.8	44	.23
6	4601	6649	9697	1553	11250	30.3	31	.30
7	3442	3066	6377	131	6508	32.1	38	.27
8	2925	6401	9206	120	9326	23.7	33	.39
9	19327	15376	15079	19624	34703	42.9	39	.41
10	2682	2469	2353	2566	5151	17.4	40	.26
11	7699	8703	7208	6204	16402	23.1	37	.24
12	7573	13303	11479	9397	20876	24.6	40	.42
13	7397	6077	8692	4782	13474	24.2	42	.25
14	7771	868	2043	6596	8639	24.0	44	.54
15	9674	943	2915	7702	10617	93.0	39	.33
16	7789	557	6021	2325	8346	37.1	38	.43
17	4394	1447	2909	2932	5841	32.4	52	.30
18	6224	10206	12131	4299	16430	47.9	51	.24
19	12316	2008	12047	2277	14324	37.7	41	.42
20	3590	1568	2148	3010	5158	17.8	33	.53
21	4775	338	3493	1620	5113	26.9	38	.32
22	5181	1099	4500	1780	6280	26.8	46	.46
23	8121	2010	1657	8474	10131	25.2	33	.44
24	9677	1821	2841	8657	11498	26.7	29	.63
25	9492	726	3854	6364	10218	19.7	27	.49
26	11536	12567	3225	878	24103	21.9	44	.49
27	9033	4581	11512	2102	13614	16.0	28	.61
28	6285	13801	17156	2930	20086	19.3	41	.33
29	7894	11686	15162	4418	19580	22.2	35	.46

TABLE 13. Resource quantities used by below average growth rate group, 1950-1964.

FARM NO.	GROSS INCOME	CAPITAL MANAGED	WORKING CAPITAL	REAL ESTATE CAPITAL	MACHINERY INVESTMENT	LIVESTOCK INVESTMENT
1	$150463	$607094	$211467	$420115	$ 53655	$157812
2	351032	1070319	512726	755863	148559	364167
3	155063	506122	193267	345622	113574	79693
4	235417	62786	324098	336805	150247	173851
5	404298	903672	327899	549392	71948	255951
6	167074	824953	219971	653406	78334	141637
7	201156	755591	227168	553271	73749	153419
8	200486	786192	344827	464220	229592	115235
9	233235	1007293	615487	748391	146105	469382
10	175670	1003316	491438	547248	131311	360127
11	165096	921264	456407	493754	104714	351673
12	242827	751650	305342	476329	83543	221799
13	348283	1859897	677696	1183523	94478	583218
14	269375	835910	294581	651572	71311	223270
15	319265	1828508	422619	1221439	116161	306458
16	268668	535594	231732	336152	64629	167103
17	570974	1119112	414256	776957	152043	262213
18	212234	830133	327341	527992	94944	232397
19	195970	1034396	426464	639132	103333	323131
20	280978	1540054	490728	949132	155027	335701
21	274875	1407997	377977	1030020	104912	273065
22	496680	3139431	1370587	1868844	187959	1182628
23	182004	973821	430893	542928	187636	243257
24	328568	801663	350721	450940	56435	294286
25	258734	1268198	336072	932126	30560	305512
26	255157	1118008	345985	1412871	91547	254438
27	666416	2314182	901311	1772023	73832	827479
28	288252	2010734	412675	1598059	126189	286486
29	437287	2471280	650733	1820547	182559	468174

TABLE 13 (continued)

FARM NO.	CROP ACRES	PASTURE ACRES	LAND OWNED	LAND RENTED	TOTAL ACRES	NO. OF MEN	AGE	COEF. OF VARIATION
1	4098	627	2227	2498	4725	16.6	39	.34
2	5225	5036	3426	6835	10261	27.6	35	.23
3	2630	2082	2077	2635	4712	18.3	38	.24
4	1098	11426	1997	10527	12524	16.9	34	.28
5	8558	2240	10638	160	10798	39.5	37	.14
6	4306	8714	10256	2764	13020	18.2	45	.26
7	3850	1512	3251	2111	5362	20.3	48	.33
8	4977	2309	5089	2197	7286	29.7	60	.29
9	3291	2964	5505	750	6255	26.8	47	.28
10	4425	1889	4249	2065	6314	30.3	57	.29
11	3743	2237	3360	2620	5980	31.2	54	.27
12	2508	2917	141	5284	5425	18.9	53	.18
13	3489	6671	9152	1008	10160	37.5	37	.33
14	5454	5695	2166	8983	11149	27.0	46	.19
15	9953	18291	27254	990	28244	26.4	41	.22
16	3520	2122	1897	3745	5642	18.9	41	.20
17	5460	5737	6039	5158	11197	32.5	43	.22
18	5719	8615	5308	9026	14334	18.7	34	.19
19	4163	5243	7009	2397	9406	17.3	50	.28
20	10024	5720	8549	7195	15744	37.4	47	.31
21	4025	316	1218	3123	4341	21.7	34	.25
22	6290	2189	7519	960	8479	35.6	61	.41
23	4271	577	4363	485	4848	16.6	52	.20
24	3135	1538	2573	2100	4673	30.3	44	.19
25	7626	1330	5041	3915	8956	19.8	43	.26
26	3566	925	2669	1822	4491	18.5	22	.33
27	8149	1188	4179	5158	9337	36.1	46	.35
28	11974	1106	3790	9290	13080	22.9	34	.35
29	11537	2386	3223	10700	13923	34.5	31	.23

APPENDIX B Statistical Tools

This appendix represents a brief outline of the model used and of the statistical tests of the hypotheses discussed. All statistical tests were calculated by means of an IBM 360/50 computer or a desk calculator.

The Model

Multiple linear regression techniques were used in the analysis of growth. Five alternative equations were estimated using various independent variables (see table 3) in which gross income was the dependent variable. Each set of independent variables were used for the three groups; above and below average growth, and all observations.

The equation which was estimated can be written in the following general fashion:[a]

$$Y_i = a + B_1X_{i1} + B_2X_{i2} + \ldots + B_jX_{ij}$$

where:

$i = 1 \ldots n$,

and,

Y_i is the ith observed value of gross income (dependent variable).

X_{ij} is the ith value of the jth independent variable.

a is the constant term.

B_j is the coefficient of the jth independent variable.

The partial regression coefficient, which is the change in Y with respect to the change in X_{ij}, is the marginal productivity and is considered the productivity level of a particular independent variable.

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[a]Source: Blair, Morris Meyers, Elementary Statistics, (New York: Henry Holt and Company, 1952), p. 287.

The Statistical Tests

The t Test

The t test was used to ascertain whether each independent variable had an effect on gross income significantly different from zero. That is:

$$H_0: B_j = 0 \qquad H_a: b_j \neq 0$$

The form of the t test was:[a] $t = b_j - 0/Sb_j$

where:

b_j is the estimated partial regression coefficient of the jth independent variable.

Sb_j is the estimated standard error of b_j.

The t test was also used to determine the significance of difference between pairs of partial regression coefficients. The hypotheses used were:

$$H_0: b_1 - b_2 = 0 \qquad H_a: b_1 - b_2 \neq 0$$

The form of the t test was:[b] $t = b_1 - b_2/\sigma b_1 - \sigma b_2$

where:

b_1 and b_2 are the pairs of partial regression coefficients.

σb_1 and σb_2 are the standard deviations of b_1 and b_2.

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[a]Source: H. C. Fryer, Concepts and Methods of Experimental Statistics, (Boston, Mass.: Allyn and Bacon, Inc., 1966), p. 220.

[b]Source: Morris Meyers Blair, Elementary Statistics, (New York: Henry Holt and Company, 1952), p. 287.

The Chi-Square Test for Independence

This test was used to determine if size and growth (both in terms of gross income) were independent. The hypotheses tested were:

H_0: Size and growth are independent.

H_a: Size and growth are not independent.

The form of the chi-square test was:[a]

$$X^2 = \frac{n(ad-bc-n/2)^2}{(a+b)\ (c+d)\ (a+c)\ b+d)}$$

As can be determined from table 14, a = 19; b = 10; c = 10; d = 19; and n = 58.

TABLE 14. Contingency table used to test for independent of growth and size.

GROSS INCOME	GROWTH RATE		
	ABOVE	BELOW	TOTAL
Large	19	10	29
Small	10	19	29
Total	29	29	58

$X^2_{1d.f.} = 4.4137$

H_0 would be rejected in favor of H_a at the five per cent level.

[a]Source: Taro Yamane, Statistics, An Introductory Analysis, (New York: Harper and Row, 1964), p. 595.

BIBLIOGRAPHY

Auer, Ludwig. "Technological Progress in Relation to Growth of the Farm Firm". Farm Management in the West, Problems in Economic Growth. Proceedings of Western Agricultural Economics Research Council, Denver, Colo., 1964, and Portland, Oregon, 1965. Report No. 6.

Bailey, Warran R. "Necessary Conditions for Growth of the Farm Business Firm". Farm Management in the West, Problems in Economic Growth. Proceedings of Western Agricultural Economics Research Council, Denver, Colo., 1964, and Portland, Oregon, 1965. Report No. 6.

Blair, Morris Meyers. Elementary Statistics. New York: Henry Holt and Company, 1952.

Board of Governors, Federal Reserve System. Federal Reserve Bulletin. Division of Administrative Services, Washington, D. C., Jan., 1951-1965.

Davis, Lynn H. "Scale and Size Relationships of the Farm Firm". Farm Management in the West, Problems in Economic Growth. Proceedings of Western Agricultural Economics Research Council, Denver, Colo., 1964, and Portland, Oregon, 1965. Report No. 6.

Fletcher, Lehman B., and Kramer, Donald D. Firm Growth Processes and Structural Changes in the Grain Industries of the North Central Region. North Central Regional Research Pub. No. 177, Iowa Ag. Exp. Sta., Research Bulletin 557, Nov., 1967.

Fryer, H. C. Concepts and Methods of Experimental Statistics. Boston: Allyn and Bacon, Inc., 1966.

Heady, Earl O. Economics of Agricultural Production and Resource Use. New York: Prentice-Hall, Inc., 1952.

Irwin, George D. "A Comparative Review of Some Firm Growth Models". Agriculture Economics Research. Vol. 20, No. 3, USDA, ERS. Washington, D. C.: Government Printing Office, July, 1968.

Johnson, Stanley R. "A Multi-Period Stochastic Model of Firm Growth". Economics of Firm Growth. Proceedings of GP-2 Council, Sylvan Lake, S. D., S. D. Ag. Exp. Sta., Pub. No. 29, 1965.

Kansas State Board of Agriculture. Farm Facts. Statistical Division, Federal Building, Topeka, Kansas. 1950-1964.

Martin, J. R. "Conceptual Aspects and Problems in Formulating Firm Growth Research". Economics of Firm Growth. Proceedings of GP-2 Council, Sylvan Lake, S. D., S. D. Ag. Exp. Sta., Pub. No. 29, 1965.

Martin, J. R., and Plaxico, James S. Polyperiod Analysis of Growth and Capital Accumulation of Farms in the Rolling Plains of Oklahoma and Texas. Technical Bulletin No. 1381. USDA, ERS. Farm Production Economics Division. Washington, D. C.: Gov't. Printing Office, 1967.

Nelson, Aaron G. "Financial Aspects of Growth of the Farm Firm". Farm Management in the West, Problems in Economic Growth. Proceedings of Western Agricultural Economics Research Council, Denver, Colo., 1964, and Portland, Oregon, 1965. Report No. 6.

Penrose, Edith T. A Theory of the Growth of the Firm. New York: John Wiley and Sons, Inc., 1959.

Robinson, R. R. "Towards A Growth Theory of the Farm Firm". Farm Management in the West, Problems in Economic Growth. Proceedings of Western Agricultural Economics Research Council, Denver, Colo., 1964, and Portland, Oregon, 1965. Report No. 6.

Tintner, Gerhard. Econometrics. New York: John Wiley and Sons, Inc., 1952.

Vickrey, William S. Microstatics. New York: Harcourt, Brace and World, Inc., 1964.

Wittlesay, Norman K. and Butcher, Walter R. "Technological Change and Growth in Size of Farms Past and Future". Farm Management in the West, Problems in Economic Growth. Proceedings of Western Agricultural Economics Research Council, Denver, Colo., 1964, and Portland, Oregon, 1965. Report No. 6.

Yamane, Tara. Statistics, An Introductory Analysis. New York: Harper and Row, 1964.

GROWTH OF GROSS INCOME OF AGRICULTURAL FIRMS IN NORTHCENTRAL AND SOUTHCENTRAL KANSAS

by

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AN ABSTRACT OF A MASTER'S THESIS

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This study considers factors influencing growth in gross income of fifty-eight Farm Management Association farms in Associations one and two over the period, 1950-1964.

An important assumption is that growth of gross income of agricultural firms is dependent upon the existence of alternative productive opportunities for resource use. The primary objective is to identify resources that have a significant influence on growth of gross income. This is accomplished by identifying a meaningful statistical relationship between gross income of agricultural firms and productive resources.

For the secondary objective, firms were stratified on the basis of growth rates and classified as above and below average growth. A test of significance was used to determine if a statistically significant difference existed between the productivity levels of resources used by the two groups. This would reveal the growth limitations and possibilities of firms in each group.

A third objective was to evaluate if size of the firm provides economic advantages to the growth process.

Models for the first two objectives were multiple linear regression with gross income as the dependent variable. The five models used were:

(1) Y = f (Capital managed, No. of men, Age, Coefficient of variation).

(2) Y = f (Working capital, Real estate capital, No. of men, Age, Coefficient of variation).

(3) Y = f (Machinery investment, Livestock investment, Total acres, No. of men, Coefficient of variation).

(4) Y = f (Machinery investment, Livestock investment, Crop acres, Pasture acres, No. of men).

(5) Y = f (Working capital, Land owned, Land rented, No. of men).

The age variable was included as it is believed that the attitude toward growth changes with age. The coefficient of variation was used to test the notion that farmers sacrifice greater income in the long run for stability of income.

The model for the third objective considered the functional relationship between the average growth rate for individual firms over the fifteen year period, and the level of gross income generated.

Concerning the primary objective, results indicate that capital managed, working capital, livestock investment and number of men are highly significant factors influencing growth. Estimated regression coefficients for the above variables are approximately; $0.13, $0.30, $0.32, and $7,000, respectively. These indicate that the resources could be employed more intensively to accomplish additional growth.

Significant differences existed between the stratified groups in the productivity of resources for all resources except labor. Thus, the below average growth group was in a less favorable situation to increase growth without improving the productivity of resources. The average growth rate for the below group was 0.9% while the above group was 11.9%.

To estimate the relationship between size and growth, a chi-square test of independence was used. Results indicate that they are not independent at the five per cent level. In order to determine the degree of dependency, a simple correlation coefficient was calculated and the coefficient obtained was .40. Thus, size and growth are dependent and positively correlated although the degree of association is low.

Conclusions from this study are:

1. All managers are not fully exploiting existing productive opportunities as witnessed by the high productivity of various capital items.

2. Entrepreneurs had increased use of higher return resources resulting in higher growth rates.

3. Above average growth firm managers are able to keep resource productivity levels high while increasing the usage of resources.

4. The vast differences in individual growth rates of farm firms indicates that certain managers are following a well defined growth plan while others are not growth conscious, competent, able to cope with risk and uncertainty, or do not have a large enough base on which to grow.

5. As economic pressures are exerted towards larger and fewer farms, it is logical that firms that have not developed a growth plan may not survive.