INCOME VARIABILITY OF ALTERNATIVE PLANS, SELECTED FARM AND RANCH SITUATIONS, ROLLING PLAINS OF NORTHWEST OKLAHOMA

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PREFACE

The work reported in this dissertation is a part of the research being conducted jointly by Agricultural Experiment Stations in the Great Plains states, in cooperation with the U. S. Department of Agriculture. The regional project (GP-2) is titled: "Organizing and operating dry-land farms in the Great Plains to meet variable climatic and changing economic conditions." The contributing Oklahoma project is Agricultural Experiment Station Project 968, "An economic appraisal of alternative systems of farming and ranching in high risk areas of Oklahoma."

In Oklahoma Experiment Station Bulletin B-563, estimates of production, price, and income variability of individual major crop and livestock enterprises in northwest Oklahoma were previously published by Robert W. Greve, James S. Plaxico, and William F. Lagrone. They also published input-output information for the area in Processed Series P-390. A third publication in the process of being developed will evaluate normal income expectations of alternative farming and ranching systems.

The analyses presented here used part of the research results in the above manuscripts as a base from which to develop models to estimate variability arising from alternative farming and ranching systems. The consequences of selected alternative managerial strategies are also estimated. The specific interpretations of the results are those of the author.

ACKNOWLEDGMENTS

Sincere appreciation is extended to Dr. James S. Plaxico, Graduate Committee Chairman, for his encouragement, counsel, understanding, and patience throughout my graduate program.

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Many thanks are due to Mrs. Juanita Marshall, who typed the final draft, and to the other members of the secretarial staff who typed the preceding drafts.

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CHAPTER I

INTRODUCTION

Problem Statement

Variable income is characteristic of Great Plains agriculture. Instability in gross income is due to fluctuations in yields caused by weather variability and other natural or physical hazards, and to changes in the prices of agricultural products. The result is that area and individual farm income is variable and uncertain, whereas cost commitments and living requirements are relatively fixed.

The income variability and uncertainty problem is further aggravated by the tendency of favorable and unfavorable years to bunch. Bunchiness may not be significant for the operator who owns land debt clear and who has operating capital reserves. However, for the operator with limited operating capital reserves and little equity in land, the bunching of unfavorable income periods may be more significant than the degree of variability.

A plan might be derived to maximize the long-run returns for a given resource situation under anticipated conditions. Yet this may not be the best plan when variability and income sequences are considered, because the farm firm may not survive the short-run due to a series of unfavorable incomes.

Survival of the farm firm is defined, for purposes of this study, as income sufficient to cover nondeferable business and minimum living expenditures. Information is needed as to the optimum management strategies for meeting the survival goal. Therefore, there is a need for research directed at discovering adjustments in farm organization that will reduce fluctuations in farm income and increase the probability of financial survival.

Purpose and Objectives

The overall purpose of this study is to ascertain the management strategies best fitted to the economic and climatic conditions, and land resources in a Great Plains area of Oklahoma. The specific objectives are:

1. To derive alternative combinations of enterprises for selected land resource situations,
2. To calculate the expected variation in annual returns for the enterprises included in these alternative farm plans,
3. To evaluate the nature of income variability associated with alternative combinations of enterprises for selected resource situations, and
4. To analyze the effects on capital accumulation and survival of the farm firm of these alternative organizations under selected tenure and equity situations.

Study Area

The inferences of this study apply to the area shown in Figure 1. The U. S. Southern Great Plains Field Station, Woodward, Oklahoma, is near the center of this area. Records indicate that the average annual precipitation at the Woodward Station is 23 inches with a range in annual rainfall of from about 10 to 42 inches. Seventy percent of the precipitation occurs in the summer months. The most severe drought in 77 years of recorded weather occurred during 4 of the 16 years included in this study. Precipitation for these four years averaged about 15.5 inches with less than 10 inches in 1954.

Approximately 97 percent of the study area is in farms and ranches, with nearly 65 percent of the farm and ranch land in native or reseeded grasses. About 50 percent of the agricultural income is derived from livestock, primarily beef cattle, 35 percent from wheat, 10 percent from sorghum, and five percent from other crops.

The area is characterized by high winds, a high evaporation rate, and intermittent drought resulting in relatively variable crop production. Soils are predominantly of the lighter type and are subject to wind and water erosion.

Review of Literature

Risk and uncertainty studies related to agriculture have developed primarily since World War II. Research on expectations, risk, and uncertainty may be grouped under four general types, with work done

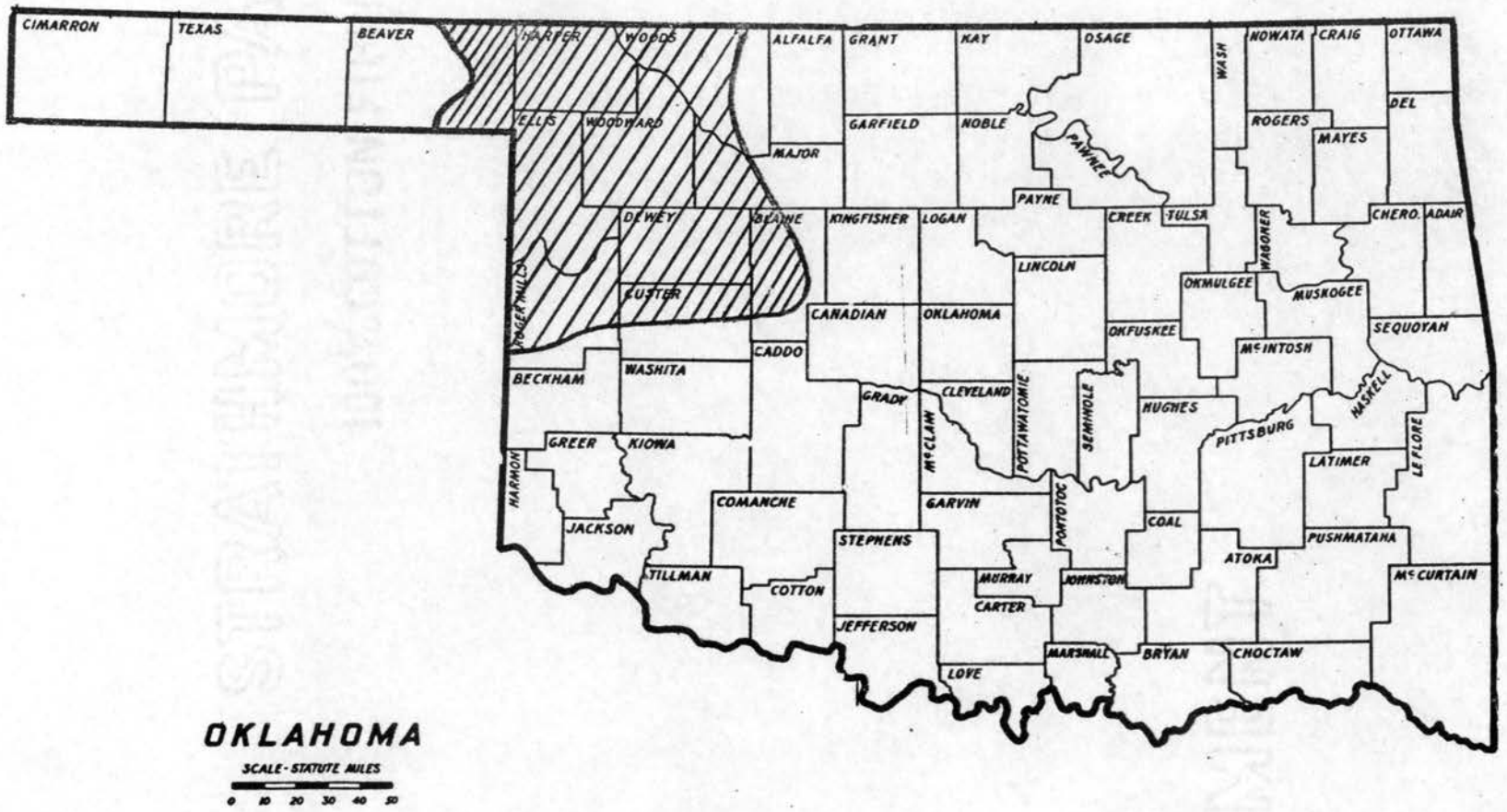

Figure 1. General Area with Farming and Ranching Operations Similar to the Typical Resource Situations Analyzed.

primarily under one type often including one or more of the other types. These headings suggested by Bowman[1] are:

1. The formation and structuring of farmers' expectations; degrees of uncertainty and attitudes toward risk and uncertainty;
2. The rationale of optimization within the farm enterprise under conditions of risk and uncertainty and the effects of uncertainty on resource use and efficiency;
3. Actual behavior of the farm enterprise under conditions of uncertainty; studies providing the empirical evidence concerning the effects of expectations, uncertainties, and risk attitudes on decision making and action; and
4. Public policies to minimize uncertainty.

The general consensus is that the individual farm operator can make some adjustments to reduce fluctuations in income and that society can provide other measures. Generally, the adjustments suggested to be made by the farm operator include one or more of the following: flexibility, product diversification, feed reserves, financial reserves, tenure choice, geographical diversification, and selection of low risk enterprises. It is suggested that society might provide a measure of security through insurance, price guarantees, flexible loan repayment plans, and special deferred tax plans.

A research conference on risk and uncertainty in agriculture was held at Bozeman, Montana in 1953. This conference served as an

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[1] M. J. Bowman, Annotated Bibliography on The Treatment of Expectations, Risk, and Uncertainty in American Farm Enterprise Economics, Mimeograph (Unknown, 1956).

orientation meeting, summarized risk and uncertainty theory, and suggested areas of research to solve the problems. A general conclusion arising from the conference was that farmers need help, not in adjusting to historical average prices and yields, but in learning to adjust to uncertain variations in income.[2]

To further stimulate research related to strategies in the organization and operation of Great Plains farms and ranches, a methodological workshop was held at Lincoln, Nebraska in 1959. The stated purposes of this meeting were to define more clearly the areas to be studied, to present research techniques that might be useful, and to stimulate thinking among the Great Plains Research technical committee membership as to the selection and adaptation of techniques toward problem solving.[3]

In a Kansas study, Barber concluded that no single measure solves the variability and uncertainty problem for farmers in the specialized wheat area of western Kansas. His study showed that crop insurance offset the more serious yield fluctuations but that much income instability remained. Net income deficits were reduced by wheat crop insurance and avoided by multiple crop insurance. However, even with multiple crop insurance there were seven years when the operators' net income was less than minimum family living expenses (estimated at $1,400).

Grain storage facilities on the farm with a capacity of 5,000 bushels would have been effective in smoothing over short periods of

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[2]Phillip J. Thair, Glenn L. Johnson, and Rainer Schickele, eds., Proceedings of Research Conference on Risk and Uncertainty in Agriculture, Great Plains Publication No. 11, North Dakota Agricultural Experiment Station, Bulletin 400 (Fargo, 1955).

[3]Howard W. Ottoson, Laurel D. Loftsgard, and Frank Orazem, eds., Management Strategies in Great Plains Farming, Great Plains Council Publication No. 19, Nebraska Agricultural Experiment Station, MP 7 (Lincoln, 1961).

low income, but would have failed to maintain income over a long period of low yields such as 1933-40. Barber also indicated that the tenant-operator may be in a better position than the encumbered owner-operator both as to maximum deficiency of net income and average surplus after living allowance.[4]

Thair analyzed a typical grain farm in the small grain and livestock area in the central part of North Dakota. Only yield variation was analyzed since prices and farm organizations were held constant. Thair's analyses showed that no one of the stabilizing techniques studied was sufficient to maintain the farm business and to provide a minimum family living each year. Although crop insurance alone eliminated negative incomes, in some cases it increased the number of years in which net income was insufficient to cover a minimum living allowance. Cash reserves reduced the number of deficit years both for the farm business and family living. A grain storage program could also reduce the number of deficit years. Cash reserves plus crop insurance could eliminate the negative years due to yield variability if prices did not change. Emergency credit was suggested as another survival measure which could eliminate deficit years. The encumbered owner required more emergency credit than the debt free owner-operator or the tenant-operator.[5]

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[4] E. Lloyd Barber, Meeting Weather Risks in Kansas Wheat Farming, Kansas Agricultural Experiment Station and USDA, Agricultural Economics Report No. 44 (Manhattan, 1950).

[5] Philip J. Thair, Stabilizing Farm Income Against Crop Yield Fluctuations, North Dakota Agricultural Experiment Station and Bureau of Agricultural Economics, USDA cooperating, Bulletin 362 (Fargo, 1950).

In another study, Thair found that farmers with crop insurance on the average had lower equities, more assets in relatively fixed types, less livestock, larger wheat acreages, and larger families to support than farmers without crop insurance. He found no evidence to show that farmers in high risk areas participate in crop insurance plans in greater numbers than farmers in low risk areas. This study also showed that there was less livestock in the high risk area than in the low risk area.[6]

Hjort studied the reserves required for short-run survival for 67 wheat yield series in Montana's dryland wheat area. He found high variability in the maximum financial reserve required for short-run survival with a range of from zero for a high yield series to over $40,000 for the lowest winter wheat yield series. He also found that one or two high yields near the beginning of a series may be sufficient to generate the reserves required to survive. Hjort concluded that from a farm unit of adequate size reserves can be generated which will promote income stability for the farm operator.[7]

Bostwick, as part of a broad study of weather and the economy of dryland farms, defined a wheat yield statistic in terms of the probability

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[6]Philip J. Thair, Meeting the Impact of Crop Yield Risks in Great Plains Farming, North Dakota Agricultural Experiment Station in cooperation with the Production Economics Research Branch, ARS, USDA, Bulletin 392 (Fargo, 1954).

[7]Howard W. Hjort, "The Use and Effectiveness of Financial and Physical Reserves in Montana's Dryland Wheat Areas," (unpub. M.S. thesis, Montana State College, 1959).

that wheat yields sufficient to cover various costs will occur. Using this criteria, farmers who consistently got yields above the annual county average yield could expect to show a re-investible surplus over 90 percent of the time, whereas farmers who consistently got yields below the county average could expect to cover cash costs less than 90 percent of the time.

Another variable analyzed in the Bostwick study was the relationship between field dispersion and yield variability for the farm unit. The data for Judith Basin County supported the hypothesis that wheat yield variability and field dispersion are inversely related. However, while field dispersion appeared to reduce income uncertainty for wheat farmers, the income over time did not appear to be changed in any measurable way.[8]

Using yield data from Hjort,[9] Bostwick in a later study used the Markov Chain approach to estimate probable yields. This analysis was based on the assumption of a two-year sequential dependence of yields with specified yield levels as starting states. The study suggested that if data were available to construct a valid Markov Chain, then a strategy for adding to and withdrawing from cash reserves could be derived so as to maintain some required level of reserves in the long-run.[10]

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[8]Don Bostwick, Studies in Yield Variability, Montana Agricultural Experiment Station in cooperation with Farm Economics Division, ERS, USDA, Bulletin 574 (Bozeman, 1963).

[9]Hjort, pp. 66-74.

[10]Don Bostwick, "Yield Probabilities as a Markov Process," Agricultural Economics Research, Vol. XIV, No. 2, ERS, USDA (Washington, 1962), pp. 49-56.

Freund developed a model for considering risk in programming.[11] The Freund model was later adapted by Rein.[12] The problem becomes one of maximizing utility, measured in terms of net revenue, subject to risk aversion and variance restraints. The larger the value of the risk aversion factor, the more rapidly the marginal utility of revenue declines since a greater negative weight is given to the variance.

Using a simplified program with seven alternative crops, Rein programmed plans with different assumed degrees of risk aversion. The conventional net income maximizing program resulted in a plan with an income of $10,000 and a standard deviation of $3,989. With the same alternatives and the highest risk aversion factor used, the net revenue was reduced to $7,200 with a standard deviation of only $1,220. As the risk aversion factor was increased, the optimum plan included fewer acres of tomatoes and alfalfa with a less variable crop--corn--increasing in importance.

A risk and income opportunity curve was derived from the risk program by varying the risk aversion factor. Every point on this curve represents a different risk aversion constant. Theoretically, the plan chosen by an entrepreneur would be the plan producing the income with the variance specified where his indifference curve for income and variance is tangent to the opportunity curve.

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[11] Rudolph J. Freund, "The Introduction of Risk into A Programming Model," Econometrica, Vol. 24, Econometric Society (New Haven, 1956), pp. 253-263.

[12] Rudolph J. Freund and M. E. Rein, "Aspects of Risk Programming," (unpub. 20 page paper based on Freund's unpub. Ph.D. thesis, North Carolina State College, 1955; and Rein's unpub. M.S. thesis, Virginia Polytechnic Institute, 1958).

Risk was introduced into the decision model of the firm by describing risky outcomes as probability distributions and choosing from among alternative possible distributions by the expected utility hypothesis. The Freund model is a problem in quadratic programming and with the number of activities usually included in linear programming models, a large scale computer is required.

Castle analyzed the effect of diversification on variability. Whether or not diversification will reduce variability depends upon the variance of the original enterprise as compared with the variance of the added enterprise and upon the degree of correlation of the returns from the two enterprises. If the enterprise added has a higher variance than the enterprise originally produced from the given bundle of resources, the degree of correlation must be correspondingly lower to reduce total variance.

Castle analyzed variability of returns per acre based on physical data from the Colby and Garden City, Kansas, experiment stations. Livestock were brought into the analysis as a function of feed. Price and yield variability were combined to study gross income variability per acre. In this study, the coefficient of variation was used as a basis of comparison for enterprise income variability.

The Castle data indicated that cattle at both stations had the lowest gross income variability, primarily due to the low variability of sorghum forage production. At the Garden City station, gross income variability of wheat-milo was lower than for either alone. However, adding cattle to wheat alone would result in the lowest

variability. Likewise, at Colby gross income variability was reduced if wheat was combined with either milo or cattle. Castle observed that although the reduction in variability at both stations was small, it may occur in strategic years since the number of complete failures was reduced.

By combining data from the two stations, the effects on variance of area diversification were simulated. The reduction in variability by growing wheat at one station and another crop at the other station was approximately the same as product diversification at either of the stations. In addition to diversification, this study suggests flexibility and liquidity as precautions to reduce uncertainty.[13]

Ottoson and Finley studied the effects of shifting land resources between wheat and other crops for two counties in Nebraska. Wheat was the most profitable crop, but in terms of absolute variance, it was the most risky. Generally, as one of the other crops was combined with wheat, the combination had less variance and less income than wheat alone. Due to the lack of adequate procedures for translating pasture and forage data into meaningful livestock production coefficients diversifying by diverting acres to livestock enterprises was not analyzed.[14]

Greve, Plaxico, and Lagrone estimated the variability of production, price, and income per acre for selected enterprises in northwest

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[13]Emery N. Castle, Adapting Western Kansas Farms to Uncertain Prices and Yields, Kansas Agricultural Experiment Station, Technical Bulletin 75 (Manhattan, 1954).

[14]Howard W. Ottoson and Robert Finley, "Strategies to Meet the Hazards of Farming and Ranching in the Plains," University of Nebraska, College of Agriculture, Mimeograph (Lincoln, 1960).

Oklahoma over a 16-year period. The enterprises considered were wheat, grain sorghum, moderate graze steers, and a moderate graze cow-calf system. In terms of returns over variable production costs, wheat was least variable followed by the cow-calf system, grain sorghum, and steers in that order. Analyses based on deflated prices and constant prices indicated that most of the variability in the case of wheat and grain sorghum was due to yield variation, but in the case of steer and cow-calf enterprises, the variability was due primarily to price variations.

Tests for bunchiness of physical production suggested the presence of cycles or bunches in the data series. The cow-calf production data tended to cluster near the mean with a low coefficient of variation. The importance of reserves and long term planning in the Great Plains was emphasized by the high variation for the other three series and their bunching tendencies.

Correlation between the four series was low. Therefore, the conclusion was that there may be a stabilizing effect when enterprises are combined. However, no systematic evaluation of income effects of combining enterprises on a typical farm unit was made in this study.[15]

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[15]Robert W. Greve, James S. Plaxico, and William F. Lagrone, Production and Income Variability of Alternative Farm Enterprises in Northwest Oklahoma, Oklahoma Agricultural Experiment Station in cooperation with Farm Economics Research Division, Bulletin B-563 (Stillwater, 1960).

Study Plan

The present study was based on information derived for the four selected enterprises studied by Greve, Plaxico, and Lagrone.[16] Similar data was derived for other enterprises, included in programmed plans for typical resource situations on the rolling plains of northwestern Oklahoma. Variability of enterprises and whole farm plans are analyzed in terms of farm and ranch organization for both optimum and less variable income opportunities. To further analyze the effects of farm income variability upon survival of the family farm unit and capital accumulation, income sequences and bunchiness of income levels were examined.

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[16] Ibid.

CHAPTER II

METHODS OF ANALYSES

The farm plans analyzed in this study were derived within a linear programming framework. With several restrictions and many alternative activities to be analyzed, linear programming is an efficient method of ascertaining maximizing solutions. The criterion used for deriving the farm plans used in this study was to maximize returns subject to the selected alternatives and assumed restrictions for the specified situations.

Restrictions and Assumptions

In general, technical coefficients were obtained from published sources and estimates of agricultural workers. Where data were not available, estimates were derived by statistical techniques and checked for logical relationships with professional agricultural workers. The resource requirements, costs, and expected returns, which served as the basic input-output data for deriving the farm plans analyzed, are from Greve, Plaxico, and Lagrone.[1]

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[1] Robert W. Greve, James S. Plaxico, and William F. Lagrone, Resource Requirements, Costs and Expected Returns; Alternative Crop and Livestock Enterprises; Rolling Plains, Northwestern Oklahoma, Oklahoma Agricultural Experiment Station and Farm Economics Division, ERS, USDA, Processed Series P-390 (Stillwater, 1961).

Land Resources

Table I shows five land resource situations selected as being typical in the area. Cropland soils in the area were divided into five productivity classes on the basis of topography, depth, and texture of topsoil.[2]

TABLE I

ASSUMED LAND RESOURCE COMBINATIONS FOR LINEAR PROGRAMMING MODEL, NORTHWEST OKLAHOMA

Farm Type	Cropland[a]	Range	Farmstead and Waste	Total	Classification
			- Acres -		
I	320	288	32	640	Small Balanced
II	320	1,200	80	1,600	Small Range
III	960	864	96	1,920	Large Balanced
IV	160	2,348	132	2,640	Large Range
V	1,240	90	70	1,400	Large Cropland

[a]Wheat allotment was assumed to be 50 percent of the cropland for each resource situation.

Labor

Family labor available is assumed to be the same for a given resource situation regardless of tenure status. However, the number of hours available is reduced as farm size is increased. The assumption was made that more of the operator's time would be required for management and decision making as farm size increases. Table II shows the

[2]Ibid., p. 33.

three levels of family labor assumed for this study. Additional labor was assumed to be available for hire at $1.25 per hour.

TABLE II

OPERATOR AND FAMILY LABOR AVAILABLE FOR FARM LABOR

Labor Period	Hours Available for Each Resource Situation		
	I	II	III, IV, V
January-April	710	624	581
May-July	638	572	539
August-September	440	396	374
October-December	594	528	495

Tenure

The initial programmed farm plans are for an owner-operator with full land equity. Four of these plans were analyzed for an encumbered owner with 50 percent land equity and 50 percent being purchased, a part-owner with 50 percent land equity and 50 percent rented, and a tenant-operator.

Income and Cost Assumptions

Prices

In the linear programming model used to derive the farm plans analyzed, cash grain and livestock prices were based on estimates of the prices received by farmers in the northwestern Oklahoma area in 1961 (Appendix A, Table I). The assumed price paid for production factors for deriving the returns over cash costs for the static plans are shown in Appendix A, Table II.

For the variability analyses, the value of the cow herd is assumed to be constant. However, the prices of calves and yearling steers were assumed to have the same variability as the deflated prices for the 1942-57 period. Annual cash costs of production were assumed to be constant.

Interest Rates

In all of the cost and returns analyses, an interest rate of six percent was used for annual operating capital. Returns on land capital were calculated at an annual rate of five percent. Payments on land purchased were amortized at an interest rate of five percent for a 33-year period.

Land Values

The land values used in this study were calculated on the basis of marginal value product coefficients for the five different classes of cropland, rangeland marginal value product, and the average census value of all farmland in Woodward County.[3] The marginal value product coefficients used were those for the large balanced unit with only the cow-calf enterprises allowed as livestock alternatives in the plan. The computed value of a composite acre of cropland was $88.23, with rangeland valued at $35 per acre.

Rental Rates

The rental rate assumed for cash crops is based on a one-third landlord crop share. The rental rate for range and feed crops was

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[3]United States Department of Commerce, Bureau of the Census, U. S. Census of Agriculture for Oklahoma, 1959.

assumed to be at a level which would give the landlord about the same return per dollar invested in rangeland and feed cropland as the one-third crop share return yields per dollar invested in cash cropland. The rate used was derived from the optimum crop plan for the large cropland unit with all livestock activities excluded. The computed average rental rates were $5.44 per acre of cropland and $2.05 per acre of rangeland.

Other Cost Assumptions

Some costs which are difficult to prorate to individual enterprises were grouped under the term overhead costs. These costs were assumed to be primarily nondeferable annual operating costs. Included were the costs of owning and operating a farm truck, telephone service, bookkeeping and tax service, and building and machinery insurance. Appendix A, Table III shows the two levels of these costs assumed. For resource situations I and II, $696 was assumed to be the total cost for these items while for resource situations III, IV, and V, the assumed total was $1,157.

Real estate taxes were based on observed average tax rates in the area. For this study, the rate used was 88 cents per acre for cropland and 24 cents per acre for rangeland.

In addition to farm operating expenses, the farm family must meet certain minimum living expenses. The money to pay these required disbursements must come from annual farm income or savings from previous years. From observation of census and farm record data, the trend seems to be toward higher expenditures. Based on data available, $3,500 was

assumed to be the minimum average annual farm family outlay for necessary living at the present time.

Planning Situations

The farm plans included in these analyses were selected from a larger group of programmed alternative plans for northwestern Oklahoma.[4] The plans analyzed represent four different planning situations with respect to enterprise alternatives at two different annual operating capital levels. Thus, eight combinations of enterprise alternatives programmed for the five resource situations specified in Table I were analyzed.

Activity Restrictions

The full linear programming model used in deriving the farm plans analyzed, involved 80 activities and 19 resources. Cash grain crops selected for inclusion were continuous wheat, barley, and grain sorghum. Wheat could also be produced in two rotations. These rotations were wheat-fallow and wheat-grain sorghum-fallow.

Cropland activities related to supplying grazing for livestock included forage sorghum, Sudan grass, Johnson grass, Weeping Love grass, Sandyland mix, wheat to graze out, and "go back" grass. Forage sorghum harvested was the source of forage for supplemental harvested feed. Sage brush control was included as a range improvement practice.

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[4]The plans analyzed in this study are part of a group of plans programmed cooperatively with Robert W. Greve, Agricultural Economist, USDA, for a planned companion publication entitled, "Income Expectations From Alternative Farm-Ranch Organization in Northwestern Oklahoma."

The livestock enterprises in the model were buy-sell steer grazing activities and cow-calf activities. Three grazing intensities for both steer and cow-calf activities were included for the native range and cropland reseeded to permanent grass. Other livestock activities, using forage sorghum hay and/or temporary grazing, included five steer activities and three cow-calf activities. Other activities in the program provided for hiring labor, borrowing capital, and buying forage.[5]

In the programming process, the model was modified so as to eliminate specified activities. These different alternative enterprise combinations for discussion purposes are denoted by the letters A, B, C, and D, as shown in Table III.

TABLE III

DEFINITION OF ENTERPRISE PLANNING SITUATIONS USED FOR PROGRAMMING EACH FARM UNIT

Plan[a]	Program Model Activities Excluded As Alternative Enterprises
A	None
B	Temporary Graze Steers
C	Heavy Graze Steers Temporary Graze Steers
D	All Steer Activities

[a]The plans analyzed are also later identified by a number indicating the interest rate used in deriving the plan.

[5]For a more comprehensive description of those activities included in the programmed optimum plans, see Chapter III.

Capital Limitation

The absolute level of capital used was changed by requiring different marginal value products for capital. If a high rate of interest is required on capital, the amount of capital used will be lower than the level of capital used by the plan derived if a low rate of interest is required. In effect, the interest rate assumed acts as a predetermined marginal value product for capital with only those activities which return at least this rate in the optimum plan.[6]

Each of the four enterprise planning situations was programmed at a six percent and an 18 percent annual cost of capital. The reduction in the use of capital by increasing the charge for capital from six to 18 percent is shown in Appendix A, Table IV.

Variability of Returns

In this study, analyses of variations in income that arise from both product price and yield variability were estimated. Because the actual price series overestimates the degree of price variability when there is an upward trend in all prices, a deflated price series was used.[7] In effect, deflating removes variation due to changes in the

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[6]Alfred L. Barr and James S. Plaxico, Optimum Cattle Systems and Range Improvement Practices for Northeastern Oklahoma: Dynamic and Static Analyses, Oklahoma Agricultural Experiment Station, Miscellaneous Publication 62 (Stillwater, 1961), p. 4.

[7]The price series used was for the 16-year period, 1942-57, after deflating by the U. S. Bureau of Labor Statistics index of wholesale prices of all commodities for the 1935-39 base period. See Greve, Lagrone and Plaxico, Bulletin B-563, pp. 11-13.

general price level to arrive at real values. After a price series has been deflated, deviations from the long-run mean of the deflated series represent the random elements of price variation.[8] Observed yield variability arises essentially from uncertain weather conditions, whereas, gross income variability arises from the interaction of product price and yield.

Enterprise Variability

The variance of deflated gross income can be computed for any enterprise for which data on yields are available or can be estimated for the period to be analyzed. By this method, the estimated adjusted gross returns were ascertained for the income producing enterprises that entered significantly into the programmed farm plans analyzed.

The variation in physical productivity for the different types of grazing used by the livestock enterprises was estimated. This variability was estimated in terms of yield of forage, pounds of beef from steers, and pounds of beef from a cow-calf unit. The variation in pounds of beef per acre was combined to produce the variation in pounds of beef produced per steer and the pounds of beef produced per cow-calf unit.[9] Using the estimated pounds of beef per livestock unit, the deflated price

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[8] H. O. Carter and G. W. Dean, "Income, Price, and Yield Variability for Principal California Crops and Cropping Systems," Hilgardia, Vol. 30, No. 6, California Agricultural Experiment Station (Berkeley, 1960), p. 177.

[9] For the computed pounds of beef produced per production period, see Appendix B.

series, and the acres of grazing required per production period, the deflated annual per acre gross incomes were computed.

The variability of deflated gross returns to wheat and grain sorghum was the same as used in an earlier Oklahoma Experiment Station publication.[10] The level of grain sorghum returns, however, was adjusted upward to reflect the present and expected future use of higher yielding hybrid grain sorghum varieties than was possible in the period for the collected data.

Total Farm Unit Variability

When two enterprises are combined by bringing together the resources required by each, the variance for the total income is defined by the following equation:

$$2.1 \qquad S_t^2 = S_1^2 + S_2^2 + 2r_{12}S_1S_2$$

For "n" enterprises, the general equation for the variance of total income becomes:

$$2.2 \qquad S_t^2 = \sum_{i=1}^{n} S_i^2 + 2 \sum_{i<j}^{n} r_{ij}S_iS_j \qquad 2 \leq j \leq n$$

where S_i^2 is the variance of the income from the i^{th} enterprise, r is the simple correlation coefficient between the i^{th} and j^{th} enterprises, and S_i and S_j are the standard deviations of the income from the i^{th} and j^{th} enterprises.

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[10] Greve, Plaxico, and Lagrone, Bulletin B-563, p. 15, Table V.

The income from enterprise "i" may defined as a linear combination of "a" units of the deflated returns per acre for the i^{th} enterprise.[11] If the variance of deflated returns per acre is defined as s_i^2, then the variance of the income from enterprise "i" is given by the relationship:

$$S_i^2 = a_i^2 \, s_i^2 \qquad 2.3$$

where a_i is given by the equation:

$$a_i = \frac{\text{Income from enterprise "i"}}{\text{Deflated income per acre from enterprise "i"}} \qquad 2.4$$

and s_i^2 is the unbiased estimate of the variance of the deflated income per acre for enterprise "i". An evaluation of these values in equation 2.2 for any farm plan gives the total variance of the income from that farm plan.

Income-Standard Deviation Function

The income for each farm plan can be plotted against the standard deviation of that plan. Removing the enterprise with the highest variability from the programming matrix will result in a farm plan with another income-variance combination. Each time this operation is repeated, another point can be plotted. An income-variability curve such as in Figure 2 can be derived by plotting the average income and standard deviation for each of a series of programmed farm plans.

If a determinant equilibrium planning position is to be attained, the shape of the indifference curve must be such that it is tangent to

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[11] Paul G. Hoel, Introduction to Mathematical Statistics, 2nd ed. (New York, 1954), pp. 196-200.

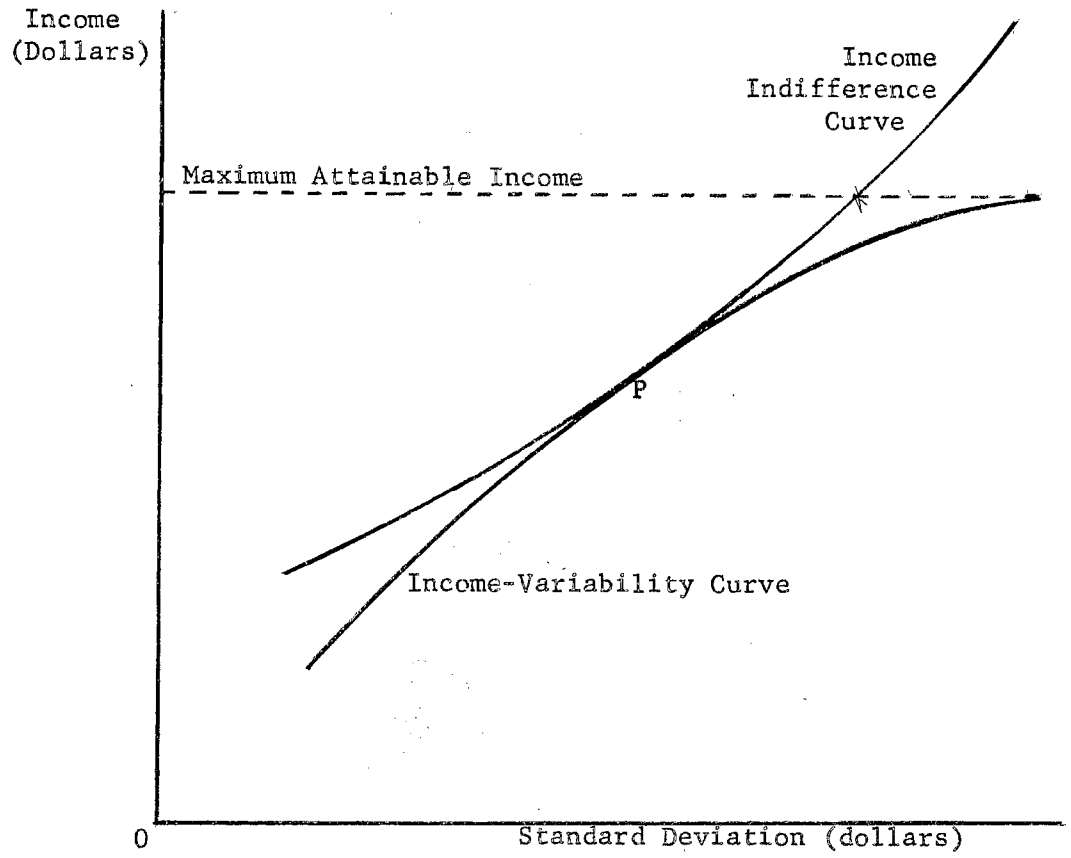

Figure 2. Illustration of Income-Variability Curve and Income Indifference Curve.

the income opportunity curve at only one point. Further, the curves must not intersect at any other point. The shape of the indifference curve for different individual farmers could vary from a convex curve as shown in Figure 2 to a curve of the same general concave form as the hypothetical income curve. The degree of concavity of the indifference curve must be less than the degree of concavity of the income curve if it is to be nonintersecting and tangent to the income curve at only one point. If the concavity of the indifference curve were greater, the curves could intersect at two points, resulting in an indeterminant situation. If the indifference curve should coincide with the income curve, then all plans would appear to be equally desirable. These various forms that the indifference curve could theoretically take on may serve as a partial explanation of why, in situations that appear similar, individual farm operators make different decisions as to the plan to follow.

Theoretically, the optimum farm plan would be the plan indicated by a point such as P in Figure 2. At this point, the farm operator's indifference curve, with respect to income and variability of income, is tangent to the income variability curve. With a low risk aversion, the shape and location of the farm operator's indifference curve will be such that the point of tangency lies to the right hand portion of the income curve, which allows more variable and higher income enterprises to enter the farm plan. If the farm operator has a high risk aversion, the point of tangency will be towards the left hand portion of the income curve, which allows less variable and lower income enterprises to be included in the farm plan.

The income-variability curve suggested here is similar to the risk opportunity curve derived by Freund and Rein.[12] Their model was developed by the use of an expected utility function that brought risk aversion into a quadratic programming model. By the use of a variance-covariance matrix and a technology matrix for seven crops single valued points on the curve were computed. With a low risk aversion factor in the utility function, the plan derived was essentially the same as the plan when risk was not considered. Increasing the magnitude of the risk aversion factor resulted in programmed plans that included crops with a lower degree of risk and a lower and less variable farm income. Thus, with different risk aversion factors, points on the curve representing different combinations of income and variance were derived by quadratic programming.

Probability and Sequence of Farm Income

If the average income and the standard deviation of the annual income are known for a given farm plan, the probability of a specified level of income from that farm plan can be calculated. This type of probability analysis can be made if the assumption of a random normally distributed variable is valid.[13]

The expected stream of farm incomes for the period being analyzed can be obtained by estimating sequences of incomes for different plans.

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[12] Freund and Rein, p. 5.

[13] See Appendix C for a discussion of relevant normal probability theory.

These calculated sequences of incomes show the absolute level of incomes and the period in time that a given level of income for a specified plan could have occurred. Through these sequences, the bunchiness of deficits and surpluses can be observed.[14]

For the analyses of business survival and capital accumulation in Chapter V, income sequences of estimated returns available for reserves or debt payment were utilized (Appendix F, Tables II through XIII). These figures were derived by subtracting all expenditure items except returns to annual capital, returns to land equity, and management from gross income sequences.[15] By this method, the appropriate sequences were calculated for given tenure and resource situations for the different farm plans analyzed. By making an assumption with respect to equity position and starting point in the income sequence, possible changes in equity and credit required over time were also computed.

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[14]For an example of the calculation of a typical gross income sequence, see Appendix F, Table I.

[15]Sepcific expenditure items are tabulated in Appendix E.

CHAPTER III

PROGRAMMED STATIC OPTIMUM FARM PLANS

For each of the five farm and ranch land resource situations, enterprise combinations that maximize net returns to available resources were ascertained by linear programming techniques. Eight optimum enterprise combinations were derived by assuming four different enterprise planning situations at two capital levels. These plans for each resource situation are presented in Appendix D.

The programmed farm plans provide estimates of the optimum combinations of enterprises, returns over specified costs, annual operating capital requirements, and the hired labor required. Imputed returns were derived only after making assumptions with respect to returns to family labor, real estate taxes, and levels of general overhead costs that were not included in the enterprise budgets.

Activities In The Plan

For the plans analyzed in this study, there were ten different cash income producing enterprises that entered significantly into one or more of the optimum plans. These ten enterprises[1] were defined as (1) continuous wheat for harvest; (2) a wheat-grain sorghum-fallow

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[1]For a more detailed description of these enterprises, see Greve, Plaxico, and Lagrone, Processed Series P-390.

rotation; (3) a moderate graze steer enterprise producing good feeders off native range; (4) a heavy graze steer enterprise producing good feeders off native range; (5) a moderate graze steer enterprise using supplemental forage sorghum during the winter grazing period to produce good feeders off native range; (6) a yearlong temporary steer grazing enterprise producing good feeders off Johnson grass, small grain for harvest, and native range; (7) a yearlong temporary steer grazing enterprise producing good feeders (the same as 6 above except that Johnson grass was replaced by Sudan grass and small grain to graze out); (8) spring calving cow-calf units producing choice stocker calves October 1 off native range; (9) spring calving cow-calf units producing choice stocker calves October 1 off Johnson grass, small grain for harvest, and native range; and (10) spring calving cow-calf units producing choice stocker calves October 1 (the same as 9 above except that Johnson grass was replaced by Sudan grass and small grain to graze out).

To support the livestock alternatives, part of the cropland was used to produce forage for winter feed. Johnson grass, Sudan grass and wheat for grazing were used by the temporary grazing enterprises (6, 7, 9, and 10). Additional grazing was also available for temporary graze activities in the October-February grazing period from wheat for harvest. Weeping Love grass was used to supply permanent range on cropland as an additional source of grazing for the native range enterprises (3, 4, 5, and 8). If the Weeping Love grass activity is excluded from the program, Sandyland grass mix replaces it with a very small reduction in income.

In general, when operating capital was limited, the plan derived included less continuous wheat, more wheat-grain sorghum-fallow, less livestock, and a less variable but lower gross income, than if a six percent marginal value product for capital was required.[2] When the livestock alternatives were restricted so as to change the optimum plan from plan A to plan D with a given marginal value product for capital, a shift also took place from continuous wheat to the wheat-grain sorghum-fallow rotation, with a reduction in the proportion of cropland devoted to livestock accompanied by a reduction in income and variability of income.

Levels of returns available for family living and equity accumulation by the farm operator are of more significance than gross income in farm decision making. In the next section, the relationship between returns and expenditures for alternative resource situations and planning situations are examined.

Expected Returns and Expenditures

For the analyses of allocation of income, average annual living expenditures were assumed to be $3,500. An alternative assumption could be that this $3,500 represents the opportunity cost for family labor used on the farm. After the family living cost, cash farm expenditures, real estate taxes, depreciation, six percent returns on

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[2]The required marginal value product for capital was changed in the programming model by changing the interest rate charged for borrowed operating capital. Initially, the rate was changed from six to 36 percent by six percent increments. In the present analysis, only the six and 18 percent levels were used.

annual operating capital, and five percent returns to land capital have been deducted from gross income, the residual was imputed to management. For analyses with other tenure classes assumed, part or all of the returns to land capital were replaced by either a charge for rent paid to the landlord or an amortized land payment.

Four of the farm plans for each resource situation were analyzed for three tenure classes in addition to the owner-operator. These tenure classes are the encumbered owner, part owner, and tenant.[3] The four plans analyzed for these three tenure classes are the high capital level moderate graze steer plan (6C), the high capital level cow-calf plan (6D), and both the high capital level plan (6A) and the low capital level plan (18A) when the full programming model is used. Appendix E consists of the tables of allocation of gross income for the four tenure classes.

In a static framework, whether or not the plan is preferred depends upon the level of income from this plan in relation to income from alternative plans. Of the plans considered in these analyses, plan 6A consistently showed the highest net income (Appendix E). With a static decision criterion to maximize returns over costs, and with unlimited capital, this would be the best plan to follow, although with variability considered other plans may be preferred.

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[3]The encumbered owner was defined as having full equity in 50 percent of his land and purchasing 50 percent of his land. The part owner has full equity in 50 percent of his land and rents 50 percent. The tenant rents all of his land and may also be referred to as a tenant-operator.

Potential Investment Funds

Potential investment funds constitute the fraction of farm income that may be available for reserves, debt payment, and/or expansion. The sources of these funds are returns to owned sources including management.[4] In this section, the production of potential investment funds for selected plans was ascertained by assuming full equity in annual operating capital. In Chapter V, this assumption is relaxed to analyze the effects of starting with less than full equity in annual operating capital on firm survival and capital accumulation.

Returns to owned resources were highest for the owner-operator tenure class. For this tenure class, all plans except the low capital level cow-calf plan (18D) on the small balanced unit showed positive long-run returns to owned resources. Even with 100 percent equity in both land and capital assumed, the owner-operator's return over annual expenditures from this plan was less than average family living. In the long-run, this plan would result in a reduction in equity if family living is maintained at $3,500 (Appendix E).

Balanced Farm Units

As shown in Table IV, none of the plans for the small balanced unit produced enough income to maintain the tenant-operator's family at the average level of living assumed. In the long-run, the tenant-operator on this unit faces a lower level of living and/or a reduction in equity.

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[4]These funds include returns to annual operating capital, land equity, and management. The portion of the gross income allocated to each of these factors is specified in Appendix E.

The part owner on this unit could have some returns to capital available when plan 6A was followed. With the low capital plan (18A), family living could be maintained at $3,500 with only 11 dollars allocated to returns to capital per year, assuming that family living represents returns to operator labor. The moderate graze steer plan (6C) and the cow-calf plan (6D) did not produce enough income to maintain average family living. For the encumbered owner, only plan 6A returned a surplus of returns over the land payment, other annual expenditures, and average family living on the small balanced unit.

TABLE IV

ESTIMATED ANNUAL RETURNS TO ANNUAL OPERATING CAPITAL, LAND EQUITY, AND MANAGEMENT; FOUR SELECTED PLANNING SITUATIONS FOR TWO BALANCED FARM UNITS; FOUR TENURE CLASSES

Planning Number	Size of Balanced Farm Unit[a]	Tenure Class			
		Owner-Operator	Encumbered Owner	Part Owner	Tenant-Operator
	(Acres)		- Dollars -		
6A	640	1,891	659	904	-82
	1,920	11,404	7,708	8,445	5,486
6C	640	807	-425	-180	-1,166
	1,920	9,204	5,508	6,245	3,286
6D	640	177	-1,055	-810	-1,796
	1,920	8,048	4,352	5,089	2,130
18A	640	998	-234	11	-975
	1,920	9,305	5,609	6,346	3,387

[a]For these balanced units, it was assumed that 50 percent of the land was cropland.

The large balanced farm unit showed significant positive returns to annual operating capital, land equity, and management for all plans regardless of tenure. The owner-operator showed the possibility of the highest returns to these factors ($11,404) if he followed plan 6A. The lowest returns ($2,130) were shown for the tenant-operator if he used plan 6D. The returns for all plans for the encumbered owner and the partial tenant on the large balanced unit were between the above extremes, as shown in Table IV.

Ranch Units

For the two ranch units, the only plan of the four analyzed that showed negative long-run reserves was the cow-calf plan (6D), when the tenant-operator class of tenure was assumed. For these two units, if all the land were rented with the range used for a cow-calf operation, an average level of living lower than $3,500 would have to be accepted or else the tenant-operator's equity in annual operating capital would be reduced. This reduction would occur at the rate of at least $35 per year for the large range unit and at least $221 per year on the small range unit as shown in Table V. With less than full equity in annual operating capital, the tenant-operator's level of family living would be further reduced by the amount of interest on capital borrowed to carry out plan 6D.

The tenant-operator's return to annual operating capital with full equity for planning situation 18A on the large range unit was only 2.2 percent. If his average equity were less than 65 percent, his family living level would have to be decreased with no funds available

for reserves. The average returns to annual operating capital, if plan 6C were chosen by a tenant-operator on the range units, would be 5.3 percent on the large range unit and 4.8 percent on the small range unit.

TABLE V

ESTIMATED ANNUAL RETURNS TO ANNUAL OPERATING CAPITAL, LAND EQUITY, AND MANAGEMENT; FOUR SELECTED PLANNING SITUATIONS FOR TWO RANCH UNITS; FOUR TENURE CLASSES

Planning Situation	Size of Ranch Unit[a]	Tenure Class			
		Owner-Operator	Encumbered Owner	Part Owner	Tenant-Operator
	(Acres)		- Dollars -		
6A	1,600	6,969	4,687	5,163	3,357
	2,640	9,812	6,659	7,338	4,865
6C	1,600	4,905	2,623	3,099	1,293
	2,640	7,012	3,859	4,538	2,065
6D	1,600	3,391	1,109	1,585	-221
	2,640	4,912	1,759	2,438	-35
18A	1,600	5,948	3,666	4,142	2,336
	2,640	5,551	2,394	3,077	604

[a]Includes 320 acres of cropland for the 1,600 acre unit and 160 acres of cropland for the 2,640 acre unit.

For the part-owner on either of the range units, all four plans indicate the possibility of accumulating reserves. Assuming a six percent return to annual operating capital, the average return to the operator's land equity would be less than one percent if plan 6D were followed. Similarly, returns to the operator's land equity would be less than three percent if plan 18A were used on the large range unit. The part owner using plan 6C on either of the range units would realize a return of less than 4.5 percent on his land equity, with a

slightly higher rate of return to land from the smaller unit. The long-run rate of return to land was higher for the small range unit than for the large range unit because of the higher proportion of cropland on the smaller unit and due to the fact that less hired labor was needed on the smaller unit for a given planning situation.

The long-run total returns to the encumbered owner's equity is higher than the return to the part-owner's equity for any of the specified plans. His average rate of return to land equity is also higher than for the part-owner. However, even with these higher returns, problems of short-run survival could arise because of the annual land payments required and the fact that these funds may not be as easy to transfer as other types of reserves. These statements in relation to the encumbered owner on the range resources situations should hold in general for all of the resource situations analyzed.

Cropland Unit

The fifth resource situation to be analyzed was the large cropland unit (Table VI). The returns from this unit were high enough so that regardless of the tenure situation, all plans showed a significant level of returns for reserves.

In this section, the long-run estimated returns over all specified costs except management were considered for selected programmed plans. These management returns were combined with returns to annual operating capital and returns to land equity to estimate the average annual

possible change in equity and reserves.[5] This approach indicated what the average returns from using a given plan could be. It does not, however, give an estimate as to what the distribution of income would be for a given plan to reach the average income from a given plan.

The problems for Chapters IV and V are to estimate the variability of income inherent in each plan analyzed, and to use the information so derived to analyze the possibilities of farm firm survival and capital accumulation.

TABLE VI

ESTIMATED ANNUAL RETURNS TO ANNUAL OPERATING CAPITAL, LAND EQUITY, AND MANAGEMENT; FOUR SELECTED PLANNING SITUATIONS FOR A LARGE CROPLAND UNIT; FOUR TENURE CLASSES

Planning Situation[a]	Tenure Class			
	Owner-Operator	Encumbered Owner	Part Owner	Tenant-Operator
	- Dollars -			
6A	10,975	7,382	8,074	5,174
6C	8,720	5,127	5,819	2,919
6D	8,318	4,725	5,417	2,517
18A	8,525	4,932	5,624	2,724

[a]All plans analyzed are for a 1,400 acre farm unit with 1,240 acres of cropland.

[5]The income levels analyzed in this section assume full equity in annual operating capital. The net realized funds would be reduced by the payment of income and social security taxes.

CHAPTER IV

VARIABILITY OF ENTERPRISES AND SELECTED FARM PLANS

After estimating the variance of selected enterprise income series and the correlations between the returns for these enterprises, the equations specified in Chapter II were used to estimate the variability of gross income for all farm plans analyzed. An estimate of income variability for ten different income producing enterprises was required. These enterprises were winter wheat, grain sorghum, five steer activities, and three cow-calf activities.[1]

Variability data for winter wheat, grain sorghum, moderate graze steers, and the cow-calf activity with constant herd values have previously been published.[2] Data for the heavy graze steer activity on native range was calculated from experimental records and annual reports for the Southern Great Plains Field Station.[3]

The expected physical production and gross returns sequences for four livestock activities using temporary grazing were computed. This computation was accomplished by combining the production expected from

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[1]For a specification of these enterprises, see Chapter III.

[2]Greve, Plaxico and Lagrone, Bulletin B-563, pp. 10-15.

[3]United States Southern Great Plains Field Station, ARS, USDA, Woodward, Oklahoma.

each type of grazing used by these enterprises (Appendix B, Tables III and IV). The moderate graze steer enterprise, for which .35 tons of harvested forage sorghum was substituted for 2.6 acres of native range was assumed to have the same variability as the moderate graze steer enterprise on native range.

Enterprise Variability

Coefficients of variation are shown in Table VII for five different types of grazing. The highest coefficient of variation in productivity was found in wheat grazing for the October to February grazing period, while Johnson grass had the lowest coefficient of variation. The estimated levels of productivity over time for these grazing activities are shown in Appendix B, Table I.

Using the per acre expected pounds of gain (Appendix B, Table I) for each different type of grazing the estimated pounds of beef production per unit of each enterprise for 16 time periods were derived. In terms of physical production, the productivity over time for the income producing activities in the plans being analyzed are summarized in Table VIII. The most stable livestock alternative was the cow-calf enterprise grazed on Johnson grass while the most variable livestock enterprise was the temporary graze steer activity, when the grazing was provided by wheat and Sudan grass.

Using the deflated prices and physical returns per acre, the adjusted gross returns per acre were computed (Table IX). For the steer buy-sell enterprises, the returns shown were adjusted for the difference in purchase and sale price of the initial weight of the animal put on pasture.

TABLE VII

COEFFICIENTS OF VARIATION AND LEVELS OF PHYSICAL PRODUCTION PER ACRE, FORAGE AND BEEF

Item	Unit	Native Range[a]	Johnson Grass	Sudan Grass	Wheat (Oct-Feb)	Wheat (Mar-May)
Forage	Pct.	38.5[d]	32.9[f]	57.3[g]	81.2	39.7
	AUM[c]	.67	1.68	1.45	.19	2.58
Steers[b]	Pct.	22.9[e]	19.6	34.1	48.3[h]	23.6[i]
	Lbs.[c]	39.1	88.8	83.9	11.2	137.7
Cow-Calf	Pct.	4.2[e]	3.6	6.3	8.9	4.3
	Lbs.[c]	24.0	57.6	49.9	6.7	82.1

[a]Grasses planted on cropland were assumed to have the same variability as native range but with a higher carrying capacity per acre.

[b]The variability and average pounds of gain shown for native range are for moderate graze steers. For the heavy graze steers, the coefficient of variation was 19.8 and the gain per acre was 47.5 pounds.

[c]The levels of physical production are levels of production used in the programming model as expected averages. The AUM's figures are based on the quality of land usually used for producing the forage in the programmed plans.

[d]Unpublished data at the United States Southern Great Plains Field Station, ARS, USDA, Woodward, Oklahoma.

[e]Robert W. Greve, James S. Plaxico, and William F. Lagrone, Production and Income Variability of Alternative Enterprises in Northwest Oklahoma, Bulletin B-563 (Stillwater, 1960), p. 10.

[f]Unpublished Southern Great Plains Experiment Station data of pounds of harvested forage sorghum produced per acre for 1926-59. Johnson grass was assumed to have the same variability of production as this data had for the period 1942-1957. Forage sorghum pounds were converted to an average of 1.68 AUM's of Johnson grass.

[g]Sudan grass data for 1953-1957 was regressed with forage sorghum data. The estimating equation derived was

$$\hat{Y} = 1.484 + \underset{(.26)}{1.996}\ X \qquad r^2 = .95$$

Data for Sudan grass was tabulated from "Annual Reports of Progress in Forage Crop Research" conducted by the Oklahoma Agricultural Experiment Station in cooperation with the Forage and Range Section, ARS, USDA.

TABLE VII (Continued)

[h]Based on an estimating equation derived by Odell Walker and James S. Plaxico, A Survey of Production Levels and Variability of Small Grain Pastures in Oklahoma, Processed Series P-366 (Oklahoma, 1959), p. 21. The estimating equation used was

$$\hat{Y} = .93 + 1.81\ X \qquad r^2 = .61$$
$$(.40)$$

Information for X (Sept.-Feb. rainfall) was from Climatic Survey - Oklahoma, United States Department of Commerce, Weather Bureau.

[i]Based on data for five years of steer gains from W. C. Elder, Grazing Characteristics and Clipping Responses of Small Grains, Bulletin B-567 (Stillwater, 1960), p. 6. The regression equation used with Oct.-Feb. yields for deriving Mar.-May data was

$$\hat{Y} = 77.67 + 4.96\ X \qquad r^2 = .69$$
$$(2.81)$$

TABLE VIII

ESTIMATED PHYSICAL PRODUCT PRODUCED, BUSHELS OF GRAIN PER ACRE AND POUNDS OF BEEF PER STEER OR PER COW-CALF UNIT, 1942-57

Base Period (Year)	Wheat	Grain Sorghum	P61[a] Steers Moderate Graze Native	P62[a] Steers Heavy Graze Native	P67a[b] Steers Johnson Grass Native	P67b[b] Steers Wheat Sudan Native	P69[a] Cow-Calf Native	P73a[c] Cow-Calf Johnson Grass Native	P73b[c] Cow-Calf Wheat Sudan Native
	- Bushel -						- Pounds -		
1942	11.0	16.4	300.6	330.8	487.9	491.7	492.7	488.0	488.9
1943	12.4	9.0	299.8	311.0	343.4	506.0	493.6	453.7	489.3
1944	19.3	9.7	363.0	361.2	465.6	492.0	439.6	481.5	487.1
1945	14.5	13.0	330.8	323.4	408.5	444.8	437.8	468.8	475.5
1946	14.3	2.5	340.0	333.7	395.3	389.1	422.4	466.5	465.3
1947	10.1	11.2	311.9	268.5	333.9	453.1	485.5	451.9	476.5
1948	9.7	8.7	357.2	347.7	425.3	408.4	640.4	470.1	467.1
1949	13.8	4.3	293.9	286.2	388.4	396.3	453.1	463.4	462.9
1950	12.6	21.9	349.9	342.0	456.9	429.0	436.0	479.4	475.9
1951	13.3	27.9	325.9	327.2	304.6	263.7	423.3	446.9	438.4
1952	21.6	10.0	282.3	200.6	348.4	344.1	401.7	456.0	454.7
1953	6.9	21.8	371.2	314.2	386.8	338.2	390.9	466.3	456.0
1954	9.5	10.1	264.7	193.4	301.4	251.1	351.3	442.9	431.5
1955	7.0	10.1	322.7	295.1	315.7	250.6	442.3	451.1	438.0
1956	7.4	19.5	276.7	216.7	286.4	249.6	436.9	442.6	435.0
1957	16.8	15.2	285.4	307.5	298.3	239.9	488.2	440.9	428.6
Mean	12.5	13.2	317.2	297.5	371.7	371.7	452.2	460.7	460.7
S.D.[d]	4.1	6.8	32.9	52.2	64.7	96.4	63.4	14.7	21.1
C.V.[d]	33.1	51.6	10.4	17.5	17.4	25.9	14.0	3.2	4.6

[a]Data from Appendix B, Table II.

[b]Data from Appendix B, Table III.

[c]Data from Appendix B, Table IV.

[d]S.D. = Standard Deviation, C.V. = Coefficient of Variation.

TABLE IX

ESTIMATED ADJUSTED GROSS RETURNS, DOLLARS PER ACRE, BASED ON DEFLATED PRICES, 1942-57

Base Period (Year)	Wheat	Grain Sorghum	P61 Steers Moderate Graze Native	P62 Steers Heavy Graze Native	P67a Steers Johnson Grass Native	P67b Steers Wheat Sudan Native	P69 Cow-Calf Native	P73a Cow-Calf Johnson Grass Native	P73b Cow-Calf Wheat Sudan Native
					- Dollars -				
1942	10.01	11.64	2.34	3.92	9.08	12.25	1.84	3.66	4.75
1943	13.39	8.64	1.68	2.73	4.69	10.05	1.76	3.26	4.55
1944	20.84	6.98	3.44	5.38	8.20	11.63	2.03	3.58	4.69
1945	15.95	11.83	3.67	5.52	8.55	12.41	2.10	3.68	4.83
1946	17.16	2.48	4.34	6.52	8.91	11.79	2.35	4.01	5.17
1947	11.92	11.65	2.68	3.49	6.56	12.15	2.10	3.81	5.21
1948	9.60	5.22	2.87	3.85	10.95	14.19	2.13	4.38	5.63
1949	13.66	2.49	2.53	3.71	7.26	9.98	2.21	4.03	5.21
1950	12.98	11.61	6.96	10.37	16.23	20.68	2.98	5.29	6.79
1951	13.30	16.46	5.19	7.91	8.74	10.09	3.10	5.09	6.45
1952	21.38	7.50	0.47	-1.07	2.21	2.84	2.04	3.46	4.47
1953	6.97	12.64	0.96	0.69	1.79	1.50	1.42	2.46	3.10
1954	9.79	5.86	3.71	4.41	6.56	7.64	1.30	2.63	3.31
1955	6.79	4.44	1.90	2.10	2.86	2.39	1.42	2.68	3.36
1956	6.81	10.92	1.69	1.64	3.28	3.66	1.10	2.24	2.84
1957	14.45	6.23	2.32	3.92	7.34	8.39	1.43	3.17	3.98
Mean	12.81	8.54	2.92	4.07	7.08	9.48	1.96	3.59	4.65
S.D.[a]	4.51	4.02	1.63	2.76	3.67	5.02	0.56	0.87	1.14
C.V.[a]	35.2	47.0	55.7	67.9	51.9	53.0	28.7	24.2	24.5

[a]S.D. = Standard Deviation, C.V. = Coefficient of Variation.

With this adjustment, the returns per acre for the heavy graze steers in one time period were -$1.07 due to a deflated negative price margin of $4.83 per hundred pounds on the purchased weight. Although the heavy graze steer enterprise is more profitable in the long-run, it is subject to more variability of returns than the moderate intensity of steer grazing enterprise. When both production and price were considered for the livestock enterprises, the cow-calf enterprise grazed on Johnson grass had the least relative variability.

Of the two grain enterprises, wheat had a lower relative variability of returns than grain sorghum, both in physical and monetary terms. When price was considered, grain sorghum decreased in variability compared to considering only yield, while wheat variability increased slightly when both price and production were considered.

Variability of Whole Farm Income

The data in Table IX were used to compute the simple correlations between all pairs of activities. Table X is the resulting correlation coefficient matrix for deflated gross returns per acre.

The relative variability of the gross income from each of the programmed farm plans was calculated.[4] These calculations indicated that

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[4]The unbiased estimate of variance for each farm plan was computed using equation 2.2, Chapter II. The standard deviation of the income for a given farm plan is the square root of the corresponding variance. Relative variability or coefficient of variation is defined here as follows:

$$CV = \frac{\text{Standard Deviation}}{\text{Average Income}}$$

TABLE X

ESTIMATES OF SIMPLE CORRELATION COEFFICIENTS FOR DEFLATED GROSS RETURNS PER ACRE, SELECTED ENTERPRISES

Item	Wheat	Grain Sorghum	P61 Steers Moderate Graze Native	P62 Steers Heavy Graze Native	$P67_a$ Steers Johnson Grass Native	$P67_b$ Steers Wheat Sudan Native	P69 Cow-Calf Native	$P73_a$ Cow-Calf Johnson Grass Native	$P73_b$ Cow-Calf Wheat Sudan Native
Wheat	1.0000	-.1773	.1457	.1611	.1790	.2510	.4362	.3668	.3900
Milo		1.0000	.1868	.1884	.0726	.0881	.2660	.1911	.1981
P61			1.0000	.9789	.8622	.7770	.7180	.7367	.7084
P62				1.0000	.8847	.8193	.7121	.7464	.7250
$P67_a$					1.0000	.9493	.6887	.8106	.7954
$P67_b$						1.0000	.6818	.7953	.8172
P69							1.0000	.9640	.9591
$P73_a$								1.0000	.9931
$P73_b$									1.0000

for resource situations I, III, and V, plan 6D which restricted the livestock to the cow-calf activities had the lowest coefficient of variation (Table XI). In the case of resource situations II and IV, the coefficient of variation was lowest when the 18 percent capital opportunity cost rate was used in deriving the cow-calf plan (18D). In terms of returns, plan 18D with capital restricted by the higher opportunity cost and the livestock activities restricted to the cow-calf alternatives yielded the lowest income and had the smallest standard deviation for all resource situations.

The highest coefficient of variation of gross income for resource situations I and III was for plan 6A which included all activities as alternatives in the programming model. For resource situations II, IV, and V, the maximum coefficient of variation occurred when the temporary graze steer activity was restricted (6B). For resource situations IV and V, plan 6B had the highest standard deviation of gross income. This higher variability resulted for these two situations because a high proportion of the income was from the heavy graze steer enterprise which is the most variable enterprise.

Gross Income-Standard Deviation Functions

Graphically the relationship between gross income and variability can be shown as gross farm income opportunity curves. These curves were derived for each of the five resource situations by plotting the gross income and standard deviation for each programmed plan.[5] Sketching smooth lines through the area of the plotted points for each resource situation resulted in the curves shown in Figure 3.

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[5]See Table XI for the data for these curves.

TABLE XI

LEVELS OF GROSS INCOME, STANDARD DEVIATIONS, AND COEFFICIENTS OF VARIATION; FIVE SPECIFIED RESOURCE SITUATIONS; SELECTED ALTERNATIVE ENTERPRISE COMBINATIONS

Plan	Item	Unit	Resource Situation I-Small Balanced	II-Small Range	III-Large Balanced	IV-Large Range	V-Large Cropland
6A	Income	dol.	10,178	18,744	27,352	26,432	26,727
	S.D.[a]	dol.	4,832	10,102	10,780	16,506	9,234
	C.V.[a]	pct.	47.5	53.9	39.4	62.4	34.6
6B	Income	dol.	10,178	18,532	26,632	26,340	26,447
	S.D.[a]	dol.	4,832	10,088	10,232	16,514	9,240
	C.V.[a]	pct.	47.5	54.4	38.4	62.7	34.9
6C	Income	dol.	8,557	15,068	23,112	19,727	22,478
	S.D.[a]	dol.	3,203	6,695	7,051	9,884	6,097
	C.V.[a]	pct.	37.4	44.4	30.5	50.1	27.1
6D	Income	dol.	7,014	11,888	20,413	15,746	20,959
	S.D.[a]	dol.	1,690	2,927	5,026	4,210	5,450
	C.V.[a]	pct.	24.1	24.6	24.6	26.7	26.0
18A	Income	dol.	8,372	16,184	22,493	16,130	21,446
	S.D.[a]	dol.	2,904	8,005	6,968	7,762	5,613
	C.V.[a]	pct.	34.7	49.5	31.0	48.1	26.2
18B	Income	dol.	8,032	15,869	22,384	16,050	20,996
	S.D.[a]	dol.	2,725	7,831	7,280	7,754	5,601
	C.V.[a]	pct.	33.9	49.4	32.5	48.3	26.7
18C	Income	dol.	7,232	13,784	21,655	16,050	20,549
	S.D.[a]	dol.	2,034	5,375	6,081	7,754	5,413
	C.V.[a]	pct.	28.1	39.0	28.1	48.3	26.3
18D	Income	dol.	6,426	10,463	19,187	13,061	20,150
	S.D.[a]	dol.	1,610	2,568	4,812	3,454	5,355
	C.V.[a]	pct.	25.0	24.5	25.1	26.5	26.6

[a]S.D. = Standard Deviation, C.V. = Coefficient of Variation.

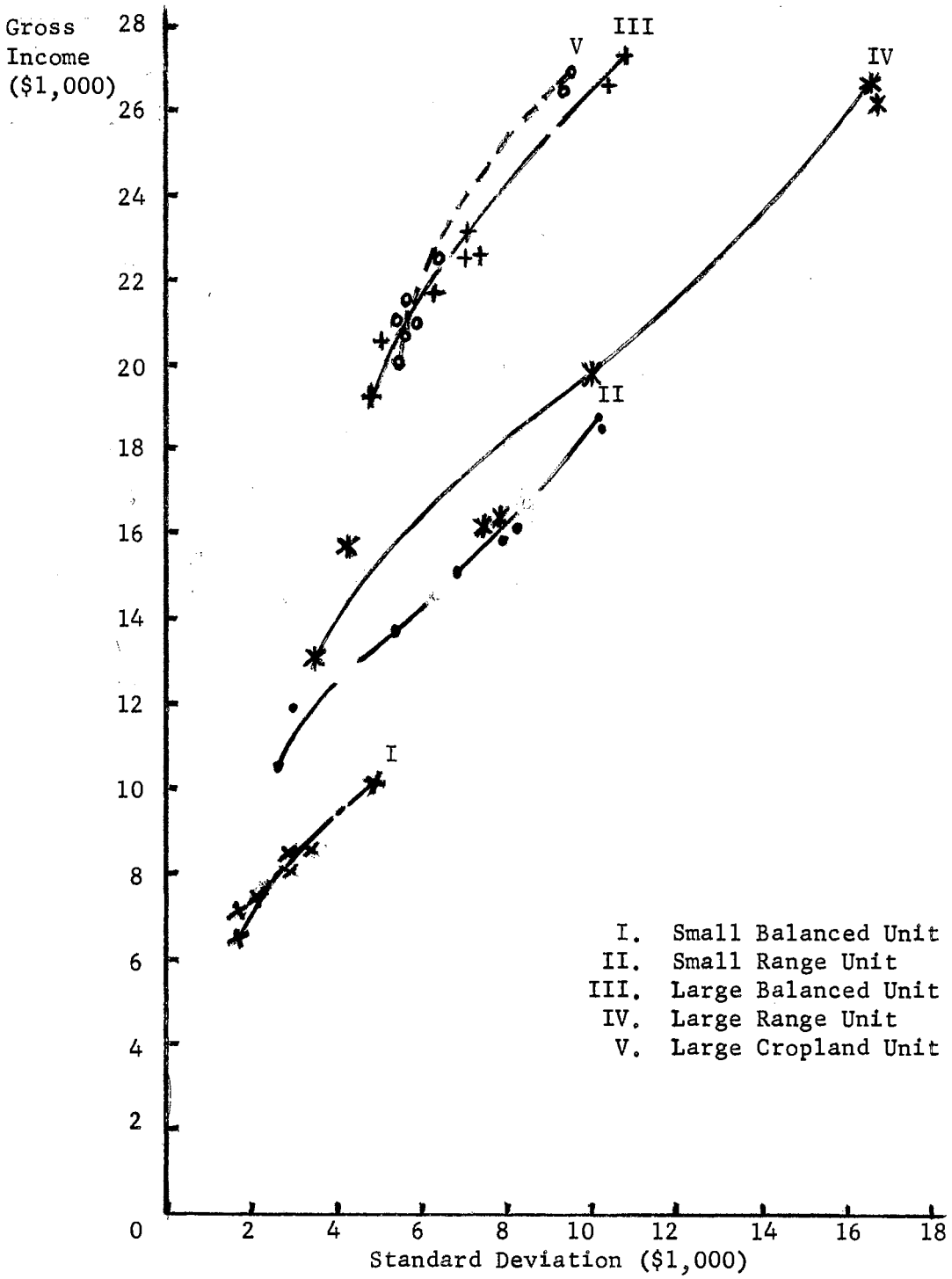

Figure 3. Gross Income-Standard Deviation Functions, Eight Planning Situations, Selected Farm and Ranch Land Resource Situations.

In the short-run, the farm operator is faced with a given land resource situation. As the planning horizon is lengthened, decisions to be made also include the possibility of changing land base as well as current operating plans. For example, an individual farm operator who currently is operating on Curve I may plan to expand his land base so that Curve III becomes his gross income opportunity curve.

Curve I and Curve III represent income opportunity curves for the balanced farm units. As indicated by Curve I, the small balanced farm unit (640 acres) would have a lower gross income than any of the other four resource situations for all alternative enterprise combinations.

The large balanced land resource situation (1,920 acres) is represented by income opportunity Curve III. Most plans for the large balanced unit included a higher proportion of the wheat-grain sorghum-fallow rotation and a lower concentration of livestock than plans for the smaller unit.[6] With the income nearly three times as high from this unit as from the small balanced unit, the standard deviation for each planning situation was higher. However, because of the reduction in the proportion of livestock to cash grain crops, the standard deviation generally did not increase at as fast a rate as the income. Thereby the relative variability of income from the large balanced unit was lower for five of the planning situations. With planning situation 6D for the small balanced unit, all three of the cow-calf enterprises

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[6]The differences in profitability of enterprises between these two units is due to the difference in the size of the units. The larger unit requires the hiring of labor for all plans except plans 18C and 18D. The programmed plans for these two planning situations for the larger unit were linear combinations of the plans for the same situations on the smaller unit.

were included in the optimum plan resulting in a lower coefficient of variation. The optimum plan (6D) for the larger balanced unit included only two of the cow-calf alternatives with 85 percent of the cows grazed on native range.

Curve II (small range unit) and Curve IV (large range unit) show a rather sharp decline in gross income relative to the reduced variability as a shift is made from plans including steers to plans that include the cow-calf activity. In the case of resource situation IV, there was also a very sharp decline in gross income for plans 18A, 18B, and 18C with only a slight decline in variability level.[7] In fact, these plans are closer to the curve for resource situation II, with their standard deviations at about 7,760 and gross incomes near $16,000.

The relative positions of the curves indicate that the large cropland unit (Curve V) generally has a potential for a higher gross income for a given standard deviation than other resource situations. Alternatively, if an income level was specified, the specified income could be produced by a farm plan for the large cropland unit with less variability than the income at that level would have if it were from the large balanced or large range resource situations. An exception to this general statement occurs when a level of income consistent with the cow-calf plans on the large balanced unit is specified. At this income level, the large balanced unit shows the lowest variability.

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[7]The programmed gross income for all three of these plans is primarily from moderate graze steers that have a relatively high variability. The reduction in income is due to a shift from heavy graze steers to moderate graze steers occurring as a result of the rationing of capital.

In summary, Figure 3 indicates that although resource situation I showed the lowest absolute variability for a given planning situation, it also yielded the lowest gross income. Resource situation IV, which has the highest proportion of rangeland, had the greatest variability. For a given level of income, plans for resource situations III and V can produce that level of income with only 55 to 60 percent of the variability of the same income level produced on the large range unit. In general, the higher the proportion of rangeland on a farm or ranch, the higher the variability of the income produced. The higher proportion of income from livestock enterprises, that are more variable than crop enterprises, produced this result.

Potential Disposable Income Opportunity Curves

If the farm firm is to survive, the level of disposable income must be high enough to provide a desirable level of living for the farm family. Funds must also be provided for increases in business equity and for reserves to meet the financial requirements of unfavorable years. The variability that is associated with the disposable income from alternative enterprise combinations is also a significant factor in the choice of farm plan to follow.

Income opportunity curves may serve as a method of studying the relationships between income levels and variability of income from selected resource and planning situations. By plotting average disposable returns

and the standard deviation of these returns, the income opportunity curves shown in Figure 4 were constructed.[8]

Each individual operator's evaluation of income levels and variability would result in some indifference curve which would be tangent to the income opportunity curve at some point. If this point of tangency is toward the right portion of the income opportunity curve, a plan which includes the more concentrated livestock such as heavy graze steers is selected. The plan would also include all or most of the wheat allotment as continuous wheat. If the point of tangency falls toward the left portion of the income opportunity curve, the plan will be one which includes less intense livestock enterprises, such as cow-calf units, and a wheat-grain sorghum-fallow rotation on most of the cropland.

Although only eight different plans were plotted to draw these income opportunity curves, theoretically, there are combinations of livestock and crops which will form a continuum of plans all along these curves. Each of these plans is a possible alternative which could be selected as the management plan to follow by an individual farmer after evaluation of the alternative incomes, variability, and his ability to survive the variability based on his equity position and living requirements.

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[8]These income levels include $3,500 that was allocated for family living plus returns available for reserves or debt payment with average family living (Appendix E, Tables I through V). Since annual operation costs were assumed constant for the variable costs of operation, the standard deviation of disposable returns for the owner-operator are the same as for gross income (Appendix D). The level of the curves would be shifted down for the owner-operator with less than full equity in annual operating capital.

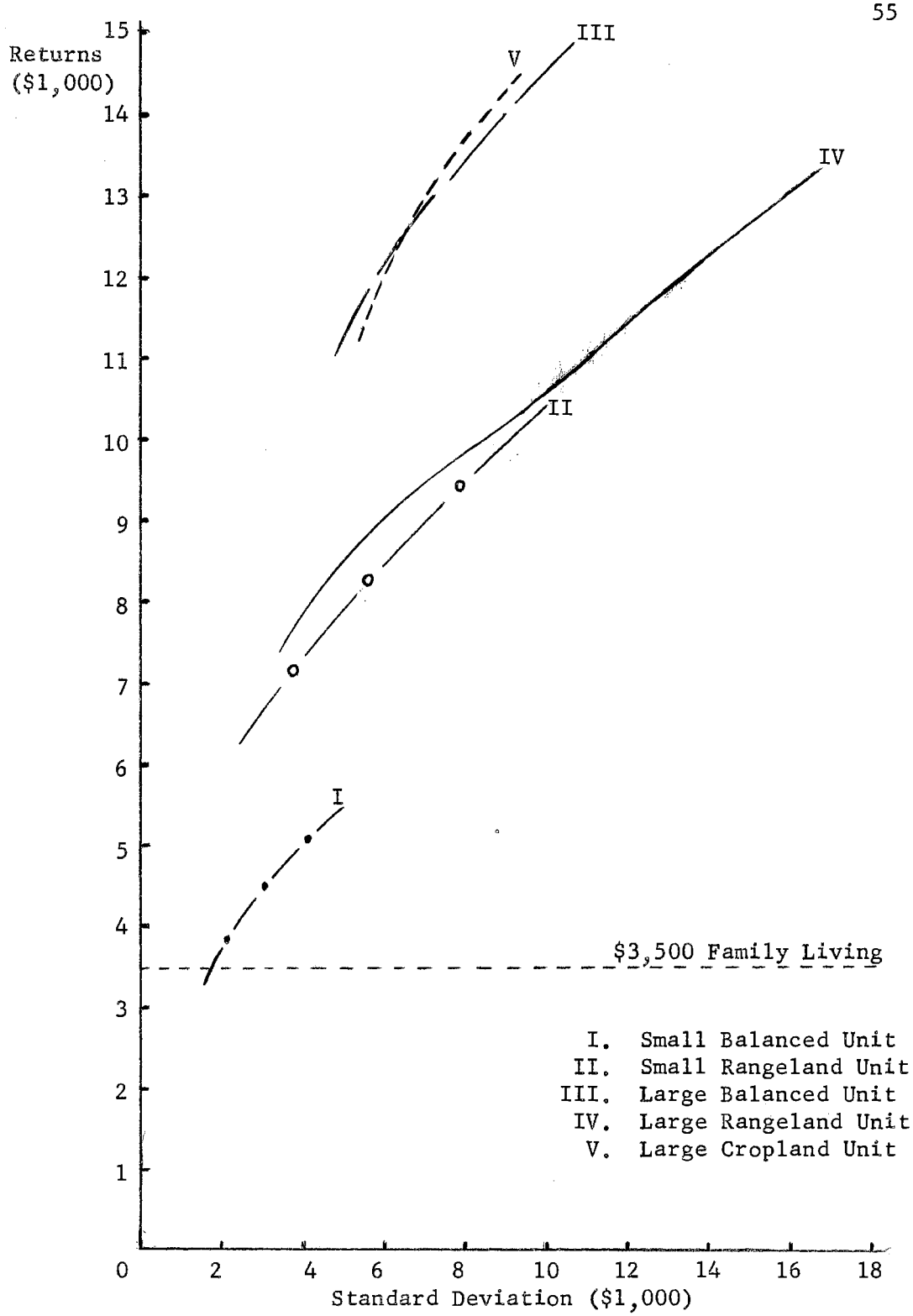

Figure 4. Disposable Income Opportunity Curves, Owner-Operator with Full Equity in Annual Operating Capital, Selected Farm and Ranch Resource Situations.

In terms of all the possible plans that could be followed for a given resource situation, those plans that are plotted below the income opportunity curve are inferior to plans on the curve. For a plan which falls below the curve, there is some plan on the curve with a lower variability and the same income. There is also a plan on the curve with the same variability but a higher income than the plan falling below the curve. Similarly, when the income opportunity line is drawn as a smooth curve, there will be some plans that will be plotted above the curve. Any plan above the curve may be considered superior to a plan on the curve with either the same standard deviation or the same income level.

Of the five resource situations programmed, the large balanced farm unit yields the highest level of disposable returns for six of the eight assumed planning situations. For two planning situations (6D and 18D) that restrict the livestock activities to a cow-calf operation, the large cropland unit yields a higher disposable income than the large balanced unit. However, the coefficients of variation for these two planning situations were lower for the large balanced unit than for the cropland units.[9]

Although the large range unit showed a lower level of disposable returns for the eight planning situations than the large balanced farm unit or the cropland unit, the level of variability was higher for six of the planning situations. For the two cow-calf planning situations,

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[9]The calculated coefficient of variation for planning situation 6D was 43, compared with 46, and for planning situation 18D, it was 44, compared with 47.

the level of variability was lower for the large range unit than for the balanced or cropland units. However, the coefficient of variation of even these two planning situations was higher for the large range unit due to the high proportion of the total farm income derived from the relatively more variable livestock enterprises, rather than from the less variable cash grain enterprises.

Further observations of the disposable income opportunity curves indicate the relative levels of income and variability for the five different land resource situations. A high level of variability was noted in the range units compared with the large balanced unit and the large cropland unit. For a given level of standard deviation, the range units produced a lower income than the cropland unit or large balanced unit. For a given standard deviation, such as $8,000, the intersection of the income opportunity by a vertical line from this point varies from $9,400 for the small range unit to $13,700 for the cropland unit. In Figure 4, the income opportunity curves for the large balanced unit and the large cropland unit cross at an income of about $12,200 with a standard deviation of $6,100. This intersection point corresponds to the approximate income and variability for the high capital level moderate graze steer plan (6C) on the cropland unit and the low capital level moderate graze steer plan (18C) on the large balanced unit.

Other analyses of the relationship between resource situation, farm plan followed, business survival, and capital accumulation are reserved for Chapter V.

Tenure Effects on Income Opportunity Curves

The effects of tenure on income and variability of income were analyzed for four of the eight plans derived for each resource situation. Since the same basic plans were used for all tenure classes, there was no change in the gross income opportunity curves for the farm units. When income remaining after any combination of selected costs that included rent was considered for the tenant or part-owner, changes occurred in both the level and variability of the income opportunity curves. The payment to the landlord by the tenant was assumed to vary with the annual level of production of cash grain crops. Since the payment of rent to the landlord is lowest when cash grain income is lowest and highest when cash grain income is highest, the absolute variability of income to the tenant was less than the variability of total gross income from the farm units (Appendix F). The greater the proportion of cropland, the more the variability was reduced for the tenant-operator compared with the variability for an owner-operator. Obviously, the level of returns to land was lower for the operator who rented all or part of his land, although the rate of return allocated to land equity was the same.

The variability of income for the encumbered owner was the same as for the owner with full land equity. The significant difference for the encumbered owner was the level of unallocated disposable returns after making a principal payment on land. The analysis for all land resource situations showed that disposable levels of returns to the encumbered owner were lower than for the owner and part owner, due to this land payment.

In Figure 4, relationships between the income opportunity curves were shown for the farm operator with full equity in selected land resource units. Using the data for four of the planning situations, Figure 5 was constructed to show the differences in income opportunity and variability when different tenure classes were considered on the balanced farm units.[10] When tenure is considered, the variability reduction produced by the correlation of rent payments with grain income shifts the curves to the left for the operators renting land. The higher the proportion of rented land, the farther the curve shifts to the left, due to the degree of reduction in standard deviation. The income opportunity curve for the operator renting land was also shifted down as a function of his lower equity in land, compared to the owner-operator of a similar unit. For the encumbered owner, the shift in the disposable income curve is down, due to the land payment. Since the land payment is a constant amortized amount, the variability of disposable income is the same for the encumbered owner as for the owner-operator with full land equity.

In relation to the curves, plans 6A and 6D are at the extreme ends. Plan 18A is located either on or above the curves with plan 6C located

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[10]The four planning situations included were the high and low capital level plans with heavy graze steers, the high capital level moderate graze steer plan, and the high capital level cow-calf plan. The four tenure classes may be denoted by the following notation: OO owner-operator, EO encumbered owner, PO part owner, (50 percent owned, 50 percent rented), and TO tenant-operator.

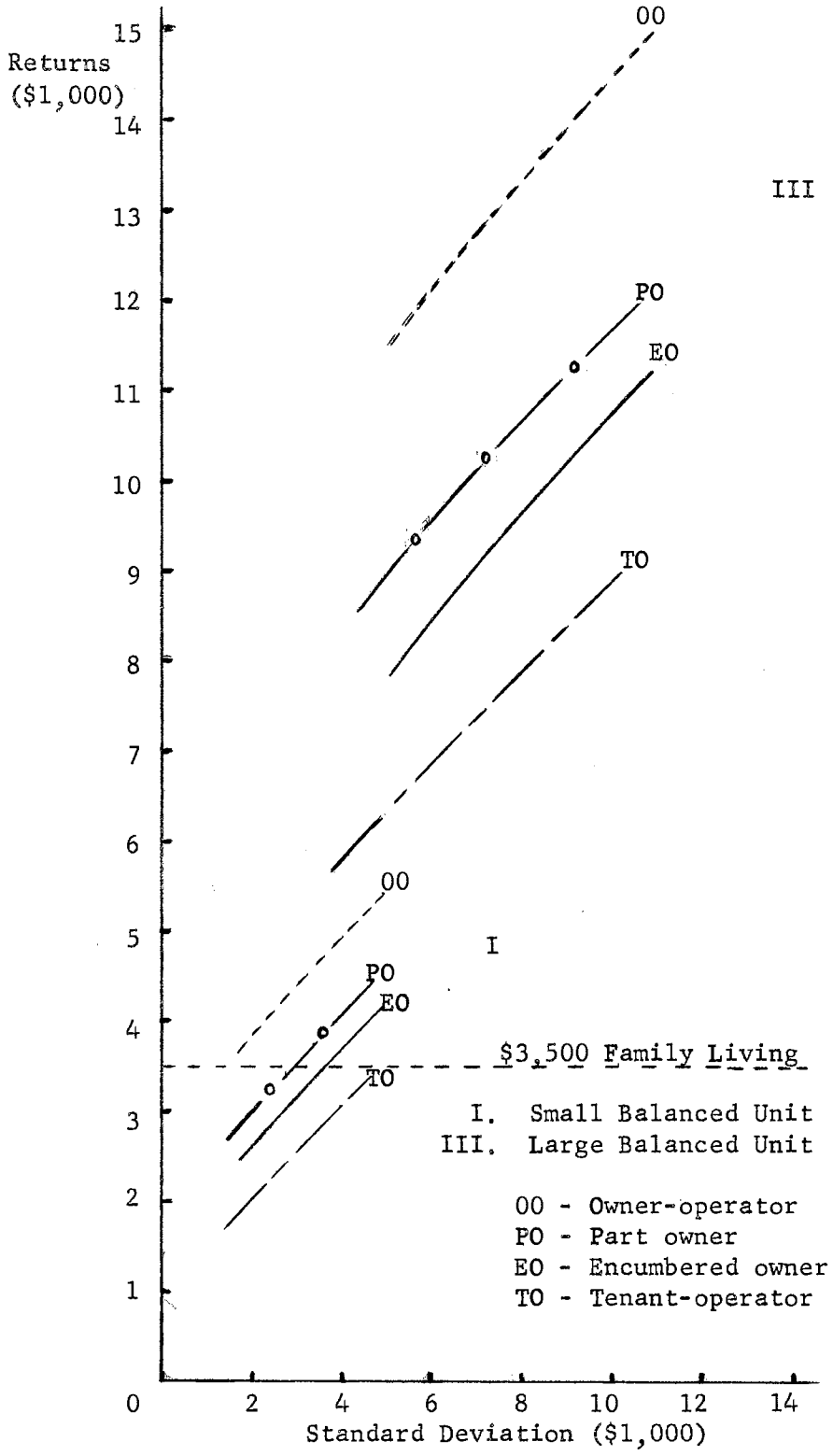

Figure 5. Disposable Income Opportunity Curves, Four Tenure Classes with Full Equity in Annual Operating Capital, Two Balanced Farm Resource Situations.

below the curves, except for resource situation IV. For resource situation IV, the constructed curves pass through the point representing plan 6C with plan 18A below the curves.[11]

Figure 6 is a comparison of the small range unit and the large range unit when tenure is considered. When only the four planning situations (6A, 18A, 6C, and 6D) were considered, the derived curves for the range units are slightly convex down to the right. This shape was due to a relatively sharp decline in variability as a change was made from the moderate graze steer plan to the cow-calf plan. With this change, variability decreased at a faster rate than income. On the range units, income curves shifted down when less than full equity in land was assumed. However, due to the fact that the greater part of the income was from livestock, the reduction in variability was low, compared with the balanced units when all or part of the land was rented.

Differences in variability are apparent between the range units as a result of the higher proportion of cropland on the small range unit compared with the large range unit. Cropland comprises 20 percent of the land resources on the smaller unit, compared with six percent on the larger unit. For example, the income from plan 6A on the small range unit has a coefficient of variation of 96, compared with a coefficient of variation of 124 for the same planning situation on the large range

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[11] For resource situation IV under planning situation 18A, moderate graze steers enter the optimum plan rather than heavy graze steers as in the other resource situations. This change in optimum plan is due to the high proportion of hired labor required for this unit and the increased cost of this labor when the 18 percent marginal value product of capital was required.

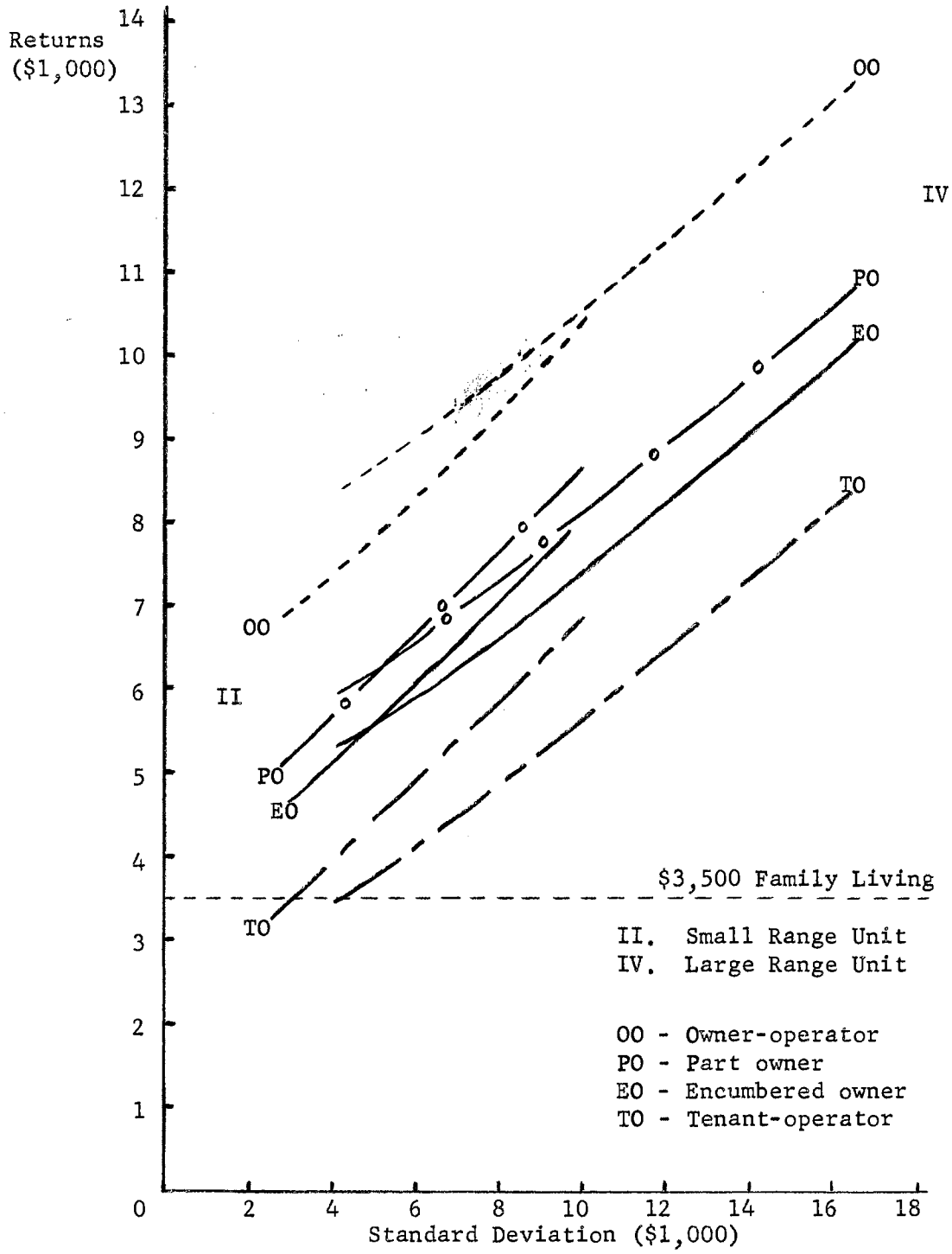

Figure 6. Disposable Income Opportunity Curves, Four Tenure Classes with Full Equity in Annual Operating Capital, Two Range Resource Situations.

unit. Plan 6C showed a coefficient of variation of 94 on the large range unit. Plan 6C on the large range unit corresponds to the point where the OO curve for II nearly touches the OO curve for IV in Figure 6. On the small range unit, the coefficient of variation for plan 6C was 80 at an income level of $8,400.

The effects of tenure on the disposable income for the large cropland unit are shown in Figure 7. Because of the higher proportion of income from cash grain crops on a cropland unit and the high correlation between rent (crop share) and cash grain income, the reduction in variability for a rental unit was greatest on the cropland unit. For example, if the tenant employed optimum plan 6A, the standard deviation of disposable returns would be 12 percent lower than for the full owner of a cropland unit. With this reduction in variability through the payment of crop share rent, disposable income was reduced by 40 percent. The same analysis for a large range unit indicated only about 0.5 percent reduction in variability with a 38 percent reduction in disposable income. The data also indicated a six percent reduction in variability for the tenant on the large balanced unit with a 40 percent lower disposable income than the owner-operator with the same plan on this balanced unit.

Probability of Specified Income Levels

Farm operators with high land equity and adequate operating reserves may be most interested in long-run returns from different plans on different types of farm units. For operators with low equities, bunchiness and timing of income levels may be more important (see Chapter V).

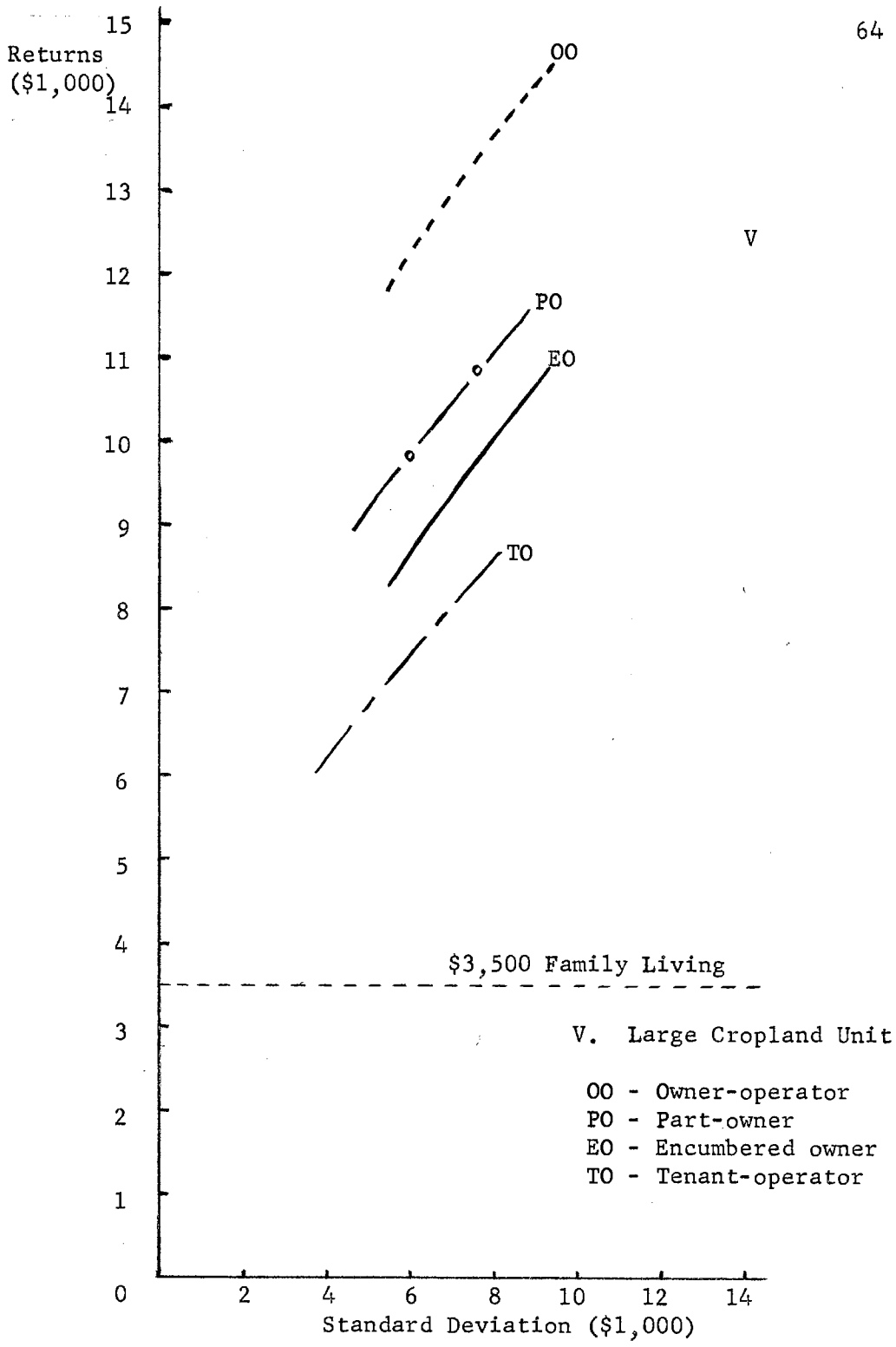

Figure 7. Disposable Income Opportunity Curves, Four Tenure Classes with Full Equity in Annual Operating Capital, Large Cropland Resource Situation.

To analyze the probability of specified income levels, the probabilities of gross incomes equal to or greater than cumulated expenditures were tabulated (Appendix G).[12] These probabilities were tabulated for the owner-operator for the eight plans on each of the different types of farm units.

When a level of gross income high enough to cover only family living was considered, the cow-calf plans (6D and 18D) had the highest probability of yielding that level of income for all resource situations. This probability ranged from .96 for the small balanced unit to .99 for the large crop unit. However, when all specified expenditure items were considered, the cow-calf plan derived by restricting capital with an 18 percent opportunity cost had the lowest probability of attaining a gross income equal to the cumulated expenditure total. This probability varies from .08 for the small balanced unit to .60 for the large crop unit.

The two plans, 6A and 6B, which have the highest average gross income but the most variability, showed the lowest probability of covering only family living. However, the level of probability is relatively high being between .92 for the small balanced unit and .99 for the large crop unit. The higher proportion of low incomes for these plans are balanced by a higher proportion of high incomes, especially for plan 6A, relative to the other plans so that plan 6A shows the highest

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[12]The probabilities in Appendix G were based on the probability theory discussed in Appendix C, the expenditure data (Appendix E, Tables I through V), and standard deviation data from Table XI.

probability of covering all expenditures for resource situations I, II, and IV. For resource situations III and V, plan 18A had the same probability of covering all expenditures as plan 6A. For plan 6A, the probability of covering all expenditures on the small balanced unit was only .41.

Examining the level of cumulated expenditures, which includes all expenses except the returns to capital, showed that there was not as much consistency in the plans that exhibit the most or least probability of covering expenditures when the different resource situations are considered. For resource situation I, the cow-calf plans showed the lowest probability of covering this level of cost, while for the other four resource situations, plans 6B and 6A showed the lowest probability of returning all costs except interest on investment.

Resource situation I differs from the other four resource situations in this case, due to the fact that the unit is so small that the gross income from plans 18D and 6D is so low that the annual general overhead expenses and real estate taxes which are considered constant for the planning situations forces the two cow-calf plans to be least likely to return all costs except interest. The predetermined fixed costs more than offset the reduced variability for these two plans. In a similar manner for situation I, the highest income and most variable plan (6A) is most likely to cover all specified costs except interest on annual operating capital and interest on land capital.

For the other four resource situations, the cow-calf plan derived using the six percent capital opportunity cost showed the highest probability of covering all specified costs except interest on annual

operating and land capital. For resource situations II and IV, although the coefficients of variation for plan 18D were slightly lower; the lower average gross income prevented them from having a higher probability of covering this level of expenditure. In the case of resource situation III, plan 18D had both a higher coefficient of variation and a lower income than plan 6D. For resource situation V, plan 18A was about equivalent to plan 6D having both a higher income and higher coefficient of variation.

None of the plans programmed for the small balanced farm unit produced an income large enough to cover all costs 50 percent of the time. As indicated by Figure 8, the income levels above and below which 50 percent of incomes will occur are approximately $10,200, $8,600, $8,400, and $7,000, respectively for plans 6A, 6C, 18A, and 6D. The use of expenditure information from Appendix E shows that 50 percent of the time returns to land capital will be less than $885 for plan 6A, less than $90 for plan 6C, and less than $420 for plan 18A. An average of $1,972 is required if land is to return five percent on its calculated value. Plan 6D returns less than $160 for returns to annual operating capital 50 percent of the time and no returns to land capital 57 percent of the time. A six percent return to annual operating capital would be $493 for plan 6D.

In contrast, resource situation III, which is a balanced unit three times as large as situation I, yields returns to management more than 50 percent of the time for all plans. An analysis of Figure 9 indicates that the income levels 84 percent of the time will be equal to or greater than $16,570, $16,050, $15,550, and $15,450 for plans 6A, 6C,

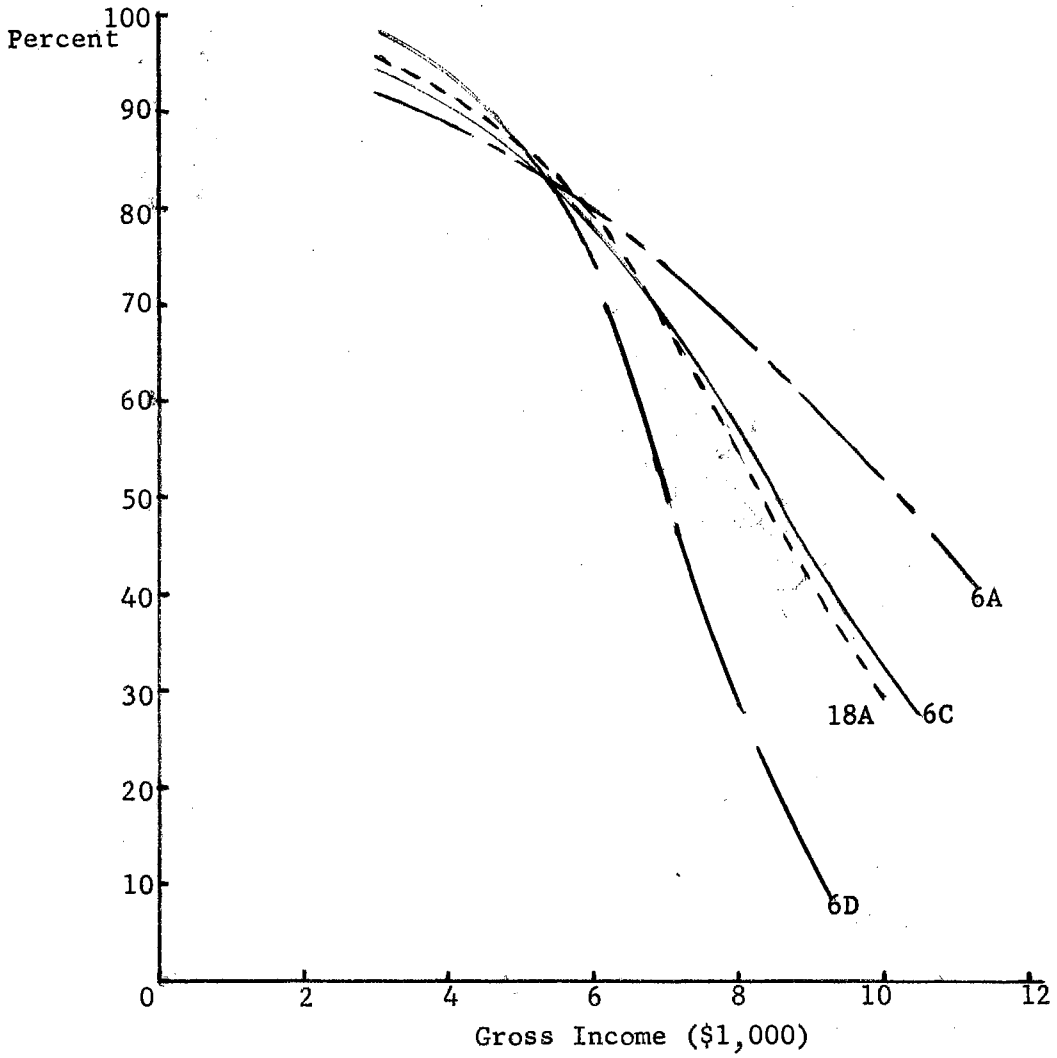

Figure 8. Percent of Time that Gross Income may be expected to be equal to or greater than Cumulated Annual Expenditure Items, Four Selected Plans, Small Balanced Unit.

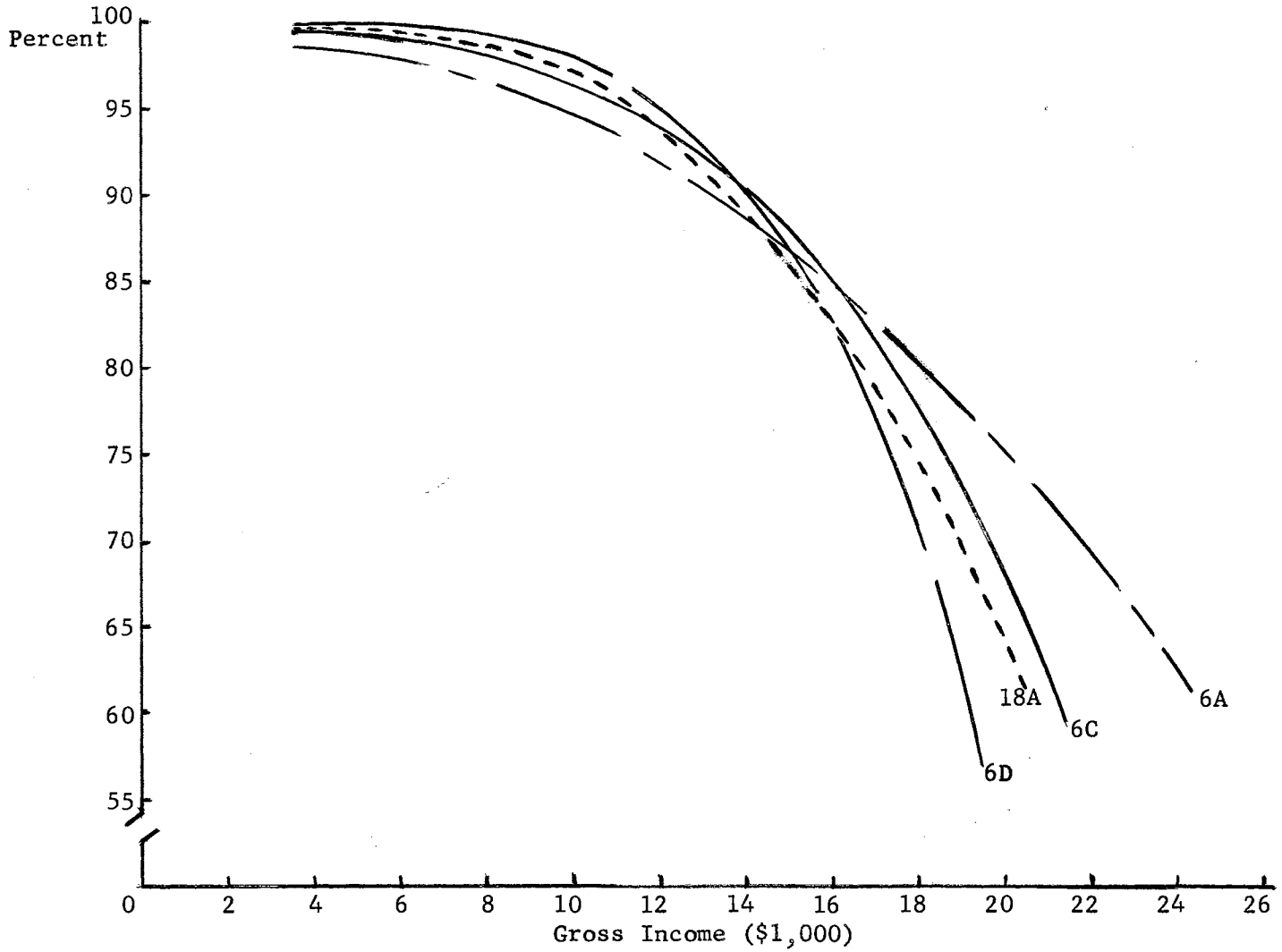

Figure 9. Percent of Time that Gross Income may be expected to be equal to or greater than Cumulated Annual Expenditure Items, Four Selected Plans, Large Balanced Unit.

18A, and 6D, respectively. At a probability of .84 for plan 6A, the returns to annual capital are greater than $620. Appendix G was used with Figure 9 to calculate the returns to land capital at the .84 probability level for the four plans. With this information, plan 6C shows returns to land capital of $565 or greater 84 percent of the time. At the same probability level, plan 6D shows $1,780 returns to land, while plan 18A shows $970 returns to land. For resource situation III, a five percent return to land requires $5,915. For plan 6A, a six percent return to annual operating capital requires $2,416. These comparisons for the two balanced farm units point out the higher probability of receiving returns to capital with the larger unit (III) compared with the smaller unit (I).

The range resource situations are both analyzed at the .50 probability level, since some of the plans for each of them will not yield returns to management over 50 percent of the time. Returns to management are $1,166 or more 50 percent of the time for plan 6A and with this same probability, they are $662 for plan 18A on the small range unit. Figure 10 indicates that the income level above and below which 50 percent of the incomes would occur for plan 6C is approximately $15,100, while for plan 6D this income level is about $11,900. Based on these incomes, plan 6C yields more than $3,330 returns to land capital while plan 6D yields more tha $2,575 returns to land capital 50 percent of the time, with no returns to management 52 percent of the time (6C) and 69 percent of the time (6D).

For the large range unit (IV) of the four plans graphed, only plan 6A yields returns to management more than 50 percent of the time

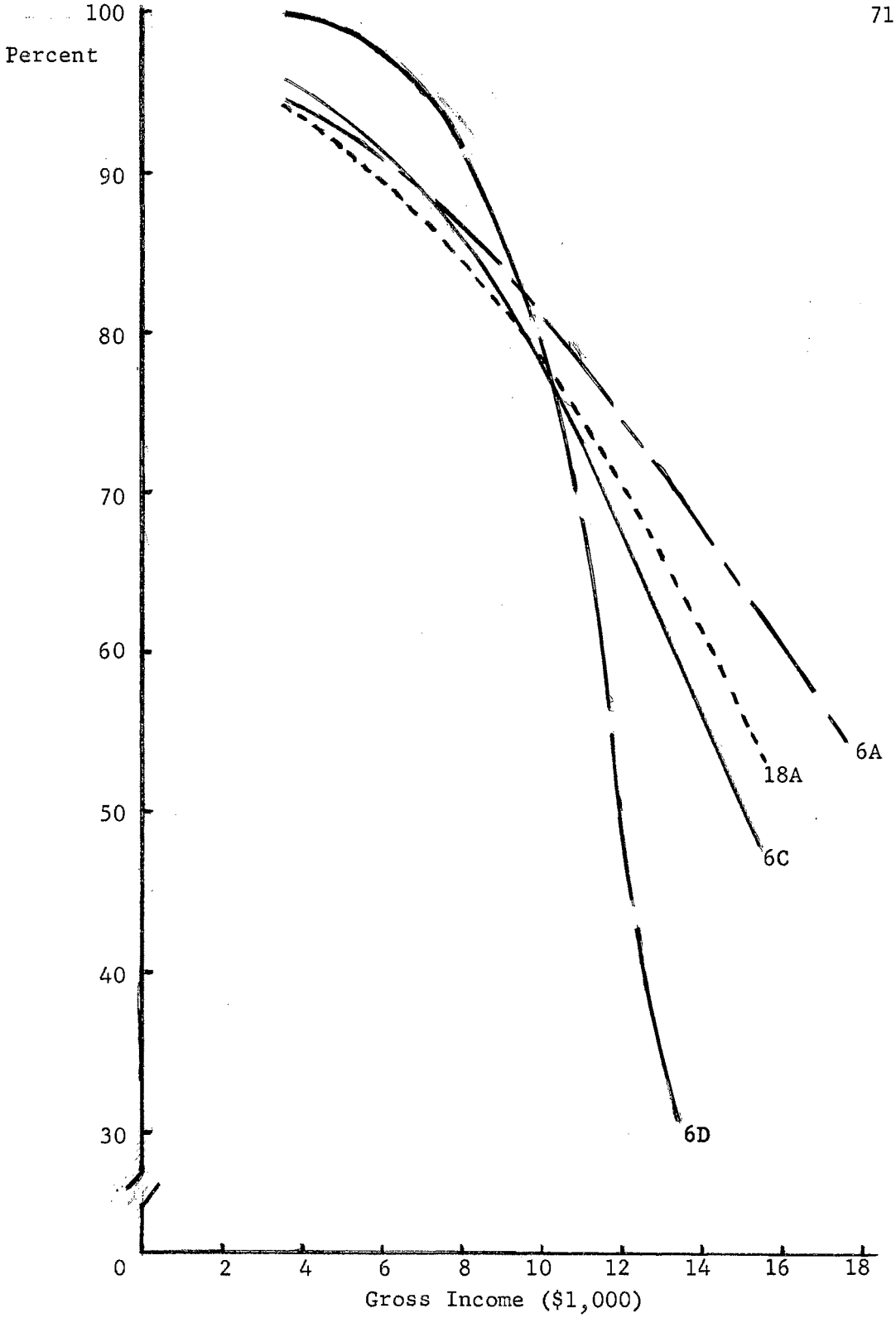

Figure 10. Percent of Time that Gross Income may be expected to be equal to or greater than Cumulated Annual Expenditure Items, Four Selected Plans, Small Range Unit.

(Figure 11). Returns to management are $1,329 with a probability of .50 of attaining at least this level. After paying all other specified expenditures for this resource situation, plan 6C produces $4,666 or greater returns to land 50 percent of the time. If the alternative plan 6D is followed, the returns to land are $2,786 while for plan 18A the returns to land are $3,849 on the same basis. For the last three plans, no returns to management are indicated 51, 70, and 56 percent of the time, respectively, for plans 6C, 6D, and 18A.

All the plans studied for the large cropland unit indicate returns to management over 50 percent of the time. Based on the incomes indicated on Figure 12 at the .84 probability level and expenditures shown in Appendix E, Table V, plan 6A shows a return of at least $1,740 to annual capital 84 percent of the time with no returns to land capital only 43 percent of the time. Plans 6C, 6D, and 18A show returns to land capital 84 percent of the time. The returns for these three plans are at least $1,550, $1,960, and $2,130 in that order at the .84 probability level.

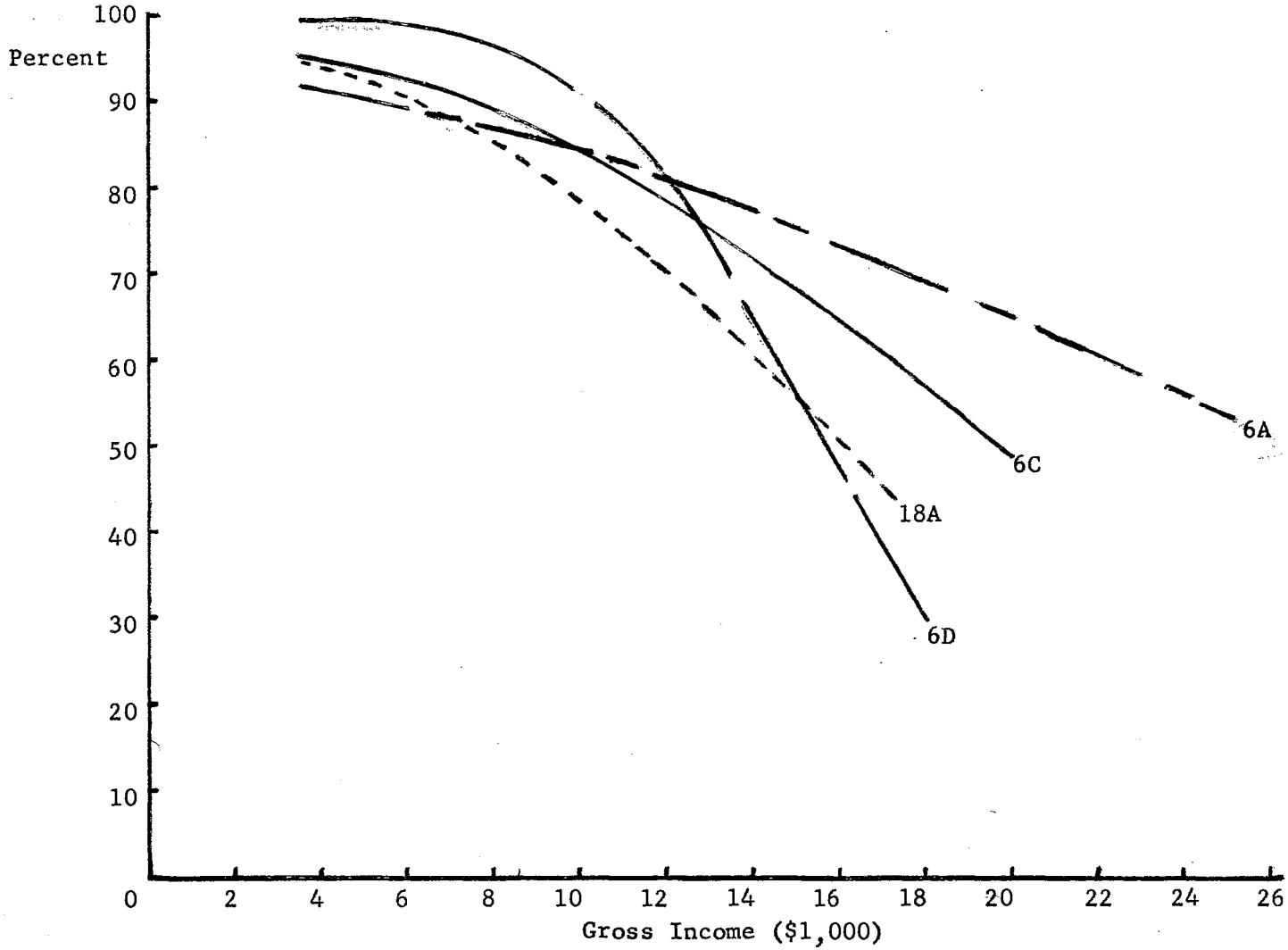

Figure 11. Percent of Time that Gross Income may be expected to be equal to or greater than Cumulated Annual Expenditure Items, Four Selected Plans, Large Range Unit.

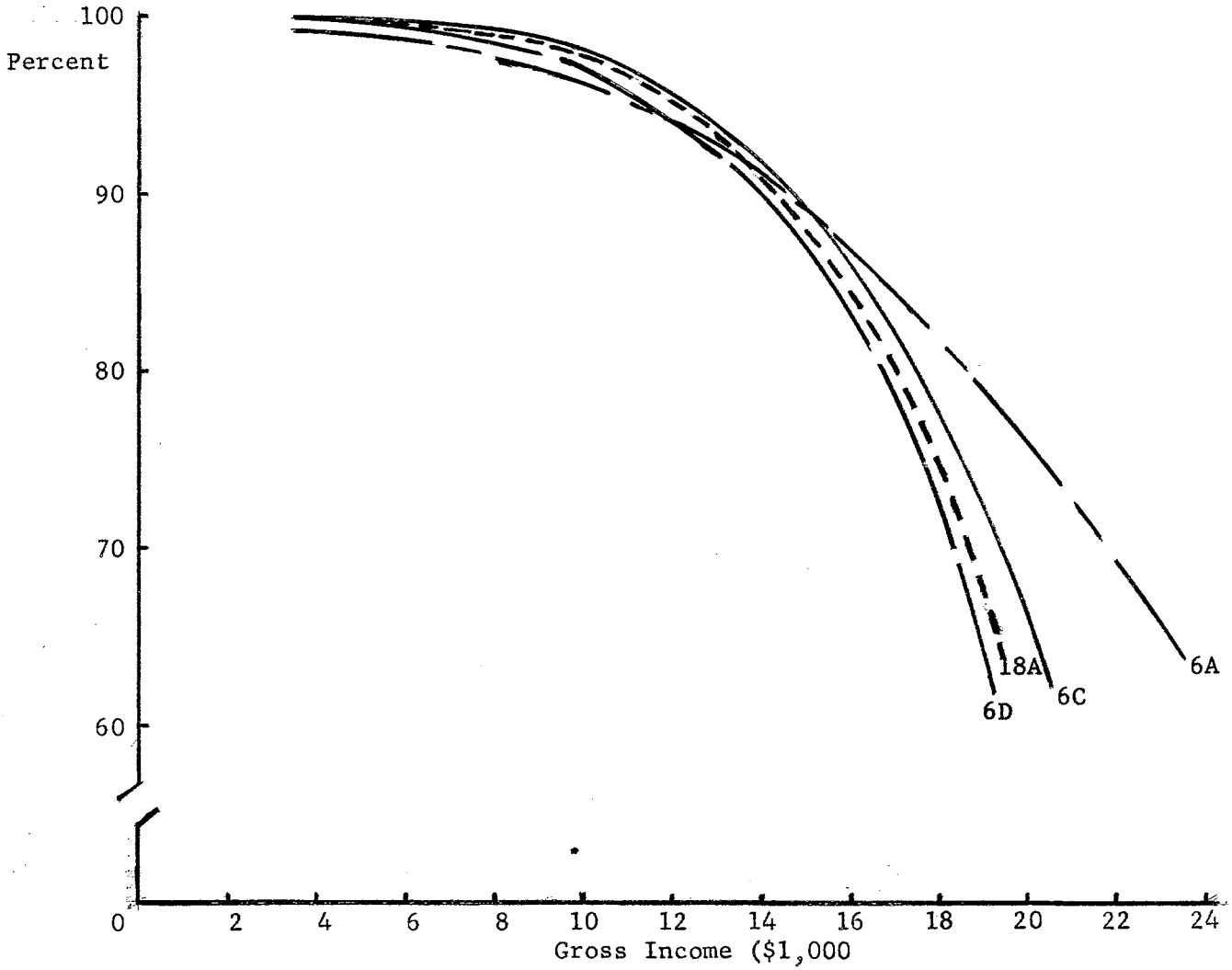

Figure 12. Percent of Time that Gross Income may be expected to be equal to or greater than Cumulated Annual Expenditure Items, Four Selected Plans, Large Cropland Unit.

CHAPTER V

BUSINESS SURVIVAL AND CAPITAL ACCUMULATION

For short-run survival the time periods and sequence in which given levels of income occur are critical. The tendency of bunchiness of income levels increases the danger of financial failure of the farm firm if several relatively low income years should occur before the farm operator has acquired sufficient equity.

The computed disposable operator returns[1] based on the variability for the 1942 to 1957 period are shown in Appendix F. The returns shown for the operator in these tables are the returns that would occur for the specified plans if the gross income varied as in 1942-57 with the programmed income level as an average annual income.

The frequency distributions of estimated annual farm income levels for selected plans were tabulated for each farm by income intervals. Generally, the more income intervals over which the annual returns are dispersed, the greater the income variability for that plan. The stronger the tendency for annual farm income levels to bunch in income

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[1] These values are the returns to operating capital, land equity, and management. These are the sequences used as a base for calculating credit required and capital accumulation, assuming a specified starting equity. The amount of $3,500 was deducted from disposable returns used in Chapter IV, as an allowance for minimum family living and was assumed to be returns to family labor.

intervals about the mean, the greater the income stability for that plan.

Frequency Distribution of Potential Reserve Funds

The frequency distributions of the maximum funds available for reserves are shown in Table XII for the owner operator tenure class. Four farm plans for each of the five resource situations were analyzed. Under each land resource situation the plans were ordered in terms of the level of returns on the large balanced unit.

For all resource situations the plan that includes heavy and temporary graze steers (6A) showed the widest range of income intervals. The distribution of incomes was also more concentrated in the income intervals near the mean for plan 6D than for plan 6A. As measured by coefficient of variation and standard deviation plan 6D was also the least variable of the four plans analyzed.

The dispersion of the frequency distribution of the returns in Table XII decreased with the income level for the large units and for the small range unit. However, for the small balanced unit with plan 18A, which showed a slightly higher return to capital, land, and management than plan 6C, the dispersion of income was less than for plan 6C on the same unit. The difference in dispersion was due to the fact that a higher proportion of the income was derived from cash grain crops with plan 18A than with plan 6C.

The effects of renting land on the frequency distribution of returns that could be available for reserves can be observed by comparing Table XIII with Table XII. Table XIII shows the expected

TABLE XII

EXPECTED FREQUENCY DISTRIBUTION OF RETURNS TO ANNUAL OPERATING CAPITAL, LAND, AND MANAGEMENT; FOUR PLANNING SITUATIONS, FIVE LAND RESOURCE UNITS, OWNER-OPERATOR TENURE CLASS, 16 PRODUCTION PERIODS[a]

Return Interval ($1,000)	Land Resource Planning Situations																			
	Small Balanced Unit Plans				Small Range Unit Plans				Large Balanced Unit Plans				Large Range Unit Plans				Large Cropland Unit Plans			
	6A	18A	6C	6D	6A	18A	6C	6D	6A	18A	6C	6D	6A	18A	6C	6D	6A	18A	6C	6D
33-48									1[b]				1[c]							
30-33													1		1					
27-30					1												1			
24-27													1	1						
21-24						1			2	1	1				1		1			
18-21					1		1		2	1	1		2				2		1	
15-18					1	1				2	3	1		1	1		1	2	2	2
12-15	1				2	1	1		2	1		4		1	1	2	1	3	3	2
9-12						2	2		3	1		1	2	2	2		6	2		2
6-9	3	1	1		4		2	3	2	5	5	5	4	1	1	5	1	4	3	5
3-6	1	4	3		1	6	4	5	1	2	3	2		3	4	4		2	4	2
0-3	6	5	5	9	1	1	2	5		1	1	2	1	2		3		2	2	2
-3-0	2	4	6	7	1	2	3	3		2	2	1		3	3	2	1	1	1	1
-6- -3	3	2	1		1	2	1		2				1	2	1		2			
-9- -6					3				1				1		1					
-12- -9													1							
-15- -12																				
-20- -15													1[d]							
Mean ($100)	19	10	8	2	70	59	49	34	114	93	92	80	98	55	70	49	110	85	87	83
S.D.[e] ($100)	48	29	32	17	101	80	67	29	108	70	71	50	165	78	99	42	92	56	61	55

[a]Data from Appendix F, Tables II, III, and IV.

[b]$34,251.

[c]$47,540.

[d]-$19,282.

[e]S.D. = Standard Deviation.

TABLE XIII

EXPECTED FREQUENCY DISTRIBUTION OF RETURNS TO ANNUAL OPERATING CAPITAL AND MANAGEMENT; FOUR PLANNING SITUATIONS, FIVE LAND RESOURCE UNITS, TENANT-OPERATOR TENURE CLASS, 16 PRODUCTION PERIODS[a]

Return Interval ($1,000)	Land Resource Planning Situations																			
	Small Balanced Unit Plans				Small Range Unit Plans				Large Balanced Unit Plans				Large Range Unit Plans				Large Cropland Unit Plans			
	6A	18A	6C	6D	6A	18A	6C	6D	6A	18A	6C	6D	6A	18A	6C	6D	6A	18A	6C	6D
30-43													1[b]							
27-30									1											
24-27					1								1		1					
21-24																	1			
18-21						1							1	1						
15-18					1		1			1	1				1					
12-15					1	1			1				2				2			
9-12	1				1	1	1			4	3			1	1		1		2	
6-9					1	2	1		3		1	3	1	1	2	2	4	5	3	2
3-6	3	1	1		3		3	2	3	4	1	3	4	3	1		3	2	1	4
0-3	3	4	4		3	6	3	6	1	3	6	5	1	1	2	7	2	5	6	6
-3-0	5	7	6	12	1	1	2	5		1	1	3	1	4	3	2		3	2	3
-6- -3	2	4	5	4	1	2	3	3	1	3	3	2		3	3	4		1	2	1
-9- -6	2				1	1	2		2				1			1	2			
-12- -9					1	1			2				1	2	2		1			
-15- -12					1				1											
-18- -15									1				1							
-25- -18													1[c]							
Mean ($100)	-1	-10	-12	-18	34	23	13	-2	55	34	33	21	49	6	21	0	52	29	27	25
S.D.[d] ($100)	46	26	30	13	100	78	65	26	101	60	61	37	164	77	98	41	82	39	45	37

[a]Data from Appendix F, Tables XI, XII, and XIII.

[b]$42,497.

[c]-$24,619.

[d]S.D. = Standard Deviation.

frequency distribution of returns when all land was considered as being rented.[2]

As shown in Table XIII, the level of the distribution of returns to equity and management would be lower for the tenant-operator than for the owner-operator. This lower level of returns reflects the returns to equity in land at a zero level for the operator who rents all of his land. It was also observed that the returns tended to be more concentrated about the mean for the tenant group. The most concentrated frequency distribution of these returns was exhibited by the cow-calf plan (6D) on the small balanced unit. This distribution was about a mean of -$1,800 in two return intervals. Twelve observations were in the interval -3,000 to zero, with four observations in the interval -6,000 to -3,000. This distribution indicates that on the average either family living would have to be reduced by at least $1,800 or else equity would decline for the tenant-operator on the 640 acre balanced unit using plan 6D.

The frequency distribution for the operator who rented half of his land was between that for the full owner and the tenant-operator, both in terms of income levels and observed frequencies. The frequency distribution of returns for the encumbered owner was at a slightly lower level than for the part-owner, while the variability exhibited by this frequency distribution was nearly the same as for the full owner. The calculated standard deviation was the same for both the full

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[2]For the partial tenant tenure situation the same type data is recorded in Appendix H, Table I, and for the encumbered owner the same type of data is recorded in Appendix H, Table II.

owner and the encumbered owner. The returns to the encumbered owner are those returns that could be available for capital accumulation other than increases in land equity. The frequency distribution of income levels for the part-owner and encumbered owner were as shown in Appendix H, Tables I and II.

Conditions for Farm Unit Survival and Expansion

The net change in capital that could take place for specified resource, tenure, and planning situations can be analyzed only after making allowances for interest on borrowed capital and taxes. The sequence of incomes analyzed was the sequence that was most unfavorable for the high capital level cow-calf plans (6D) on all resource units. For this computation of capital accumulation, the assumption was made that the base period years 1953 through 1957 preceded the years 1942 through 1952. For the cow-calf plans other sequences of years would be more favorable. However, if the base period 1952 was also moved to the beginning of the sequence, a more unfavorable sequence of incomes would result for the steer grazing plans.

For all plans the assumption was made that the operator had cash and/or equity in machinery and livestock equivalent to $13,000. In the first period the required annual operating capital in excess of $13,000 was borrowed. In subsequent periods the amount of borrowed capital required was determined by the change in annual operating capital equity. The equity for the succeeding periods is the current equity plus the returns to land equity, annual operating capital, and

management minus interest on borrowed capital, Federal income tax, social security tax, and Oklahoma income tax.[3]

The assumption was made that when equity falls below $13,000, part of the annual specified costs could be deferred to reduce the amount of borrowed capital.[4] It was assumed that when equity exceeded $13,000, previously deferred expenditures could be recovered. It was further assumed that $1,500 could be withdrawn to raise the level of family living to $5,000 when equity was above a quantity equal to $13,000, plus the difference between $13,000 and the lowest equity attained. If equity exceeded 100 percent of annual operating capital, the withdrawal for additional family living was increased to $3,500.

In analyzing the encumbered owner tenure class, the assumption was made that the 16-year base period represented the 10th through the 25th year of a 33-year amortization period. This assumption was made to simulate an average change in land equity for encumbered owners. At a given point in time, individual operators would be at different stages in the amortization period.

Levels of accumulated equity, credit, family living, and expenditure deferrals were calculated based on these assumptions. These

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[3]For income tax computation it was assumed that the number of dependent exemptions claimed was four.

[4]Expenses to be deferred when necessary were $500 family living, annual depreciation, part of the general overhead costs, and real estate taxes, in that order. It was assumed that taxes could be deferred for four years, and that annual depreciation and overhead costs could be deferred for a maximum of five years.

relationships are discussed below in relation to the five previously specified resource situations.[5]

Balanced Farm Units

The small balanced farm unit could not provide a family living of $3,500 and yield a positive increment to annual operating capital equity for the part owner, encumbered owner, and tenant-operator. The cow-calf plan if used by an owner-operator would also result in a decrease in annual capital equity (Table XIV). However, this owner-operator would have the possibility with this plan of renting additional land so that the total land farmed could result in net returns with which to increase operating equity. For example computations for the tenant-operator on the large balanced unit, indicated that a unit of this larger size is capable of producing a $9,000 increase in equity, plus $5,000 toward a higher level of family living.

With the assumed unfavorable sequence of income, the owner-operator could have increased his capital equity by employing any of the three steer grazing plans if family living did not exceed the $3,500 specified. If the withdrawal for a higher level of family living indicated in Table XIV was made, a negative change in capital equity would have resulted for two of these plans (18A and 6C). The level of credit required for the owner-operator appeared to be low enough so that he should not have experienced difficulty in securing the needed credit from established credit agencies.

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[5]Data for eight selected situations discussed in the following sections but not included in the text tables are in Appendix I.

TABLE XIV

CHANGES IN EQUITY DERIVED FROM RETURNS TO LAND EQUITY, ANNUAL OPERATING CAPITAL, AND MANAGEMENT; CREDIT REQUIREMENTS AND DEFERRAL OF ANNUAL OPERATING EXPENSES; OWNER-OPERATOR TENURE CLASS, FOUR SELECTED PLANS, SMALL BALANCED UNIT, 16 PRODUCTION PERIODS

Item	Planning Situation			
	6A	18A	6C	6D
	- Dollars -			
Total Returns to Land Equity, Annual Operating Capital, and Management	30,255	15,965	12,913	2,825
Allocation of Returns				
Interest on borrowed capital	5,662	1,290	2,667	434
Federal income tax	9,351	6,378	5,802	3,764
Social security tax	3,859	3,844	3,559	3,699
Oklahoma income tax	433	201	202	89
Withdrawal for a higher level of family living[a]	6,500	4,500	1,500	0
Number of years at $5,000	2	3	1	-
Number of years at $7,000	1	0	0	-
Equity Relationships				
Annual operating capital	16,796	10,121	12,641	8,222
Beginning capital equity	13,000	13,000	13,000	13,000
Change in capital equity	4,450	-248	-817	-5,161
Average capital equity	11,469	8,778	9,865	7,771
Debt free equity in land	39,434	39,434	39,434	39,434
Percent return on equities[b]	2.2	1.9	1.3	0.3
Credit Requirements				
Number of years required	14	10	14	10
Average credit required	6,088	2,149	3,175	722
Maximum credit required	10,627	4,480	6,886	2,135
Percent of annual capital	63	44	54	26
Deferral of Annual Expenditures				
Number of years requiring partially deferred expenses	8	4	7	7
Total expenses deferred	7,892	3,386	5,820	6,320
Family living	4,000	2,000	3,500	3,500
Other	3,892	1,385	2,320	2,820

[a]Withdrawal of funds to attain a family living level of either $5,000 or $7,000 rather than the assumed minimum level of $3,500.

[b]Average return on equity in land and owned annual operating capital after deducting $3,500 for family labor and paying interest on borrowed capital.

All four tenure classes could increase their equity in annual operating capital with each of the four plans on the large balanced farm unit. As indicated by Table XV, the part owner on this type of unit could accumulate equity in excess of average annual operating capital. These funds would be available for savings or investment. At the same time family living would be at a level considerably above $3,500. The low level capital heavy graze steer plan (18A) showed the possibility of the highest level of family living with the assumed system of withdrawal of additional family living funds. In terms of combined change in equity and family living, the high capital level heavy graze steer plan (6A) showed the greatest change.

Plan 6A also required the most borrowed capital. The maximum credit required reached over $39,000 for this plan. Although this figure represents 98 percent of the average annual operating capital, with a good credit record the operator should be able to secure the needed credit. This seems likely since the major portion of the capital needed is for the purchase of steers to graze and also because the operator was assumed to have a debt free equity in 50 percent of the land farmed.

Range Resource Units

The encumbered owner on the small range unit using the cow-calf plan (6D) could not maintain his operating capital equity and family living while making payments on the land. Computations indicated that the encumbered owner using the moderate graze steer plan (6C) could increase his operating capital equity by $6,500, providing that he could

TABLE XV

CHANGES IN EQUITY DERIVED FROM RETURNS TO LAND EQUITY, ANNUAL OPERATING CAPITAL, AND MANAGEMENT; CREDIT REQUIREMENTS AND DEFERRAL OF ANNUAL OPERATING EXPENSES; PART OWNER TENURE CLASS, FOUR SELECTED PLANS, LARGE BALANCED UNIT, 16 PRODUCTION PERIODS

Item	Planning Situation			
	6A	18A	6C	6D
	- Dollars -			
Total Returns to Land Equity, Annual Operating Capital, and Management	135,127	101,532	99,925	81,420
Allocation of Returns				
Interest on borrowed capital	18,348	4,905	7,108	3,926
Federal income tax	33,743	24,709	24,138	18,354
Social security tax	4,348	4,444	4,507	4,637
Oklahoma income tax	2,710	1,307	1,278	864
Withdrawal for a higher level of family living[a]	22,000	31,000	29,500	29,500
Number of years at $5,000	3	2	1	1
Number of years at $7,000	5	8	8	8
Equity Relationships				
Annual operating capital	40,261	22,677	26,285	20,696
Beginning capital equity	13,000	13,000	13,000	13,000
Change in capital equity	54,607	35,167	33,394	24,139
Average capital equity	21,749	17,668	19,019	16,605
Debt free equity in land	59,150	59,150	59,150	59,150
Percent return on equities[b]	9.0	7.9	7.4	6.4
Credit Requirements				
Number of years required	12	9	9	8
Average credit required	24,683	8,904	12,927	8,181
Maximum credit required	39,472	11,252	15,136	10,254
Percent of annual capital	98	50	58	50
Deferral of Annual Expenditures				
Number of years requiring partially deferred expenses	5	3	3	2
Total expenses deferred	10,753	5,859	6,390	2,727
Family living	2,500	1,500	1,500	1,000
Other	8,253	4,359	4,890	1,727

[a]Withdrawal of funds to attain a family living level of either $5,000 or $7,000 rather than the assumed minimum level of $3,500.

[b]Average return on equity in land and owned annual operating capital after deducting $3,500 for family labor and paying interest on borrowed capital.

secure annual operating credit equal to 104 percent of the average annual operating capital level of $26,668. For the low capital heavy graze steer plan (18A), the maximum level of financing required was about the same as annual operating capital. Equity increased by $13,325 with an additional $6,500 available for family living from this plan. Similarly, plan (6A) yielded a $17,269 increase in annual operating capital equity with $6,500 additional family living. The maximum credit required by this plan was 110 percent of the annual operating capital. Land equity increased $16,740 in the same period for the encumbered owner on the small range unit.

The tenant-operator on this unit would have negative returns after considering interest on borrowed capital and taxes for plans 6C and 6D. With plans 6A and 18A, equity levels would increase if he could survive the short-run. However, plan 6A requires that capital be borrowed equal to a maximum of 120 percent of annual operating capital, while plan 18A requires maximum credit equal to 113 percent of annual operating capital. Some type of emergency credit program would likely have to be available in order for the tenant-operator to survive on this unit.

Calculations for the part owner on the small range unit were as shown in Table XVI. All four plans indicated the possibility of capital accumulation. Levels of credit required were low enough so that survival appeared to be possible for all four plans on this unit.

The most credit was required by the highest income and most variable plan (6A). The least credit was required by the lowest income and least variable of the plans (6D). Plan 18A allowed the highest withdrawal of funds for family living, whereas plan 6A showed the highest total change

TABLE XVI

CHANGES IN EQUITY DERIVED FROM RETURNS TO LAND EQUITY, ANNUAL OPERATING CAPITAL, AND MANAGEMENT; CREDIT REQUIREMENTS AND DEFERRAL OF ANNUAL OPERATING EXPENSES; PART OWNER TENURE CLASS, FOUR SELECTED PLANS, SMALL RANGE UNIT, 16 PRODUCTION PERIODS

Item	Planning Situation			
	6A	18A	6C	6D
	- Dollars -			
Total Returns to Land Equity, Annual Operating Capital, and Management	82,600	66,266	49,575	25,367
Allocation of Returns				
Interest on borrowed capital	20,533	12,374	13,791	8,323
Federal income tax	18,801	16,732	12,889	5,288
Social security tax	4,009	4,040	3,665	3,724
Oklahoma income tax	1,368	1,018	701	166
Withdrawal for a higher level of family living[a]	12,000	15,000	6,500	1,500
Number of years at $5,000	1	3	2	1
Number of years at $7,000	3	3	1	0
Equity Relationships				
Annual operating capital	35,852	27,236	26,668	19,932
Beginning capital equity	13,000	13,000	13,000	13,000
Change in capital equity	25,889	17,102	12,029	6,366
Average capital equity	14,913	14,759	13,051	11,748
Debt free equity in land	36,517	36,517	36,517	36,517
Percent return on equities[b]	7.5	6.6	4.5	2.2
Credit Requirements				
Number of years required	14	14	15	16
Average credit required	23,930	14,260	14,804	8,184
Maximum credit required	35,935	22,550	21,113	11,828
Percent of annual capital	99	83	79	59
Deferral of Annual Expenditures				
Number of years requiring partially deferred expenses	8	8	9	10
Total expenses deferred	8,430	8,120	8,485	8,950
Family living	4,000	4,000	4,500	5,000
Other	4,430	4,120	3,985	3,950

[a]Withdrawal of funds to attain a family living level of either $5,000 or $7,000 rather than the assumed minimum level of $3,500.

[b]Average return on equity in land and owned annual operating capital after deducting $3,500 for family labor and paying interest on borrowed capital.

in annual operating capital equity plus family living. Both plans 6A and 18A provided funds in excess of annual operating capital that could be used for savings or investment.

On the large range unit only plan 6A over the 16 production periods could produce positive cumulated returns for the tenant-operator. However, the net increase after taxes and interest on borrowed capital was only $407 with family living maintained at $3,500. Even with this plan survival appeared unlikely, since maximum borrowed capital would reach 145 percent of annual capital. Furthermore, the average borrowed capital would exceed annual operating capital.

On both of the range units with the assumed rental rate, survival appeared unlikely for a tenant-operator. To attain survival, a lower rental rate and/or a larger land resource base than were assumed, would be required for survival of tenant-operated ranch units.

On the large range unit, the encumbered owner could not maintain equity and family living by the use of plan 18A or plan 6D.[6] When the high capital level moderate graze steer plan (6C) was assumed, annual operating capital equity increased by $7,864 with family living maintained at $3,500. By the use of the heavy graze steer plan (6A) annual operating capital equity could increase $17,457 with $4,500 withdrawn for additional family living. Although both of these plans require a maximum level of borrowed capital in excess of 110 percent of annual operating capital, survival of the ranch firm should have been possible with current lending practices and the increase in land equity that was

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[6]For planning situation 18A on the large range unit the optimum plan had moderate graze steers rather than heavy graze steers. Plan 6D is a moderate graze cow-calf plan.

occurring. Over the sixteen-year period, land equity increased $23,129.

For the part owner tenure class, although all four plans would accumulate equity, none of them accumulated sufficient funds to provide a savings or investment other than in annual operating capital (Table XVII). The cow-calf plan provided only the minimum $3,500 family living while the three steer grazing plans allowed for the withdrawal of $6,500 for a higher level of family living.

As indicated by the low rate of return (1.2 percent) on owned capital and land equity, this unit is close to the minimum size for the cow-calf plan. To provide more than the minimum family living, this unit would have to expand. If additional cropland were added, this would not only increase net income but would also decrease the coefficient of variation.

Borrowed capital requirements were relatively high. However, with a beginning debt-free land equity of over $50,000, the part-owner should be able to secure sufficient credit to survive with the assumed sequence of incomes.

Cropland Unit

All four of the plans analyzed for the cropland unit would provide a family living level above $3,500 and increase annual operating capital equity for all tenure situations. These relationships are shown in Table XVIII for the part owner tenure class.

A cropland unit of the size programmed permitted a higher withdrawal for family living than the other four programmed resource

TABLE XVII

CHANGES IN EQUITY DERIVED FROM RETURNS TO LAND EQUITY, ANNUAL OPERATING CAPITAL, AND MANAGEMENT; CREDIT REQUIREMENTS AND DEFERRAL OF ANNUAL OPERATING EXPENSES; PART OWNER TENURE CLASS, FOUR SELECTED PLANS, LARGE RANGE UNIT, 16 PRODUCTION PERIODS

Item	Planning Situation			
	6A	18A	6C	6D
	- Dollars -			
Total Returns to Land Equity, Annual Operating Capital, and Management	117,413	49,230	72,616	39,016
Allocation of Returns				
Interest on borrowed capital	43,324	15,650	24,845	27,760
Federal income tax	28,282	13,150	17,202	4,063
Social security tax	3,948	3,542	3,662	3,420
Oklahoma income tax	2,301	818	1,169	196
Withdrawal for a higher level of family living[a]	6,500	6,500	6,500	0
Number of years at $5,000	2	2	2	-
Number of years at $7,000	1	1	1	-
Equity Relationships				
Annual operating capital	57,276	28,371	39,095	35,436
Beginning capital equity	13,000	13,000	13,000	13,000
Changes in capital equity	33,085	9,570	18,732	3,577
Average capital equity	12,790	12,751	13,214	7,537
Debt free equity in land	50,458	50,458	50,458	50,458
Percent return on equities[b]	7.3	3.3	4.6	1.2
Credit Requirements				
Number of years required	15	15	15	16
Average credit required	47,452	16,661	27,606	27,899
Maximum credit required	65,710	24,020	36,704	34,744
Percent of annual capital	115	79	94	98
Deferral of Annual Expenditures				
Number of years requiring partially deferred expenses	8	9	9	13
Total expenses deferred	10,132	9,682	9,942	12,037
Family living	4,000	4,500	4,500	6,500
Other	6,132	5,182	5,442	5,532

[a]Withdrawal of funds to attain a family living level of either $5,000 or $7,000 rather than the assumed minimum of $3,500.

[b]Average return on equity in land and owned annual operating capital after deducting $3,500 for family labor and paying interest on borrowed capital.

TABLE XVIII

CHANGES IN EQUITY DERIVED FROM RETURNS TO LAND EQUITY, ANNUAL OPERATING CAPITAL, AND MANAGEMENT; CREDIT REQUIREMENTS AND DEFERRAL OF ANNUAL OPERATING EXPENSES; PART OWNER TENURE CLASS, FOUR SELECTED PLANS, LARGE CROPLAND UNIT, 16 PRODUCTION PERIODS

Item	Planning Situation			
	6A	18A	6C	6D
	- Dollars -			
Total Returns to Land Equity, Annual Operating Capital, and Management	129,188	89,977	93,111	86,667
Allocation of Returns				
Interest on borrowed capital	12,232	101	3,159	770
Federal income tax	31,111	21,098	22,045	19,296
Social security tax	4,444	4,702	4,534	4,619
Oklahoma income tax	1,886	1,030	1,109	914
Withdrawal for a higher level of family living[a]	26,000	38,500	33,000	36,500
Number of years at $5,000	1	0	1	1
Number of years at $7,000	7	11	9	10
Equity Relationships				
Annual operating capital	33,086	13,002	17,856	15,139
Beginning capital equity	13,000	13,000	13,000	13,000
Changes in capital equity	53,515	24,546	30,263	24,568
Average capital equity	20,840	12,966	15,708	14,406
Debt free equity in land	57,502	57,502	57,502	57,502
Percent return on equities[b]	9.3	8.0	7.8	7.5
Credit Requirements				
Number of years required	10	2	8	7
Average credit required	19,594	291	4,296	1,674
Maximum credit required	28,705	362	5,410	2,255
Percent of annual capital	87	3	30	15
Deferral of Annual Expenditures				
Number of years requiring partially deferred expenses	5	2	3	3
Total expenses deferred	11,310	3,432	6,131	3,942
Family living	2,500	1,000	1,500	1,500
Other	8,810	2,432	4,631	2,442

[a]Withdrawal of funds to attain a family living level of either $5,000 or $7,000 rather than the assumed minimum of $3,500.

[b]Average return on equity in land and owned annual operating capital after deducting $3,500 for family labor and paying interest on borrowed capital.

situations. The highest level of living was possible under the low capital level heavy graze steer plan (18A). With this plan for eleven of the sixteen years, a $7,000 level of family living was possible for the part owner.

In addititon, all four plans provided a sufficient increase in capital equity so that funds would be available for savings and investment. For a given planning situation, the rate of return on owned capital and land equity was higher for the cropland unit than for the other four land resource units.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The two primary purposes of this study were (1) to estimate the income variability inherent in different enterprise combinations, and (2) to ascertain the probable effect on capital accumulation and survival for farm operators using these alternative plans.

The plans analyzed were derived within a linear programming framework. Land resource situations used in programming included five different sizes of farm units and combinations of range and cropland. Alternative plans for each resource situation were derived by changing the enterprise alternatives in the programming matrix and by changing the interest rate charged for operating capital. Production alternatives considered in the full model included wheat, grain sorghum, barley, temporary grazing crops, reseeding to grass, forage crops, cow-calf enterprises, and buy-sell steer grazing enterprises.

Based on the estimated variability of the cash income producing enterprises that entered significantly into the plans, the variability of gross farm income from each of the alternative plans was computed. Income opportunity curves were constructed for each farm based on the standard deviation and income level for each alternative plan.

Gross income sequences for 16 production periods were derived. These sequences were assumed to have the same variability as the income

from these plans would have had for the period 1942 through 1957. The programmed income for each plan was assumed to be the average income for that plan. This average was based on prices current in 1960-61 and the estimated net loan price for wheat in 1961. Based on the above averages and variability, the probabilities of covering different income levels were estimated for selected plans on each resource situation.

Sequences of returns to annual operating capital, land equity, and management were derived from gross income sequences for four selected plans on each farm unit. The ability of operators to accumulate capital, after paying interest on borrowed capital, income taxes, and social security taxes was assessed. Through this process the possibility of firm survival for selected combinations of farm plan, resource situation, and tenure situation were estimated. The tenure classes considered were owner-operator, part owner, encumbered owner, and tenant-operator.

The order of the sequences of income assumed for these analyses was one which placed a group of the five most unfavorable consecutive years for the cow-calf plans at the beginning of the series. Consequently, the base years 1953-57 were assumed to precede 1942-52. The information derived through this ordering of production periods resulted in data that indicated one of the most unfavorable sequences of income for the survival of the farm firms analyzed.

Results

In analyzing the results of this study, only the four plans for which all computations were derived are considered. For all resource situations the highest income plan was the heavy graze steer plan (6A). This plan also exhibited the highest degree of variability. Of these four plans, the cow-calf plan (6D) produced the lowest income and had the lowest variability on all of the farm units. Reducing the level of capital employed generally resulted in a reduction in both income and variability for a given planning situation. This change resulted from a reduction in the quantity of livestock produced and a shift from continuous wheat to a wheat-grain sorghum-fallow rotation.

The renting of land resulted in both a reduction in income and absolute variability. The higher the proportion of rented land to owned land, the more variability was reduced. Also, the higher the proportion of cropland in the rented land the more variability was reduced. However, relative variability increased since income was reduced at a faster rate than standard deviation.

For a given resource situation, the highest returns for all tenure classes was derived from plan 6A. Similarly, for a given plan the owner-operator received the greatest returns, while the tenant-operator received the lowest returns. The owner-operator with plan 6A on the large balanced resource unit could receive the highest return. The tenant-operator would not receive high enough returns from plan 6D to provide $3,500 family living on the small balanced unit and the two range units.

Under the assumptions of this study, a farm operator in any of the tenure classes could survive the hypothesized income sequence if he operated a farm firm such as the large balanced unit or the large cropland unit. An analysis of each of the four farm plans for these two units indicated a substantial increase in annual operating capital equity and the possibility of a family living level significantly higher than $3,500.

With the same planning alternatives, survival of the small balanced farm firm appeared to be possible only for the owner-operator employing one of the high risk buy-sell steer grazing plans. The low level of income from a cow-calf plan on this unit resulted in a negative change in capital equity even with an assumption of the most favorable sequence of income.

For the range resource units the question of survival or nonsurvival of the farm firm was not as clearly defined. Survival of the ranch units with a tenant operator appeared unlikely, although for plans 6A and 18A on the small range unit, it may be possible if emergency credit were available.

For the encumbered owner on the small range unit, survival appeared to be possible if the buy-sell steer grazing plans were followed. With the cow-calf plan family living would have to be at a level lower than $3,500, with some of the annual depreciation and overhead expenditures deferred if land payments are to be made. With respect to the large range unit, the same statement holds for the cow-calf plan and for the low capital level moderate graze steer plan. With the high capital

level, heavy and moderate graze steer plans (6A and 6C), land payments and minimum family living could be attained by the encumbered owner.

Survival was possible for either of the ranch units operated by a part owner. Family living could be maintained above $3,500 with the buy-sell steer plans and at $3,500 when the cow-calf plan was used. For the owner-operator, all plans would maintain the family at a level above the minimum assumed standard.

In all of the income sequences analyzed, the two income periods represented by the years 1950 and 1951 were unusually favorable years. If these two income periods had occurred at the beginning of the income series, all plans would have appeared more feasible. Similarly for the plans that included buy-sell steers, the feasibility of the plans would have been reduced for the range units and balanced units, if the unfavorable income period represented by 1952 had been assumed to occur at the beginning of the income series. However, for the cow-calf plans on all units and for all plans on the cropland unit, the occurrence of that particular income period at the beginning of the income series would have improved the feasibility of those plans. The different results that could have occurred with such a change in the income series points up the particular importance of the timing of only one or two extremely favorable or unfavorable years in relation to the rest of the series.

The general farm organization chosen will depend on the criteria used in arriving at this decision. The plan selected could be the plan that maximizes equity accumulation or alternatively it could be the plan that maximizes family living level over time. Three other criteria

that might be included are lowest variability, lowest borrowed capital required, and maximum rate of return to owned capital.

The high capital level heavy graze steer plan (6A) would be the plan chosen if the goal were to maximize the increase in equity. With a goal of maximum family living, the plan chosen would also be this plan for the owner-operator on the small balanced unit. The low capital level heavy graze steer plan (18A) maximizes family living on the small ranch unit, large balanced unit, and large cropland unit. On the large range unit, the three steer grazing plans all provided the same level of family living with the cow-calf plan providing the lowest level of family living.

With a criterion of lowest variability, the cow-calf plan would be chosen for all units. The cow-calf plan would also be chosen on the basis of lowest borrowed capital required for the balanced farm units and the small range unit. However, on the large range unit and the cropland unit, the low capital level steer grazing plans required the least borrowed capital.

Implications

For survival, a farm unit larger than a balanced farm of 640 acres is required, if a family of four were to enjoy a "desirable" standard of living. An alternative, not examined in this study, is the possibility of off-farm employment of the farm operator. Since for plans on this farm unit, surplus operator labor was available, this may be a realistic alternative for some operators. If the owner-operator is to

obtain a satisfactory living solely from income derived from a balanced farm unit, he must rent or buy additional land.

Assuming that the goal of a farm operator is to receive $3,500 for family labor, five percent return on land capital and six percent return on annual operating capital, then by linear adjustment the size of balanced farm unit required can be inferred. Computation of these relationships indicated that with the heavy graze steer plan, the size of farm required was about 1,160 acres, while with a cow-calf plan it was about 1,620 acres.[1] The large balanced unit was larger than either of these so that no adjustment problem appears to be present on this unit. However, if the level of farm product prices declined significantly without a compensating decline in the cost of production factors and family living, the larger unit might also conceivably have problems.

For the small range unit if the moderate graze steer plan or the cow-calf plan are employed, the size of the unit is not large enough to provide the rates of return to land and other capital assumed. To obtain the assumed levels both the part-owner and encumbered owner with either of these plans would have to expand their ranch units.

If a tenant-operator is to survive on a unit composed chiefly of rangeland, it appears that a higher proportion of cropland is needed than was assumed for either of the rangeland resource situations. The addition of cropland would increase the overall productivity of capital

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[1] The linear adjustment was made down from the large balanced farm unit, since because of the large size of the desired unit it was assumed that the overhead costs for the larger unit would apply.

on a ranch unit and thereby reduce the credit required relative to net income.

Similarly for the part-owner and encumbered owner on the large range unit, the renting of additional cropland would provide a more stable program of credit requirements for his annual operating capital. With either the low capital moderate graze steer plan or the cow-calf plan on this unit, additional rangeland may also be needed if an adequate level of living is to be maintained.

The expansion of some farm units would mean that the individual operators remaining would need more total credit initially, but the need for credit may in the long-run decline if through the larger units, the operator builds up his equity in annual operating capital.

In the analysis of the farm plans where annual operating capital borrowed reached a high level, the need for a sound credit program is evident. For example, if an encumbered owner had both his land mortgage and annual capital notes with the same credit agency, all of his credit needs could be integrated in terms of his total equity in land and capital. Whereas, if two credit agencies were concerned, the necessary short and intermediate term credit may not be available.

For survival of the farm firm the level of owned capital to start a sequence of income years appears critical. Because of the high level of interest paid out for a series of unfavorable years, the credit required may determine by itself whether or not a plan can maintain the initial capital equity.

In addition, high variability in income tax payments resulted from very high rates in a few years with refunds in others. In relation to these two factors, perhaps a revision of the tax structure might result in higher capital equity and lower requirements for borrowed capital.

Need for Further Study

In this study a primary limitation was the availability of production data over time for some of the activities in the programmed plans. Research is needed to provide comparable data for all enterprises concerned.

The present study, that was limited to selected plans for five resource situations, could be expanded to include other enterprise combinations and resource situations. With the data from this study a dynamic model that would allow for growth in terms of land and livestock enterprises might be developed. However, such a model would require a larger computer than was available.

Research is needed on the specific types of credit required over time. Such a study might delineate the adequacy of present sources of credit, as well as suggest changes in credit agencies and credit policy that would promote the survival of efficient units and the adjustment of other units.

This study was based on the price relationships that existed over the 16-year period (1942-57). If a significant number of farm operators were to shift part of their land resources from cow-calf units to steer

grazing units, the relative price relationship between stockers and feeders may become less favorable for the steer enterprises. It may be desirable to do additional research in order to derive information about the effects on the preference for different plans if such an adjustment should occur.

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A P P E N D I X E S

APPENDIX A, TABLE I

ASSUMED PRICES RECEIVED BY FARMERS, NORTHWEST OKLAHOMA[a]

Item	Unit	Price (Dollars)
Wheat	bu.	1.67
Grain sorghum	cwt.	1.70
Grain sorghum	bu.	.95
Barley	bu.	.88
Yearling Steers	cwt.	21.00
Beef calf	cwt.	22.00
Cull Beef Cow	cwt.	13.50

[a]Assumed price for wheat is approximately the 1961 support price with other grain prices comparable. Livestock prices are consistent with Processed Series P-390, Robert W. Greve, James S. Plaxico, and William F. Lagrone, Resource Requirements, Costs, and Expected Returns; Alternative Crop and Livestock Enterprises, Northwestern Oklahoma, Oklahoma Agricultural Experiment Station and Farm Economics Division, ERS, USDA (Stillwater, 1961).

APPENDIX A, TABLE II

ASSUMED PRICES PAID BY FARMERS, NORTHWEST OKLAHOMA

Item	Unit	Price (Dollars)
Prices Paid		
Seed and Feed		
Seed wheat	bu.	2.05
Seed barley	bu.	1.20
Grain sorghum seed (hybrid)	cwt.	15.00
Forage sorghum seed	cwt.	7.00
Sudan seed	cwt.	6.00
Johnson grass seed	cwt.	30.00
Weeping Lovegrass seed	lb.	1.50
Sandyland grass mixture seed	acre	6.00
Cottonseed cake	ton	76.00
Salt	cwt.	1.00
Hire Labor	hr.	1.25
Custom Rates		
Combining wheat, barley, and grain sorghum	acre	3.00
Hauling wheat, barley, and grain sorghum	bu.	.07
Binding forage sorghum	acre	3.00
Hauling forage sorghum	ton	3.00
Fuel and Lubricants		
Gasoline	gal.	.20
L. P. gas	gal.	.09
Diesel oil	gal.	.16
Kerosene	gal.	.15
Motor oil	gal.	1.00
Lubricant	lb.	.20
Steer calves	cwt.	23.00

Source: Robert W. Greve, James S. Plaxico, and William F. Lagrone, Resource Requirements, Costs, and Expected Returns; Alternative Crop and Livestock Enterprises; Rolling Plains, Northwestern Oklahoma, Processed Series P-390, Oklahoma Agricultural Experiment Station and Farm Economics Division, ERS, USDA (Stillwater, 1961).

APPENDIX A, TABLE III

TWO LEVELS OF ASSUMED ANNUAL OVERHEAD COST FOR FARMS, ROLLING PLAINS, NORTHWEST OKLAHOMA

Item	Size of Operation	
	Small	Large
	- Dollars -	
Truck		
Interest on average investment	60	116
Annual Depreciation	132	253
Repairs (4 pct. of original cost)	72	138
Taxes (1 pct. of original cost)	18	34
Insurance (liability only)	22	25
Fuel, Oil, Lubrication	177	276
Telephone	75	105
Bookkeeping and Tax Service	40	60
Building and Machinery Insurance	100	150
Total	696	1,157
Truck Acquisition Price	1,800[a]	3,450[b]
Truck Salvage Value	216	416
Years to Depreciate	12	12

[a]A 1/2-ton truck with an average of 7,000 miles per year was assumed.

[b]A 1/2-ton truck with an average of 9,000 miles per year was assumed.

APPENDIX A, TABLE IV

CAPITAL REQUIREMENTS FOR SELECTED OPTIMUM PLANS FOR FIVE SPECIFIED RESOURCE SITUATIONS

Plan Symbol[a]	Annual Operating Capital				
	Small Balanced	Small Range	Large Balanced	Large Range	Large Cropland
			- Dollars -		
6A	16,796	35,852	40,261	57,276	33,086
6B	16,796	34,800	35,630	56,709	31,176
6C	12,643	26,668	26,285	39,095	17,856
6D	8,222	19,932	20,696	35,436	15,139
18A	10,121	27,236	22,677	28,371	13,002
18B	9,061	26,265	22,473	28,212	12,095
18C	7,001	20,993	20,893	28,212	10,951
18D	5,528	14,955	16,384	26,065	10,320
			Estimated Value of Land		
All Plans	39,434	73,034	118,301	100,917	115,005

[a]A - All activities in the full programming model included as alternatives.

B - Temporary graze steer activities ($P67_a$ and $P67_b$) excluded as alternatives.

C - Heavy graze steers (P62) plus temporary graze steer activities excluded as alternatives.

D - All steer activities excluded as alternatives.

The number preceding the letter indicates the rate that was assumed as the required capital marginal value product for all annual operating capital used by the plan. For cost analysis, interest on annual capital was adjusted to an annual rate of six percent. Returns to land capital were charged at the rate of five percent.

APPENDIX B, TABLE I

ESTIMATED VARIABILITY OF POUNDS OF BEEF PRODUCTION PER ACRE, STEERS AND COW-CALF FOR SELECTED TYPES OF GRAZING, 1942-57

Base Period (Year)	Native Grass							Wheat		Wheat	
	Heavy Graze Steers[a]	Moderate Graze Steers[b]	Moderate Graze Cow-Calf[b]	Johnson Grass[c] Steers	Johnson Grass[c] Cow-Calf	Sudan Steers	Sudan Cow-Calf	Oct.-Feb. Steers[e]	Oct.-Feb. Cow-Calf	Mar.-May Steers[f]	Mar.-May Cow-Calf
	- Pounds -										
1942	45.94	32.56	24.20	123.49	61.71	140.76	51.38	21.59	7.79	145.99	83.03
1943	43.80	32.18	23.16	83.50	56.95	75.17	56.10	13.71	6.93	152.52	85.32
1944	64.50	48.70	24.91	111.35	60.27	120.83	53.89	12.62	6.81	199.70	88.87
1945	54.81	43.88	24.40	97.26	58.59	97.73	50.46	16.14	7.19	167.07	83.74
1946	60.67	47.79	24.81	92.16	57.98	89.39	48.90	11.28	6.67	211.61	90.16
1947	38.36	34.41	23.39	80.04	56.54	69.49	48.27	23.58	8.00	137.97	81.46
1948	31.04	27.38	22.65	103.01	59.87	115.37	53.31	10.21	6.55	131.56	82.15
1949	44.72	35.77	23.54	94.68	58.28	93.56	50.91	12.06	6.75	142.64	79.09
1950	58.97	46.94	24.72	109.59	60.06	117.95	53.60	9.81	6.51	109.77	82.66
1951	58.43	45.26	24.54	67.97	55.10	49.71	46.10	6.57	6.15	129.17	81.77
1952	48.93	41.66	24.16	81.38	56.70	71.71	48.52	10.68	6.60	134.38	81.20
1953	59.28	56.91	25.90	86.44	57.30	80.79	49.52	7.05	6.20	101.87	78.22
1954	38.68	41.66	23.43	68.32	55.14	46.06	45.70	7.07	6.20	112.64	78.36
1955	28.38	30.24	23.92	76.53	56.12	62.42	47.50	5.44	6.03	103.00	79.40
1956	33.86	37.54	23.94	65.71	54.83	49.69	46.10	6.78	6.17	111.03	79.23
1957	34.17	23.40	21.68	74.21	55.84	60.97	47.34	5.25	6.01	112.76	79.42
$\bar{X}$[g]	47.53	39.14	23.95	88.79	57.58	83.85	49.85	11.24	6.66	137.73	82.13
S.D.[h]	9.43	8.98	0.99	17.41	2.07	28.59	3.14	5.43	0.59	32.49	3.55
C.V.[h]	19.84	22.94	4.15	19.61	3.60	34.10	6.30	48.28	8.86	23.59	4.33

APPENDIX B, TABLE I (Continued)

[a]Data for heavy graze steers were compiled from annual summaries of experimental work at the United States Southern Great Plains Field Station, ARS, USDA, Woodward, Oklahoma.

[b]Robert W. Greve, James S. Plaxico, and William F. Lagrone, Bulletin B-563, p. 10.

[c]Unpublished Southern Great Plains Experiment Station data of pounds of harvested forage sorghum per acre for 1926-59. Johnson grass was assumed to have the same variability of production as this data had for the period 1942-57. Variability of pounds of beef produced was based on the relationship that existed between native range, steers, and cow-calf units at the experiment station.

[d]Sudan grass data for 1953-57 was regressed with forage sorghum data. The estimating equation derived was

$$\hat{Y} = -1.484 + \underset{(.26)}{1.996}\ X \qquad r^2 = .95$$

Data for Sudan grass was tabulated from "Annual Reports of Progress in Forage Crop Research" conducted by the Oklahoma Agricultural Experiment Station in cooperation with the Forage and Range Section, ARS, USDA. Variability of pounds of beef was based on the relationship between native range, steers, and cow-calf units.

[e]Based on an estimating equation derived by Odell Walker and James S. Plaxico, in A Survey of Production Levels and Variability of Small Grain Pastures in Oklahoma, Processed Series P-366 (Oklahoma, 1959), p. 21. Estimating equation used was

$$\hat{Y} = .93 + \underset{(.40)}{1.81}\ X \qquad r^2 = .61$$

Information for X (Sept.-Feb. rainfall) was from Climatic Survey - Oklahoma, United States Department of Commerce Weather Bureau. Variability of pounds of beef was based on relationship between native range, steers, and cow-calf units.

[f]Based on data for five years of steer gains from W. C. Elder, Grazing Characteristics and Clipping Responses of Small Grains, Bulletin B-567 (Stillwater, 1960), p. 6. Regression equation used with Oct.-Feb. gains for deriving Mar.-May steer estimates was

$$\hat{Y} = 77.67 + \underset{(2.81)}{4.96}\ X \qquad r^2 = .69$$

Variability of pounds of beef from cow-calf units was based on the relationship between steers and cow-calf units on native range.

APPENDIX B, TABLE I (Continued)

[g]Average pounds of beef shown are the gains expected on the quality of land most commonly used for each enterprise in the programmed plans.

[h]S.D. = Standard Deviation, C.V. = Coefficient of Variation.

APPENDIX B, TABLE II

ESTIMATED ACRES OF NATIVE RANGE REQUIRED FOR THE SPECIFIED GRAZING INTENSITY AND POUNDS OF BEEF PRODUCED PER BEEF UNIT, 1942-57[a]

Base Period	Moderate Graze P61 Steers		Heavy Graze P62 Steers		Moderate Graze P69 Cow-Calf	
(Year)	(Acres)	(Pounds)	(Acres)	(Pounds)	(Acres)	(Pounds)
1942	10.9	300.6	7.2	330.8	22.0	492.7
1943	11.0	299.8	7.1	311.0	22.1	493.6
1944	8.8	363.0	5.6	361.2	17.6	439.6
1945	8.9	330.8	5.9	323.4	17.9	437.8
1946	8.4	340.0	5.5	333.7	16.8	422.4
1947	10.7	311.9	7.0	268.5	21.4	485.5
1948	15.4	357.2	11.2	347.7	31.1	640.4
1949	9.7	293.9	6.4	286.2	19.5	453.1
1950	8.8	349.9	5.8	342.0	17.6	436.0
1951	8.5	325.9	5.6	327.2	17.0	423.3
1952	8.0	282.3	4.1	200.6	16.2	401.7
1953	7.7	371.2	5.3	314.2	15.7	390.9
1954	7.5	264.7	5.0	193.4	17.1	351.3
1955	12.6	322.7	10.4	295.1	20.3	442.3
1956	8.7	276.7	6.4	216.7	22.0	436.9
1957	14.4	285.4	9.0	307.5	27.1	488.2
$\bar{X}$	10.0	317.25	6.72	297.45	20.09	452.17
S.D.[b]		32.93		52.17		63.43
C.V.[b]		10.38		17.54		14.03

[a]Annual Progress Reports, United States Great Plains Field Station, Agricultural Research Service, USDA, Woodward, Oklahoma. Four of these reports from which data was compiled for use in this study are listed in the selected bibliography.

[b]S.D. = Standard Deviation, C.V. = Coefficient of Variation.

APPENDIX B, TABLE III

ESTIMATED POUNDS OF BEEF PRODUCED PER STEER, TEMPORARY GRAZING, 1942-57

Base Period (Year)	$P67_a$ Steers (Temporary Graze) Johnson Grass	Native	Total	$P67_b$ Steers (Temporary Graze) Wheat Oct. Feb.	Wheat Mar. May	Sudan June Sept.	Native	Total
	- Pounds -							
1942	444.56	43.33	487.89	204.24	45.69	198.42	43.33	491.68
1943	300.60	42.80	343.40	129.70	47.74	285.79	42.80	506.03
1944	400.86	64.75	465.61	119.39	62.51	245.32	64.73	491.95
1945	350.14	58.36	408.50	152.69	52.29	181.49	58.35	444.82
1946	331.78	63.54	395.32	106.71	66.23	152.62	63.54	389.10
1947	288.14	45.73	333.87	223.07	43.18	141.09	45.73	453.07
1948	388.84	36.42	425.26	96.59	41.18	234.24	36.42	408.43
1949	340.85	47.59	388.44	114.09	44.65	189.95	47.58	396.27
1950	394.52	62.34	456.86	92.80	34.36	239.47	62.33	428.96
1951	244.69	60.21	304.90	62.15	40.43	100.93	60.21	263.72
1952	292.97	55.43	348.40	101.03	42.06	145.59	55.42	344.10
1953	311.18	75.64	386.82	66.69	31.89	164.02	75.63	338.23
1954	245.95	55.43	301.38	66.88	35.26	93.51	55.42	251.07
1955	275.51	40.15	315.66	51.46	32.24	126.73	40.15	250.58
1956	236.56	49.85	286.41	64.14	34.75	100.89	49.84	249.62
1957	267.16	31.10	298.26	49.67	35.29	123.79	31.11	239.86
$\bar{X}$	319.65	52.04	371.69	106.33	43.11	170.24	52.04	371.72
S.D.[a]			64.73					96.42
C.V.[a]	19.6	22.9	17.42	48.3	23.6	34.1	22.9	25.94

[a]S.D. = Standard Deviation, C.V. = Coefficient of Variation.

APPENDIX B, TABLE IV

ESTIMATED POUNDS OF BEEF PRODUCED, TEMPORARY GRAZING, 1942-57

Base Period (Year)	$P73_a$ Cow-Calf (Temporary Graze) Johnson Grass	Native	Total	$P73_b$ Cow-Calf (Temporary Graze) Wheat Oct. Feb.	Wheat Mar. May	Sudan June Sept.	Native	Total
				- Pounds -				
1942	394.94	93.09	488.03	142.98	50.59	202.26	93.08	488.91
1943	364.48	89.25	453.73	127.20	51.99	220.84	89.24	489.27
1944	385.73	95.78	481.51	125.00	54.15	212.14	95.77	487.06
1945	374.98	93.85	468.83	131.97	51.02	198.64	93.85	475.48
1946	371.07	95.39	466.46	122.43	54.93	192.50	95.39	465.25
1947	361.86	90.02	451.88	146.84	49.63	190.02	90.01	476.50
1948	383.17	86.94	470.11	120.22	50.05	209.86	86.94	467.07
1949	372.99	90.40	463.39	123.89	48.19	200.41	90.39	462.88
1950	384.38	95.01	479.39	119.49	50.36	211.00	95.01	475.86
1951	352.64	94.24	446.88	112.88	49.82	181.48	94.24	438.42
1952	362.88	93.09	455.97	121.14	49.48	191.00	93.08	454.70
1953	366.72	99.62	466.34	113.80	47.66	194.94	99.62	456.02
1954	352.90	90.02	442.90	113.80	47.74	179.90	90.01	431.45
1955	359.17	91.94	451.11	110.68	48.38	186.99	91.93	437.98
1956	350.91	91.94	442.85	113.25	48.27	181.48	91.93	434.93
1957	357.38	83.49	440.86	110.31	48.39	186.36	83.48	428.54
$\bar{X}$	368.51	92.13	460.64	122.24	50.04	196.23	92.13	460.64
S.D.[a]			14.65					21.13
C.V.[a]	3.6	4.2	3.18	8.9	4.3	6.3	4.2	4.59

[a]S.D. = Standard Deviation, C.V. = Coefficient of Variation.

APPENDIX C

INCOME DISTRIBUTION PROBABILITY

The income calculated for an optimum plan based on a given resource situation with specified alternatives is the income that would be attained if all of the input-output coefficients were constant over time at the levels entered in the programming matrix. In the real world, this is not the case. If the observed data for such a plan were available over time, or if an income sequence for a given plan is hypothesized based on historical physical production relationships and prices, the income would vary significantly from year to year. Upon examining the distribution of the incomes over the years for each of the different farm plans analyzed in this study, it was observed that these calculated incomes may approach the normal or Gaussian distribution. Although a tendency for bunchiness exists in the income sequences, the occurrence of runs at different income levels tends to balance so that the distribution of annual income nearly approaches the normal.

By making the assumption of a normal distribution, the normal density function may be used to determine the probability of income levels equal to or greater than a specified level. For example, it may be used to estimate the probability of an income equal to or greater than family living or any combination of family living and operational costs.

A useful characteristic of the normal distribution may be stated in the following manner. If X is a random, normally distributed variable with mean u and standard deviation σ, then approximately 68

percent of the X values deviate less than one standard deviation from the mean and approximately 95 percent of the X values deviate less than two standard deviations from the same mean.[1] In the same way since the normal distribution is a symetrical distribiton, 50 percent of the X values would be expected to be on either side of the mean of the population.

Since the normal distribution is completely determined by specifying its mean and standard deviation the appropriate normal distribution to analyze for each planning situation can be ascertained by these statistics for a given income sequence.[2] The proportion of the area under a normal curve between any two values is also completely determined by the mean and standard deviation. If the data is adjusted to standard units then the probability of attaining an income equal to or greater than a specified level can be determined if the use of a table of noraml areas for the normal distribution with zero mean and unit standard deviation.

The normal distribution with mean u and variance σ^2 is given by $\frac{1}{\sigma\sqrt{2\pi}}$ exp. $-1/2\left(\frac{x-u}{\sigma}\right)^2$ for $-\infty<x<\infty$.[3] Since the normal distribution is symetrical about the mean, the normal area table usually contains values only for the integral $\int_0^t \frac{1}{\sqrt{2\pi}}$ exp. $-\frac{t^2}{2}$ dt where the standard unit (t) equals $\frac{x-u}{\sigma}$.[4]

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[1]Michael J. Brennan, Jr., Preface to Econometrics (Dallas, 1960), pp. 272-275.

[2]Hoel, pp. 76-79.

[3]In this notation, exp. denotes the exponent of e as indicated.

[4]Charles D. Hodgman, ed., C.R.C., Standard Mathematical Tables, 12th ed., (Cleveland, 1959), pp. 244-249. Some textbooks designate the standard unit in terms of z or U instead of "t" as used in the table consulted.

If the sign of the standard unit (t) is negative, the normal area value from the table is added to .5, but if the sign of the standard unit (t) is positive, the normal area value from the table is subtracted from .5 to calculate the probability of X greater than some constant (C). For example, if t = -1.645, the normal area table value is .45, and the P (X>C) = .50 + .45 = .95 (Diagram 1a). Similarly, if t = +.84, the normal area table value is .30 and the P (X>C) = .50 - .30 = .20 (Diagram 1b).

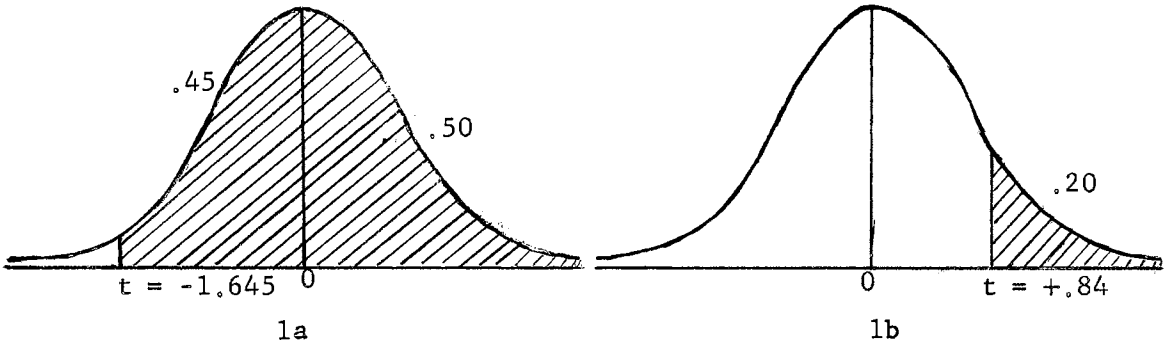

Diagram 1. Examples of standardized normal curve areas, showing probability that X assumes a value equal to or greater than a specified value.

In terms of the data for this study, the equation forms used to estimate the probability that income will be equal to or greater than a sepcified level were:

C.1 $$.50 + \int_{0}^{-t} \phi(t)\, dt = P\ (I > CE)$$

C.2 $$.50 - \int_{0}^{+t} \phi(t)\, dt = P\ (I > CE)$$

C.3 $$t = \frac{CE - \bar{I}}{S_t}$$

where $\bar{I}$ is the average income for a given farm plan, S_t is the standard deviation of the whole farm income for that plan based on a 16-year period, and CE is the income level required to cover a specified cumulation of expenditures.

APPENDIX D, TABLE I

SMALL BALANCED UNIT, OPTIMUM PLANS, 640 ACRES, 320 ACRES CROPLAND, 160 ACRES WHEAT ALLOTMENT, SELECTED ENTERPRISE COMBINATIONS, 6 AND 18 PERCENT ANNUAL CAPITAL CHARGES

Item	6 Percent Capital				18 Percent Capital			
	A	B	C	D	A	B	C	D
Wheat (Continuous)	160	160	160	112	112	95	95	95
Rotation								
Wheat				48	48	65	65	65
Grain sorghum				48	48	65	65	65
Fallow				47	48	65	65	65
Forage sorghum (Harvested)	2	2	10	1	3	1	1	1
Wheat (Grazeout)				7				
Sudan				35	1			
Johnson Grass				22	60			
Weeping Love	158	158	150					
"Go Back" Grass						29	29	29
Sage Controlled	288	288	288	288	288	288	288	-
Steers								
Moderate Graze P61			44				39	
Heavy Graze P62	123	123			51	57		
Moderate F/S P63			42					
Temp. Yearlong $P67_a$					15			
Temp. Yearlong $P67_b$					-			
Cow-Calf								
Moderate Graze P69				16				16
Temp. Yearlong $P73_a$				2				
Temp. Yearlong $P73_b$				8				
Labor Hours Used								
Operator	1,122	1,122	986	590	734	702	559	440
Hired	--	--	--	--	--	--	--	--
Total Capital	17,148	17,148	12,925	8,454	10,355	9,276	7,164	5,696
Annual Capital	16,796	16,796	12,643	8,222	10,121	9,061	7,001	5,528
Gross Returns	10,178	10,178	8,557	7,014	8,372	8,032	7,232	6,426
S.D.[a]	4,832	4,832	3,203	1,690	2,904	2,725	2,034	1,610
C.V.[a]	47.5	47.5	37.4	24.1	34.7	33.9	28.1	25.0

[a]S.D. = Standard Deviation, C.V. = Coefficient of Variation.

APPENDIX D, TABLE II

SMALL RANGE UNIT, OPTIMUM PLANS, 1600 ACRES, 320 ACRES CROPLAND, 160 ACRES WHEAT ALLOTMENT, SELECTED ENTERPRISE COMBINATIONS, 6 AND 18 PERCENT ANNUAL CAPITAL CHARGES

Item	6 Percent Capital				18 Percent Capital			
	A	B	C	D	A	B	C	D
Wheat (Continuous)	160	136	160	97	112	97	96	96
Rotation								
Wheat		24		63	48	63	64	64
Grain sorghum		24		63	48	63	64	64
Fallow		24		63	48	64	64	64
Forage sorghum (Harvested)	7	4	10	5	7	4	3	3
Wheat (Grazeout)	9							
Sudan	49							
Johnson Grass	30			29	57			
Weeping Love	65	108	150					
"Go Back" Grass						29	29	29
Sage Controlled	1,200	1,200	1,200	1,200	594	586	1,200	-
Steers								
Moderate Graze P61			165				153	
Heavy Graze P62	248	269			198	204		
Moderate F/S P63			34					
Temp. Yearlong $P67_a$	6				14			
Temp. Yearlong $P67_b$	23				-			
Cow-Calf								
Moderate Graze P69				74				61
Temp. Yearlong $P73_a$				3				
Labor Hours Used								
Operator	2,063	2,070	1,838	1,089	1,851	1,822	1,429	948
Hired	267	261	--	55	--	--	--	--
Total Capital	36,758	35,670	27,215	20,474	27,809	26,828	21,636	15,372
Annual Capital	35,852	34,800	26,668	19,932	27,236	26,265	20,993	14,955
Gross Returns	18,744	18,532	15,068	11,888	16,184	15,869	13,784	10,463
S.D.[a]	10,102	10,088	6,695	2,927	8,005	7,831	5,376	2,568
C.V.[a]	53.9	54.4	44.4	24.6	49.5	49.4	39.0	24.5

[a]S.D. = Standard Deviation, C.V. = Coefficient of Variation.

APPENDIX D, TABLE III

LARGE BALANCED UNIT, OPTIMUM PLANS, 1920 ACRES, 960 ACRES CROPLAND, 480 ACRES WHEAT ALLOTMENT, SELECTED ENTERPRISE COMBINATIONS, 6 AND 18 PERCENT ANNUAL CAPITAL CHARGES

Item	6 Percent Capital				18 Percent Capital			
	A	B	C	D	A	B	C	D
Wheat (Continuous)	480	340	338	287	287	285	284	285
Rotation								
Wheat		140	142	193	193	195	196	195
Grain sorghum		140	142	193	193	195	196	195
Fallow		140	142	193	193	195	196	195
Forage sorghum (Harvested)	19	4	3	4	5	4	2	4
Wheat (Grazeout)	27							
Sudan	143			1				
Johnson Grass	291			89	89			
Weeping Love		196	193					
"Go Back" Grass						86	86	86
Sage Controlled	864	864	864	864	-	-	864	-
Steers								
Moderate Graze P61			158				116	
Heavy Graze P62	133	237			116	139		
Temp. Yearlong $P67_a$	77				17			
Temp. Yearlong $P67_b$	68				-			
Cow-Calf								
Moderate Graze P69				52	3			47
Temp. Yearlong $P73_a$				9				
Labor Hours Used								
Operator	1,989	1,989	1,887	1,452	1,796	1,824	1,680	1,821
Hired	596	657	172	68	40	37	--	--
Total Capital	41,541	36,829	26,993	21,317	23,274	23,067	21,407	16,884
Annual Capital	40,261	35,630	26,285	20,696	22,677	22,473	20,893	16,384
Gross Returns	27,352	26,634	23,112	20,413	22,493	22,384	21,655	19,187
S.D.[a]	10,780	10,232	7,051	5,026	6,968	7,280	6,081	4,812
C.V.[a]	39.4	38.4	30.5	24.6	31.0	32.5	28.1	25.1

[a]S.D. = Standard Deviation, C.V. = Coefficient of Variation.

APPENDIX D, TABLE IV

LARGE RANGE UNIT, OPTIMUM PLANS, 2640 ACRES, 160 ACRES CROPLAND, 80 ACRES WHEAT ALLOTMENT, SELECTED ENTERPRISE COMBINATIONS, 6 AND 18 PERCENT ANNUAL CAPITAL CHARGES

	6 Percent Capital				18 Percent Capital			
Item	A	B	C	D	A	B	C	D
Wheat (Continuous)	80	60	58	52	50	50	50	51
Rotation								
Wheat		20	22	28	30	30	30	29
Grain sorghum		20	22	28	30	30	30	29
Fallow		20	22	28	30	30	30	29
Forage sorghum (Harvested)	10	7	5	10	6	6	6	8
Wheat (Grazeout)	3							
Sudan	24							
Johnson Grass	43			14	14			
Weeping Love		33	31					
"Go Back" Grass						14	14	14
Sage Controlled	2,348	2,348	2,348	2,348	-	-	-	-
Steers								
Moderate Graze P61			303		234	236	236	
Heavy Graze P62	434	451						
Temp. Yearlong $P67_a$	10				3			
Temp. Yearlong $P67_b$	12				-			
Cow-Calf								
Moderate Graze P69				146				118
Temp. Yearlong $P73_a$				2				
Labor Hours Used								
Operator	1,989	1,989	1,948	1,159	1,773	1,768	1,768	1,051
Hired	1,568	1,581	496	644	164	161	161	398
Total Capital	59,391	58,815	40,165	36,747	29,080	28,916	28,916	27,010
Annual Capital	57,276	56,709	39,095	35,436	28,371	28,212	28,212	26,065
Gross Returns	26,432	26,340	19,727	15,746	16,130	16,050	16,050	13,061
S.D.[a]	16,506	16,514	9,884	4,210	7,762	7,754	7,754	3,454
C.V.[a]	62.4	62.7	50.1	26.7	48.1	48.3	48.3	26.5

[a]S.D. = Standard Deviation, C. V. = Coefficient of Variation.

APPENDIX D, TABLE V

LARGE CROP UNIT, OPTIMUM PLANS, 1400 ACRES, 1240 ACRES CROPLAND, 620 ACRES WHEAT ALLOTMENT, SELECTED ENTERPRISE COMBINATIONS, 6 AND 18 PERCENT ANNUAL CAPITAL CHARGES

Item	6 Percent Capital				18 Percent Capital			
	A	B	C	D	A	B	C	D
Wheat (Continuous)	610	517	435	434	372	366	366	366
Rotation								
Wheat	10	103	185	186	248	254	254	254
Grain sorghum	10	103	185	186	248	254	254	254
Fallow	10	103	185	186	248	253	253	253
Forage sorghum (Harvested)	17	3	1	1	4	1	1	1
Wheat (Grazeout)	27							
Sudan	186			2	1			
Johnson Grass	200			241	119			
Weeping Love	170	411	249	4				
"Go Back" Grass						112	112	112
Sage Controlled	90	90	90	90	90	90	90	-
Steers								
Moderate Graze P61			75				21	
Heavy Graze P62	68	189			12	31		
Temp. Yearlong $P67_a$	48				24			
Temp. Yearlong $P67_b$	88				-			
Cow-Calf								
Moderate Graze P69								9
Temp. Yearlong $P73_a$				31				
Labor Hours Used								
Operator	1,935	1,989	1,514	1,368	1,289	1,264	1,187	1,133
Hired	400	553	164	27	--	--	--	--
Total Capital	33,073	32,238	18,425	15,617	13,394	12,476	11,309	10,678
Annual Capital	33,086	31,176	17,856	15,139	13,002	12,095	10,951	10,320
Gross Returns	26,727	26,447	22,478	20,959	21,446	20,996	20,549	20,150
S.D.[a]	9,234	9,240	6,097	5,450	5,613	5,601	5,413	5,355
C.V.[a]	34.6	34.9	27.1	26.0	26.2	26.7	26.3	26.6

[a]S.D. = Standard Deviation, C.V. = Coefficient of Variation.

APPENDIX E, TABLE I

OWNER-OPERATOR, EXPECTED RETURNS, AVERAGE LIVING ALLOWANCE AND OPERATION EXPENSES, EIGHT SELECTED PLANS, SMALL BALANCED UNIT

Item	Plan Number							
	6A	6B	6C	6D	18A	18B	18C	18D
	- Dollars -							
Gross Income	10,178	10,178	8,557	7,014	8,372	8,032	7,232	6,426
Family Living	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Nondeferable								
Enterprise	3,475	3,475	2,966	2,047	2,592	2,493	2,199	1,796
General	696	696	696	696	696	696	696	696
Real Estate Taxes	358	358	358	358	358	358	358	358
Annual Depreciation	258	258	230	236	228	217	202	198
6 Pct. Annual Capital	1,008	1,008	759	493	607	544	420	332
5 Pct. Land Capital	1,972	1,972	1,972	1,972	1,972	1,972	1,972	1,972
Management Returns[a]	-1,089	-1,089	-1,924	-2,288	-1,581	-1,748	-2,115	-2,426
Returns Available for Reserves or Debt Payment with Average Family Living[b]	1,891	1,891	807	177	998	768	277	-122

[a]Family living or returns on capital would be reduced by the amount of negative returns shown for management.

[b]If part of the annual operating capital is borrowed, these figures are reduced by the average interest on such loans. Included in these figures are returns to annual capital, land equity, and management.

APPENDIX E, TABLE II

OWNER-OPERATOR, EXPECTED RETURNS, AVERAGE LIVING ALLOWANCE AND OPERATION EXPENSES, EIGHT SELECTED PLANS, SMALL RANGE UNIT

Item	Plan Number							
	6A	6B	6C	6D	18A	18B	18C	18D
	- Dollars -							
Gross Income	18,744	18,532	15,068	11,888	16,184	15,869	13,784	10,463
Family Living	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Nondeferable								
Enterprise	6,574	6,505	5,051	3,392	5,097	4,998	4,316	2,682
General	696	696	696	696	696	696	696	696
Real Estate Taxes	589	589	589	589	589	589	589	589
Annual Depreciation	416	394	327	320	354	344	300	281
6 Pct. Annual Capital	2,151	2,088	1,600	1,196	1,634	1,576	1,260	897
5 Pct. Land Capital	3,652	3,652	3,652	3,652	3,652	3,652	3,652	3,652
Management Returns[a]	1,166	1,108	-347	-1,457	662	514	-529	-1,834
Returns Available for Reserves or Debt Payment with Average Family Living[b]	6,969	6,848	4,905	3,391	5,948	5,742	4,383	2,715

[a]For the four plans which show negative returns for management, returns to capital or family living would be reduced by the amount shown.

[b]If part of the annual operating capital is borrowed, these figures are reduced by the average interest on such loans. Included in these figures are returns to annual capital, land equity, and management.

APPENDIX E, TABLE III

OWNER-OPERATOR, EXPECTED RETURNS, AVERAGE LIVING ALLOWANCE AND OPERATION EXPENSES, EIGHT SELECTED PLANS, LARGE BALANCED UNIT

Item	Plan Number							
	6A	6B	6C	6D	18A	18B	18C	18D
	- Dollars -							
Gross Income	27,352	26,634	23,112	20,413	22,493	22,384	21,655	19,187
Family Living	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Nondeferable								
Enterprise	9,444	9,427	7,532	5,994	6,810	6,790	6,561	5,377
General	1,157	1,157	1,157	1,157	1,157	1,157	1,157	1,157
Real Estate Taxes	1,075	1,075	1,075	1,075	1,075	1,075	1,075	1,075
Annual Depreciation	772	712	644	639	646	624	603	591
6 Pct. Annual Capital	2,416	2,138	1,577	1,242	1,361	1,348	1,254	983
5 Pct. Land Capital	5,915	5,915	5,915	5,915	5,915	5,915	5,915	5,915
Management Returns	3,073	2,710	1,712	891	2,029	1,975	1,590	589
Returns Available for Reserves or Debt Payment with Average Family Living[a]	11,404	10,763	9,204	8,048	9,305	9,238	8,759	7,487

[a]If part of the annual operating capital is borrowed, these figures are reduced by the average interest on such loans. Included in these figures are returns to annual capital, land equity, and management.

APPENDIX E, TABLE IV

OWNER-OPERATOR, EXPECTED RETURNS, AVERAGE LIVING ALLOWANCE AND OPERATION EXPENSES, EIGHT SELECTED PLANS, LARGE RANGE UNIT

Item	Plan Number							
	6A	6B	6C	6D	18A	18B	18C	18D
	- Dollars -							
Gross Income	26,432	26,340	19,727	15,746	16,130	16,050	16,050	13,061
Family Living	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Nondeferable								
Enterprise	10,744	10,758	6,977	5,077	4,893	4,863	4,863	3,581
General	1,157	1,157	1,157	1,157	1,157	1,157	1,157	1,157
Real Estate Taxes	736	736	736	736	736	736	736	736
Annual Depreciation	483	474	345	364	293	288	288	304
6 Pct. Annual Capital	3,437	3,403	2,346	2,126	1,702	1,693	1,693	1,564
5 Pct. Land Capital	5,046	5,046	5,046	5,046	5,046	5,046	5,046	5,046
Management Returns[a]	1,329	1,266	-380	-2,260	-1,197	-1,233	-1,233	-2,827
Returns Available for Reserves or Debt Payment with Average Family Living[b]	9,812	9,715	7,012	4,912	5,551	5,506	5,506	3,783

[a]For the six plans which show negative returns for management, returns to capital or family living would be reduced by the amount shown.

[b]When part of the annual operating capital is borrowed, these figures are reduced by the average interest on such loans. Included in these figures are returns to annual capital, land equity, and management.

APPENDIX E, TABLE V

OWNER-OPERATOR, EXPECTED RETURNS, AVERAGE LIVING ALLOWANCE AND OPERATION EXPENSES, EIGHT SELECTED PLANS, LARGE CROPLAND UNIT

Item	Plan Number							
	6A	6B	6C	6D	18A	18B	18C	18D
	- Dollars -							
Gross Income	26,727	26,447	22,478	20,959	21,446	20,996	20,549	20,150
Family Living	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Nondeferable								
Enterprise	9,104	9,412	7,253	6,141	6,425	6,259	6,105	5,912
General	1,157	1,157	1,157	1,157	1,157	1,157	1,157	1,157
Real Estate Taxes	1,130	1,130	1,130	1,130	1,130	1,130	1,130	1,130
Annual Depreciation	861	789	718	713	709	676	667	666
6 Pct. Annual Capital	1,985	1,871	1,071	908	780	726	657	619
5 Pct. Land Capital	5,750	5,750	5,750	5,750	5,750	5,750	5,750	5,750
Management Returns	3,240	2,838	1,899	1,660	1,995	1,798	1,583	1,416
Returns Available for Reserves or Debt Payment with Average Family Living[a]	10,975	10,459	8,720	8,318	8,525	8,274	7,990	7,785

[a]When part of the annual operating capital is borrowed, these figures are reduced by the average interest on such loans. Included in these figures are returns to annual capital, land equity, and management.

APPENDIX E, TABLE VI

PART OWNER (50 PERCENT OWNED AND 50 PERCENT RENTED), EXPECTED RETURNS, AVERAGE LIVING ALLOWANCE AND OPERATING EXPENSES, FOUR SELECTED PLANS FOR THE BALANCED UNITS

Item	I Small Balanced Unit				III Large Balanced Unit			
	6A	6C	6D	18A	6A	6C	6D	18A
	- Dollars -							
Gross Income	10,178	8,557	7,014	8,372	27,352	23,112	20,413	22,493
Family Living	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Landlord Share	1,166	1,166	1,166	1,166	3,497	3,497	3,497	3,497
Nondeferable								
Enterprise	3,475	2,966	2,047	2,592	9,444	7,532	5,994	6,810
Overhead	696	696	696	696	1,157	1,157	1,157	1,157
Real Estate Taxes	179	179	179	179	537	537	537	537
Depreciation	258	230	236	228	772	644	639	646
6 Pct. Annual Capital	1,008	759	493	607	2,416	1,577	1,242	1,361
5 Pct. Land Capital	986	986	986	986	2,958	2,958	2,958	2,958
Management	-1,090	-1,925	-2,289	-1,582	3,071	1,710	889	2,027
Returns Available for Reserves or Debt Payment with Average Family Living	904	-180	-810	11	8,445	6,245	5,089	6,346

APPENDIX E, TABLE VII

ENCUMBERED OWNER, EXPECTED RETURNS, AVERAGE LIVING ALLOWANCE, LAND PAYMENT, AND OPERATING EXPENSES, FOUR SELECTED PLANS FOR THE BALANCED UNITS

Item	I Small Balanced Unit				III Large Balanced Unit			
	6A	6C	6D	18A	6A	6C	6D	18A
	- Dollars -							
Gross Income	10,178	8,557	7,014	8,372	27,352	23,112	20,413	22,493
Family Living	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Nondeferable								
Enterprise	3,475	2,966	2,047	2,592	9,444	7,532	5,994	6,810
Overhead	696	696	696	696	1,157	1,157	1,157	1,157
Land Payment[a]								
Principal	597	597	597	597	1,792	1,792	1,792	1,792
Interest	635	635	635	635	1,904	1,904	1,904	1,904
Real Estate Taxes	358	358	358	358	1,075	1,075	1,075	1,075
Depreciation	258	230	236	228	772	644	639	646
6 Pct. Annual Capital	1,008	759	493	607	2,416	1,577	1,242	1,361
5 Pct. Land Capital	1,337	1,337	1,337	1,337	4,011	4,011	4,011	4,011
Management[b]	-1,686	-2,521	-2,885	-2,178	1,281	-80	-901	237
Returns Available for Reserves or Debt Payment with Average Family Living	659	-425	-1,055	-234	7,708	5,508	4,352	5,609

[a]Land payment when one-half the land is purchased amortized at five percent for 33 years.

[b]Residual to management after payments on land and interest on investment have been allocated. These figures plus principal payment on land are net returns to management.

APPENDIX E, TABLE VIII

TENANT-OPERATOR, EXPECTED RETURNS, AVERAGE LIVING ALLOWANCE AND OPERATING EXPENSES, FOUR SELECTED PLANS FOR THE BALANCED UNITS

Item	I Small Balanced Unit				III Large Balanced Unit			
	6A	6C	6D	18A	6A	6C	6D	18A
	- Dollars -							
Gross Income	10,178	8,557	7,014	8,372	27,352	23,112	20,413	22,493
Family Living	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Landlord Share	2,331	2,331	2,331	2,331	6,993	6,993	6,993	6,993
Nondeferable								
Enterprise	3,475	2,966	2,047	2,592	9,444	7,532	5,994	6,810
Overhead	696	696	696	696	1,157	1,157	1,157	1,157
Depreciation	258	230	236	228	772	644	639	646
6 Pct. Annual Capital	1,008	759	493	607	2,416	1,577	1,242	1,361
Management Returns	-1,090	-1,925	-2,289	-1,582	3,070	1,709	888	2,026
Returns Available for Reserves or Debt Payment with Average Family Living	-82	-1,166	-1,796	-975	5,486	3,286	2,130	3,387

APPENDIX E, TABLE IX

PART OWNER (50 PERCENT OWNED AND 50 PERCENT RENTED), EXPECTED RETURNS, AVERAGE LIVING ALLOWANCE AND OPERATING EXPENSES, FOUR SELECTED PLANS FOR THE RANGE UNITS

Item	II Small Range Unit				IV Large Range Unit			
	6A	6C	6D	18A	6A	6C	6D	18A
	- Dollars -							
Gross Income	18,744	15,068	11,888	16,184	26,432	19,727	15,746	16,130
Family Living	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Landlord Share	2,100	2,100	2,100	2,100	2,842	2,842	2,842	2,842
Nondeferable								
Enterprise	6,574	5,051	3,392	5,097	10,744	6,977	5,077	4,893
Overhead	696	696	696	696	1,157	1,157	1,157	1,157
Real Estate Taxes	295	295	295	295	368	368	368	368
Depreciation	416	327	320	354	483	345	364	293
6 Pct. Annual Capital	2,151	1,600	1,196	1,634	3,437	2,346	2,126	1,702
5 Pct. Land Capital	1,826	1,826	1,826	1,826	2,523	2,523	2,523	2,523
Management	1,186	-327	-1,437	682	1,378	-331	-2,211	-1,148
Returns Available for Reserves or Debt Payment with Average Family Living	5,163	3,099	1,585	4,142	7,338	4,538	2,438	3,077

APPENDIX E, TABLE X

ENCUMBERED OWNER, EXPECTED RETURNS, AVERAGE LIVING ALLOWANCE, LAND PAYMENT, AND OPERATING EXPENSES, FOUR SELECTED PLANS FOR THE RANGE UNITS

Item	II Small Range Unit				IV Large Range Units			
	6A	6C	6D	18A	6A	6C	6D	18A
	- Dollars -							
Gross Income	18,744	15,068	11,888	16,184	26,432	19,727	15,746	16,130
Family Living	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Nondeferable								
Enterprise	6,574	5,051	3,392	5,097	10,744	6,977	5,077	4,893
Overhead	696	696	696	696	1,157	1,157	1,157	1,157
Land Payment[a]								
Principal	1,107	1,107	1,107	1,107	1,529	1,529	1,529	1,529
Interest	1,175	1,175	1,175	1,175	1,624	1,624	1,624	1,624
Real Estate Taxes	589	589	589	589	736	736	736	736
Depreciation	416	327	320	354	483	345	364	293
6 Pct. Annual Capital	2,151	1,600	1,196	1,634	3,437	2,346	2,126	1,702
5 Pct. Land Capital	2,477	2,477	2,477	2,477	3,422	3,422	3,422	3,422
Management[b]	59	-1,454	-2,564	-445	-200	-1,909	-3,789	-2,726
Returns Available for Reserves or Debt Payment with Average Family Living	4,687	2,623	1,109	3,666	6,659	3,859	1,759	2,394

[a]Land payment when one-half the land is amortized at five percent for 33 years.

[b]Residual to management after payments on land and interest on investment have been allocated. These figures plus principal payment on land are net returns to management.

APPENDIX E, TABLE XI

TENANT-OPERATOR, EXPECTED RETURNS, AVERAGE LIVING ALLOWANCE AND OPERATION EXPENSES, FOUR SELECTED PLANS FOR THE RANGE UNITS

Item	II Small Range Unit				IV Large Range Unit			
	6A	6C	6D	18A	6A	6C	6D	18A
	- Dollars -							
Gross Income	18,744	15,068	11,888	16,184	26,432	19,727	15,746	16,130
Family Living	3,500	3,500	3,500	3,500	3,500	3,500	3,500	3,500
Landlord Share	4,201	4,201	4,201	4,201	5,683	5,683	5,683	5,683
Nondeferable								
Enterprise	6,574	5,051	3,392	5,097	10,744	6,977	5,077	4,893
Overhead	696	696	696	696	1,157	1,157	1,157	1,157
Depreciation	416	327	320	354	483	345	364	293
6 Pct. Annual Capital	2,151	1,600	1,196	1,634	3,437	2,346	2,126	1,702
Management Returns	1,206	-307	-1,417	702	1,428	-281	-2,161	-1,098
Returns Available for Reserves or Debt Payment with Average Family Living	3,357	1,293	-221	2,336	4,865	2,065	-35	604

APPENDIX E, TABLE XII

PART OWNER (50 PERCENT OWNED AND 50 PERCENT RENTED), EXPECTED RETURNS, AVERAGE LIVING ALLOWANCE AND OPERATING EXPENSES, FOUR SELECTED PLANS FOR THE CROPLAND UNIT

Item	V Cropland Unit			
	6A	6C	6D	18A
	- Dollars -			
Gross Income	26,727	22,478	20,959	21,446
Family Living	3,500	3,500	3,500	3,500
Landlord Share	3,466	3,466	3,466	3,466
Nondeferable				
Enterprise	9,104	7,253	6,141	6,425
Overhead	1,157	1,157	1,157	1,157
Real Estate Taxes	565	565	565	565
Depreciation	861	718	713	709
6 Pct. Annual Capital	1,985	1,071	908	780
5 Pct. Land Capital	2,875	2,875	2,875	2,875
Management	3,214	1,873	1,634	1,969
Returns Available for Reserves or Debt Payment with Average Family Living	8,074	5,819	5,417	5,624

APPENDIX E, TABLE XIII

ENCUMBERED OWNER, EXPECTED RETURNS, AVERAGE LIVING ALLOWANCE, LAND PAYMENT, AND OPERATING EXPENSES, FOUR SELECTED PLANS FOR THE CROPLAND UNIT

Item	V Cropland Unit			
	6A	6C	6D	18A
	- Dollars -			
Gross Income	26,727	22,478	20,959	21,446
Family Living	3,500	3,500	3,500	3,500
Nondeferable				
Enterprise	9,104	7,253	6,141	6,425
Overhead	1,157	1,157	1,157	1,157
Land Payment[a]				
Principal	1,742	1,742	1,742	1,742
Interest	1,851	1,851	1,851	1,851
Real Estate Taxes	1,130	1,130	1,130	1,130
Depreciation	861	718	713	709
6 Pct. Annual Capital	1,985	1,071	908	780
5 Pct. Land Capital	3,899	3,899	3,899	3,899
Management[b]	1,498	157	-82	253
Returns Available for Reserves or Debt Payment with Average Family Living	7,382	5,127	4,725	4,932

[a]Land payment when one-half the land is purchased amortized at five percent for 33 years.

[b]Residual to management after payments on land and interest on investment have been allocated. These figures plus principal payment on land are net returns to management.

APPENDIX E, TABLE XIV

TENANT-OPERATOR, EXPECTED RETURNS, AVERAGE LIVING ALLOWANCE AND OPERATION EXPENSES, FOUR SELECTED PLANS FOR THE CROPLAND UNIT

Item	V Large Cropland Unit			
	6A	6C	6D	18A
	- Dollars -			
Gross Income	26,727	22,478	20,959	21,446
Family Living	3,500	3,500	3,500	3,500
Landlord Share	6,931	6,931	6,931	6,931
Nondeferable				
Enterprise	9,104	7,253	6,141	6,425
Overhead	1,157	1,157	1,157	1,157
Depreciation	861	718	713	709
6 Pct. Annual Capital	1,985	1,071	908	780
Management Returns	3,189	1,848	1,609	1,944
Returns Available for Reserves or Debt Payment with Average Family Living	5,174	2,919	2,517	2,724

APPENDIX F, TABLE I

EXAMPLE OF THE DERIVED SEQUENCE OF GROSS FARM INCOME FOR A SPECIFIC PLAN

Base Period (k)	Enterprise (i) Wheat (Y_{ik})	Milo (Y_{ik})	P69 (Y_{ik})	$P73_a$ (Y_{ik})	Gross Income (I_{ik})
1942	8,831	4,928	4,404	827	18,990
1943	11,813	3,658	4,213	737	20,421
1944	18,386	2,955	4,859	809	27,009
1945	14,072	5,008	5,027	832	24,939
1946	15,140	1,050	5,625	906	22,721
1947	10,517	4,932	5,027	861	21,337
1948	8,470	2,210	5,098	990	16,768
1949	12,052	1,054	5,290	911	19,307
1950	11,452	4,915	7,133	1,195	24,695
1951	11,734	6,968	7,420	1,150	27,272
1952	18,863	3,175	4,883	782	27,703
1953	6,149	5,351	3,399	556	15,455
1954	8,637	2,481	3,112	594	14,824
1955	5,991	1,880	3,399	606	11,876
1956	6,008	4,623	2,633	506	13,770
1957	12,749	2,637	3,423	716	19,525
$\bar{Y}_i$	11,304	3,614	4,684	811	20,413($\bar{I}$)
S.D.[a]	3,979	1,700	1,344	197	5,026
C.V.[a]	35.2	47.0	28.7	24.2	24.6

[a] S.D. = Standard Deviation, C.V. = Coefficient of Variation.

Method of Deriving Data for Income Sequences

The sequences of whole farm income for the programmed plans were derived from the sequences of gross deflated returns per acre (Table IX) and the returns for the enterprises in each of the programmed plans (Appendix D). The example shown is for the high capital level cow-calf plan on the large balanced farm unit. From Plan 6D, the following enterprise gross incomes were obtained:

Enterprise (i)	$\bar{Y}$
Wheat	$11,304
Milo	3,614
Cow-calf(P69)	4,684
Cow-calf($P73_a$)	811

The computational form used to derive the sequences of enterprise returns was:

$$\frac{\bar{Y}_i}{\bar{X}_i} X_{ik} = Y_{ik}$$

where

$\bar{Y}_i$ is defined as the programmed returns from the i^{th} enterprise

$\bar{X}_i$ is the deflated average per acre return from the i^{th} enterprise, and

X_{ik} is the deflated return per acre from the i^{th} enterprise in the k^{th} period.

The computed value Y_{ik} is the expected gross income for the farm plan from the i^{th} enterprise in the k^{th} period.

The computed gross farm income, which is the sum of the enterprise returns in the k^{th} period, is given by:

$$\sum_{i=1}^{n} Y_{ik} = I_k \qquad 1 \leq k \leq p$$

If the computations are mathematically correct, the following equation should check except for rounding error.

$$\frac{1}{p} \sum_{k=1}^{p} \sum_{i=1}^{n} Y_{ik} = \sum_{i=1}^{n} \bar{Y}_i = \bar{I}$$

where

n is the number of enterprises

p is the number of income periods, and

I_k is the computed gross farm income for the k^{th} period.

The derived sequence of gross farm income can also be used to check the accuracy of equation 2.2, Chapter II. If the unbiased estimate of the variance of the sequence of estimated gross income is computed, the value obtained should be the same as the value calculated using equation 2.2, except for rounding error.

Tables II through XIII in this appendix were derived from the total gross farm income sequences by subtracting operating expenditures including average family living. The residual represents the sequence of expected returns to annual operating capital, land equity, and management.

APPENDIX F, TABLE II

OWNER-OPERATOR, FULL EQUITY, RETURNS TO ANNUAL CAPITAL, LAND, AND MANAGEMENT, BY INCOME PERIODS

Base Period (Year)	I Small Balanced Unit				III Large Balanced Unit			
	6A	6C	6D	18A	6A	6C	6D	18A
	-Dollars-							
1942	864	-968	-386	680	11,486	5,895	6,625	8,217
1943	-110	-1,137	143	-46	8,134	5,878	8,056	7,420
1944	6,269	3,943	2,426	4,227	22,277	17,416	14,644	17,913
1945	5,120	2,958	1,578	3,445	19,002	15,345	12,574	15,930
1946	7,076	4,434	1,206	3,530	21,736	15,551	10,356	14,654
1947	705	146	416	608	10,522	8,644	8,972	8,895
1948	635	-184	-796	88	13,243	5,158	4,403	5,364
1949	1,550	380	82	391	11,858	6,823	6,942	7,011
1950	12,125	7,702	1,730	6,856	34,251	22,904	12,330	21,929
1951	8,238	4,790	2,373	4,784	19,992	19,201	14,907	19,363
1952	-4,006	-942	2,614	-706	3,130	8,802	15,338	7,845
1953	-5,213	-4,163	-1,788	-3,277	-6,890	-773	3,090	-161
1954	1,594	1,294	-1,725	-17	8,229	8,146	2,459	5,855
1955	-2,983	-2,619	-2,656	-3,106	-3,407	-591	-489	-1,474
1956	-3,721	-2,969	-2,307	-2,663	-3,305	818	1,405	607
1957	2,112	246	-85	1,171	12,208	8,047	7,160	9,515
$\bar{X}$	1,891	807	177	998	11,404	9,204	8,048	9,305
S.D.[a]	4,832	3,203	1,690	2,904	10,780	7,051	5,026	6,968

[a] S.D. = Standard Deviation.

APPENDIX F, TABLE III

OWNER-OPERATOR, FULL EQUITY, RETURNS TO ANNUAL CAPITAL, LAND, AND MANAGEMENT, BY INCOME PERIODS

Base Period (Year)	II Small Range Unit				IV Large Range Unit			
	6A	6C	6D	18A	6A	6C	6D	18A
	-Dollars-							
1942	6,235	1,834	2,600	5,327	8,985	3,276	3,909	2,614
1943	2,290	194	2,879	2,341	2,089	-320	3,663	-154
1944	13,827	9,195	5,785	11,706	18,702	11,200	6,489	9,054
1945	13,025	8,723	5,265	11,192	18,910	12,095	6,545	9,726
1946	16,664	11,692	5,202	13,199	24,766	15,830	7,840	12,384
1947	4,835	3,705	4,064	4,448	6,563	5,585	5,947	4,496
1948	6,367	3,798	2,636	4,577	8,859	6,077	5,438	4,724
1949	6,100	3,605	3,698	4,644	7,946	4,505	6,386	3,470
1950	29,948	20,798	7,478	23,898	47,540	31,311	12,088	24,667
1951	20,003	13,943	8,638	17,148	31,995	21,013	13,232	16,663
1952	-8,667	-2,308	6,041	-5,631	-19,282	-6,443	6,662	-4,701
1953	-7,127	-4,437	326	-4,806	-11,418	-5,365	641	-4,238
1954	7,048	7,148	-179	5,595	11,138	11,155	-162	8,550
1955	-2,320	-798	-845	-1,929	-3,230	-164	118	-442
1956	-3,671	-1,616	-1,066	-2,373	-5,707	-1,108	-1,652	-965
1957	6,957	3,003	1,727	5,834	9,132	3,544	1,448	2,869
$\bar{X}$	6,969	4,905	3,391	5,948	9,812	7,012	4,912	5,551
S.D.[a]	10,102	6,695	2,927	8,005	16,506	9,884	4,210	7,762

[a] S.D. = Standard Deviation.

APPENDIX F, TABLE IV

OWNER-OPERATOR, FULL EQUITY, RETURNS TO ANNUAL CAPITAL, LAND, AND MANAGEMENT BY INCOME PERIODS

Base Period (Year)	V Large Cropland Unit			
	6A	6C	6D	18A
	- Dollars -			
1942	10,404	5,936	6,456	7,439
1943	9,709	7,586	8,765	8,502
1944	22,699	18,015	16,837	17,280
1945	18,213	14,768	13,335	14,446
1946	19,981	13,288	11,104	10,974
1947	10,943	8,625	8,759	8,997
1948	11,724	3,606	3,891	3,879
1949	11,816	6,615	7,126	6,185
1950	27,657	16,151	11,104	13,400
1951	16,244	15,898	13,321	14,365
1952	9,601	14,454	17,574	15,841
1953	-5,484	835	2,465	2,402
1954	6,565	5,330	3,012	3,564
1955	-3,621	-1,361	-963	-1,807
1956	-2,896	1,023	1,398	1,763
1957	12,041	8,750	8,907	9,171
$\bar{X}$	10,975	8,720	8,318	8,525
S.D.[a]	9,234	6,097	5,450	5,613

[a] S.D. = Standard Deviation.

APPENDIX F, TABLE V

PART OWNER (50 PERCENT OWNED AND 50 PERCENT RENTED), RETURNS TO ANNUAL OPERATING CAPITAL, LAND EQUITY, AND MANAGEMENT, BY INCOME PERIODS

Base Period (Year)	I Small Balanced Unit				III Large Balanced Unit			
	6A	6C	6D	18A	6A	6C	6D	18A
	-Dollars-							
1942	-73	-1,905	-1,323	-257	8,676	3,085	3,814	5,406
1943	-1,127	-2,154	-874	-1,063	5,084	2,828	5,005	4,369
1944	4,934	2,608	1,091	2,892	18,272	13,411	10,638	13,907
1945	3,886	1,724	344	2,211	15,300	11,643	8,871	12,227
1946	6,049	3,407	179	2,503	18,657	12,472	7,277	11,575
1947	-326	-885	-615	-423	7,429	5,551	5,878	5,801
1948	-100	-919	-1,531	-647	11,038	2,953	2,197	3,158
1949	695	-475	-773	-464	9,293	4,258	4,376	4,445
1950	11,042	6,619	647	5,773	31,004	19,657	9,082	18,681
1951	7,002	3,554	1,137	3,548	16,285	15,494	11,199	15,655
1952	-5,383	-2,319	1,237	-2,083	-1,000	4,672	11,208	3,715
1953	-6,030	-4,980	-2,605	-4,094	-9,340	-3,223	639	-2,612
1954	831	531	-2,488	-780	5,942	5,859	172	3,568
1955	-3,558	-3,194	-3,231	-3,681	-5,132	-2,316	-2,215	-3,200
1956	-4,482	-3,730	-3,068	-3,424	-5,587	-1,464	-878	-1,675
1957	1,111	-755	-1,086	170	9,206	5,045	4,157	6,512
$\bar{X}$	904	-180	-810	11	8,445	6,245	5,089	6,346
S.D.[a]	4,731	3,083	1,504	2,762	10,430	6,573	4,363	6,466

[a]S.D. = Standard Deviation.

APPENDIX F, TABLE VI

PART OWNER (50 PERCENT OWNED AND 50 PERCENT RENTED), RETURNS TO ANNUAL OPERATING CAPITAL, LAND EQUITY, AND MANAGEMENT, BY INCOME PERIODS

Base Period (Year)	II Small Range Unit				IV Large Range Unit			
	6A	6C	6D	18A	6A	6C	6D	18A
	-Dollars-							
1942	4,476	77	844	3,570	6,536	827	1,460	264
1943	453	-1,643	1,043	504	-399	-2,808	1,175	-2,643
1944	11,671	7,040	3,631	9,551	16,054	8,553	3,841	6,405
1945	10,970	6,668	3,211	9,137	16,312	9,497	3,947	7,127
1946	14,817	9,845	3,356	11,352	22,272	13,336	5,346	9,889
1947	2,984	1,854	2,214	2,597	4,068	3,090	3,452	2,000
1948	4,812	2,243	1,082	3,022	6,511	3,729	3,090	2,375
1949	4,425	1,930	2,024	2,969	5,538	2,097	3,978	1,061
1950	28,041	18,896	5,577	21,996	45,018	28,789	9,566	22,144
1951	17,947	11,887	6,583	15,092	29,397	18,415	10,634	14,064
1952	-10,864	-4,505	3,845	-7,828	-21,950	-9,111	3,994	-7,370
1953	-8,764	-6,074	-1,310	-6,443	-13,807	-7,754	-1,748	-6,623
1954	5,465	5,565	-1,759	4,012	8,778	8,794	-2,523	6,188
1955	-3,715	-2,193	-2,237	-3,324	-5,498	-2,432	-2,150	-2,711
1956	-5,252	-3,197	-2,644	-3,954	-8,068	-3,469	-4,013	-3,327
1957	5,134	1,182	-93	4,013	6,651	1,063	-1,033	387
$\bar{X}$	5,163	3,099	1,585	4,142	7,338	4,538	2,438	3,077
S.D.[a]	10,074	6,609	2,739	7,917	16,473	9,850	4,134	7,743

[a] S.D. = Standard Deviation.

APPENDIX F, TABLE VII

PART OWNER (50 PERCENT OWNED AND 50 PERCENT RENTED), RETURNS TO ANNUAL OPERATING CAPITAL, LAND EQUITY, AND MANAGEMENT BY INCOME PERIODS

Base Period (Year)	V Large Cropland Unit			
	6A	6C	6D	18A
	- Dollars -			
1942	7,695	3,227	3,746	4,729
1943	6,690	4,567	5,745	5,482
1944	18,447	13,763	12,584	13,027
1945	14,352	10,907	9,473	10,584
1946	16,926	10,233	8,048	7,918
1947	7,869	5,551	5,684	5,922
1948	9,797	1,679	1,963	1,951
1949	9,424	4,223	4,733	3,792
1950	24,384	12,878	7,830	10,126
1951	12,377	12,031	9,453	10,497
1952	5,188	10,041	13,160	11,427
1953	-7,727	-1,408	221	158
1954	4,533	3,298	979	1,531
1955	-4,928	-2,668	-2,271	-3,115
1956	-4,923	-1,004	-630	-265
1957	9,084	5,793	5,949	6,213
$\bar{X}$	8,074	5,819	5,417	5,624
S.D.[a]	8,665	5,291	4,581	4,748

[a] S.D. = Standard Deviation.

APPENDIX F, TABLE VIII

ENCUMBERED OWNER, RETURNS TO ANNUAL OPERATING CAPITAL, AVERAGE LAND EQUITY, AND MANAGEMENT AFTER ANNUAL LAND PAYMENT, BY INCOME PERIODS

Base Period (Year)	I Small Balanced Unit				III Large Balanced Unit			
	6A	6C	6D	18A	6A	6C	6D	18A
	-Dollars-							
1942	-368	-2,200	-1,618	-552	7,790	2,199	2,929	4,521
1943	-1,342	-2,369	-1,089	-1,278	4,438	2,182	4,360	3,724
1944	5,037	2,711	1,194	2,995	18,581	13,720	10,948	14,217
1945	3,888	1,726	346	2,213	15,306	11,649	8,878	12,234
1946	5,844	3,202	-26	2,298	18,040	11,855	6,660	10,958
1947	-527	-1,086	-816	-624	6,826	4,948	5,276	5,199
1948	-597	-1,416	-2,028	-1,144	9,547	1,462	707	1,668
1949	318	-852	-1,150	-841	8,162	3,127	3,246	3,315
1950	10,893	6,470	498	5,624	30,555	19,208	8,634	18,233
1951	7,006	3,558	1,141	3,552	16,296	15,505	11,211	15,667
1952	-5,238	-2,174	1,382	-1,938	-566	5,106	11,642	4,149
1953	-6,445	-5,395	-3,020	-4,509	-10,586	-4,469	-606	-3,857
1954	362	62	-2,957	-1,249	4,533	4,450	-1,237	2,159
1955	-4,215	-3,851	-3,888	-4,338	-7,103	-4,287	-4,185	-5,170
1956	-4,953	-4,201	-3,539	-3,895	-7,001	-2,878	-2,291	-3,089
1957	880	-986	-1,317	-61	8,512	4,351	3,464	5,819
$\bar{X}$	659	-425	-1,055	-234	7,708	5,508	4,352	5,609
S.D.[a]	4,832	3,203	1,690	2,904	10,780	7,051	5,026	6,968

[a] S.D. = Standard Deviation.

APPENDIX F, TABLE IX

ENCUMBERED OWNER, RETURNS TO ANNUAL OPERATING CAPITAL, AVERAGE LAND EQUITY, AND MANAGEMENT AFTER ANNUAL LAND PAYMENT, BY INCOME PERIODS

Base	II Small Range Unit				IV Large Range Unit			
Period	6A	6C	6D	18A	6A	6C	6D	18A
(Year)	-Dollars-							
1942	3,953	-448	318	3,045	5,832	123	756	-443
1943	8	-2,088	597	59	-1,064	-3,473	510	-3,311
1944	11,545	6,913	3,503	9,424	15,549	8,048	3,336	5,897
1945	10,743	6,441	2,983	8,910	15,757	8,942	3,392	6,569
1946	14,382	9,410	2,920	10,917	21,613	12,677	4,687	9,227
1947	2,553	1,423	1,782	2,166	3,410	2,432	2,794	1,339
1948	4,085	1,516	354	2,295	5,706	2,924	2,285	1,567
1949	3,818	1,323	1,416	2,362	4,793	1,352	3,233	313
1950	27,666	18,516	5,196	21,616	44,388	28,158	8,935	21,510
1951	17,721	11,661	6,356	14,866	28,842	17,860	10,079	13,506
1952	-10,949	-4,590	3,759	-7,913	-22,435	-9,596	3,509	-7,858
1953	-9,409	-6,719	-1,956	-7,088	-14,571	-8,518	-2,512	-7,395
1954	4,766	4,866	-2,461	3,313	7,986	8,002	-3,315	5,393
1955	-4,602	-3,080	-3,127	-4,211	-6,383	-3,317	-3,035	-3,599
1956	-5,953	-3,898	-3,348	-4,655	-8,860	-4,261	-4,805	-4,122
1957	4,675	721	-555	3,552	5,979	391	-1,705	-288
$\bar{X}$	4,687	2,623	1,109	3,666	6,659	3,859	1,759	2,394
S.D.[a]	10,102	6,695	2,927	8,005	16,506	9,884	4,210	7,762

[a] S.D. = Standard Deviation.

APPENDIX F, TABLE X

ENCUMBERED OWNER, RETURNS TO ANNUAL OPERATING CAPITAL, AVERAGE LAND EQUITY, AND MANAGEMENT AFTER ANNUAL LAND PAYMENT, BY INCOME PERIODS

Base Period	V Large Cropland Unit			
	6A	6C	6D	18A
(Year)	- Dollars -			
1942	6,811	2,343	2,863	3,846
1943	6,116	3,993	5,172	4,909
1944	19,106	14,422	13,244	13,687
1945	14,620	11,175	9,742	10,853
1946	16,388	9,695	7,511	7,381
1947	7,350	5,032	5,166	5,404
1948	8,131	13	298	286
1949	8,223	3,022	3,533	2,592
1950	24,064	12,558	7,511	9,807
1951	12,651	12,305	9,728	10,772
1952	6,008	10,861	13,981	12,248
1953	-9,077	-2,759	-1,128	-1,191
1954	2,972	1,737	-581	-29
1955	-7,214	-4,954	-4,556	-5,400
1956	-6,489	-2,570	-2,195	-1,830
1957	8,448	5,157	5,314	5,578
$\bar{X}$	7,382	5,127	4,725	4,932
S.D.[a]	9,234	6,097	5,450	5,613

[a] S.D. = Standard Deviation.

APPENDIX F, TABLE XI

TENANT-OPERATOR, RETURNS TO ANNUAL OPERATING CAPITAL AND MANAGEMENT, BY INCOME PERIODS

Base Period (Year)	I Small Balanced Unit				III Large Balanced Unit			
	6A	6C	6D	18A	6A	6C	6D	18A
	-Dollars-							
1942	-1,010	-2,842	-2,260	-1,194	5,865	274	1,004	2,596
1943	-2,144	-3,170	-1,891	-2,080	2,033	-223	1,955	1,319
1944	3,599	1,273	-244	1,557	14,266	9,405	6,633	9,903
1945	2,651	489	-891	976	11,596	7,939	5,168	8,524
1946	5,022	2,380	-848	1,476	15,578	9,393	4,198	8,496
1947	-1,357	-1,916	-1,646	-1,454	4,335	2,457	2,785	2,709
1948	-835	-1,654	-2,266	-1,382	8,832	747	-8	953
1949	-160	-1,330	-1,628	-1,319	6,727	1,692	1,811	1,880
1950	9,960	5,527	-435	4,691	27,757	16,410	5,836	15,435
1951	5,766	2,318	-99	2,312	12,576	11,785	7,491	11,948
1952	-6,760	-3,696	-140	-3,460	-5,131	541	7,077	-415
1953	-6,847	-5,795	-3,422	-4,911	-11,791	-5,674	-1,811	-5,062
1954	68	-232	-3,251	-1,543	3,655	3,572	-2,115	1,282
1955	-4,133	-3,768	-3,806	-4,256	-6,858	-4,042	-3,940	-4,925
1956	-5,243	-4,491	-3,829	-4,185	-7,870	-3,747	-3,160	-3,958
1957	110	-1,756	-2,087	-831	6,203	2,042	1,155	3,510
$\bar{X}$	-82	-1,166	-1,796	-975	5,486	3,286	2,130	3,387
S.D.[a]	4,640	2,975	1,294	2,633	10,114	6,135	3,710	6,002

[a] S.D. = Standard Deviation.

APPENDIX F, TABLE XII

TENANT-OPERATOR, RETURNS TO ANNUAL OPERATING CAPITAL AND MANAGEMENT, BY INCOME PERIODS

Base Period (Year)	II Small Range Unit				IV Large Range Unit			
	6A	6C	6D	18A	6A	6C	6D	18A
	-Dollars-							
1942	2,731	-1,686	-913	1,814	4,087	-1,622	-989	-2,184
1943	-1,384	-3,479	-794	-1,332	-2,888	-5,297	-1,314	-5,131
1944	9,516	4,886	1,476	7,397	13,407	5,906	1,194	3,759
1945	8,916	4,615	1,157	7,084	13,715	6,900	1,350	4,531
1946	12,970	7,999	1,509	9,506	19,779	10,843	2,853	7,397
1947	1,133	4	363	747	1,572	594	956	-495
1948	3,257	689	-473	1,468	4,163	1,381	742	28
1949	2,750	256	349	1,295	3,130	-311	1,570	-1,346
1950	26,143	16,994	3,674	20,094	42,497	26,268	7,045	19,624
1951	15,891	9,832	4,527	13,037	26,799	15,817	8,036	11,467
1952	-13,061	-6,701	1,648	-10,024	-24,619	-11,780	1,325	-10,038
1953	-10,401	-7,710	-2,947	-8,079	-16,196	-10,143	-4,137	-9,016
1954	3,882	3,983	-3,344	2,430	6,416	6,432	-4,885	3,827
1955	-5,110	-3,587	-3,634	-4,718	-7,766	-4,700	-4,418	-4,978
1956	-6,833	-4,777	-4,227	-5,534	-10,429	-5,830	-6,374	-5,687
1957	3,315	-638	-1,914	2,193	4,170	-1,418	-3,514	-2,093
$\bar{X}$	3,357	1,293	-221	2,336	4,865	2,065	-35	604
S.D.[a]	10,001	6,530	2,559	7,834	16,443	9,819	4,062	7,709

[a] S.D. = Standard Deviation.

APPENDIX F, TABLE XIII

TENANT-OPERATOR, RETURNS TO ANNUAL OPERATING CAPITAL AND MANAGEMENT BY INCOME PERIODS

Base Period (Year)	V Large Cropland Unit			
	6A	6C	6D	18A
	- Dollars -			
1942	4,987	519	1,039	2,022
1943	3,672	1,549	2,728	2,465
1944	14,195	9,511	8,333	8,776
1945	10,490	7,045	5,612	6,723
1946	13,870	7,177	4,993	4,863
1947	4,795	2,477	2,611	2,849
1948	7,870	-248	37	25
1949	7,032	1,831	2,342	1,401
1950	21,112	9,606	4,559	6,855
1951	8,509	8,163	5,586	6,630
1952	774	5,627	8,747	7,014
1953	-9,971	-3,652	-2,022	-2,085
1954	2,501	1,266	-1,052	-500
1955	-6,235	-3,975	-3,577	-4,421
1956	-6,949	-3,030	-2,655	-2,290
1957	6,128	2,837	2,994	3,258
$\bar{X}$	5,174	2,919	2,517	2,724
S.D.[a]	8,155	4,517	3,722	3,895

[a] S.D. = Standard Deviation.

APPENDIX G, TABLE I

PROBABILITY OF COVERING CUMULATED EXPENDITURES, EIGHT SELECTED PLANS, SMALL BALANCED UNIT

Expenditure Items	Plan Number							
	6A	6B	6C	6D	18A	18B	18C	18D
Family Living	.916	.916	.942	.981	.953	.951	.966	.965
Nondeferable								
Enterprise	.745	.745	.742	.806	.784	.772	.774	.758
General	.695	.695	.668	.683	.707	.688	.659	.606
Real Estate Taxes	.671	.671	.626	.599	.663	.641	.592	.518
Annual Depreciation	.652	.652	.599	.544	.634	.610	.553	.472
6 Pct. Annual Capital	.572	.572	.508	.428	.552	.532	.472	.397
5 Pct. Land Capital	.412	.412	.275	.089	.294	.261	.150	.076

APPENDIX G, TABLE II

PROBABILITY OF COVERING CUMULATED EXPENDITURES, EIGHT SELECTED PLANS, SMALL RANGE UNIT

Expenditure Items	Plan Number							
	6A	6B	6C	6D	18A	18B	18C	18D
Family Living	.944	.932	.958	.998	.943	.942	.972	.997
Nondeferable								
Enterprise	.805	.800	.834	.956	.828	.827	.867	.952
General	.785	.781	.807	.929	.805	.803	.837	.918
Real Estate Taxes	.767	.763	.782	.897	.784	.781	.808	.877
Annual Depreciation	.755	.750	.768	.876	.771	.768	.788	.854
6 Pct. Annual Capital	.682	.681	.688	.801	.704	.702	.719	.759
5 Pct. Land Capital	.545	.543	.480	.309	.533	.524	.463	.238

APPENDIX G, TABLE III

PROBABILITY OF COVERING CUMULATED EXPENDITURES, EIGHT SELECTED PLANS, LARGE BALANCED UNIT

Expenditure Items	Plan Number							
	6A	6B	6C	6D	18A	18B	18C	18D
Family Living	.986	.988	.997	.999	.997	.995	.998	.999
Nondeferable								
Enterprise	.909	.913	.957	.985	.966	.952	.971	.984
General	.890	.893	.939	.974	.945	.933	.956	.971
Real Estate Taxes	.870	.871	.918	.955	.922	.912	.938	.954
Annual Depreciation	.842	.856	.903	.945	.908	.898	.925	.940
6 Pct. Annual Capital	.797	.803	.860	.912	.873	.860	.891	.912
5 Pct. Land Capital	.612	.603	.595	.570	.614	.606	.603	.548

APPENDIX G, TABLE IV

PROBABILITY OF COVERING CUMULATED EXPENDITURES, EIGHT SELECTED PLANS, LARGE RANGE UNIT

Expenditure Items	Plan Number							
	6A	6B	6C	6D	18A	18B	18C	18D
Family Living	.918	.916	.950	.998	.948	.947	.947	.997
Nondeferable								
Enterprise	.770	.767	.825	.955	.840	.839	.839	.958
General	.747	.746	.792	.923	.801	.800	.800	.918
Real Estate Taxes	.733	.731	.770	.894	.774	.772	.772	.882
Annual Depreciation	.723	.720	.760	.878	.762	.760	.760	.863
6 Pct. Annual Capital	.649	.648	.681	.746	.689	.688	.688	.739
5 Pct. Land Capital	.532	.529	.486	.297	.439	.437	.437	.208

APPENDIX G, TABLE V

PROBABILITY OF COVERING CUMULATED EXPENDITURES, EIGHT SELECTED PLANS, LARGE CROPLAND UNIT

Expenditure Items	Plan Number							
	6A	6B	6C	6D	18A	18B	18C	18D
Family Living	.994	.993	.999	.999	.999	.999	.999	.999
Nondeferable								
Enterprise	.936	.928	.973	.981	.980	.978	.978	.977
General	.919	.909	.958	.969	.967	.964	.965	.964
Real Estate Taxes	.900	.887	.939	.951	.950	.945	.945	.943
Annual Depreciation	.883	.871	.924	.936	.935	.931	.929	.926
6 Pct. Annual Capital	.834	.824	.895	.913	.916	.911	.912	.910
5 Pct. Land Capital	.637	.622	.622	.618	.638	.626	.615	.604

APPENDIX H, TABLE I

EXPECTED FREQUENCY DISTRIBUTION OF RETURNS TO ANNUAL OPERATING CAPITAL, LAND EQUITY, AND MANAGEMENT, FOUR PLANNING SITUATIONS, FIVE LAND RESOURCE UNITS, PART OWNER TENURE CLASS, 16 PRODUCTION PERIODS[a]

Return Interval ($1,000)	Land Resource Planning Situations																			
	Small Balanced Unit Plans				Small Range Unit Plans				Large Balanced Unit Plans				Large Range Unit Plans				Large Cropland Unit Plans			
	6A	18A	6C	6D	6A	18A	6C	6D	6A	18A	6C	6D	6A	18A	6C	6D	6A	18A	6C	6D
30-46									1[b]				1[c]							
27-30					1								1		1					
24-27																	1			
21-24						1							1	1						
18-21							1		2	1	1				1		1			
15-18					1	1			2	1	1		2				1			
12-15					1					2	2			1	1		2	1	3	2
9-12	1				2	3	2		3	1	1	4		1	2	2	3	4	3	2
6-9	2		1				2	1	2	1		3	4	3	1		3	2		3
3-6	2	2	2		5	4	1	5	2	7	6	4	2	3	2	7	2	4	6	4
0-3	3	4	3	6	2	3	5	5			2	3		2	3	2		3	1	3
-3-0	4	7	7	8			2	5	1	2	2	2	1	2	2	4		1	3	2
-6- -3	3	3	3	2	2	2	2		2	1	1		1	1	1	1	2	1		
-9- -6	1				1	2	1						1	2	1		1			
-12- -9					1				1						1					
-15- -12													1							
-18- -15																				
-22- -18													1[d]							
$\bar{X}$ ($100)	9	0	-2	-8	52	41	31	16	84	63	62	51	73	31	45	24	81	56	58	54
S.D.[e] ($100)	47	28	31	15	101	79	66	27	104	65	66	44	165	77	91	41	87	47	53	46

[a]Data from Appendix F, Tables V, VI, and VII.

[b]$31,004.

[c]$45,018.

[d]-$21,950.

[e]S.D. = Standard Deviation.

APPENDIX H, TABLE II

EXPECTED FREQUENCY DISTRIBUTION OF RETURNS TO ANNUAL OPERATING CAPITAL, LAND EQUITY, AND MANAGEMENT, FOUR PLANNING SITUATIONS, FIVE LAND RESOURCE UNITS, ENCUMBERED OWNER TENURE CLASS, 16 PRODUCTION PERIODS[a]

Return Interval ($1,000)	Land Resource Planning Situations																			
	Small Balanced Unit Plans				Small Range Unit Plans				Large Balanced Unit Plans				Large Range Unit Plans				Large Cropland Unit Plans			
	6A	18A	6C	6D	6A	18A	6C	6D	6A	18A	6C	6D	6A	18A	6C	6D	6A	18A	6C	6D
30-45									1[b]				1[c]							
27-30					1								1		1					
24-27																	1			
21-24						1							1	1						
18-21							1		2	1	1						1			
15-18					1				2	1	1		2		1		1			
12-15					1	1				2	1			1	1		2	2	3	2
9-12	1				2	2	2		1	1	2	3		1		1		3	3	2
6-9	1		1			1	2	1	4			3	1	1	3	1	7	1		2
3-6	3	2	2		5	3	1	3	2	6	5	4	5	2		5		4	4	4
0-3	3	3	3	5	2	4	4	7		2	3	2		3	5	4	1	2	3	2
-3-0	4	8	7	8			2	3	1		1	3	1	2		2		3	2	3
-6- -3	3	3	3	3	2	2	3	2		3	2	1		3	3	3		1	1	1
-9- -6	1					2	1		2				2	2	1		2			
-12- -9					2				1						1		1			
-15- -12													1							
-18- -15																				
-23- -18													1[d]							
$\bar{X}$ ($100)	7	-2	-4	-11	47	37	26	11	77	51	55	44	67	24	39	18	74	49	51	47
S.D.[e] ($100)	48	29	32	17	101	80	67	29	108	70	71	50	165	78	99	42	92	56	61	55

[a]Data from Appendix F, Tables VIII, IX, and X.

[b]$30,555.

[c]$44,388.

[d]-$22,435.

[e]S.D. = Standard Deviation.

APPENDIX I, TABLE I

CHANGES IN EQUITY DERIVED FROM RETURNS TO LAND EQUITY, ANNUAL OPERATING CAPITAL, AND MANAGEMENT; CREDIT REQUIREMENTS AND DEFERRAL OF ANNUAL OPERATING EXPENSES; ENCUMBERED OWNER TENURE CLASS, SELECTED RESOURCE AND PLANNING SITUATIONS, 16 PRODUCTION PERIODS

Item	Resource and Planning Situation			
	II-6A	II-18A	II-6C	IV-6C
	- Dollars -			
Total Returns to Land Equity, Annual Operating Capital, and Management[a]	75,002	58,658	41,967	61,744
Allocation of Returns				
Interest on borrowed capital	24,321	14,485	16,653	29,514
Federal income tax	21,441	18,351	14,292	19,427
Social security tax	4,025	4,078	3,712	3,667
Oklahoma income tax	1,446	919	771	1,282
Withdrawal for a higher level of family living[b]	6,500	6,500	0	0
Number of years at $5,000	2	2	-	-
Number of years at $7,000	1	1	-	-
Equity Relationships				
Annual operating capital	35,852	27,236	26,668	39,095
Beginning capital equity	13,000	13,000	13,000	13,000
Change in capital equity	17,269	13,325	6,533	7,864
Average capital equity	10,535	11,105	9,386	8,761
Beginning land equity	41,546	41,546	41,546	57,408
Change in land equity	16,740	16,740	16,740	23,129
Percent return on equities[c]	7.0	6.2	4.5	4.5
Credit Requirements				
Number of years required	15	14	16	16
Average credit required	27,005	16,131	17,348	30,743
Maximum credit required	39,562	26,895	27,707	44,343
Percent of annual capital	110	99	104	113
Deferral of Annual Expenditures				
Number of years requiring partially deferred expenses	9	8	11	13
Total expenses deferred	7,750	6,940	8,305	10,470
Family living	4,500	4,000	5,500	6,500
Other	3,250	2,940	2,805	3,970

[a]In addition the operator has made a land payment resulting in a change in land equity as indicated above and interest payments on the amortized loan during the 16-year period.

[b]Withdrawal of funds to attain a family living level of either $5,000 or $7,000 rather than the assumed minimum of $3,500.

[c]Average return on equity in land and owned annual operating capital after deducting $3,500 for family labor and paying interest on borrowed capital.

APPENDIX I, TABLE II

CHANGES IN EQUITY DERIVED FROM RETURNS TO LAND EQUITY, ANNUAL OPERATING CAPITAL, AND MANAGEMENT; CREDIT REQUIREMENTS AND DEFERRAL OF ANNUAL OPERATING EXPENSES; TENANT-OPERATOR TENURE CLASS, SELECTED RESOURCE AND PLANNING SITUATIONS, 16 PRODUCTION PERIODS

Item	Resource and Planning Situation			
	II-6A	II-18A	III-6D	IV-6A
	- Dollars -			
Total Returns to Land Equity, Annual Operating Capital, and Management	53,715	37,378	34,079	77,837
Allocation of Returns				
Interest on borrowed capital	27,267	18,648	8,340	56,383
Federal income tax	11,305	9,175	7,500	15,929
Social security tax	3,545	3,588	3,825	3,378
Oklahoma income tax	994	704	292	1,740
Withdrawal for a higher level of family living[a]	0	0	5,000	0
Number of years at $5,000	-	-	1	-
Number of years at $7,000	-	-	1	-
Equity Relationships				
Annual operating capital	35,852	27,236	20,696	57,276
Beginning capital equity	13,000	13,000	13,000	13,000
Change in capital equity	13,604	5,263	9,122	407
Average capital equity	7,445	7,809	12,006	4,800
Percent return on equity[b]	22.2	15.0	13.4	27.9
Credit Requirements				
Number of years required	16	16	16	16
Average credit required	28,407	19,427	8,690	59,772
Maximum credit required	43,114	30,701	14,647	83,223
Percent of annual capital	120	113	71	145
Deferral of Annual Expenditures				
Number of years requiring partially deferred expenses	10	13	8	13
Total expenses deferred	8,585	9,440	9,440	10,825
Family living	5,000	6,500	4,000	6,500
Other	3,585	2,940	5,440	4,325

[a]Withdrawal of funds to attain a family living level of either $5,000 or $7,000 rather than the assumed minimum of $3,500.

[b]Average return on owned annual operating capital after deducting $3,500 for family labor and paying interest on borrowed capital.

VITA

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Candidate for the Degree of

Doctor of Philosophy

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