Polyperiod Analysis of

Growth and Capital Accumulation of Farms in the Rolling Plains of OKLAHOMA AND TEXAS

PREFACE

Changes in the structure of farm producing units continue to occur at a rapid rate. Joint research efforts by the Economic Research Service, U.S. Department of Agriculture, and colleges and universities throughout the Nation analyze these changes and their implications. This study is a part of a broader comprehensive study of adjustments in agriculture.

This part of the study is an analysis of capital accumulation and the growth of farm firms. Since growth was involved, the analysis was conducted in a nonstatic economic environment. Very little specific knowledge is available concerning the firm growth process. For this reason, the analysis was conducted within a sequential framework. First, the effect of different farm-operator objectives on the growth process was investigated. Following this, the effects on capital accumulation of variables such as tenure situations, starting farm size, capital rationing, and consumption levels were analyzed. Finally, minimum starting farm equity levels required to obtain various growth conditions over time were determined.

Linear programming techniques in a polyperiod framework were used to depict growth of the firm. This framework is appropriate since it incorporates many of the important aspects of the problem. These aspects include resources, their use and development, alternatives by which resources may be developed or used over time, objectives to be fulfilled, and a structural framework which relates the component parts of the problem and which makes previous decisions binding on alternatives in later production periods.

This analysis contributes to Southern Regional Research Project S-42, "An Economic Appraisal of Farming Adjustment Opportunities in the Southern Region to Meet Changing Conditions," and also to Regional Research Project GP-2, "Economics of Establishment, Survival and Growth of Dryland Farms in the Great Plains Environment."

This report was developed from a dissertation submitted in partial fulfillment of the requirements for the Doctor of Philosophy degree by James R. Martin, Oklahoma State University.

William F. Lagrone, Economic Research Service, stationed at Lincoln, Nebr., should be acknowledged for assistance in formulating the study in its early stages.

i

CONTENTS

ii

September 1967

TABLES

SUMMARY

Linear programming techniques in a polyperiod framework were used in this study to depict the growth of the farm firm. A representative farm firm was established assuming that the operator controlled a specific bundle of farm resources. The farm could grow through purchasing additional resources. Capital was withdrawn in each production period to meet farm overhead and family living expenses. Operating capital could be borrowed with owned resources used as security. A planning horizon of 30 years was used in the study.

Minimum starting farm equity requirements to obtain specific growth rates over time were computed by assuming that the starting farm resource situation consisted of a farm operator supplying 1,900 hours of annual labor and nothing else. All other farm resources had to be purchased to generate capital to satisfy a family consumption function and accumulate additional capital if specified. The technique used minimized equity subject to specified constraints, but it also allowed the firm to grow above the level required just to fulfill the constraints.

Minimum starting equity requirements were determined for different tenure situations, consumption levels, and growth objectives, and under conditions of constant and increasing land values. Minimum starting equities ranged from a low of about $18,000. Differences in minimum starting equities for different farm growth situations were not large when all farmland could be rented; however, the difference in required growth rates over time was quite significant. Minimum starting equities increased substantially, from about $47,000 upward, when all farmland was purchased. The most relevant variable, with respect to minimum starting equity requirements, was tenure situations. However, growth objectives and annual consumption levels were important, especially for owner-operated farms. Increasing land values tended to satisfy growth objectives over time when land acquisition occurred through purchase rather than renting, but increasing land values raised minimum starting equity requirements for obtaining comparable annual consumption levels over time. As land values were increased, growth, in terms of additional acres purchased, ceased, because the additional capital generated from an additional acre of land became insufficient to meet the required land payments.

However, land continued to be purchased until its value was about 40 percent higher than current selling prices.

The effect of a number of criterion functions on the growth process was tested. An objective of maximizing the present value of net returns resulted in the same growth over time as maximizing the objectives of present value of gross sales, undiscounted value of net returns, ending owned capital, and acres of land operated. Other criterion functions resulted in somewhat different growth rates; however, the difference resulted from the way in which the problem was formulated.

Further analysis determined the importance of other variables on the growth process. The analysis was based upon different tenure, starting farm sizes, capital rationing, and consumption conditions. Farm growth was maximum under a policy of renting all land operated for expansion purposes. Land acquisition through purchasing all land operated was one of the most limiting factors to farm growth. Different starting farm sizes also resulted in different growth rates. The effect of borrowed capital levels was significant, but different consumption levels had more effect on the growth process. An annual consumption function equal to $3,000 plus 75 percent of the net returns almost precluded growth.

Polyperiod Analysis of Growth and Capital Accumulation of Farms in the Rolling Plains of Oklahoma and Texas

By J. Rod Martin and James S. Plaxico[1]

INTRODUCTION

The changes which have occurred in agriculture in the United States have been phenomenal. One pronounced adjustment in recent times has been the trend toward fewer and larger farms. After reaching a peak of about 716,000 in 1935, the number of farms in Oklahoma and Texas dropped to about 300,000 in 1960. During this same period, the average farm size increased from 240 acres to over 600 acres (24, 25).[2]

The present trend toward fewer and larger farms will continue. However, the capital structure of many small farms will likely impede expansion of their land base. On the other hand, operators of larger farms with more favorable capital structures may find that they can expand with little difficulty.

There may be many incentives motivating farm operators to expand their land base. Acquiring additional land may be consistent with profit maximization, as the farm may be operated with greater efficiency, thus reducing the cost of inputs relative to the value of outputs. Much existing farm technology is uneconomical on smaller farm units; however, the larger farms that have profitably adopted innovations exert pressure on others to use the technology to minimize their losses (23). Another possible incentive for farmers to expand their land base is that of capital accumulation.

---

[1] J. Rod Martin is an agricultural economist with the Farm Production Economics Division, Economic Research Service, USDA, stationed at Texas A&M University; and James S. Plaxico is professor and head of the Department of Agricultural Economics, Oklahoma State University.
[2] Underscored numbers in parentheses refer to items in the Selected References, p. 87.

The trend to fewer and larger farms raises many questions with respect to farm growth problems. Who are the farm operators that can expand their farm size? What are their capital and equity characteristics? Under the existing policies and structure of real estate credit institutions, which farmers can borrow purchasing power for capital goods? Answers to these questions may provide some insight as to the structural characteristics of the farm producing units of the future.

Purposes of Study

Little evidence is available with respect to what constitutes adequate farm capital or equity structures for expansion or capital accumulation. The agricultural industry, suppliers, and individual farmers have much at stake in answers to problems of farm capital accumulation. This study was designed to shed some light on these problems.

The primary purpose of the study was to analyze the capital accumulation and growth problems of the farm firms in the Rolling Plains of Oklahoma and Texas. Specific objectives were:

(1) To analyze the effect of different variables, including farm operator objectives, land acquisition methods, capital rationing, and different family consumption levels or capital withdrawals, on the growth of farm firms.

(2) To simulate different growth models to determine possible growth rates under different conditions of farm resource use.

(3) To determine minimum starting farm equities required to obtain specified growth rates over time.

Area of Study

Farms of level loam soils in the Rolling Plains of Oklahoma and Texas were studied. The area is located in southwestern Oklahoma and north-central Texas; it includes the southeastern part of the Texas Panhandle (fig. 1). Farms within the area are primarily those that produce field crops--cotton, wheat, and other small grains--with supplementary livestock enterprises. Large livestock ranches and other livestock farms are scattered throughout the area. However, cash grain and cotton farms account for more than one-half of all the other farms, about two-thirds of the total land in farms, and more than three-fourths of the cropland harvested (24, 25).

2

TEXAS AND OKLAHOMA COUNTIES CONTAINING
LOAM SOILS* IN THE ROLLING PLAINS

* SHADED COUNTIES CONTAIN LOAM SOILS FOR WHICH
THIS PUBLICATION IS APPLICABLE.

U S DEPARTMENT OF AGRICULTURE   ECONOMIC RESEARCH SERVICE
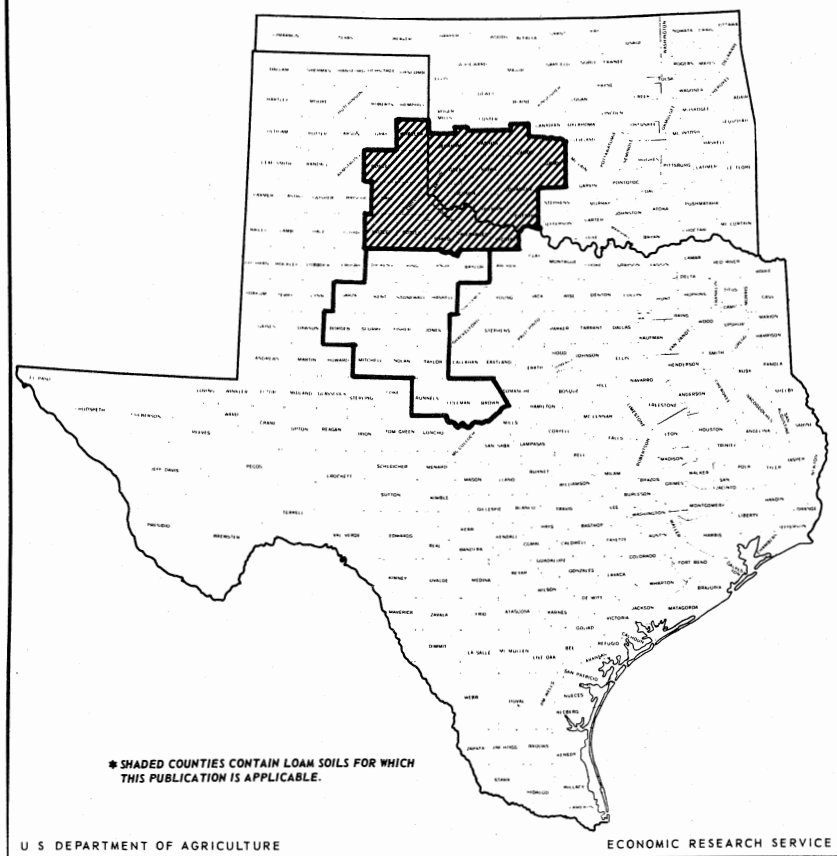
Figure 1

The Rolling Plains area is composed of three broad groups of
soil types: clay soils, loam soils, and sandy soils. Each type is
found in relatively homogeneous blocks. The loam soils are found
mostly in the northern counties of the Rolling Plains area. They
are commonly found in two phases designated level loam and rolling
loam. The level loam phase is predominantly bottomland, medium-
textured soil with moderately permeable subsoil. This soil type is
most representative for cropland acreage; farms with this type of
soil account for a large proportion of the total farm production in
the area (11).

3

CONCEPTUAL DEVELOPMENT

The traditional static theory of the firm has been useful in dealing with many microeconomic problems. The very nature of growth and capital accumulation problems, however, renders static theory somewhat unrealistic.

Dynamic Nature of the Problem

In developing a dynamic model, Plaxico (17) states:

> By omitting time as a variable, one may greatly simplify conceptual and empirical models. At the same time, one tends to ignore (assume away) certain practical important problems of production timing, capital acquisition and accumulation, transitory resource efficiency, and the impact of a decision in one time period on production opportunities and choices during subsequent periods.

Samuelson (19) has commented that in order to understand many problems of the real world the economist has no choice but to study dynamics. His concept of dynamics is best summarized in his own words:

> Statics concerns itself with the simultaneous and instantaneous or timeless determination of economic variables by mutually interdependent relations. . . . It is the essence of dynamics that economic variables at different points of time are functionally related . . . . It is important to note that each such dynamic system generates its own behavior over time. . . .This feature of self-generating development over time is the crux of every dynamic process.

Hicks (14) states that the firm in attempting to maximize returns should maximize the present value of the stream of expected returns. "Future costs only enter into the present value of the plan at their discounted values; and the same is true of future receipts. . . ."

Baumol (3) classifies the Hicks approach as statics involving time rather than dynamics. He explains that in the model, phenomena are not considered in their relation to preceding and succeeding events; and if the process of change does not concern us, we can consider the situation at a given moment. The moment may be dated, but the analysis of it can be static. Baumol's concept of economic dynamics emphasizes the structural aspects: "Economic dynamics is the study of economic phenomena in relation to preceding and succeeding events."

Harrod (12) also emphasizes the changing structural relationship in economic dynamics. In economic statics certain fundamental

conditions are taken as given, and these known conditions determine the values of certain unknowns. In dynamics, however, the fundamental conditions will themselves be changing, and the unknowns in the equations to be solved will not be specific magnitudes per time period but increases or decreases in the magnitudes per time period.

While economists may detect differences among eminent economists in concepts of economic dynamics, the layman would be struck by the similarities. The general agreement and, perhaps, a precise definition is given by the statement, "....how the various variables move through time....(6)."

Development of Deterministic Model

THEORY OF DYNAMIC MODEL

A graphic illustration of a dynamic model is given by Plaxico (17) and compared to a usual static model. Figure 2 shows the usual static resource use problem. Theory suggests that the point of

RESOURCE ALLOCATION PROBLEM IN A STATIC FRAMEWORK

Present
Consumption
(Z_1)

Capital Accumulation (Z_2)

Figure 2

5
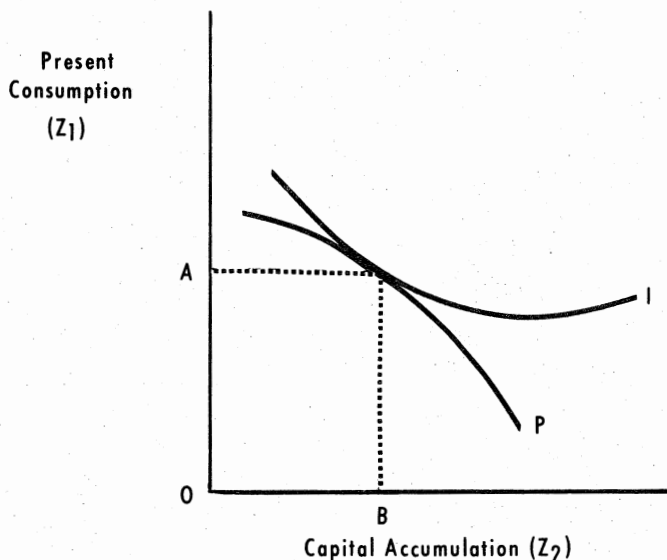
tangency of the production possibilities curve (line P) with the indifference curve (line I) specifies the optimum allocation of resources between production for present consumption and production for capital accumulation. Quantity OB of capital accumulation and OA of present consumption is the optimum allocation of resources which maximizes utility.

Figure 3 illustrates the same problem in a dynamic setting. Line P_{t_1} is an iso-resource curve for the time period t_1, and I_1 is an indifference curve. Also, P_{t_2} is an iso-resource curve representing the possible combinations of production for present consumption and capital accumulation in period t_2 if OB production for capital

RESOURCE ALLOCATION PROBLEM IN A DYNAMIC FRAMEWORK

Figure 3

6
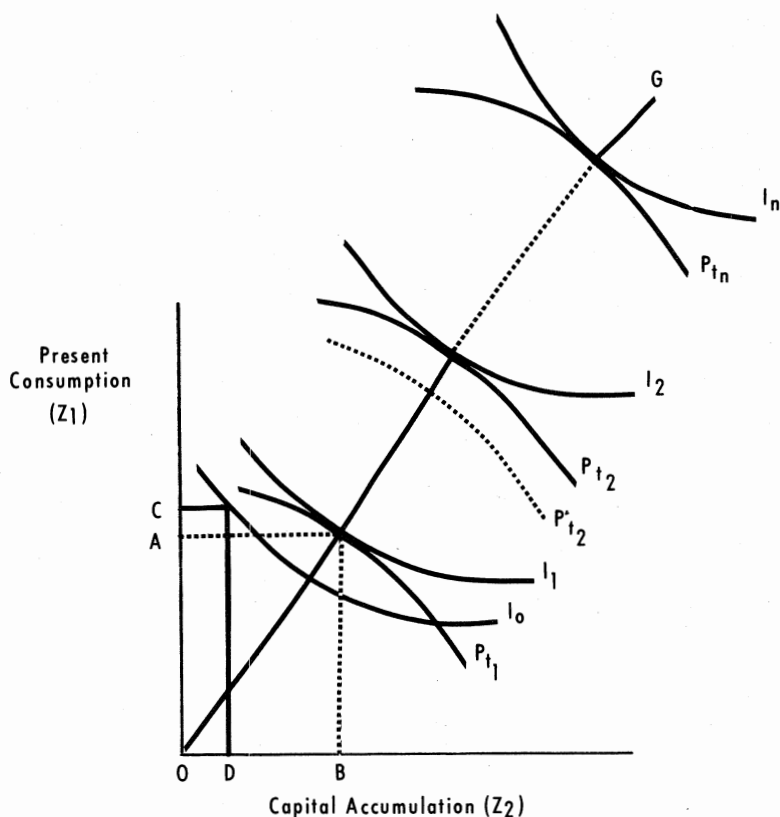
accumulation and OA for present consumption were produced in t_1. The indifference curve I_2 expresses an individual's desires with regard to present consumption and production for capital accumulation during time period t_2. For n = time periods, we would have n production possibility curves and a series of n tangencies of the production possibility curves with the indifference curves. The line G would be the firm's growth path over time which would result in maximum utility.

The model does not ignore the structure of the system. For example, the position of the production possibility curve P_{t_2} depends upon the allocation of resources in time period t_1, i.e., P_{t_2} is the production possibility curve for time period t_2 if and only if resources are allocated in t_1 so that quantities OA for present consumption and OB for capital accumulation were produced in t_1. Therefore, only one optimum growth path is available to the firm. To illustrate this, assume that I_0 is an indifference curve which lies below I_1. A level of production OC for present consumption and OD for capital accumulation is a possibility but results in a lower level of utility or satisfaction. Also, for this allocation of resources the production possibility curve for time period t_2 would lie below P_{t_2} as curve P'_{t_2} does. Thus, a choice of decision in an earlier time period is binding on and affects alternatives in the later time periods, and the structure of the system is not ignored.

DETERMINISTIC MODEL OF THE STUDY

"Dynamic linear programming" is a deterministic model developed to solve problems such as the one shown in figure 3. Dynamic linear programming is a subspecies of linear programming; its relation to linear programming is roughly that of economic dynamics to statics (16). The usual linear programming problem may be stated as:

$$\text{Maximize} \quad C'X = Z$$

Subject to:

$$B \geq AX$$

$$X \geq 0$$

In this formulation A is a matrix of input-output coefficients which describes technology. The vector C is the choice indicator, which may be the net revenue from each unit of the alternative products which may be produced. The vector X represents the

alternative ways that resources might be transformed into alternative products. The vector B usually specifies the availability of scarce resources.

The input-output matrix A of the usual linear programming problem (the matrix A above) may be transformed into submatrices in order to render the static model dynamic (16). The input-output matrix A may be transformed into:

$$A = \begin{bmatrix} & A_1 & \\ & A_2 & \\ & \quad \ldots A_t & \\ & & \end{bmatrix} , A_t \cong A_{t-1}$$

where the submatrices A_1, A_2, . . ., A_t are the input coefficients for products produced in time periods 1,2, . . ., t, respectively, and overlap in some rows or columns or both. Overlapping in rows would mean that certain commodities produced during time period t may also be required for the production of some commodity in time $t + k$. Overlapping columns would indicate that products (or the returns from these products) being produced during time t could be used in the production of products in time $t+k$.

The vector B of the usual linear programming problem may also be transformed into subvectors for the dynamic model. Each subvector would specify the availability of scarce resources for a given production period. The availability of scarce resources for a future production period is not likely to be the same as those available for a former production period because resources may be added (or used up) or created during the production process. The change in resource levels and resource ratios over time which allows changes in production patterns over time results from the structure of the system. The structure of the system over time is an explicit feature of the dynamic model.

The vector C, the choice indicator, is extended over all production periods, which may represent the stream of net revenues over time.

Specification of Goals of Farm Operators

Usually the production problem is considered to be a choice or decision on how resources are organized to maximize a particular objective (13). A great deal of economic literature is devoted to relevant goals. In a detailed analysis of longrun adjustments of

farm operators, Connor (8) discusses various hypotheses concerning the motives of decision makers. The following objectives are discussed:

(1) Maximizing profits,
(2) Producing at a level below the profit-maximizing output,
(3) Producing at a level above the profit-maximizing output,
(4) Preserving status quo,
(5) Maximizing some preference-function,
(6) Survival of the firm,
(7) Maximizing sales after obtaining some minimum profit level,
(8) Selecting a course of action consistent with a "satisficing" principle,
(9) Securing some income target.

Each of the above goals or decision criteria may be relevant within the decision-making framework. Unfortunately, some of the apparent relevant criteria are not easily quantified. This is the case in attempting to determine the utility functions of figures 2 and 3. Other criteria are not well defined within a polyperiod framework. For example, in a static analysis an income goal appears to be quite relevant; however, when considering time as a variable, certain questions must be answered to make the concept operational. What is the nature of this income goal? Is the capital generated consumed outside the firm, or may it be used within the firm, in the capital accumulation process?

Hicks (14) deals explicitly with entrepreneurial objectives in a dynamic system. He states that the relevant criterion for an entrepreneur within this framework is the maximization of the present value of prospective net receipts or prospective surpluses. This objective is analytically convenient but not without specification problems. What should be the operational surplus values relevant to farm operators? If the production plan calls for expanding the land base through purchasing land, should net worth be included in the surplus value as a cost or return? What are typical and relevant price and interest expectations (discount rates)?

The firm-household interrelationship must be recognized in the polyperiod analysis. Income flows are typically allocated between farm family consumption and reinvestment in the farm business as a basis for later income and consumption (13). In this analysis it is assumed that returns from farming are the only source of reinvestment in the farm business. Also, the operation of the farm is subject to the fulfillment of an annual fixed expense requirement and withdrawals of capital to be used for household consumption.

9

METHOD OF ANALYSIS

The procedure used to establish the framework for this poly-period linear programming analysis had three phases: (1) Selecting a representative farm resource situation and a relevant farm enterprise organization to investigate capital accumulation problems; (2) constructing a structural framework for the linear programming model by determining resource levels, operational restrictions, and activities for the various production periods; and (3) selecting objective functions to establish criteria for production over time.

In general, the framework of the analysis and the construction of the model used in this study portray capital accumulation characteristics of a typical farm firm. The farm operator has the necessary management ability and controls some farm resources, such as capital, land, and perhaps a complement of equipment and livestock. Some family labor is available for farmwork, and additional farm resources, such as labor, may be hired or purchased as needed. In addition to the variable costs and capital requirements associated with farm enterprises, capital must be withdrawn in each production period to meet farm overhead expenses which include a family living expense.

Operating capital may be borrowed with owned resources used as security. The farm may grow through renting or purchasing additional farmland. If growth occurs, additional livestock must be purchased. Additional equipment must be purchased when expansion reaches a point where the owned complement of equipment is inadequate, and overhead expenses increase as growth occurs beyond a certain size.

Representative Resource Situation and Enterprise Organization

The consideration of several dozen enterprise alternatives and an analysis over a number of time periods presents computational problems and the model becomes intractable. A small model greatly facilitates the analysis of a large number of situations and is, therefore, desirable for this study. Part of this technical problem was solved by the simultaneous selection of the representative farm resource situation and an operating activity representing an aggregation of enterprises or a given farm organization.

The resource situation with the enterprise organization shown in table 1 was chosen as a representative farm for this study. The table shows the minimum land requirement and optimum

Table 1.--Resource and enterprise organization, returns, and cash costs, total and per acre, representative 426-acre farm

Item	Total	Per acre
Cropland ....acres..	333	0.78
Native pasture ....do....	78	.18
Cotton allotment ....do....	67	.15
Wheat allotment ....do....	97	.23
Cropland organization:		
Cotton...do....	67	.15
Wheat..do....	97	.23
Alfalfa..do....	76	.19
Grain sorghum....................................do....	70	.16
Small grain, hay.................................do....	9	.02
Small grain, grazing.............................do....	15	.03
Cows...animals..	4	.01
Feeders..do....	36	.08
Operator labor..................................hours..	1,339	3.14
Hired labor..do....	213	.50
Investment:		
Land and buildings..........................dollars..	102,240	---
Machinery..do....	9,170	---
Operating capital[1]..............................do....	11,486	---
Total capital requirements.........................do....	122,896	---
Gross receipts.....................................do....	18,351	43.08
Enterprise operating costs[2].......................do....	7,713	18.11
Overhead costs[3]..................................do....	565	---
Machinery depreciation costs[4]....................do....	967	---

[1] Includes the total capital required to operate the farm for 1 year, enterprise expense and investments, equipment depreciation expense, overhead costs, and taxes.
[2] Includes $426 land taxes.
[3] Includes transportation, telephone, bookkeeping, and insurance costs; overhead costs increase by $1.25 an acre for a farm size over 700 acres.
[4] Includes $807 depreciation on farm equipment and $160 depreciation on pickup.

combination of enterprises needed to obtain a return of $3,000 to operator labor and management; the organization was determined by linear programming computations (22). The enterprise requirements on a per acre basis are used to represent a farm operation activity used in the model of this analysis (P_1, table 2). The enterprise operating costs are estimated cash expenditures during the year.

Overhead and machinery depreciation costs in this analysis represent annual cash costs. Most of these costs are somewhat lumpy regardless of the acres operated, and therefore cannot be computed on a per acre basis when the acres operated are variable (land taxes are an exception).

All costs are cash costs only. No costs or charges are made for the use of land and capital. This is a necessary and realistic accounting procedure, because returns to owned factors are used indiscriminately in capital accumulation.

Used within this framework, 1 acre of the operation requires, in addition to 1 acre of land, more than 3 hours of labor, $18.11

Table 2.--Linear programming tableau used in the capital accumulation and farm growth analysis

Activity Identification					1ØPER	1BLN5	1BLN1	1RLAN	1BLAB	1BCAP	1BYEQ	1FIX	1INVE	1MPC25	1ACAP	1STØ2C
					Production Period 1											

Objective Functions[1]: (Cj values)

	No.	1ØPER	1BLN5	1BLN1	1RLAN	1BLAB	1BCAP	1BYEQ	1FIX	1INVE	1MPC25	1ACAP	1STØ2C
	No. 1	124.85	-2.00	-282.96	-60.00	-5.00	-.30	-73.22	-1.69	0	0	0	0
	No. 2	105.18	-2.00	-148.43	-50.55	-4.21	-2.53	-38.16	-1.46	0	0	-9999	0
	No. 3	0	240.00	72.50	0	0	0	0	0	0	0	0	0
	No. 4	1.00	0	0	0	0	0	0	0	0	0	0	0
	No. 5	181.48	0	0	0	0	0	0	0	0	0	0	0
	No. 6	0	0	0	0	0	0	0	0	0	0	0	0

Row ID[2]	Activity	Unit	Resource or Restriction Level		Operating Activity	Land Acquisition			Hire Labor	Borrow Capital	Buy Equipment	Fixed Cost	Buy Livestock	Consume 25% of Net Returns	Acquire Capital	Transfer Savings 1 to Capital 2
						Cash Buy	Amortized Loan	Rent Land								
			$P_0(B1)$	$P_0'(B2)$	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}	P_{11}	P_{12}
Production Period 1																
+ 1LAND	Land	ac.	426	0	1.00	-1.00	-1.00	-1.00	0	0	0	0	0	0	0	0
+ 1LABR	Labor	hr.	1,900	1,900	3.14	0	0	0	-1.00	0	0	0	0	0	0	0
+ 1CAPT	Capital	dol.	6,106	-1,085	18.11	242.00	16.05	12.00	1.00	-1.00	3.95	1.00	5.26	.05	-1.00	0
+ 1SECR	Security	dol.	102,240	0	0	-240.00	285.53	0	0	2.00	0	0	-5.26	0	0	0
+ 1EQPT	Equipment	ac.	700	700	1.00	0	0	0	0	0	-1.00	0	0	0	0	0
+ 1EINV	Livestock Investment	ac.	426	0	1.00	0	0	0	0	0	0	0	-1.00	0	0	0
1FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	1.00	0	0	0	0
1MPCR	Net Returns	dol.	0	-854	-124.85	2.00	64.94	60.00	5.00	.30	13.22	1.69	0	1.00	0	0
+ 1SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	80.25	60.00	5.00	.30	19.75	5.00	5.26	.25	-1.00	1.00
+ 1RENT	Rent Restriction	ac.	(3)	0	0	-1.00	-1.00	1.00	0	0	0	0	0	0	0	0
- 1RESC	Net Worth $t_1 \le$ N.W. t_2	dol.	(3)	-4,571	0	240.00	15.30	0	0	0	6.53	0	5.26	0	-1.00	1.00
Production Period 2																
+ 2LAND	Land	ac.	426	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0
+ 2LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0	0
+ 2CAPT	Capital	dol.	6,106	-1,085	0	0	16.05	0	0	0	2.40	0	0	0	0	-1.00
+ 2SECR	Security	dol.	102,240	4,571	0	-240.00	252.33	0	0	0	-6.53	0	-5.26	0	0	0
+ 2EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	-1.00	0	0	0	0	0
+ 2EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	-1.00	0	0	0
2FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0	0
2MPCR	Net Returns	dol.	0	0	0	0	60.25	0	0	0	12.00	0	0	0	0	0
+ 2SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	160.50	60.00	5.00	.30	31.75	5.00	5.26	.25	-1.00	0
+ 2RENT	Rent Restriction	ac.	(3)	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0
- 2RESC	Net Worth $t_1 \le$ N.W. t_3	dol.	(3)	-4,571	0	240.00	35.30	0	0	0	6.53	0	5.26	0	-1.00	0

See footnotes at end of table.

Production Period 3

			Col1	Col2												
+ 3LAND	Land	ac.	426	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0
+ 3LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0	0
+ 3CAPT	Capital	dol.	6,106	0	0	0	16.05	0	0	0	2.40	0	0	0	0	0
+ 3SECR	Security	dol.	102,240	0	0	-240.00	208.93	0	0	0	-6.53	0	-5.26	0	0	0
+ 3EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	-1.00	0	0	0	0	0
+ 3EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	-1.00	0	0	0
3FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0	0
3MPCR	Net Returns	dol.	0	0	0	0	54.12	0	0	0	12.00	0	0	0	0	0
+ 3SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	240.75	60.00	5.00	.30	43.75	5.00	5.26	.25	-1.00	0
+ 3RENT	Rent Restriction	ac.	(3)	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0
- 3RESC	Net Worth $t_1 \leq$ N.W. t_4	dol.	(3)	-4,571	0	240.00	61.43	0	0	0	6.53	0	5.26	0	-1.00	0

Production Period 4

			Col1	Col2												
+ 4LAND	Land	ac.	426	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0
+ 4LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0	0
+ 4CAPT	Capital	dol.	6,106	0	0	0	16.05	0	0	0	2.40	0	0	0	0	0
+ 4SECR	Security	dol.	102,240	0	0	-240.00	152.23	0	0	0	-6.53	0	-5.26	0	0	0
+ 4EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	-1.00	0	0	0	0	0
+ 4EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	-1.00	0	0	0
4FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0	0
4MPCR	Net Returns	dol.	0	0	0	0	46.11	0	0	0	12.00	0	0	0	0	0
+ 4SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	321.00	60.00	5.00	.30	55.75	5.00	5.26	.25	-1.00	0
+ 4RENT	Rent Restriction	ac.	(3)	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0
- 4RESC	Net Worth $t_1 \leq$ N.W. t_5	dol.	(3)	-4,571	0	240.00	95.57	0	0	0	6.53	0	5.26	0	-1.00	0

Production Period 5

			Col1	Col2												
+ 5LAND	Land	ac.	426	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0
+ 5LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0	0
+ 5CAPT	Capital	dol.	6,106	0	0	0	16.05	0	0	0	2.40	0	0	0	0	0
+ 5SECR	Security	dol.	102,240	0	0	-240.00	78.21	0	0	0	-6.53	0	-5.26	0	0	0
+ 5EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	-1.00	0	0	0	0	0
+ 5EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	-1.00	0	0	0
5FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0	0
5MPCR	Net Returns	dol.	0	0	0	0	35.61	0	0	0	12.00	0	0	0	0	0
+ 5SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	401.25	60.00	5.00	.30	67.75	5.00	5.26	.25	-1.00	0
+ 5RENT	Rent Restriction	ac.	(3)	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0
- 5RESC	Net Worth $t_1 \leq$ N.W. t_6	dol.	(3)	-4,571	0	240.00	140.21	0	0	0	6.53	0	5.26	0	-1.00	0

Production Period 6

			Col1	Col2												
+ 6LAND	Land	ac.	426	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0
+ 6LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0	0
+ 6CAPT	Capital	dol.	6,106	0	0	0	16.05	0	0	0	2.40	0	0	0	0	0
+ 6SECR	Security	dol.	102,240	0	0	-240.00	-18.72	0	0	0	-6.53	0	-5.26	0	0	0
+ 6EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	-1.00	0	0	0	0	0
+ 6EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	-1.00	0	0	0
6FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0	0
6MPCR	Net Returns	dol.	0	0	0	0	21.95	0	0	0	12.00	0	0	0	0	0
+ 6SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	481.50	60.00	5.00	.30	79.75	5.00	5.26	.25	-1.00	0
+ 6RENT	Rent Restriction	ac.	(3)	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0
- 6RESC	Net Worth $t_1 \leq$ N.W. t_7	dol.	(3)	-4,571	0	240.00	198.54	0	0	0	6.53	0	5.26	0	-1.00	0

13 See footnotes at end of table.

Table 2.--Linear programming tableau used in the capital accumulation and farm growth analysis--Continued

Activity Identification				2ØPER	2BLN5	2BLN1	2RLAN	2BLAB	2BCAP	2BYEQ	2FIX	2INVE	2MPC25	2STØ2C
								Production Period 2						
Objective Functions[1]: No. 1 (Cj values)				124.85	-2.00	-261.04	-60.00	-5.00	-.30	-61.22	-1.69	0	0	0
No. 2				78.60	-1.49	-107.64	-37.77	-3.15	-.189	-26.75	-1.06	0	0	0
No. 3				0	177.85	46.21	0	0	0	0	0	0	0	0
No. 4				1.00	0	0	0	0	0	0	0	0	0	0
No. 5				135.60	0	0	0	0	0	0	0	0	0	0
No. 6				0	0	0	0	0	0	0	0	0	0	0

Row ID[2]	Activity	Unit	Resource or Restriction Level P_o(B1)	Resource or Restriction Level P_o'(B2)	Operating Activity	Land Acquisition Cash Buy	Land Acquisition Amortized Loan	Land Acquisition Rent Land	Hire Labor	Borrow Capital	Buy Equipment	Fixed Cost	Buy Livestock	Consume 25% of Net Returns	Transfer Savings 2 to Capital 3
					P_{13}	P_{14}	P_{15}	P_{16}	P_{17}	P_{18}	P_{19}	P_{20}	P_{21}	P_{22}	P_{23}
	Production Period 1														
+ 1LAND	Land	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
+ 1LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+ 1CAPT	Capital	dol.	6,106	-1,085	0	0	0	0	0	0	0	0	0	0	0
+ 1SECR	Security	dol.	102,240	0	0	0	0	0	0	0	0	0	0	0	0
+ 1EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	0	0	0	0	0
+ 1EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
1FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
1MPCR	Net Returns	dol.	0	-854	0	0	0	0	0	0	0	0	0	0	0
+ 1SAVE	Reinvestment Capital	dol.	6,106	-5,425	0	0	0	0	0	0	0	0	0	0	0
+ 1RENT	Rent Restriction	ac.	(3)	0	0	0	0	0	0	0	0	0	0	0	0
- 1RESC	Net Worth $t_1 \leq$ N.W. t_2	dol.	(3)	-4,571	0	0	0	0	0	0	0	0	0	0	0
	Production Period 2														
+ 2LAND	Land	ac.	426	0	1.00	-1.00	-1.00	-1.00	0	0	0	0	0	0	0
+ 2LABR	Labor	hr.	1,900	1,900	3.14	0	0	0	-1.00	0	0	0	0	0	0
+ 2CAPT	Capital	dol.	6,106	-1,085	18.11	242.00	16.05	12.00	1.00	-1.00	3.95	1.00	5.26	.05	0
+ 2SECR	Security	dol.	102,240	4,571	0	-240.00	285.53	0	0	2.00	0	0	-5.26	0	0
+ 2EQPT	Equipment	ac.	700	700	1.00	0	0	0	0	0	-1.00	0	0	0	0
+ 2EINV	Livestock Investment	ac.	426	0	1.00	0	0	0	0	0	0	0	-1.00	0	0
2FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	1.00	0	0	0
2MPCR	Net Returns	dol.	0	0	-124.85	2.00	64.94	60.00	5.00	.30	13.22	1.69	0	1.00	0
+ 2SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	80.25	60.00	5.00	.30	19.75	5.00	5.26	.25	1.00
+ 2RENT	Rent Restriction	ac.	(3)	0	0	-1.00	-1.00	1.00	0	0	0	0	0	0	0
- 2RESC	Net Worth $t_1 \leq$ N.W. t_3	dol.	(3)	-4,571	0	240.00	15.30	0	0	0	6.53	0	5.26	0	1.00

See footnotes at end of table.

Production Period 3

	Code	Description	Unit													
+	3LAND	Land	ac.	426	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
+	3LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+	3CAPT	Capital	dol.	6,106	0	0	0	16.05	0	0	0	2.40	0	0	0	-1.00
+	3SECR	Security	dol.	102,240	0	0	-240.00	252.33	0	0	0	-6.53	0	5.26	0	0
+	3EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	-1.00	0	0	0	0
+	3EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	-1.00	0	0
	3FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
	3MPCR	Net Returns	dol.	0	0	0	0	60.25	0	0	0	12.00	0	0	0	0
+	3SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	160.50	60.00	5.00	.30	31.75	5.00	5.26	.25	0
+	3RENT	Rent Restriction	ac.	(3)	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
-	3RESC	Net Worth $t_1 \leq$ N.W. t_4	dol.	(3)	-4,571	0	240.00	35.30	0	0	0	6.53	0	5.26	0	0

Production Period 4

	Code	Description	Unit													
+	4LAND	Land	ac.	426	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0
+	4LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+	4CAPT	Capital	dol.	6,106	0	0	16.05	0	0	0	0	2.40	0	0	0	0
+	4SECR	Security	dol.	102,240	0	-240.00	208.93	0	0	0	0	-6.53	0	-5.26	0	0
+	4EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	-1.00	0	0	0	0
+	4EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	-1.00	0	0
	4FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
	4MPCR	Net Returns	dol.	0	0	0	54.12	0	0	0	0	12.00	0	0	0	0
+	4SAVE	Reinvestment Capital	dol.	6,106	-5,425	242.00	240.75	60.00	5.00	5.00	.30	43.75	5.00	5.26	.25	-1.00
+	4RENT	Rent Restriction	ac.	(3)	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0
-	4RESC	Net Worth $t_1 \leq$ N.W. t_5	dol.	(3)	-4,571	240.00	61.43	0	0	0	0	6.53	0	5.26	0	-1.00

Production Period 5

	Code	Description	Unit													
+	5LAND	Land	ac.	426	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
+	5LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+	5CAPT	Capital	dol.	6,106	0	0	0	16.05	0	0	0	2.40	0	0	0	0
+	5SECR	Security	dol.	102,240	0	0	-240.00	152.23	0	0	0	-6.53	0	-5.26	0	0
+	5EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	-1.00	0	0	0	0
+	5EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	-1.00	0	0
	5FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
	5MPCR	Net Returns	dol.	0	0	0	0	46.11	0	0	0	12.00	0	0	0	0
+	5SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	321.00	60.00	5.00	.30	55.75	5.00	5.26	.25	0
+	5RENT	Rent Restriction	ac.	(3)	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
-	5RESC	Net Worth $t_1 \leq$ N.W. t_6	dol.	(3)	-4,571	0	240.00	95.57	0	0	0	6.53	0	5.26	0	0

Production Period 6

	Code	Description	Unit													
+	6LAND	Land	ac.	426	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
+	6LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+	6CAPT	Capital	dol.	6,106	0	0	0	16.05	0	0	0	2.40	0	0	0	0
+	6SECR	Security	dol.	102,240	0	0	-240.00	78.21	0	0	0	-6.53	0	-5.26	0	0
+	6EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	-1.00	0	0	0	0
+	6EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	-1.00	0	0
	6FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
	6MPCR	Net Returns	dol.	0	0	0	0	35.61	0	0	0	12.00	0	0	0	0
+	6SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	401.25	60.00	5.00	.30	67.75	5.00	5.26	.25	0
+	6RENT	Rent Restriction	ac.	(3)	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
-	6RESC	Net Worth $t_1 \leq$ N.W. t_7	dol.	(3)	-4,571	0	240.00	140.21	0	0	0	6.53	0	5.26	0	0

See footnotes at end of table.

Table 2.--Linear programming tableau used in the capital accumulation and farm growth analysis--Continued

			Activity Identification		3ØPER	3BLN5	3BLN1	3RLAN	3BLAB	3BCAP	3BYEQ	3FIX	3INVE	3MPC25	3STØ4C
									Production Period 3						
		Objective Functions[1] (Cj values)	No. 1		124.85	-2.00	-225.43	-60.00	-5.00	-.30	-49.22	-1.69	0	0	0
			No. 2		58.73	-1.12	-75.17	-28.23	-2.35	-.141	-18.23	-.79	0	0	0
			No. 3		0	132.90	27.62	0	0	0	0	0	0	0	0
			No. 4		1.00	0	0	0	0	0	0	0	0	0	0
			No. 5		101.33	0	0	0	0	0	0	0	0	0	0
			No. 6		0	0	0	0	0	0	0	0	0	0	0
Row ID[2]	Activity	Unit	Resource or Restriction Level		Operating Activity	Land Acquisition			Hire Labor	Borrow Capital	Buy Equipment	Fixed Cost	Buy Livestock	Consume 25% of Net Returns	Transfer Savings 3 to Capital 4
						Cash Buy	Amortized Loan	Rent Land							
			$P_o(B1)$	$P_o(B2)$	P_{24}	P_{25}	P_{26}	P_{27}	P_{28}	P_{29}	P_{30}	P_{31}	P_{32}	P_{33}	P_{34}
Production Period 1															
+ 1LAND	Land	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
+ 1LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+ 1CAPT	Capital	dol.	6,106	-1,085	0	0	0	0	0	0	0	0	0	0	0
+ 1SECR	Security	dol.	102,240	0	0	0	0	0	0	0	0	0	0	0	0
+ 1EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	0	0	0	0	0
+ 1EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
1FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
1MPCR	Net Returns	dol.	0	-854	0	0	0	0	0	0	0	0	0	0	0
+ 1SAVE	Reinvestment Capital	dol.	6,106	-5,425	0	0	0	0	0	0	0	0	0	0	0
+ 1RENT	Rent Restriction	ac.	(3)	(3)	0	0	0	0	0	0	0	0	0	0	0
- 1RESC	Net Worth $t_1 \leq$ N.W. t_2	dol.	(3)	-4,571	0	0	0	0	0	0	0	0	0	0	0
Production Period 2															
+ 2LAND	Land	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
+ 2LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+ 2CAPT	Capital	dol.	6,106	-1,085	0	0	0	0	0	0	0	0	0	0	0
+ 2SECR	Security	dol.	102,240	4,571	0	0	0	0	0	0	0	0	0	0	0
+ 2EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	0	0	0	0	0
+ 2EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
2FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
2MPCR	Net Returns	dol.	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 2SAVE	Reinvestment Capital	dol.	6,106	-5,425	0	0	0	0	0	0	0	0	0	0	0
+ 2RENT	Rent Restriction	ac.	(3)	0	0	0	0	0	0	0	0	0	0	0	0
- 2RESC	Net Worth $t_1 \leq$ N.W. t_3	dol.	(3)	-4,571	0	0	0	0	0	0	0	0	0	0	0

See footnotes at end of table.

Production Period 3

	Item	Unit													
+ 3LAND	Land	ac.	426	0	1.00	-1.00	-1.00	-1.00	0	0	0	0	0	0	0
+ 3LABR	Labor	hr.	1,900	1,900	3.14	0	0	0	-1.00	0	0	0	0	0	0
+ 3CAPT	Capital	dol.	6,106	0	18.11	242.00	16.05	12.00	1.00	-1.00	3.95	1.00	5.26	.05	0
+ 3SECR	Security	dol.	102,240	0	0	-240.00	285.53	0	0	2.00	0	0	-5.26	0	0
+ 3EQPT	Equipment	ac.	700	700	1.00	0	0	0	0	0	-1.00	0	0	0	0
+ 3EINV	Livestock Investment	ac.	426	0	1.00	0	0	0	0	0	0	0	-1.00	0	0
3FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	1.00	0	0	0
3MPCR	Net Returns	dol.	0	0	-124.85	2.00	64.94	60.00	5.00	.30	13.22	1.69	0	1.00	0
+ 3SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	80.25	60.00	5.00	.30	19.75	5.00	5.26	.25	1.00
+ 3RENT	Rent Restriction	ac.	[3]	0	0	-1.00	-1.00	1.00	0	0	0	0	0	0	0
- 3RESC	Net Worth $t_1 \leq$ N.W. t_4	dol.	[3]	-4,571	0	240.00	15.30	0	0	0	6.53	0	5.26	0	1.00

Production Period 4

	Item	Unit													
+ 4LAND	Land	ac.	426	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
+ 4LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+ 4CAPT	Capital	dol.	6,106	0	0	0	16.05	0	0	0	2.40	0	0	0	-1.00
+ 4SECR	Security	dol.	102,240	0	0	-240.00	252.33	0	0	0	-6.53	0	-5.26	0	0
+ 4EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	-1.00	0	0	0	0
+ 4EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	-1.00	0	0
4FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
4MPCR	Net Returns	dol.	0	0	0	0	60.25	0	0	0	12.00	0	0	0	0
+ 4SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	160.50	60.00	5.00	.30	31.75	5.00	5.26	.25	0
+ 4RENT	Rent Restriction	ac.	[3]	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
- 4RESC	Net Worth $t_1 \leq$ N.W. t_5	dol.	[3]	-4,571	0	240.00	35.30	0	0	0	6.53	0	5.26	0	0

Production Period 5

	Item	Unit													
+ 5LAND	Land	ac.	426	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
+ 5LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+ 5CAPT	Capital	dol.	6,106	0	0	0	16.05	0	0	0	2.40	0	0	0	0
+ 5SECR	Security	dol.	102,240	0	0	-240.00	208.93	0	0	0	-6.53	0	-5.26	0	0
+ 5EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	-1.00	0	0	0	0
+ 5EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	-1.00	0	0
5FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
5MPCR	Net Returns	dol.	0	0	0	0	54.12	0	0	0	12.00	0	0	0	0
+ 5SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	240.75	60.00	5.00	.30	43.75	5.00	5.26	.25	0
+ 5RENT	Rent Restriction	ac.	[3]	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
- 5RESC	Net Worth $t_1 \leq$ N.W. t_6	dol.	[3]	-4,571	0	240.00	61.43	0	0	0	6.53	0	5.26	0	0

Production Period 6

	Item	Unit													
+ 6LAND	Land	ac.	426	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
+ 6LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+ 6CAPT	Capital	dol.	6,106	0	0	0	16.05	0	0	0	2.40	0	0	0	0
+ 6SECR	Security	dol.	102,240	0	0	-240.00	-18.72	0	0	0	-6.53	0	-5.26	0	0
+ 6EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	-1.00	0	0	0	0
+ 6EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	-1.00	0	0
6FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
6MPCR	Net Returns	dol.	0	0	0	0	21.95	0	0	0	12.00	0	0	0	0
+ 6SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	481.50	60.00	5.00	.30	79.75	5.00	5.26	.25	0
+ 6RENT	Rent Restriction	ac.	[3]	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
- 6RESC	Net Worth $t_1 \leq$ N.W. t_7	dol.	[3]	-4,571	0	240.00	198.54	0	0	0	6.53	0	5.26	0	0

17 See footnotes at end of table.

Table 2.--Linear programming tableau used in the capital accumulation and farm growth analysis--Continued

Activity Identification	4ØPER	4BLN5	4BLN1	4RLAN	4BLAB	4BCAP	4BYEQ	4FIX	4INVE	4MPC25	4STØ5C
						Production Period 4					
Objective Functions[1] (Cj values): No. 1	124.85	-2.00	-179.32	-60.00	-5.00	-.30	-37.22	-1.69	0	0	0
No. 2	43.89	-.83	-49.38	-21.09	-1.76	-.105	-11.86	-.59	0	0	0
No. 3	0	99.31	15.66	0	0	0	0	0	0	0	0
No. 4	1.00	0	0	0	0	0	0	0	0	0	0
No. 5	75.72	0	0	0	0	0	0	0	0	0	0
No. 6	0	0	0	0	0	0	0	0	0	0	0

			Resource of Restriction Level		Operating Activity	Land Acquisition			Hire Labor	Borrow Capital	Buy Equipment	Fixed Cost	Buy Livestock	Consume 25% of Net Returns	Transfer Savings to Capital [5]
Row ID[2]	Activity	Unit				Cash Buy	Amortized Loan	Rent Land							
			$P_o(B1)$	$P_o'(B2)$	P_{35}	P_{36}	P_{37}	P_{38}	P_{39}	P_{40}	P_{41}	P_{42}	P_{43}	P_{44}	P_{45}
Production Period 1															
+ 1LAND	Land	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
+ 1LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+ 1CAPT	Capital	dol.	6,106	-1,085	0	0	0	0	0	0	0	0	0	0	0
+ 1SECR	Security	dol.	102,240	0	0	0	0	0	0	0	0	0	0	0	0
+ 1EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	0	0	0	0	0
+ 1EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
1FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
1MPCR	Net Returns	dol.	0	-854	0	0	0	0	0	0	0	0	0	0	0
+ 1SAVE	Reinvestment Capital	dol.	6,106	-5,425	0	0	0	0	0	0	0	0	0	0	0
+ 1RENT	Rent Restriction	ac.	(3)	0	0	0	0	0	0	0	0	0	0	0	0
- 1RESC	Net Worth $t_1 \leq$ N.W. t_2	dol.	(3)	-4,571	0	0	0	0	0	0	0	0	0	0	0
Production Period 2															
+ 2LAND	Land	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
+ 2LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+ 2CAPT	Capital	dol.	6,106	-1,085	0	0	0	0	0	0	0	0	0	0	0
+ 2SECR	Security	dol.	102,240	4,571	0	0	0	0	0	0	0	0	0	0	0
+ 2EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	0	0	0	0	0
+ 2EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
2FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
2MPCR	Net Returns	dol.	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 2SAVE	Reinvestment Capital	dol.	6,106	-5,425	0	0	0	0	0	0	0	0	0	0	0
+ 2RENT	Rent Restriction	ac.	(3)	0	0	0	0	0	0	0	0	0	0	0	0
- 2RESC	Net Worth $t_1 \leq$ N.W. t_3	dol.	(3)	-4,571	0	0	0	0	0	0	0	0	0	0	0

See footnotes at end of table.

Production Period 3

+ 3LAND	Land	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
+ 3LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+ 3CAPT	Capital	dol.	6,106	0	0	0	0	0	0	0	0	0	0	0	0
+ 3SECR	Security	dol.	102,240	0	0	0	0	0	0	0	0	0	0	0	0
+ 3EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	0	0	0	0	0
+ 3EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
3FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
3MPCR	Net Returns	dol.	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 3SAVE	Reinvestment Capital	dol.	6,106	-5,425	0	0	0	0	0	0	0	0	0	0	0
+ 3RENT	Rent Restriction		[3]	0	0	0	0	0	0	0	0	0	0	0	0
- 3RESC	Net Worth $t_1 \le$ N.W. t_4	dol.	[3]	-4,571	0	0	0	0	0	0	0	0	0	0	0

Production Period 4

+ 4LAND	Land	ac.	426	0	1.00	-1.00	-1.00	-1.00	0	0	0	0	0	0	0
+ 4LABR	Labor	hr.	1,900	1,900	3.14	0	0	0	-1.00	0	0	0	0	0	0
+ 4CAPT	Capital	dol.	6,106	0	18.11	242.00	16.00	12.00	1.00	-1.00	3.95	1.00	5.26	.05	0
+ 4SECR	Security	dol.	102,240	0	0	-240.00	285.53	0	0	2.00	0	0	-5.26	0	0
+ 4EQPT	Equipment	ac.	700	700	1.00	0	0	0	0	0	-1.00	0	0	0	0
+ 4EINV	Livestock Investment	ac.	426	0	1.00	0	0	0	0	0	0	0	-1.00	0	0
4FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	1.00	0	0	0
4MPCR	Net Returns	dol.	0	0	-124.85	2.00	64.94	60.00	5.00	.30	13.22	1.69	0	1.00	0
+ 4SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	80.25	60.00	5.00	.30	19.75	5.00	5.26	.25	1.00
+ 4RENT	Rent Restriction		[3]	0	0	-1.00	-1.00	1.00	0	0	0	0	0	0	0
- 4RESC	Net Worth $t_1 \le$ N.W. t_5	dol.	[3]	-4,571	0	240.00	15.30	0	0	0	6.53	0	5.26	0	1.00

Production Period 5

+ 5LAND	Land	ac.	426	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
+ 5LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+ 5CAPT	Capital	dol.	6,106	0	0	0	16.05	0	0	0	2.40	0	0	0	0
+ 5SECR	Security	dol.	102,240	0	0	-240.00	252.33	0	0	0	-6.53	0	-5.26	0	-1.00
+ 5EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	-1.00	0	0	0	0
+ 5EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	-1.00	0	0
5FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
5MPCR	Net Returns	dol.	0	0	0	0	60.25	0	0	0	12.00	0	0	0	0
+ 5SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	160.50	60.00	5.00	.30	31.75	5.00	5.26	.25	0
+ 5RENT	Rent Restriction	ac.	[3]	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
- 5RESC	Net Worth $t_1 \le$ N.W. t_6	dol.	[3]	-4,571	0	240.00	35.30	0	0	0	6.53	0	5.26	0	0

Production Period 6

+ 6LAND	Land	ac.	426	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
+ 6LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+ 6CAPT	Capital	dol.	6,106	0	0	0	16.05	0	0	0	2.40	0	0	0	0
+ 6SECR	Security	dol.	102,240	0	0	-240.00	208.93	0	0	0	-6.53	0	-5.26	0	0
+ 6EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	-1.00	0	0	0	0
+ 6EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	-1.00	0	0
6FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
6MPCR	Net Returns	dol.	0	0	0	0	54.12	0	0	0	12.00	0	0	0	0
+ 6SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	240.75	60.00	5.00	.30	43.75	5.00	5.26	.25	0
+ 6RENT	Rent Restriction	ac.	[3]	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
- 6RESC	Net Worth $t_1 \le$ N.W. t_7	dol.	[3]	-4,571	0	240.00	61.43	0	0	0	6.53	0	5.26	0	0

See footnotes at end of table.

Table 2.--Linear programming tableau used in the capital accumulation and farm growth analysis--Continued

						Production Period 5								
Activity Identification						5ØPER	5BLN5	5BLN1	5RLAN	5BLAB	5BCAP	5BYEQ	5FIX	5INVE	5MPC25	5STØ6C

Objective Functions[1] (Cj values):

No.	5ØPER	5BLN5	5BLN1	5RLAN	5BLAB	5BCAP	5BYEQ	5FIX	5INVE	5MPC25	5STØ6C
No. 1	124.85	-2.00	-125.20	-60.00	-5.00	-.30	-25.22	-1.69	0	0	0
No. 2	32.80	-.62	-28.94	-15.76	-1.31	-.078	-7.10	-.44	0	0	0
No. 3	0	74.21	7.89	0	0	0	0	0	0	0	0
No. 4	1.00	0	0	0	0	0	0	0	0	0	0
No. 5	56.58	0	0	0	0	0	0	0	0	0	0
No. 6	0	0	0	0	0	0	0	0	0	0	0

			Resource of Restriction Level		Operating Activity	Land Acquisition			Hire Labor	Borrow Capital	Buy Equipment	Fixed Cost	Buy Livestock	Consume 25% of Net Returns	Transfer Savings 5 to Capital 6
Row ID[2]	Activity	Unit				Cash Buy	Amortized Loan	Rent Land							
			P_0(B1)	P_0'(B2)	P_{46}	P_{47}	P_{48}	P_{49}	P_{50}	P_{51}	P_{52}	P_{53}	P_{54}	P_{55}	P_{56}
Production Period 1															
+ 1LAND	Land	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
+ 1LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+ 1CAPT	Capital	dol.	6,106	-1,085	0	0	0	0	0	0	0	0	0	0	0
+ 1SECR	Security	dol.	102,240	0	0	0	0	0	0	0	0	0	0	0	0
+ 1EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	0	0	0	0	0
+ 1EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
1FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
1MPCR	Net Returns	dol.	0	-854	0	0	0	0	0	0	0	0	0	0	0
+ 1SAVE	Reinvestment Capital	dol.	6,106	-5,425	0	0	0	0	0	0	0	0	0	0	0
+ 1RENT	Rent Restriction	ac.	(3)	0	0	0	0	0	0	0	0	0	0	0	0
- 1RESC	Net Worth $t_1 \le$ N.W. t_2	dol.	(3)	-4,571	0	0	0	0	0	0	0	0	0	0	0
Production Period 2															
+ 2LAND	Land	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
+ 2LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+ 2CAPT	Capital	dol.	6,106	-1,085	0	0	0	0	0	0	0	0	0	0	0
+ 2SECR	Security	dol.	102,240	4,571	0	0	0	0	0	0	0	0	0	0	0
+ 2EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	0	0	0	0	0
+ 2EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
2FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
2MPCR	Net Returns	dol.	0	0	0	0	0	0	0	0	0	0	0	0	0
+ SAVE	Reinvestment Capital	dol.	6,106	-5,425	0	0	0	0	0	0	0	0	0	0	0
+ 2RENT	Rent Restriction	ac.	(3)	0	0	0	0	0	0	0	0	0	0	0	0
- 2RESC	Net Worth $t_1 \le$ N.W. t_3	dol.	(3)	-4,571	0	0	0	0	0	0	0	0	0	0	0

See footnotes at end of table.

Production Period 3

	Code		Unit													
+	3LAND	Land	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
+	3LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+	3CAPT	Capital	dol.	6,106	0	0	0	0	0	0	0	0	0	0	0	0
+	3SECR	Security	dol.	102,240	0	0	0	0	0	0	0	0	0	0	0	0
+	3EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	0	0	0	0	0
+	3EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
	3FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
	3MPCR	Net Returns	dol.	0	0	0	0	0	0	0	0	0	0	0	0	0
+	3SAVE	Reinvestment Capital	dol.	6,106	-5,425	0	0	0	0	0	0	0	0	0	0	0
+	3RENT	Rent Restriction	ac.	(³)	0	0	0	0	0	0	0	0	0	0	0	0
-	3RESC	Net Worth $t_1 \le$ N.W. t_4	dol.	(³)	-4,571	0	0	0	0	0	0	0	0	0	0	0

Production Period 4

	Code		Unit													
+	4LAND	Land	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
+	4LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+	4CAPT	Capital	dol.	6,106	0	0	0	0	0	0	0	0	0	0	0	0
+	4SECR	Security	dol.	102,240	0	0	0	0	0	0	0	0	0	0	0	0
+	4EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	0	0	0	0	0
+	4EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
	4FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
	4MPCR	Net Returns	dol.	0	0	0	0	0	0	0	0	0	0	0	0	0
+	4SAVE	Reinvestment Capital	dol.	6,106	-5,425	0	0	0	0	0	0	0	0	0	0	0
+	4RENT	Rent Restriction	ac.	(³)	0	0	0	0	0	0	0	0	0	0	0	0
-	4RESC	Net Worth $t_1 \le$ N.W. t_5	dol.	(³)	-4,571	0	0	0	0	0	0	0	0	0	0	0

Production Period 5

	Code		Unit													
+	5LAND	Land	ac.	426	0	1.00	-1.00	-1.00	-1.00	0	0	0	0	0	0	0
+	5LABR	Labor	hr.	1,900	1,900	3.14	0	0	0	-1.00	0	0	0	0	0	0
+	5CAPT	Capital	dol.	6,106	0	18.11	242.00	16.05	12.00	1.00	-1.00	3.95	1.00	5.26	.05	0
+	5SECR	Security	dol.	102,240	0	0	-240.00	285.53	0	0	2.00	0	0	-5.26	0	0
+	5EQPT	Equipment	ac.	700	700	1.00	0	0	0	0	0	-1.00	0	0	0	0
+	5EINV	Livestock Investment	ac.	426	0	1.00	0	0	0	0	0	0	0	-1.00	0	0
	5FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	1.00	0	0	0
	5MPCR	Net Returns	dol.	0	0	-124.85	2.00	64.94	60.00	5.00	.30	13.22	1.69	0	1.00	0
+	5SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	80.25	60.00	5.00	.30	19.75	5.00	5.26	.25	1.00
+	5RENT	Rent Restriction	ac.	(³)	0	0	-1.00	-1.00	1.00	0	0	0	0	0	0	0
-	5RESC	Net Worth $t_1 \le$ N.W. t_6	dol.	(³)	-4,571	0	240.00	15.30	0	0	0	6.53	0	5.26	0	1.00

Production Period 6

	Code		Unit													
+	6LAND	Land	ac.	426	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
+	6LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+	6CAPT	Capital	dol.	6,106	0	0	0	16.05	0	0	0	2.40	0	0	0	-1.00
+	6SECR	Security	dol.	102,240	0	0	-240.00	252.33	0	0	0	-6.53	0	-5.26	0	0
+	6EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	-1.00	0	0	0	0
+	6EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	-1.00	0	0
	6FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
	6MPCR	Net Returns	dol.	0	0	0	0	60.25	0	0	0	12.00	0	0	0	0
+	6SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	160.50	60.00	5.00	.30	31.75	5.00	5.26	.25	0
+	6RENT	Rent Restriction	ac.	(³)	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0
-	6RESC	Net Worth $t_1 \le$ N.W. t_7	dol.	(³)	-4,571	0	240.00	35.30	0	0	0	6.53	0	5.26	0	0

See footnotes at end of table.

Table 2.--Linear programming tableau used in the capital accumulation and farm growth analysis--Continued

						6ØPER	6BLN5	6BLN1	6RLAN	6BLAB	6BCAP	6BYEQ	6FIX	6INVE	6MPC25	6STØ7C
Activity Identification											Production Period 6					
Objective Functions[1]: No. 1						124.85	-2.00	-64.95	-60.00	-5.00	-.30	-13.22	-1.69	0	0	0
(Cj values) No. 2						24.51	-.47	-12.77	-11.78	-.98	-.059	-3.55	-.33	0	0	0
No. 3						0	55.45	2.98	0	0	0	0	0	0	0	0
No. 4						1.00	0	0	0	0	0	0	0	0	0	0
No. 5						42.28	0	0	0	0	0	0	0	0	0	0
No. 6						1.00	0	0	0	0	0	0	0	0	0	0
								Land Acquisition							Consume 25% of Net Returns	Transfer Savings 6 to Capital 7
Row ID[2]	Activity	Unit	Resource or Restriction Level		Operating Activity	Cash Buy	Amortized Loan	Rent Land	Hire Labor	Borrow Capital	Buy Equipment	Fixed Cost	Buy Livestock		
			$P_o(B1)$	$P_o'(B2)$	P_{57}	P_{58}	P_{59}	P_{60}	P_{61}	P_{62}	P_{63}	P_{64}	P_{65}	P_{66}	P_{67}
Production Period 1																
+ 1LAND	Land	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
+ 1LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+ 1CAPT	Capital	dol.	6,106	-1,085	0	0	0	0	0	0	0	0	0	0	0
+ 1SECR	Security	dol.	102,240	0	0	0	0	0	0	0	0	0	0	0	0
+ 1EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	0	0	0	0	0
+ 1EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
1FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
1MPCR	Net Returns	dol.	0	-854	0	0	0	0	0	0	0	0	0	0	0
+ 1SAVE	Reinvestment Capital	dol.	6,106	-5,425	0	0	0	0	0	0	0	0	0	0	0
+ 1RENT	Rent Restriction	ac.	(3)	0	0	0	0	0	0	0	0	0	0	0	0
- 1RESC	Net Worth $t_1 \leq$ N.W. t_2	dol.	(3)	-4,571	0	0	0	0	0	0	0	0	0	0	0
Production Period 2																
+ 2LAND	Land	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
+ 2LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0
+ 2CAPT	Capital	dol.	6,106	-1,085	0	0	0	0	0	0	0	0	0	0	0
+ 2SECR	Security	dol.	102,240	4,571	0	0	0	0	0	0	0	0	0	0	0
+ 2EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	0	0	0	0	0
+ 2EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0
2FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0
2MPCR	Net Returns	dol.	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 2SAVE	Reinvestment Capital	dol.	6,106	-5,425	0	0	0	0	0	0	0	0	0	0	0
+ 2RENT	Rent Restriction	ac.	(3)	0	0	0	0	0	0	0	0	0	0	0	0
- 2RESC	Net Worth $t_1 \leq$ N.W. t_3	dol.	(3)	-4,571	0	0	0	0	0	0	0	0	0	0	0

See footnotes at end of table.

Production Period 3

	Code	Description	Unit														
+	3LAND	Land	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0	0
+	3LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0	0
+	3CAPT	Capital	dol.	6,106	0	0	0	0	0	0	0	0	0	0	0	0	0
+	3SECR	Security	dol.	102,240	0	0	0	0	0	0	0	0	0	0	0	0	0
+	3EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	0	0	0	0	0	0
+	3EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0	0
	3FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0	0
	3MPCR	Net Returns	dol.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+	3SAVE	Reinvestment Capital	dol.	6,106	-5,425	0	0	0	0	0	0	0	0	0	0	0	0
+	3RENT	Rent Restriction	ac.	(3)	0	0	0	0	0	0	0	0	0	0	0	0	0
−	3RESC	Net Worth $t_1 \le$ N.W. t_4	dol.	(3)	-4,571	0	0	0	0	0	0	0	0	0	0	0	0

Production Period 4

	Code	Description	Unit														
+	4LAND	Land	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0	0
+	4LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0	0
+	4CAPT	Capital	dol.	6,106	0	0	0	0	0	0	0	0	0	0	0	0	0
+	4SECR	Security	dol.	102,240	0	0	0	0	0	0	0	0	0	0	0	0	0
+	4EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	0	0	0	0	0	0
+	4EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0	0
	4FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0	0
	4MPCR	Net Returns	dol.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+	4SAVE	Reinvestment Capital	dol.	6,106	-5,425	0	0	0	0	0	0	0	0	0	0	0	0
+	4RENT	Rent Restriction	ac.	(3)	0	0	0	0	0	0	0	0	0	0	0	0	0
−	4RESC	Net Worth $t_1 \le$ N.W. t_5	dol.	(3)	-4,571	0	0	0	0	0	0	0	0	0	0	0	0

Production Period 5

	Code	Description	Unit														
+	5LAND	Land	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0	0
+	5LABR	Labor	hr.	1,900	1,900	0	0	0	0	0	0	0	0	0	0	0	0
+	5CAPT	Capital	dol.	6,106	0	0	0	0	0	0	0	0	0	0	0	0	0
+	5SECR	Security	dol.	102,240	0	0	0	0	0	0	0	0	0	0	0	0	0
+	5EQPT	Equipment	ac.	700	700	0	0	0	0	0	0	0	0	0	0	0	0
+	5EINV	Livestock Investment	ac.	426	0	0	0	0	0	0	0	0	0	0	0	0	0
	5FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	0	0	0	0	0
	5MPCR	Net Returns	dol.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+	5SAVE	Reinvestment Capital	dol.	6,106	-5,425	0	0	0	0	0	0	0	0	0	0	0	0
+	5RENT	Rent Restriction	ac.	(3)	0	0	0	0	0	0	0	0	0	0	0	0	0
−	5RESC	Net Worth $t_1 \le$ N.W. t_6	dol.	(3)	-4,571	0	0	0	0	0	0	0	0	0	0	0	0

Production Period 6

	Code	Description	Unit														
+	6LAND	Land	ac.	426	0	-1.00	-1.00	-1.00	-1.00	0	0	0	0	0	0	0	
+	6LABR	Labor	hr.	1,900	1,900	3.14	0	0	0	-1.00	0	0	0	0	0	0	
+	6CAPT	Capital	dol.	6,106	0	18.11	242.00	16.05	12.00	1.00	-1.00	3.95	1.00	5.26	.05		
+	6SECR	Security	dol.	102,240	0	0	-240.00	285.53	0	0	2.00	0	0	-5.26	0		
+	6EQPT	Equipment	ac.	700	700	1.00	0	0	0	0	0	-1.00	0	0	0		
+	6EINV	Livestock Investment	ac.	426	0	1.00	0	0	0	0	0	0	0	-1.00	0		
	6FIXC	Fixed Cost	dol.	4,535	4,535	0	0	0	0	0	0	0	1.00	0	0		
	6MPCR	Net Returns	dol.	0	0	-124.85	2.00	64.94	60.00	5.00	.30	13.22	1.69	0	1.00		
+	6SAVE	Reinvestment Capital	dol.	6,106	-5,425	-124.85	242.00	80.25	60.00	5.00	.30	19.75	5.00	5.26	.25	1.00	
+	6RENT	Rent Restriction	ac.	(3)	0	0	-1.00	-1.00	1.00	0	0	0	0	0	0	0	
−	6RESC	Net Worth $t_1 \le$ N.W. t_7	dol.	(3)	-4,571	0	240.00	15.30	0	0	0	6.53	0	5.26	0	1.00	

See footnotes on following page.

enterprise operating costs, adequate equipment, and $1,532 fixed costs. Gross receipts are $43.08. The per acre net returns, not including the $1,532 fixed costs, are $24.22.

The operating activity may be looked upon as an aggregation of enterprise activities. Any farm operation, accumulation of capital, or expansion of the land base must utilize this operating activity. Therefore, the combination of enterprises is predetermined and not to be solved as a specific part of the problem. It may be argued that this is an undesirable feature of the capital accumulation model, because in the early stages of the growth of a farm, enterprises may be organized to minimize capital requirements and combined differently later when more capital is available. This is a valid criticism of the model. However, a priori knowledge supports the assumption made.

In previous static linear programming studies using the same representative resource situation as this study, similar combinations of enterprises resulted for different income targets and farm sizes. Although income targets and the resulting farm sizes were quite different, the per acre gross returns and cash costs were very similar (22).

Structural Framework of the Model

The structural framework of the linear programming model must be simultaneously determined when resource levels, operational restrictions, and activities for the various production periods are defined. The nature of the problem being analyzed requires that a moderately long planning horizon be considered. With each production period representing 5 years of farm operations, 6 production periods describe a planning horizon of 30 years. Five-year production periods simplify the computing and formulating problem so that a large number of different situations can be analyzed.

24

Operational Restrictions and Activities

Seven operational restrictions for each time period, including land, labor, capital, security, equipment, livestock investment, and fixed cost, were considered to be most relevant in the analysis (table 2). Two additional rows in each time period, rent restriction and net worth $t_1 \leq$ net worth t_i (i = 2 through 7), are included in the model when investigating specific problems. The rent restriction rows allow rented land to be restricted to any desired level. The net worth rows specify that the net worth of the firm at the end of each production period is equal to or greater than the net worth at the beginning of the first production period. This restriction was included in determining minimum starting equity requirements when no ending equity or net worth levels were specified. Without the restriction, the net worth of the firm could be used up during the planning horizon to satisfy family living and farm overhead expenses.

Two other rows or equations in each time period include net returns and reinvestment capital. Their function is accounting rather than restricting. Land renting, land buying, labor hiring, capital borrowing, and equipment and livestock purchasing activities in each time period allow resources to be expanded if they can be profitably purchased at the specified price.

The concept of net capital generated (by each activity) is utilized in the capital accumulation process throughout the model. The activity requirements or coefficients in each of the restriction rows are annual requirements; and since each period represents 5 years, the coefficients in the accounting rows, net returns and reinvestment capital, represent 5-year totals. In effect, capital may be generated over a 5-year period as reinvestment capital, and this capital (if any) may be used to expand resources in the next time period (reinvestment capital generated during a period is transferred to capital in the next period). The same effect would result from a model with annual production periods where resources are allowed to expand only every fifth year.

The function of the coefficients in the reinvestment capital rows is to accumulate the amount of net capital generated. The reinvestment capital row of production period 2 shows owned capital available. The amount of reinvestment capital available at the end of production period 2 is the capital generated during this period plus the amount of owned capital available at the beginning of it. The coefficients in the reinvestment capital rows of production periods subsequent to the ones where the activities originate are only accounting procedures to account for the capital available at the beginning of the periods.

25

Although the effects of different starting levels of owned land are analyzed, one of the basic situations for part of the analysis assumes an owned land resource of 426 acres at the beginning of the first time period (B_1 or P_0, table 2). This same acreage is assumed to be available for farm operation in subsequent time periods. The land base may be expanded above the starting level by renting or purchasing additional land.

Renting land is assumed to be an annual activity, and any number of acres may be rented during any production period independent of any other period. It is assumed that the cost of renting land is equal to 5 percent of the average investment in land. This is approximately equal to the cost that would be associated with the conventional one-fourth cotton, one-third grain rental cost agreement that prevails within the study area.

The purchase of an acre of land adds an acre to the land resource of the production period in which it is purchased and also makes the same acre available in all later production periods. The cost of land is assumed to be $240 per acre plus a $2 land transfer fee unless otherwise specified. The security resource, which may be used to obtain credit, is based upon the value of owned resources. Therefore, buying land on a cash basis adds a value of $240 to the security resource. In terms of net returns, the cost of buying land on a cash basis is the transfer fee. However, in terms of net capital generated, $242 is withdrawn from the capital stream as a result of the land purchase.

An alternative method of purchasing land is through a real estate loan, where payments are amortized over a 33-year period. Equal annual installment payments are required. Part of the annual installment is for interest payments at 5 1/2 percent, and the balance is payment on the principal.

Each installment payment is $16.05, which is the capital requirement for this land purchasing activity in each production period. In production period 1, $64.95 is deducted from net returns by the activity. This is the amount of interest paid through the first production period. The deduction from net returns in production period 2 is less than $64.95, because the amount applied toward principal becomes greater and the interest payments become less. With respect to the reinvestment capital coefficients for this activity, the amount withdrawn from the capital stream (net capital generated) in each production period is 5 times the annual installment payment, or $80.25. The coefficient in the reinvestment capital row of production period 2 is $160.50. Half of this ($80.25) results from the accounting procedure explained

above, and the other $80.25 is the total capital withdrawal (net capital generated) by the activity during the second production period.

The security or mortgage value of the land being purchased is assumed to be 46 percent of the market value ($110.42) for the amortized land buying activity. (This type of real estate loan was patterned after a Federal land bank loan. The security value is equal to 68.25 percent of a "normal agricultural value" of $161.79 per acre for the land.) The real estate loan for the purchase of 1 acre ($242) less the mortgage value of the land being purchased ($110.42) leaves $131.58 of additional security needed for the loan. Land already owned by the farm operator is assumed to have the same per acre security or mortgage value as the land being purchased ($110.42 per acre). Therefore, the $131.58 additional security requires that more than an acre of owned land be mortgaged to secure a real estate loan for the land buying activity. In terms of the market value of the land this is equal to $285.53 required at the time the land is purchased. The security needed for land purchased through an amortized loan at a given time decreases in later years and production periods.

Farmowners also purchase land by making cash downpayments and then making additional payments on an amortized basis. This is equivalent to purchasing some land on a cash basis and other land on an amortized basis. Therefore, the two methods of purchasing land included in the model in effect represent three methods of purchasing land.

LABOR RESTRICTION AND HIRED LABOR

It is assumed that 1,900 hours of family labor are available annually to perform actual farmwork. Additional annual labor requirements may be satisfied by hired labor, if profitable, at a rate of $1 per hour.

CAPITAL RESTRICTIONS AND BORROWING

The assumed level of owned capital available at the beginning of the first production period is an arbitrary selection. Part of the analysis assumes that $6,106 of owned capital is available at the beginning of the first production period. This is equivalent to the returns from operating 426 acres of owned land, less a family living expense of $3,000 (table 1). The level of owned capital available in any period subsequent to the first is capital generated through farm operations plus the beginning level of owned capital.

Owned capital may be supplemented by borrowed capital or credit, up to a limit, through the capital borrowing activity (P_6, table 2). It is assumed that capital is borrowed at an annual interest rate of 6 percent. Short-term credit is limited to 50 percent of the unmortgaged value of the security available unless otherwise specified.

EQUIPMENT COMPLEMENT AND INCREASING OVERHEAD COSTS

It is assumed that the same complement of farm equipment is required for any level of operation below 700 acres of total land. The machinery complement is assumed to be maintained by annual purchases of equipment equal in value to the annual machinery depreciation costs (table 1; this is included as part of the fixed cost restriction, P_0, table 2). An operating unit of 700 acres would give the minimum average investment in equipment of about $6.55 per acre. If at any time the operation exceeds 700 acres, additional equipment must be purchased.

Certain overhead expenses are constant regardless of the acres operated. However, some of the overhead expenses are associated with the size of the farm. The amount by which overhead costs would increase with increasing size of farm would vary, but the increase would be expected to be about $1.25 per acre for a farm size greater than 700 acres.

The equipment buying activity (P_7 in table 2) is required to account for additional equipment purchases and increasing overhead costs incurred when the farm size increases beyond 700 acres of total land. The required additional equipment purchase for each acre of land operated above 700 acres is assumed to be equal to the minimum average investment in equipment when the operation is 700 acres ($6.55). Additional equipment is purchased through a 5-year amortized loan with annual installment payment of $1.55. This payment, plus a depreciation cost of $1.15, plus the increase in overhead costs of $1.25 per acre included in the activity, makes annual capital requirements $3.95. The total associated cost for the production period would be the total interest paid in purchasing the equipment, $1.22, plus 5 annual charges for equipment depreciation and overhead costs--a total of $13.22.

The total capital investments plus costs for purchasing equipment and increasing overhead costs are $19.75 (the coefficient of the reinvestment capital row). Purchasing equipment during any production period makes the equipment available in subsequent periods; however, capital requirements in subsequent periods are equal to annual machinery depreciation plus increased overhead costs (P_7, table 2).

INVESTMENT RESTRICTION AND LIVESTOCK BUYING ACTIVITY

Part of the analysis assumes that an investment of $2,241 in livestock and livestock equipment is owned by the farm operator (with a starting farm size of 426 acres). Under these conditions, an additional investment in livestock and livestock equipment must be made for each acre operated above 426 acres. The required per acre investment is $5.26. The livestock buying activity (P_9, table 2) is formulated to provide for operation expansion. An investment in any production period makes the capital investment available in subsequent periods.

ANNUAL FIXED COST AND CAPITAL WITHDRAWAL

An annual capital withdrawal of $3,000 is written into the program model. In addition, a fixed cost of $1,532 is withdrawn as capital expenditure for overhead and machinery depreciation.

There is no farm cost associated with the $3,000 capital withdrawal. However, the $1,532 overhead and machinery depreciation costs are annual farm cash costs. Net returns are reduced by $1.69 for each unit of the fixed cost activity, which is forced to $4,532 to account for the total fixed cost of $7,659 in each production period.

ACCOUNTING EQUATIONS AND CONSUMPTION ACTIVITIES

The net returns row accumulates the total net returns for a production period. In a specific part of the analysis an activity is utilized to force consumption or capital withdrawal to $3,000 plus 25 percent of the net returns. This consumption activity (P_{10}, table 2) is forced to a level equal to the net returns of the production period (see the 1.0 coefficient in the net returns row). Annual capital is reduced by one-fifth of the net returns of the production period. Higher levels of capital withdrawals, equal to 50 to 75 percent of the net returns, are also assumed in specific parts of the analysis. The capital transfer activity (P_{12}, table 2) transfers the capital owned at the end of production period 1 to capital in production period 2.

OBJECTIVE FUNCTIONS

Several different objective functions are tested. The objective function values are shown in table 2. These objective functions are described in footnote 1 of table 2.

The starting specified level of resources in the minimum equity model is 1,900 hours of operator labor and nothing else (B_2 or P_0', table 2). The negative level of resources and restrictions in B_2 results from the fact that at least a minimum complement of farm equipment must be purchased before farm operations begin. The initial equipment has an average value of $4,571 and is purchased over a 5-year period with annual payments of $1,084. Total interest payments for purchasing the equipment over the 5-year period are $854 (the -$854 initial value in the net returns row of period 1). Since this equipment purchase must take place, the net worth at the end of period 1 is at least $4,571 (the -$4,571 in B_2 of period 1).

The capital acquisition activity, P_{11}, is used in the minimum equity model with vector B_2. In the minimum model, this activity is the only source of initial capital or equity. Total equity is owned cash capital plus the value of other owned resources. In the model, capital can be converted into any other farm resource initially or during the capital accumulation process of any production period.

Minimum equity problems are analyzed by maximizing the present value of net returns subject to very high costs for each unit of equity. This minimizes equity subject to the specified constraints, but it also allows the firm to accumulate capital or grow (if possible) above the level required to fulfill just the constraints.

EFFECT OF SELECTED VARIABLES ON CAPITAL ACCUMULATION

This section presents the analysis of the effect of different criterion functions, methods of land acquisition, capital rationing, and consumption levels on the capital accumulation or growth of farm firms.

Criterion Functions

It is commonly stated that a relevant criterion function is one that maximizes the present value of the stream of net returns. The effect, with respect to land operated, investments, and capital accumulated, of applying this criterion to the capital accumulation model is presented in table 3. A discount rate of 6 percent was used to compute the present value of returns.

Table 3.--Farm organization, capital accumulation, and growth process resulting from maximum present value of net returns[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated............................acres..	1,524	2,866	5,306	9,721	17,710	32,168
Land owned...............................do....	426	426	426	426	426	426
Land rented..............................do....	1,098	2,440	4,880	9,295	17,284	31,742
Gross sales...........................dollars..	65,657	123,462	228,588	418,782	762,963	1,385,797
Operating and overhead capital............do....	50,441	98,403	185,666	343,539	629,232	1,146,224
Borrowed capital.........................do....	51,120	51,120	51,120	51,120	51,120	51,120
Consumption capital......................do....	3,000	3,000	3,000	3,000	3,000	3,000
Production period totals:						
Starting owned cash capital...............do....	6,106	56,028	150,504	321,344	630,507	1,189,971
Net returns..............................do....	76,079	125,296	214,610	376,215	668,658	1,197,868
Capital withdrawals:						
Machinery purchases.....................do....	5,381	8,762	15,935	28,829	52,170	94,408
Livestock purchases.....................do....	5,776	7,058	12,835	23,223	42,024	76,047
Capital consumed........................do....	15,000	15,000	15,000	15,000	15,000	15,000
Total.................................do....	26,157	30,820	43,770	67,052	109,194	185,455
Net cash capital generated................do....	49,922	94,476	170,840	309,163	559,464	1,012,413
Ending owned cash capital.................do....	56,028	150,504	321,344	630,507	1,189,971	2,202,384
Value of controlled resources.............do....	439,771	872,147	1,657,357	3,078,172	5,649,190	10,301,978
Net worth (end of period)...............do....	176,251	286,547	486,157	847,372	1,501,030	2,683,898
Criterion function: Present value of						
net returns..............................do....	742,945					
Undiscounted level of net returns..........do....	2,658,726					
Starting level of owned capital............do....	115,172					

[1] Starting situation 426 acres of owned land, $4,585 average value of equipment, $2,241 investment in livestock, and $6,106 owned capital.

All expansion of operations occurs through the renting of additional land. Starting with more than $115,000 in total assets allows over 1,000 acres of land to be rented during the first production period. Expansion occurs at an increasing rate within each successive 5-year period. The maximum amount of capital, $51,000, is borrowed annually.

The conditions of capital accumulation portrayed seem to be unrealistic or atypical, as much with respect to the small levels of investments in farm resources as with respect to the increase in total acres operated. Also, although the level of ending capital is sizable, capital withdrawals remain relatively small. An assumption of a constant consumption level of $3,000 annually does not appear to be realistic.

The criterion function of maximizing discounted net returns gave the same results in depicting the conditions of capital accumulation and growth as several other objectives. Other criterion functions which gave the same growth conditions included (1) maximum discounted value of gross sales, (2) maximum undiscounted value of net returns, (3) maximum owned capital at the end of the last production period, (4) maximum land operated in the last production period, and (5) maximum land operated throughout the planning period.

The maximum value of undiscounted net returns is $2,658,726, which is the same level of undiscounted net returns that resulted with the objective of maximizing the present value of net returns (table 3). The maximum value of owned capital at the end of the production period is $2,202,384, which is also the ending capital of production period 6 as shown in table 3. Maximizing operations in the last production period also gives the same growth situation and results as the objectives above. The value of this criterion function equals 32,168, the acres of land operated during production period 6. Maximizing land operated throughout the planning horizon also gives the same farm operation and growth situations over the 30-year planning period. These last two criterion functions are ways of depicting a management strategy of operating the largest possible unit.

A criterion function of maximizing the present value of consumption, with a 6-percent discount rate, was also analyzed. When this criterion was applied, the effect on capital accumulation was the same as the effect of maximizing the present value of net returns, with the exception of the last production period. Only the situation with respect to land operated, returns, etc., in the last production period, where all additional consumption occurred (other than the specified minimum level of $3,000), is different. A discount rate of 6 percent was not great enough to bring about

additional consumption in earlier time periods. In formulating the problem, it was assumed that consumption occurs during a production period rather than at the end of it. In this manner, consumption reduces the ability to generate capital over time. The problem might be formulated so that capital could be withdrawn at the end of each production period rather than during it. Under this condition, a criterion function of maximizing the present value of capital withdrawals (with a discount rate no greater than 6 percent) would be identical with a criterion of maximizing ending capital, since all additional consumption occurred during the past period.

The organization of production and the process of capital accumulation are the same with the criterion function of maximizing the present value of land purchases as with all other criterion functions discussed above, through the first 15 years of the planning period (table 4). Even though their values are discounted (at a rate of 6 percent), land purchases are maximized by accumulating capital through renting all land operated and then using the capital during the later part of the planning period to purchase land. When the objective is to maximize owned land, the investment in land is above the profit maximizing level. There is a difference of more than $1,403,800 between the undiscounted values of the stream of net returns over the 30-year planning period in the two objectives of maximizing returns and maximizing land purchases.

An objective of maximum discounted value of net returns appears to be a relevant criterion function in maximum capital accumulation over time. It is compatible with maximum accumulation of net worth. Also, application of this criterion results in the same conditions of farm firm growth as several other criteria. The objective function subject to the restrictions of the model used in this analysis does not appear to be a sensitive variable. Therefore, in the analyses that follow, it is assumed that the management strategy is one that maximizes the present value of the stream of net returns.

Effect of Other Variables

Since arbitrary consumption, capital borrowing levels, land acquisition methods, and starting asset levels are assumed, these factors are varied to determine their effect upon the capital accumulation and growth of farm firms. The effect of the specified conditions of land acquisition methods, starting farm sizes, capital borrowing levels, and consumption levels on the growth process is summarized in tables 5 through 8. The total acreage operated

33

Table 4.--Farm organization, capital accumulation, and growth resulting from maximum present value of land principal payments[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated...........................acres..	1,524	2,866	5,306	5,306	5,306	3,721
Land owned................................do....	426	426	426	1,241	2,760	5,073
Land rented...............................do....	1,098	2,440	4,880	4,065	2,546	0
Gross sales...........................dollars..	65,657	123,462	228,588	228,588	228,588	160,314
Operating and overhead capital............do....	50,441	98,403	185,666	175,616	163,542	110,559
Borrowed capital..........................do....	51,120	51,120	51,120	51,120	148,920	331,200
Consumption capital.......................do....	3,000	3,000	3,000	3,000	3,000	3,000
Production period totals:						
Starting owned cash capital...............do....	6,106	56,028	150,503	321,343	375,595	321,347
Net returns..............................do....	76,079	125,295	214,610	264,859	325,230	248,774
Capital withdrawals:						
Land purchases.........................do....	0	0	0	195,607	364,478	555,115
Machinery purchases....................do....	5,381	8,762	15,935	0	0	0
Livestock purchases....................do....	5,776	7,058	12,835	0	0	0
Capital consumed.......................do....	15,000	15,000	15,000	15,000	15,000	15,000
Total...............................do....	26,157	30,820	43,770	210,607	379,478	570,115
Net cash capital generated................do....	49,922	94,475	170,840	54,252	-54,248	-321,341
Ending owned cash capital.................do....	56,028	150,503	321,343	375,595	321,347	6
Value of controlled resources.............do....	439,771	872,147	1,657,357	1,711,609	1,657,361	1,280,020
Net worth (end of period)................do....	176,251	286,547	486,157	736,016	1,046,246	1,280,020
Criterion function: Present value of land						
principal payments.....................do....	321,895					
Present value of net returns.............do....	458,088					
Undiscounted level of net returns............do....	1,254,847					
Starting level of owned capital..............do....	115,172					

[1] Starting situation 426 acres of owned land, $4,585 average value of equipment, $2,241 investment in livestock, and $6,106 owned capital.

Table 5.--Farm size after 30-year growth period for specified methods of land acquisition, capital borrowing, and consumption levels

Method of land acquisition and starting farm size	Capital borrowing limit[1]	Consumption level	
		50 percent of net returns	25 percent of net returns
	Percent	Acres	Acres
Purchase only:			
213 acres..................................	12.5	870	1,337
	25.0	882	1,357
426 acres..................................	12.5	1,627	2,459
	25.0	1,652	2,504
Rent:			
213 acres..................................	12.5	3,800	8,624
	25.0	4,460	10,111
426 acres..................................	12.5	6,118	14,143
	25.0	7,122	16,078

[1] Capital borrowing limit is expressed as a portion of the value of unmortgaged owned land.

Table 6.--Value of net worth accumulated during the 30-year growth period for specified methods of land acquisition, capital borrowing, and consumption levels[1]

Method of land acquisition and starting farm size	Capital borrowing limit[2]	Consumption level	
		50 percent of net returns	25 percent of net returns
	Percent	Dollars	Dollars
Purchase only:			
213 acres.................................	12.5	134,414	265,405
	25.0	136,868	270,149
426 acres.................................	12.5	248,386	481,757
	25.0	253,725	492,231
Rent:			
213 acres.................................	12.5	248,111	639,426
	25.0	284,632	743,111
426 acres.................................	12.5	402,194	1,051,216
	25.0	455,733	1,180,664

[1] The starting value of net worth is $62,931 for the 213-acre farm and $115,172 for the 426-acre farm.
[2] Capital borrowing limit is expressed as a portion of the value of unmortgaged owned land.

Table 7.--Present value of the stream of net returns after 30-year growth period for specified methods of land acquisition, capital borrowing, and consumption levels

| Method of land acquisition and starting farm size | Capital borrowing limit[1] | Consumption level | |
		50 percent of net returns	25 percent of net returns
	Percent	Dollars	Dollars
Purchase only:			
213 acres....................................	12.5	101,509	126,143
	25.0	104,020	129,003
426 acres....................................	12.5	193,481	234,645
	25.0	199,193	241,134
Rent:			
213 acres....................................	12.5	167,047	256,228
	25.0	194,397	299,683
426 acres....................................	12.5	274,828	424,905
	25.0	311,898	476,882

[1] Capital borrowing limit is expressed as a portion of the value of unmortgaged owned land.

Table 8.--Undiscounted value of the stream of net returns after 30-year growth period for specified methods of land acquisition, capital borrowing, and consumption levels

| Method of land acquisition and starting farm size | Capital borrowing limit[1] | Consumption level | |
		50 percent of net returns	25 percent of net returns
	Percent	Dollars	Dollars
Purchase only:			
213 acres....................................	12.5	268,828	353,873
	25.0	273,736	360,200
426 acres....................................	12.5	496,776	642,343
	25.0	507,449	656,308
Rent:			
213 acres....................................	12.5	496,220	852,570
	25.0	571,263	990,817
426 acres....................................	12.5	804,387	1,401,622
	25.0	911,467	1,574,221

[1] Capital borrowing limit is expressed as a portion of the value of unmortgaged owned land.

during each year of the last production period is shown in table 5, the accumulated value of net worth during the 30-year growth period in table 6, the present value of the stream of net returns in table 7, and the undiscounted stream of net returns in table 8. Organization of resources, farm operation, consumption levels, and capital accumulated for each of the situations represented in tables 5 through 8 are shown in appendix tables 26 through 41.

Least growth, in terms of acres operated (or any of the other measures) during the last production period, occurs for the smallest starting farm size, lowest capital borrowing level, and highest consumption level, and where land acquisition is limited to purchasing only. This size of operation is 870 acres, compared with 16,078 acres operated where maximum growth occurs.

Maximum growth occurs with a larger starting farm size, higher capital borrowing level, and lower consumption level, and where the alternative of renting land exists. In all cases, the objective is assumed to be one where the present value of the stream of net returns is maximized over the 30-year planning period.

METHODS OF LAND ACQUISITION

Maximum growth and capital accumulation occur when all additional land operated is rented rather than purchased. With a 426-acre starting farm size, a 12.5 percent capital borrowing limit, and a 50 percent consumption level, the ending farm size after 30 years is 6,118 acres where all additional land operated is rented and only 1,627 acres where all additional land operated must be purchased (table 5). In terms of value of net worth accumulated, renting all additional land acquired over the 30-year period results in an accumulated value of $402,194. Purchasing additional land operated results in an accumulated value of $248,386 which is about 62 percent of the level accumulated by renting (table 6).

Where land acquisition may occur through renting, the acreage operated ranges from 557 acres in the first production period to 6,118 acres in the last production period (appendix table 38). Total acres operated and owned capital accumulated increase at an increasing rate, with most of the growth occurring during the last 15 years. The maximum amount of capital, $12,780, is borrowed annually. Consumption levels or annual capital withdrawals for purposes other than reinvestment into the firm, specified to the 50 percent of the forthcoming net returns, range from $5,017 in the first period to $25,697 in the last. Consumption during production period 3, when 1,855 acres of land are operated (a little less than

37

3 sections of land), is about $10,000 annually. Ending net worth increases to $517,366 at the end of production period 6 (table 6 and appendix table 38). This is $402,194 above the starting net worth, which is $115,172. The present value of the stream of net returns over the 30-year period is $274,828 (table 7).

For the same starting farm size (426 acres), capital borrowing limit (12.5 percent), and consumption level (50 percent), capital accumulation and growth are significantly less when land acquisition is limited to purchasing all additional land operated. Under this condition, the size of operations ranges from 493 acres in the first period to about 1,600 in the last production period (table 6 and appendix table 30). The total interest and principal payments for land on an amortized basis require more capital outlay than does renting land, and the ability to borrow capital is reduced because owned assets must be mortgaged to obtain a real estate loan. Under these conditions, with 67 acres of land purchased, $10,404 is borrowed annually during the first production period. In the second production period, with 268 acres of land purchased through an amortized loan, only $1,113 of capital is borrowed on an annual basis. No capital is borrowed after the second production period. All collateral or security value is utilized by mortgaging owned land in order to purchase land through the amortized real estate loan. All collateral or security value is utilized during this period, as it is during all production periods.

Annual consumption levels for this situation, at 50 percent of the net returns, range from $4,600 during the first period to over $12,000 during the last production period. Both net returns (and, therefore, consumption levels) and the accumulation of net worth during the first two production periods compare somewhat favorably with those where land may be rented. However, during subsequent periods the differences become large.

The present value of net returns, when additional land operated must be purchased, is $193,481 (table 7). This is about 30 percent below the value forthcoming when land may be rented.

EFFECT OF STARTING FARM SIZE

When the starting owned land is 213 acres (half of the starting level previously assumed), growth in terms of both acres operated and additional value of net worth accumulated at the end of the 30-year period is decreased by about 37 percent when land may be rented. This occurs with the same borrowed capital limits and consumption levels (12.5 and 50 percent, respectively) as for the 426-acre starting size. The starting security value or collateral

is less for the smaller starting size since this value is based upon the value of owned land. When starting with 213 acres the total acreage operated increases from 342 acres in period 1 to 3,800 acres (about 6 sections of land) during production period 6 (table 5 and appendix table 34). The maximum amount of capital is borrowed each year, about $6,400 annually. Net cash capital generated ranges from $12,016 in the first period to $66,513 in the last. On an annual basis this is $2,403 during the first production period and $13,303 during the last period.

Consumption levels, specified to be 50 percent of net returns, and the resulting level of capital accumulated appear to be low for a starting farm size of 213 acres. Withdrawals for consumption on an annual basis are $2,539 during the first production period (appendix table 34). During the second production period, when about a section of land is operated, annual consumption is less than $5,000. Annual consumption increases to over $10,000 only after 20 years of operations or during the last two production periods. The present value of net returns over the 30-year period (6 percent discount rate) is $167,047. This is about 61 percent of the value of the stream of net returns resulting with a starting farm size of 426 acres of owned land.

With the starting level of owned land equal to 213 acres and land acquisition limited to purchasing only, growth in terms of acres operated is limited to the purchase of about a section of land during the 30-year planning period. Land purchases range from 66 acres in the first production period to 165 acres in the last period and total acres operated range from 279 to 870 acres in the same period (appendix table 26). The growth and capital accumulation process is very similar, but on a smaller scale, to the growth process for the starting farm size of 426 acres under the same conditions of land acquisition. Consumption levels are low, a little more than $2,000 per year during the first production period and less than $5,000 for the first 20 years of the 30-year planning period. The maximum consumption level on an annual basis, which occurs during the last production period, is about $7,100.

In general, different starting farm sizes for the same levels of consumption, capital borrowing, and land acquisition result in quite different rates of growth and capital accumulation. After the 30-year growth period the difference between the ending farm sizes, in most cases, is not quite double for the two different starting sizes (table 5). The greatest relative difference occurs where the other factors, including capital borrowing, consumption, and land acquisition, are most limiting. The least relative difference occurs where the other factors of capital borrowing, consumption, and

39

land acquisition are the least limiting. The starting size of land resource becomes less important or less restricting, in terms of determining growth rates, when more capital is made available for expansion.

Several significant points are already apparent from these simulated growth situations. Competition for farm resources, especially land, is not an explicit part of the model used in the analysis. Competition for these resources would increase the price of land (whether rented or purchased) and might also cause farmland operated to be scattered over a wide area. Both of these conditions would increase land acquisition costs. Even though competition is not considered, farm firm growth rates and capital accumulation portrayed by the growth situations are not phenomenal. Starting with sizable assets, including 426 acres of owned land and renting all additional land operated, only 557 acres of land are operated during the first 5-year production period, with an annual consumption level of about $5,000 (appendix table 38). Less than 3 sections of land are operated during the first 3 production periods (first 15 years of the planning period) with a consumption level of about $10,000. The level of growth and capital accumulation is even less when all additional land operated must be purchased.

With rented land unlimited, a starting farm size of 213 acres of owned land, and net worth of $62,931, 1 section of land can be operated through the second period with a consumption level less than $5,000 (appendix table 34). Less than 2 sections are operated at the end of the first 15 years of the planning period. This starting size of assets allows 342 acres to be operated during the first production period. With a consumption level of about $2,500 each year, the annual increase in net worth is $2,539. A consumption level or capital withdrawal of about $5,000 would result in a static situation with respect to growth. This level of capital withdrawal would result in no net cash capital generated, and the ending level of owned capital would be about $6,106, which is the assumed level of starting capital. Thus, the size of assets at the end of each 5-year production period would be the same as the starting size.

NONLAND CAPITAL BORROWING

The effect of different nonland capital borrowing levels, measured in terms of acres operated (table 5), does not appear to be significant where the method of land acquisition is limited to purchasing land. For the same starting farm sizes and consumption levels, small differences exist in acres operated or capital accumulated.

The reason for this is that, where land is purchased, relatively small amounts of nonland capital are borrowed over the 30-year growth period. This capital is borrowed only at the first part of the planning period where owned capital levels are comparatively low (appendix tables 26–33). During the rest of the planning period the security value of collateral is utilized through real estate loans to purchase land on an amortized loan basis. Maximum growth occurs by following this policy, because collateral is more valuable when used to secure real estate loans than when used to borrow cash capital. If security levels used to obtain real estate loans were altered, significant differences in growth rates undoubtedly would occur.

Where the method of land acquisition is renting, all security or collateral value is utilized for nonland capital borrowing, and quite different levels of capital are actually borrowed (appendix tables 34–41). Under these conditions, differences in farm sizes range from 660 to 1,935 acres for the two different capital borrowing levels with equal starting farm sizes and consumption levels (table 5). Annual differences in borrowed capital are $6,390 and $12,780 for the 213-acre starting size and $25,560 and $12,780 for the larger starting farm size of 426 acres (appendix tables 34–41). Over a 30-year period the total amount of these differences is quite substantial.

With rented land unlimited and starting with 213 acres of owned land, reducing borrowed capital from 25 percent ($12,780 annually) to 12.5 percent ($6,390 annually) reduces the value of the stream of net returns by about 14 percent for the lower consumption level and by about 13 percent for the higher consumption level. The reduction in the stream of net returns for the different capital borrowing limits when starting with the larger farm size is about 12 percent (table 8).

With the starting level of owned cash capital $6,106 and without an alternative of borrowing additional capital, a consumption level of $3,000 annually cannot be met. However, the present value of the stream of net returns is maximized, and annual fixed costs are met when $1, 816 capital is withdrawn annually for consumption during the first production period (table 9). Under these conditions, only 152 acres of the 426 acres of owned land can be operated in the first production period.

Net capital generated during the first production period is $2,274. This capital plus the starting capital ($6,106) makes $8,380 owned capital available at the beginning of production period 2. With this amount of capital available, only 212 acres can be operated during period 2. This operation generates enough capital so that the specified withdrawal for consumption may be made during the period.

Table 9.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, capital use restricted to owned capital[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated..............................Acres..	152	212	426	1,184	2,638	5,225
Land owned..................................do....	426	426	426	426	426	426
Land rented.................................do....	0	0	0	758	2,212	4,799
Gross sales............................dollars....	6,548	9,133	18,352	51,007	113,645	225,093
Operating and overhead capital.............do....	4,277	5,360	9,247	35,167	87,232	179,733
Consumption capital.........................do....	1,816	3,000	3,000	3,000	3,000	3,000
Production period totals:						
Starting owned cash capital.................do....	6,106	8,380	12,247	42,773	99,813	199,707
Net returns................................do....	11,354	18,867	45,526	79,197	132,066	226,802
Capital withdrawals:						
Machinery purchases........................do....	0	0	0	3,170	9,524	16,945
Livestock purchases........................do....	0	0	0	3,987	7,648	13,608
Capital consumed...........................do....	9,080	15,000	15,000	15,000	15,000	15,000
Total...................................do....	9,080	15,000	15,000	22,157	32,172	45,553
Net cash capital generated.................do....	2,274	3,867	30,526	57,040	99,894	181,249
Ending owned cash capital..................do....	8,380	12,247	42,773	99,813	199,707	380,956
Value of controlled resources..............do....	117,446	121,313	151,839	397,956	863,982	1,696,664
Net worth (end of period)..................do....	117,446	121,313	151,839	216,036	333,102	544,904
Criterion function: Present value of						
net returns.................................do....	146,586					
Undiscounted level of net returns...........do....	513,812					
Starting level of owned capital.............do....	115,172					

[1] Starting situation 426 acres of owned land, $4,585 average value of equipment, $2,241 investment in livestock, and $6,106 owned capital.

Net capital generated during the second production period is $3,867, which brings ending capital to $12,247. This level of capital is just sufficient to operate all of the 426 acres of owned land. Capital accumulation increases rapidly during the last half of the planning period. The present value of net returns during the planning period is $146,586 and the value of undiscounted net returns is $513,812.

The effect of limiting capital use to owned capital is to restrict capital accumulation when owned capital is insufficient to cover all operating expenses. When owned capital does cover operating expenses and no capital is borrowed, the ending capital of production period 2 is the amount required to cover all operating expenses, including the specified level of consumption. The total undiscounted value of net returns of the last 4 production periods is $483,591. Where borrowed capital is limited to $12,780 annually, the total undiscounted value of net returns of the first four production periods is $542,600. The difference over the 20 years is $59,000. The alternative of borrowing $12,780 annually increases net returns, on an average, by almost $3,000.

EFFECTS OF HIGHER CONSUMPTION LEVELS

The different levels of consumption, where other factors are held constant, result in significantly different growth rates during the 30-year period (tables 5-8). The specified level of consumption, 25 percent of the net returns, is probably too low considering family needs, income taxes, and other capital withdrawals associated with farming, unless other sources of income exist (see appendix tables for consumption levels). However, the higher consumption levels retard growth significantly and retard it most where land is rented and where capital is least limiting. This is because capital accumulation increases at an increasing rate.

In addition to the situations represented in tables 5-8, other levels of capital withdrawal were specified to analyze further the effects of consumption levels on capital accumulation. The consumption function specified for this purpose is of the type $c = a + bY$. The value of a is $3,000 and Y is the level of net returns. Three different capital withdrawal levels (assumed to be for consumption purposes) are analyzed. These levels are $b = 25$, 50, and 75. The larger starting farm size (426 acres) was assumed. The nonland capital borrowing limit was assumed to be 50 percent of the value of unmortgaged owned land.

Marginal Propensity to Consume Equal to 25 Percent of Net Returns

When capital withdrawals for consumption are $3,000 plus 25 percent of net returns, total operations range from 1,438 acres in the first production period to 14,114 acres in the last period (table 10). All expansion of operations occurs through renting land. The maximum level of operations, 14,114 acres, is less than half as large as it is when only the minimum capital withdrawal is specified (see table 3).

The minimum capital withdrawal for consumption in the first production period is about $6,650 annually. The total value of capital withdrawn for consumption over all of the planning period is $450,452. Total capital withdrawals, which include all capital investments and consumption, over the 30-year planning period amount to $610,049, which is about $147,600 higher than the withdrawals where minimum consumption levels ($3,000 annually) are specified. The present value of the stream of net returns over the planning period is $453,960, and the undiscounted value of the stream of net returns is $1,441,806 which is more than half the value of returns when minimum consumption levels are specified.

Marginal Propensity to Consume Equal to 50 Percent of Net Returns

Higher levels of consumption or capital withdrawals, equal to 50 percent of net returns plus the minimum $3,000 annual consumption level, are quite restrictive upon capital accumulation. With higher consumption levels, the maximum size of operation is reduced to 5,425 acres in the last production period (table 11). Land expansion, which occurs through renting land, ranges from 933 acres in the first period to almost 5,000 in the last 5-year period.

Capital withdrawals for consumption range from about $10,000 annually in production period 1 to about $25,000 annually in the last period. These maximum consumption levels, which occur in the last production period, are almost $5,000 lower than the maximum consumption levels when a marginal propensity to consume of 25 percent of net returns is specified. The total value of consumption over the 30-year period is $479,401, which is only about $29,000 more than the total value of consumption when 25 percent of net returns is specified. The higher specified level of consumption (in terms of percentage of net returns) increases consumption in the first 4 production periods but decreases it in the last 2 periods.

Table 10.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, propensity to consume equal to 25 percent of net returns[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated..............................acres..	1,438	2,252	3,568	5,645	8,928	14,114
Land owned..............................do....	426	426	426	426	426	426
Land rented...........................do....	1,012	1,826	3,142	5,219	8,502	13,688
Gross sales..........................dollars..	61,954	97,017	153,716	243,199	384,605	608,049
Operating and overhead capital.............do....	47,356	76,390	123,433	197,668	314,980	500,351
Borrowed capital...........................do....	51,120	51,120	51,120	51,120	51,120	51,120
Consumption capital.........................do....	6,650	8,157	10,571	14,383	20,406	29,924
Production period totals:						
Starting owned cash capital................do....	6,106	35,705	88,460	171,505	302,755	510,149
Net returns.................................do....	72,990	103,135	151,416	227,653	348,125	538,487
Capital withdrawals:						
Machinery purchases........................do....	4,820	5,315	8,594	13,564	21,434	33,869
Livestock purchases........................do....	5,323	4,281	6,923	10,926	17,266	27,282
Capital consumed...........................do....	33,248	40,784	52,854	71,913	102,031	149,622
Total....................................do....	43,391	50,380	68,371	96,403	140,731	210,773
Net cash capital generated..................do....	29,599	52,755	83,045	131,250	207,394	327,714
Ending owned cash capital...................do....	35,705	88,460	171,505	302,755	510,149	837,863
Value of controlled resources..............do....	397,794	655,505	1,069,907	1,724,127	2,758,141	4,391,646
Net worth (end of period)...................do....	154,914	217,265	315,827	471,567	717,661	1,106,526
Criterion function: Present value of						
net returns...............................do....	453,960					
Undiscounted level of net returns............do....	1,441,806					
Starting level of owned capital..............do....	115,172					

[1] Starting situation 426 acres of owned land, $4,585 average value of equipment, $2,241 investment in livestock, and $6,106 owned capital.

Table 11.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, propensity to consume equal to 50 percent of net returns[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated............................acres..	1,359	1,722	2,268	3,011	4,030	5,425
Land owned............................do....	426	426	426	426	426	426
Land rented............................do....	933	1,296	1,842	2,585	3,604	4,999
Gross sales............................dollars..	58,540	74,170	97,687	129,710	173,595	233,709
Operating and overhead capital............do....	44,511	57,374	76,879	103,428	139,811	189,649
Borrowed capital............................do....	51,120	51,120	51,120	51,120	51,120	51,120
Consumption capital............................do....	10,014	11,398	13,404	16,141	19,892	25,030
Production period totals:						
Starting owned cash capital................do....	6,106	16,968	39,682	70,266	112,209	169,660
Net returns................................do....	70,143	83,983	104,040	131,414	168,922	220,302
Capital withdrawals:						
Machinery purchases........................do....	4,302	2,370	3,565	4,854	6,652	9,112
Livestock purchases........................do....	4,908	1,908	2,871	3,910	5,358	7,340
Capital consumed............................do....	50,071	56,991	67,020	80,707	99,461	125,151
Total.................................do....	59,281	61,269	73,456	89,471	111,471	141,603
Net cash capital generated.................do....	10,862	22,714	30,584	41,943	57,451	78,699
Ending owned cash capital..................do....	16,968	39,682	70,266	112,209	169,660	248,359
Value of controlled resources.............do....	359,164	473,276	641,336	870,363	1,184,384	1,614,335
Net worth (end of period).................do....	135,244	162,236	199,256	249,963	319,424	414,575
Criterion function: Present value of						
net returns................................do....	285,984					
Undiscounted level of net returns...........do....	778,804					
Starting level of owned capital............do....	115,172					

[1] Starting situation 426 acres of owned land, $4,585 average value of equipment, $2,241 investment in livestock, and $6,106 owned capital.

Marginal Propensity to Consume Equal to 75 Percent of Net Returns

A consumption level equal to 75 percent of net returns plus the minimum required level is also restrictive on the growth and capital accumulation process. The maximum operation with this specified level of consumption is 1,441 acres, only 214 acres more than in the first production period (table 12). Rented land increases slowly in subsequent periods, ranging from 801 acres in the first period to 1,015 acres in the last.

Annual consumption levels range from almost $13,000 in the first production period to about $14,091 in the last period. As a result of the retarding effect of higher consumption levels on capital accumulation, consumption levels in the last 4 production periods are lower when the marginal propensity to consume is 75 percent than when it is 50 percent. Also, consumption levels in the last 3 production periods are lower than when the marginal propensity to consume is 25 percent.

Higher marginal propensity to consume increases consumption in the early part of the planning period (early growth stages), but restricts capital accumulation and results in lower consumption during later years, and in this case lower total consumption over the planning period. The consumption level over the 30-year period with a marginal propensity to consume equal to 75 percent of net returns totals $403,419. This compares with total consumption levels of $450,452 with a propensity to consume of 25 percent and $479,401 when the propensity to consume is 50 percent.

IMPORTANCE OF CAPITAL WITHDRAWALS

By far, the most significant differences in growth rates occur where different methods of land acquisition are specified. For the same starting sizes, borrowed capital, and consumption levels, the growth and capital accumulation are much less when additional land operated must be purchased than when additional land operated may be rented (tables 5 through 8).

The reason for the wide differences in growth rates when land is rented and purchased can now be fully evaluated. Purchasing land rather than renting requires that more capital be withdrawn from the capital generating stream. The difference in capital requirements between renting and purchasing land on an amortized basis is $4 per acre. The total land payment, which includes interest and principal, is $4 per acre more than the annual cost of renting. To

Table 12.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, propensity to consume equal to 75 percent of net returns[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated............................acres..	1,227	1,261	1,295	1,336	1,385	1,441
Land owned...............................do....	426	426	426	426	426	426
Land rented..............................do....	801	835	869	910	959	1,015
Gross sales...........................dollars..	52,879	54,329	55,810	57,574	59,648	62,089
Operating and overhead capital...........do....	39,635	40,875	42,100	43,561	45,279	47,301
Borrowed capital.........................do....	48,459	51,120	51,120	51,120	51,120	51,120
Consumption capital......................do....	12,933	13,091	13,283	13,510	13,777	14,091
Production period totals:						
Starting owned cash capital..............do....	6,106	1	1,423	3,156	5,189	7,582
Net returns..............................do....	66,220	67,275	68,551	70,064	71,843	73,938
Capital withdrawals:						
Machinery purchases......................do....	3,444	220	224	267	314	370
Livestock purchases......................do....	4,216	177	181	216	253	298
Capital consumed.........................do....	64,665	65,456	66,413	67,548	68,883	70,454
Total.................................do....	72,325	65,853	66,818	68,031	69,450	71,122
Net cash capital generated...............do....	-6,105	1,422	1,733	2,033	2,393	2,816
Ending owned cash capital................do....	1	1,423	3,156	5,189	7,582	10,398
Value of controlled resources............do....	308,967	318,946	329,244	341,600	356,320	373,244
Net worth (end of period)................do....	116,727	118,546	120,684	123,200	126,160	129,644
Criterion function: Present value of						
net returns.............................do....	186,040					
Undiscounted level of net returns...........do....	417,891					
Starting level of owned capital.............do....	115,172					

[1] Starting situation 426 acres of owned land, $4,585 average value of equipment, $2,241 investment in livestock, and $6,106 owned capital.

illustrate the higher capital withdrawals required when land is purchased, assume that additional land operated is purchased rather than rented in the situation illustrated in appendix table 38. During the third production period, 1,429 acres are rented. If this land was purchased on an amortized basis, the $4 per acre difference would amount to a total difference of over $5,700 per year or $28,500 for the 5-year production period. The effect of these additional capital withdrawals on growth and capital accumulation is apparent from observing the growth differences for the different consumption levels shown in tables 10 through 12. Land purchases might also take place on a cash basis ($240 per acre). However, with limited capital, this method would also retard growth if utilized during early stages of the growth period. Cash land purchases are made during growth only after capital levels are built up and when security values, used to purchase land by real estate loans, become limiting.

Another growth-retarding situation exists when land is purchased rather than rented. When land is purchased on an amortized basis, the real estate loan secured requires that debt be incurred. Many years are required to gain back collateral once it is committed to secure a real estate loan, because annual land payments for a long period of time include mostly interest payments with only a small portion of the payments for principal. This real estate debt reduces the maximum amount of cash capital that may be borrowed. Limiting the amount of cash capital borrowed affects the rate of firm growth. Therefore, purchasing land reduces growth, both by increasing capital withdrawals and by reducing the amount of capital borrowed.

It is very important that this analysis of capital accumulation not be misunderstood with respect to the alternatives of renting or purchasing additional land operated. It is assumed that land may be rented at an annual cost of $12 per acre. Land may be purchased on an amortized basis with total annual payments of about $16 per acre on the basis of a 33-year loan. The analysis indicates that capital may be accumulated at a much faster rate when land is rented rather than purchased. This does not necessarily mean that land should be rented rather than purchased in order to achieve maximum growth rates. On the other hand, it means that land (or any other resource which may be purchased by alternative ways) should be acquired in a way that requires the minimum amount of capital withdrawals. Under specific conditions, capital withdrawals associated with purchasing land (total annual payment) may be less than those associated with renting land. Under these conditions, purchasing land would tend to maximize growth rates.

MINIMUM STARTING EQUITY AND CAPITAL ACCUMULATION REQUIREMENTS FOR SPECIFIC GROWTH OBJECTIVES

To this point in the analysis, the capital accumulation process has been analyzed by establishing rather arbitrary starting levels of farm resources and examining the growth of the farm firm to determine the importance of growth variables. The remaining analysis is directed to determining the minimum starting capital or equity requirements for specified growth objectives subject to different conditions of growth variables. This approach not only establishes the minimum resource requirements but also shows the farm organization and operation over time necessary to fulfill the specified growth objectives.

In minimizing starting equity, it is assumed that a farm operator starts with no farm resource except management ability. The model used in the analysis minimizes the starting capital required to establish the farm, produce, and fulfill the specified growth conditions. These conditions may be the fulfillment of certain farm family consumption levels over time or the accumulation of certain equity levels at the end of the planning period. The model used in this analysis is constructed in such a way that owned capital is the only limited resource; if capital is available, all other resources may be purchased at their average value to establish the farm. Owned capital is minimized by maximizing net returns over time subject to, for all practical purposes, infinite costs per unit of starting owned capital (see table 2). This procedure minimizes starting owned capital subject to the growth restrictions, but allows additional growth to occur if possible.

For the growth situations analyzed, the starting level of owned capital (which is minimized) is less than the total capital requirements for farm operation and family consumption purposes. This is possible because resource purchases establish an equity which may be used to borrow additional capital. Total equity is, of course, owned cash capital plus the value of other owned resources. The model used in the analysis allows cash capital to be converted into any other farm resource at the beginning or during the capital accumulation process.

For Specified Consumption Levels

Minimum equity requirements were determined for constant and increasing consumption levels under various tenure situations. Constant costs and prices are presently assumed. The effect of increasing land values is analyzed in a later section.

The minimum level of owned capital required to fulfill farm family consumption levels over time is $18,025 when all land operated may be rented (table 13). Capital withdrawals for consumption are held constant over time and are assumed to be $3,000 annually. No growth conditions are specified, but it is required that the ending equity level (at the end of the 30-year period) be equal to or greater than the starting equity.

The net returns during the first 5 years are $15,766, only slightly more than the $15,000 capital consumed during the same period. Other capital withdrawals include a total of $21,565 for equipment and livestock purchases. Owned capital at the end of the first production period is $12,226. The ending equity or net worth after the first 5 years of operation is $18,791, which includes $6,565 in average value of equipment and livestock and $12,226 in cash.

Equipment and livestock resources are maintained or replaced by annual operating and overhead expenses. Therefore, operating and total capital requirements in subsequent production periods decrease somewhat because additional equipment and livestock purchases are not required. The total capital withdrawals are equal only to the $15,000 consumption level during these periods. The ratio of owned to borrowed capital also decreases in these periods with more than $3,000 borrowed annually. The complement of equipment (which was mortgaged during period 1) and livestock is used as collateral for the $3,282 borrowed capital in period 2.

The stream of net returns from operations over the 30-year period totals $90,000. This is also the level of capital withdrawn from the farm firm (for consumption capital). The $6,565 withdrawn for equipment and livestock purchases becomes, of course, a part of the farm firm. The $18,025 starting equity is maintained at the end of the 30-year planning period; it includes $11,461 of owned cash capital and the $6,565 invested in livestock and equipment (production period 6, table 13).

Increasing consumption over time increases the starting capital somewhat and requires farm growth to increase substantially. Although the specified annual consumption level during the first production period is again $3,000 (as in the former situation with constant consumption over time), the minimum starting level of owned capital is increased by about $1,800 or to $19,811 (table 14). The starting size of operation increases by 55 acres. The increased size of operation is required so that the farm may grow to satisfy the higher annual capital withdrawals for consumption in the later production periods. Increases in annual capital withdrawals by $1,000 each production period are roughly equivalent to increasing

Table 13.--Farm organization, capital accumulation, and growth resulting from minimum starting level of owned capital necessary to obtain $3,000 consumption level over time, rented land unlimited[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated...........................acres..	379	365	364	364	362	357
Land rented..............................do....	379	365	364	364	362	357
Gross sales...........................dollars..	16,327	15,704	15,696	15,704	15,597	15,359
Operating and overhead capital............do....	13,174	12,705	12,699	12,715	12,630	12,464
Borrowed capital.........................do....	997	3,282	3,282	3,282	3,282	3,282
Consumption capital......................do....	3,000	3,000	3,000	3,000	3,000	3,000
Production period totals:						
Starting owned cash capital..............do....	18,025	12,226	12,220	12,204	12,151	11,985
Net returns.............................do....	15,766	14,994	14,984	14,947	14,834	14,476
Capital withdrawals:						
Machinery purchases....................do....	4,571	0	0	0	0	0
Livestock purchases....................do....	1,994	0	0	0	0	0
Capital consumed.......................do....	15,000	15,000	15,000	15,000	15,000	15,000
Total...............................do....	21,565	15,000	15,000	15,000	15,000	15,000
Net cash capital generated...............do....	-5,799	-5	-16	-53	-166	-524
Ending owned cash capital................do....	12,226	12,220	12,204	12,151	11,985	11,461
Value of controlled resources............do....	109,751	106,385	106,129	107,076	105,430	103,706
Net worth (end of period)................do....	18,791	18,785	18,767	18,718	18,522	18,028
Present value of net returns.............do....	42,590					
Undiscounted level of net returns........do....	90,000					
Starting level of owned capital..........do....	18,025					

[1] The starting situation is the ability to manage; all other farm resources must be purchased with the minimum owned capital ($18,025).

Table 14.--Farm organization, capital accumulation, and growth resulting from minimum starting level of owned capital necessary to obtain increasing consumption levels over time, rented land unlimited[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated.............................acres..	434	496	571	637	664	580
Land rented.............................do....	434	496	571	637	664	580
Gross sales............................dollars..	18,677	21,385	24,615	27,454	28,622	25,004
Operating and overhead capital............do....	14,825	16,694	18,964	21,059	21,965	19,350
Borrowed capital..........................do....	1,140	3,591	3,788	3,962	4,033	4,033
Consumption capital.......................do....	3,000	4,000	5,000	6,000	7,000	8,000
Production period totals:						
Starting owned cash capital...............do....	19,811	17,218	20,343	23,206	24,833	22,975
Net returns..............................do....	19,258	23,456	28,257	31,974	33,285	28,770
Capital withdrawals:						
Machinery purchases......................do....	4,571	0	0	0	0	0
Livestock purchases......................do....	2,280	331	394	347	143	0
Capital consumed.........................do....	15,000	20,000	25,000	30,000	35,000	40,000
Total................................do....	21,851	20,331	25,394	30,347	35,143	40,000
Net cash capital generated................do....	-2,593	3,125	2,863	1,627	-1,858	-11,230
Ending owned cash capital.................do....	17,218	20,343	23,206	24,833	22,975	11,745
Value of controlled resources.............do....	128,229	146,565	167,822	185,636	190,401	159,011
Net worth (end of period).................do....	24,069	27,525	30,782	32,756	31,041	19,811
Present value of net returns..............do....	62,925					
Undiscounted level of net returns..........do....	165,000					
Starting level of owned capital.............do....	19,811					

[1] The starting situation is the ability to manage; all other farm resources must be purchased with the minimum owned capital ($19,811). The required annual consumption level is indicated by consumption capital shown in the table.

consumption by about $150 annually plus the required withdrawals for income tax, assuming that annual consumption is taxable income.

Although the annual capital consumed during production period 2 is only $1,000 more than in the former situation analyzed, the land operated during the period is more than 130 acres larger. The value of controlled resources is more than $40,000 larger at the end of that period (tables 13 and 14). With annual capital consumed double the former level, as in production period 4, farm size is 273 acres larger and the value of controlled resources is increased by 75 percent to $185,636.

With increasing levels of capital consumed, net worth increases throughout the first 4 production periods. The decrease in net worth during the last 2 production periods results because accumulated net worth is used to satisfy the specified capital withdrawals during these periods. The starting capital is minimized when the accumulated net worth is used in this way. Since all capital withdrawals except capital consumed are reinvested into the farm firm and since ending equity or net worth is equal to starting equity ($18,028), the total net returns over the 30-year planning period are equal to capital consumed or $165,000. Specified farm growth conditions other than increasing capital withdrawals will be analyzed in a later section.

RENTED LAND LIMITED

The importance of the method of land acquisition in the growth of the farm was previously established. It is important to analyze minimum starting equity requirements and growth under conditions of purchasing land operated rather than renting. The high proportion of owner-operated farms in the area of study perhaps indicates that many operators prefer to own land. Also, the analysis should include owner-operated farms because the assumption of unlimited land available for renting on a wide scale is probably unrealistic.

Rented Land Limited to Half of Acreage Operated

The starting equity increases sharply when at least half of the total acres operated has to be owned. Under this condition and with consumption capital withdrawals of $3,000 annually, the required starting level of owned capital is $34,527 (table 15). The required starting size of operations is 311 acres. This is 68 acres less than the required starting size where all land operated may be rented. Net returns per acre are higher where land is owned rather than rented. Although land purchases affect capital accumulation, land payments (downpayments and principal payments) are not costs and

Table 15.--Farm organization, capital accumulation, and growth resulting from minimum starting level of owned capital necessary to obtain $3,000 consumption level over time, rented land limited to the same number of acres owned[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated............................acres..	310	301	310	319	336	368
Land owned...............................do....	155	155	155	160	168	184
Land rented..............................do....	155	146	155	160	168	184
Gross sales.............................dollars..	13,381	12,966	13,381	13,755	14,471	15,842
Operating and overhead capital...........do....	10,281	9,922	10,215	10,449	10,904	11,785
Borrowed capital.........................do....	8,428	11,532	12,431	13,011	14,270	16,888
Consumption captial......................do....	3,000	3,000	3,000	3,000	3,000	3,000
Production period totals:						
Starting owned cash capital..............do....	34,527	865	255	0	0	0
Net returns.............................do....	15,499	15,219	15,829	16,528	17,833	20,283
Capital withdrawals:						
Land purchases.........................do....	27,956	829	1,084	1,482	2,746	5,116
Machinery purchases....................do....	4,571	0	0	0	0	0
Livestock purchases....................do....	1,634	0	0	46	87	167
Capital consumed.......................do....	15,000	15,000	15,000	15,000	15,000	15,000
Total...............................do....	49,161	15,829	16,084	16,528	17,833	20,283
Net cash capital generated...............do....	-33,662	-610	-255	0	0	0
Ending owned cash capital.................do....	865	255	0	0	0	0
Value of controlled resources............do....	81,710	78,700	80,845	82,811	86,978	94,825
Net worth (end of period)................do....	35,026	35,245	36,074	37,602	40,435	45,718
Present value of net returns.............do....	47,386					
Undiscounted level of net returns...........do....	101,191					
Starting level of owned capital............do....	34,527					

[1] The starting situation is the ability to manage; all other farm resources must be purchased with the minimum owned capital ($34,527).

do not reduce returns. Annual operating and overhead capital requirements in production period 1 are almost $3,000 less than those associated with the operation where all land is rented. In terms of meeting consumption requirements, capital substitutes for land. However, the relatively large starting equity requirements, where land must be purchased, have significant implications under conditions of limited capital.

Where at least half of the land must be purchased, the net returns per acre increase in each subsequent production period, because principal payments associated with amortized land purchases increase over time as interest payments (costs) decrease. The acres of land rented decrease during production period 2 but increase to 155 acres again in period 3. The minimum land that must be owned at the beginning is 155 acres, and no additional purchases are required to satisfy the consumption requirements. However, the returns during the last 3 periods (last 15 years of the planning period) are sufficient to satisfy consumption as well as allow additional land to be purchased. No starting owned cash capital is required after the third production period, for the equity level is high enough so that all annual capital requirements may be satisfied through borrowed capital.

Capital accumulation in terms of net worth increases in each of the production periods, and the rate of growth increases during the last 3 production periods. Additional land is purchased and rented in each of these periods. The mortgage which is required at the beginning of period 1 decreases over time and allows more capital to be used to expand operations in the later production periods.

Operations Limited to Owned Land

In terms of acres operated and the value of controlled resources, the starting level of farm operations decreases significantly to fulfill consumption requirements when land acquisition is limited to purchasing or owning land only. However, minimum land and minimum total value of controlled resources are not consistent with minimum starting equity requirements. The required starting equity increases sharply (table 16). The starting level of owned capital, $47,000, compares with $34,500 when half of the acres operated may be rented. Although equity requirements are much higher, the average capital requirements for annual operating expenses and overhead during the first production period are about $5,000 less ($8,118 compared to $13,174) when all land is owned rather than rented. Capital requirements shift from operating (renting land) to investment (land purchases). The amount of capital borrowed annually is less when all land must be owned or

Table 16.--Farm organization, capital accumulation, and growth resulting from minimum starting level of owned capital necessary to obtain $3,000 consumption level over time, land acquisition limited to purchasing land only[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated............................acres..	262	262	269	282	301	332
Land owned..............................do....	262	262	269	282	301	332
Gross sales..........................dollars..	11,269	11,270	11,602	12,129	12,964	14,289
Operating and overhead capital............do....	8,118	8,031	8,214	8,503	8,957	9,677
Borrowed capital.........................do....	2,992	7,114	8,435	9,986	11,739	13,602
Consumption capital......................do....	3,000	3,000	3,000	3,000	3,000	3,000
Production period totals:						
Starting owned cash capital...............do....	47,032	3,933	2,916	1,806	753	0
Net returns...............................do....	15,757	16,197	16,941	18,132	20,034	23,060
Capital withdrawals:						
Land purchases......................do....	37,909	2,214	3,010	4,121	5,685	7,898
Machinery purchases.....................do....	4,571	0	0	0	0	0
Livestock purchases.....................do....	1,376	0	41	64	102	162
Capital consumed.........................do....	15,000	15,000	15,000	15,000	15,000	15,000
Total................................do....	58,856	17,214	18,051	19,185	20,787	23,060
Net cash capital generated.................do....	-43,099	-1,017	-1,110	-1,053	-753	0
Ending owned cash capital..................do....	3,933	2,916	1,806	753	0	0
Value of controlled resources.............do....	72,760	71,743	72,354	74,485	78,394	85,996
Net worth (end of period).................do....	47,789	48,986	50,928	54,060	59,094	67,154
Present value of net returns...............do....	48,339					
Undiscounted level of net returns...........do....	110,121					
Starting level of owned capital.............do....	47,032					

[1] The starting situation is the ability to manage; all other farm resources must be purchased with the minimum owned capital ($47,032).

57

purchased because a higher proportion of the equity is mortgaged to purchase land.

In addition to fulfilling the consumption requirements, the accumulated value of equity or net worth over the 30-year planning period is more than $19,000 above the required starting level of owned capital. Net worth at the end of the last production period is $67,154. This amount of equity, if invested to return 4.5 percent, would provide an annual retirement income of about $3,000 to the operator (also the owner in this case). The starting equity requirements for a similar retirement income where all land operated may be rented are presented in a later section.

Starting equity requirements increase by more than $13,000 to over $60,000 where all land operated must be owned and where annual capital withdrawals for consumption are increased by $1,000 each production period (table 17). With a starting farm size of 357 acres, additional land must be purchased in each production period to satisfy the consumption requirements. The increasing level of consumption increases starting equity requirements by $21,469 above the level required with a constant $3,000 consumption. However, the equity at the end of the 30-year planning period is more than 50 percent greater. The ending equity ($103,284) would provide an annual retirement income of more than $4,500 if invested at 4.5 percent interest.

At the beginning of production period 1, the outstanding mortgage is about $29,000 which is equivalent to 121 acres of land. The ratio of owned land to mortgaged land is about 2 to 1. It is possible to have an owned-to-mortgaged land ratio of about 1 to 1. Other conditions remaining the same, equity decreases as the ratio of owned to mortgaged land decreases.

It appears that starting equity requirements should decrease if the ratio of owned to mortgaged land is decreased. However, the starting level of equity is a function of the amount of short-term capital that can be borrowed, and the amount of capital that can be generated as well as the ratio of owned land to mortgaged land. Decreasing the equity reduces collateral and, therefore, decreases the ability to borrow capital. This would actually increase the starting level of owned capital because borrowed capital will substitute for owned capital. As an example, the $60,393 minimum equity requirement is equity mostly associated with owned land. The ratio of owned to mortgaged land operated during the first production period could be reduced to the point where the starting equity associated with owned land would be about $47,000 (equal to about 194 acres). However, all of this equity would have to be mortgaged to purchase the additional 163 acres which would bring the total operation up to 357 acres. This situation would require

58

Table 17.--Farm organization, capital accumulation, and growth resulting from minimum starting level of owned capital necessary to obtain increasing consumption levels over time, land acquisition limited to purchasing land only[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated...........................acres..	357	398	442	484	521	553
Land owned..............................do....	357	398	442	484	521	553
Gross sales............................dollars..	15,396	17,150	19,043	20,830	22,451	23,818
Operating and overhead capital...........do....	10,623	11,417	12,424	13,381	14,256	15,009
Borrowed capital........................do....	16,971	15,249	11,983	10,680	11,985	16,769
Consumption capital.....................do....	3,000	4,000	5,000	6,000	7,000	8,000
Production period totals:						
Starting owned cash capital.............do....	60,393	0	5,784	9,491	10,452	7,721
Net returns............................do....	23,865	28,665	33,095	37,246	40,973	44,047
Capital withdrawals:						
Land purchases.........................do....	62,807	2,667	4,157	6,067	8,506	11,601
Machinery purchases....................do....	4,571	0	0	0	0	0
Livestock purchases....................do....	1,880	214	231	218	198	167
Capital consumed.......................do....	15,000	20,000	25,000	30,000	35,000	40,000
Total..............................do....	84,258	22,881	29,388	36,285	43,704	51,768
Net cash capital generated..............do....	-60,393	5,784	3,707	961	-2,731	-7,721
Ending owned cash capital...............do....	0	5,784	9,491	10,452	7,721	0
Value of controlled resources...........do....	92,131	107,961	122,467	133,726	140,073	140,119
Net worth (end of period)...............do....	69,258	77,923	86,018	93,264	99,237	103,284
Present value of net returns............do....	79,085					
Undiscounted level of net returns.......do....	207,891					
Starting level of owned capital.........do....	60,393					

[1] The starting situation is the ability to manage; all other farm resources must be purchased with the minimum owned capital ($60,393). The required annual consumption level is indicated by consumption capital shown in the table.

the level of owned cash capital to increase by about $16,000 (since $16,000 operating capital could not be borrowed) and starting equity requirements would be greater than $60,393 ($16,000 plus $47,000).

It is not possible to increase the substitution of borrowed cash capital and thus decrease the level of owned starting capital by increasing the ratio of owned land to mortgaged land (with respect to the situation illustrated in table 17). It is not possible because capital can be borrowed only if farm operations generate enough capital to pay the borrowed capital back with interest. If more capital were borrowed, net returns would be reduced and total capital withdrawals would exceed starting owned cash capital plus net returns (see table 17). In other words, the borrowed capital could not be repaid.

Specific Ending Equity Growth Conditions

With respect to minimum requirements, the analysis reveals that significantly higher starting equity levels are required for owner-operators. However, when farm operations are limited to owned land, the nature of the investment in land, which is also collateral, allows more growth to occur than is required to fulfill consumption specifications.

Where all land may be rented, growth occurs only to fulfill the consumption requirements, and ending equity is equal to starting equity. Ending equity is specified to be equal to or greater than starting equity. Without this specification, starting equity would be "used up" for consumption purposes where all land operated may be rented, and ending equity would be much lower than starting equity. To compare the alternatives of renting versus owning land and portray higher levels of capital accumulation, higher ending equity or net worth situations as well as specific consumption levels are specified.

REQUIREMENTS FOR $3,000 ANNUAL RETIREMENT INCOME

For an owner-operator situation with constant consumption over time, the ending equity level is $67,154 (table 16). If invested at 4.5 percent interest, this equity would return $3,021 annually. The starting equity of $47,032, therefore, is the minimum required to satisfy a $3,000 annual capital withdrawal for consumption and an ending equity which would assure the owner-operator of an annual $3,000 retirement income (at 4.5 percent interest).

An ending equity of $66,667 would return $3,000 annually if invested at 4.5 percent. A minimum starting equity of $18,107 is

required for a $3,000 consumption level when all land operated may be rented, if the ending net worth is specified to be $66,667 (table 18). This starting equity is only slightly higher than that required to maintain an annual consumption level of $3,000 (see table 13). Through the growth process, it is possible to accumulate much more capital (relatively) with only slightly higher levels of starting equity. However, the growth process is significantly different. The starting size for both situations is close to 280 acres operated. This is the largest operation during the 30-year planning period where the growth objective is only to maintain the $3,000 consumption level. However, with the additional requirement of ending the planning period with at least $66,667, the size of operation increases to 922 acres in the last production period. In terms of the value of controlled resources, the size of operation during the last period, where the larger ending equity is specified, is almost 2.8 times as large as when only the consumption level is specified.

With approximately the same level of ending equity, the ending size of operation, in terms of the value of controlled resources, is more than 3.3 times as large when the land operated is rented rather than owned (see tables 16 and 18). The reason for this difference is that as a landowner the operator receives any returns that might be considered returns to land.

With increasing consumption over time, a specified ending equity of $66,667 requires a minimum starting equity of $20,070 (table 19). The additional specification of increasing consumption over time required about $2,000 or 11 percent higher starting equity. The required growth, however, in terms of acres operated is relatively larger; the ending size of operation is 28 percent larger, with almost 1,200 acres required, than when constant consumption is specified.

Although there is a large advantage in renting under conditions of minimizing equity, there are significant implications with respect to the structure and number of producing units where a large number of farm operators would rent land rather than own it. Considering the present tenure situation of farmland and the structure of the producing units, many problems would undoubtedly be encountered with attempts to rent relatively large tracts of farmland.

REQUIREMENTS TO MEET OPPORTUNITY COSTS OF NONFARM JOB AND 6 PERCENT RETURN ON STARTING EQUITY

In the preceding analyses, interest on the farm firm's owned capital is not included as a production cost. It can be argued that costs should include interest on all capital used because the

Table 18.--Farm organization, capital accumulation, and growth resulting from minimum starting level of owned capital necessary to obtain $3,000 consumption level over time, and end with owned equity of $66,667, rented land unlimited[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated...........................acres..	381	372	388	435	572	922
Land rented.............................do....	381	372	388	435	572	922
Gross sales...........................dollars..	16,434	16,038	16,724	18,728	24,653	39,710
Operating and overhead capital............do....	13,249	12,939	13,420	14,827	18,990	31,150
Borrowed capital.........................do....	1,003	3,289	3,306	3,429	3,791	4,710
Consumption capital......................do....	3,000	3,000	3,000	3,000	3,000	3,000
Production period totals:						
Starting owned cash capital..............do....	18,107	12,453	12,950	14,437	18,695	31,286
Net returns.............................do....	15,924	15,497	16,522	19,503	28,314	42,800
Capital withdrawals:						
Machinery purchases.....................do....	4,571	0	0	0	0	1,449
Livestock purchases.....................do....	2,007	0	35	245	723	1,838
Capital consumed........................do....	15,000	15,000	15,000	15,000	15,000	15,000
Total................................do....	21,578	15,000	15,035	15,245	15,723	18,287
Net cash capital generated...............do....	-5,654	497	1,487	4,258	12,519	24,513
Ending owned cash capital................do....	12,453	12,950	14,437	18,695	31,286	55,799
Value of controlled resources............do....	110,471	108,808	114,170	129,953	176,147	287,947
Net worth (end of period)................do....	19,031	19,528	21,050	25,553	38,867	66,667
Present value of net returns.............do....	54,258					
Undiscounted level of net returns...........do....	138,558					
Starting level of owned capital.............do....	18,107					

[1] The starting situation is the ability to manage; all other farm resources must be purchased with the minimum owned capital ($18,107).

Table 19.--Farm organization, capital accumulation, and growth resulting from minimum starting level of owned capital necessary to obtain increasing consumption level over time and end with owned equity of $66,667, rented land unlimited[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated.............................acres..	441	520	637	794	973	1,181
Land rented..............................do....	441	520	637	794	973	1,181
Gross sales............................dollars..	19,017	22,391	27,457	34,190	41,909	50,896
Operating and overhead capital............do....	15,064	17,401	21,062	26,531	32,986	40,498
Borrowed capital.........................do....	1,161	3,652	3,962	4,373	5,150	6,283
Consumption capital......................do....	3,000	4,000	5,000	6,000	7,000	8,000
Production period totals:						
Starting owned cash capital..............do....	20,070	17,942	22,481	28,839	35,703	43,207
Net returns.............................do....	19,765	24,951	31,976	38,297	44,617	51,992
Capital withdrawals:						
Machinery purchases......................do....	4,571	0	0	611	1,170	1,363
Livestock purchases......................do....	2,322	412	618	822	942	1,097
Capital consumed.........................do....	15,000	20,000	25,000	30,000	35,000	40,000
Total................................do....	21,893	20,412	25,618	31,433	37,112	42,460
Net cash capital generated................do....	-2,128	4,539	6,358	6,864	7,504	9,532
Ending owned cash capital.................do....	17,942	22,480	28,839	35,703	43,207	52,739
Value of controlled resources.............do....	130,675	154,585	189,642	235,619	288,195	350,106
Net worth (end of period)................do....	24,835	29,785	36,762	45,059	54,675	66,667
Present value of net returns.............do....	83,031					
Undiscounted level of net returns...........do....	211,597					
Starting level of owned capital.............do....	20,070					

[1] The starting situation is the ability to manage; all other farm resources must be purchased with the minimum owned capital ($20,070). The required annual consumption level is indicated by consumption capital shown in the table.

profitability of a business operation must be compared with alternatives that are foregone. Also, the analyses did not include, as a specific cost, the returns to operator's labor and management.

One way of applying the principle of opportunity costs in this analysis is to specify that the starting level of owned capital must return as much in farming as it could if invested in other alternatives such as stocks, bonds, etc. It may be assumed that the return to operator's labor and management is the capital consumed or the consumption level over the 30-year planning period. It is difficult to determine the alternative returns to farm operator's labor and management in general. However, it seems reasonable to assume that comparable consumption levels could be obtained by the farm operator in the form of wages in nonfarm occupations. Also, since consumption capital is capital that is actually withdrawn annually and not included as equity, the ending equity may be considered returns to starting owned capital.

With these simplifying assumptions, if returns to starting equity are measured in terms of ending equity, the principle of opportunity costs may be applied by determining the minimum starting equity necessary to satisfy specified consumption levels and return 6 percent compounded annually. In other words, starting equity must be such that annual consumption levels are satisfied, and each dollar of starting owned capital must return (in terms of ending equity) $5.74. This is the value to which $1 invested at 6 percent compound interest will grow in 30 years.

Rented Land Unlimited

With constant $3,000 annual consumption levels specified over the 30-year planning period, $18,223 starting capital is required to return, in terms of ending equity, 6 percent compounded annually, when all land operated may be rented (table 20). Equity at the end of the planning period is 5.74 times the starting level, or $104,656. Since no land operated is owned, all ending equity is in the form of equipment and livestock ($16,804) and cash ($87,852).

A high proportion of the total equity is in the form of cash throughout all production periods. The level of borrowed capital is relatively low, because such a large proportion of the net worth is maintained in the form of cash (nonuse of the owned capital would reduce returns). The level of annual operating and overhead capital in any production period is quite high in relation to the net worth at the end of the preceding period. This appears to be a vulnerable situation. This study does not attempt to evaluate risks. Further research is needed because the inclusion of risk in the analysis might alter this situation by a large extent.

Table 20.--Farm organization, capital accumulation, and growth resulting from minimum starting level of owned capital necessary to obtain $3,000 consumption level over time, starting level of owned capital required to return 6 percent compounded over the 30-year planning period, rented land unlimited[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated............................acres..	385	383	421	531	821	1,425
Land rented............................do....	385	383	421	531	821	1,425
Gross sales............................dollars..	16,588	16,519	18,125	22,871	35,380	61,403
Operating and overhead capital............do....	13,358	12,916	14,404	17,738	27,526	49,298
Borrowed capital............................do....	1,013	3,298	3,392	3,682	4,445	6,430
Consumption capital.......................do....	3,000	3,000	3,000	3,000	3,000	3,000
Production period totals:						
Starting owned cash capital..............do....	18,223	12,779	13,996	17,415	27,500	49,449
Net returns.................................do....	16,152	16,217	18,607	25,664	39,268	60,525
Capital withdrawals:						
Machinery purchases.....................do....	4,571	0	0	0	792	3,945
Livestock purchases.....................do....	2,025	0	188	579	1,527	3,177
Capital consumed........................do....	15,000	15,000	15,000	15,000	15,000	15,000
Total................................do....	21,596	15,000	15,188	15,579	17,319	22,122
Net cash capital generated................do....	-5,444	1,217	3,419	10,085	21,949	38,403
Ending owned cash capital.................do....	12,779	13,996	17,415	27,500	49,449	87,852
Value of controlled resources.............do....	111,775	112,512	125,239	162,303	256,171	446,656
Net worth (end of period).................do....	19,375	20,592	24,199	34,863	59,136	104,656
Present value of net returns...............do....	63,893					
Undiscounted level of net returns...........do....	176,433					
Starting level of owned capital.............do....	18,223					

[1] The starting situation is the ability to manage; all other farm resources must be purchased with the minimum owned capital ($18,223).

In terms of starting capital, the requirements to meet the oppor-
tunity costs of a nonfarm job and 6 percent return on starting equity
are not significantly different from the starting capital requirements
only to fulfill the consumption requirements. A difference of only
$198 of starting capital results in an ending equity difference of
more than $85,000 (see tables 13 and 20). This appears to be un-
reasonable. However, the problem is formulated in such a way that
starting capital is an extremely limited resource. The cost per
unit of starting capital, for all practical purposes, approaches
infinity. Therefore, even though an additional unit of starting capital
results in very large differences in ending capital or returns, the
additional starting unit is not justified. (The additional unit adds
more to costs than the unit can return.)

With increasing consumption levels over time, $20,480 starting
capital is required to return, in terms of ending equity, 6 percent
compounded annually, when all land operated may be rented (table
21). The capital accumulation process is similar to the former
situation with constant returns over time. However, to satisfy the
increasing consumption levels, the relative growth, in terms of net
worth, is more uniform throughout the 30-year planning period.
With increasing consumption, the increase in net worth is 28 per-
cent between production periods 1 and 2 and 43 percent between
production periods 5 and 6. With constant consumption levels over
time, the increase in net worth is only 6 percent between produc-
tion periods 1 and 2 but is almost 77 percent between production
periods 5 and 6 (table 20).

To satisfy increasing consumption levels over time, $2,257 addi-
tional starting capital is required. The ending equity is $12,962
higher; this is the amount that $2,257 would return compounded
annually at 6 percent interest over a 30-year period. Although the
starting owned capital is only $2,257 more for increasing con-
sumption than it is for constant consumption, the total amount of
resources required to support the higher consumption levels is
much greater. An additional operation of 69 acres in the first
production period and an additional 427 acres in the last produc-
tion period are needed. The additional operations, in terms of
the value of controlled resources, amount to $23,233 and $115,442,
respectively.

Operations Limited to Owned Land

When all land operated is limited to owned land, $77,225 is the
minimum starting capital required to return 6 percent compounded
annually, in terms of ending equity, over the 30-year planning period
with constant $3,000 annual consumption. Each dollar of starting

Table 21.--Farm organization, capital accumulation, and growth resulting from minimum starting level of owned capital necessary to obtain increasing consumption level over time, starting level of owned capital required to return 6 percent compounded over the 30-year planning period, rented land unlimited[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated...........................acres..	454	557	734	988	1,332	1,852
Land rented............................do....	454	557	734	988	1,332	1,852
Gross sales..........................dollars..	19,557	23,989	31,606	42,565	57,384	79,770
Operating and overhead capital...........do....	15,443	18,524	24,368	33,538	45,927	64,644
Borrowed capital........................do....	1,194	3,750	4,215	4,994	6,729	9,219
Consumption capital......................do....	3,000	4,000	5,000	6,000	7,000	8,000
Production period totals:						
Starting owned cash capital..............do....	20,480	19,089	25,874	35,914	48,052	66,283
Net returns..............................do....	20,568	27,326	36,190	45,137	57,287	75,630
Capital withdrawals:						
Machinery purchases......................do....	4,571	0	220	1,661	2,247	3,393
Livestock purchases......................do....	2,388	541	930	1,338	1,809	2,733
Capital consumed........................do....	15,000	20,000	25,000	30,000	35,000	40,000
Total................................do....	21,959	20,541	26,150	32,999	39,056	46,126
Net cash capital generated................do....	-1,391	6,785	10,040	12,138	18,231	29,504
Ending owned cash capital.................do....	19,089	25,874	35,914	48,052	66,283	95,787
Value of controlled resources.............do....	135,008	167,054	220,640	296,821	401,668	562,098
Net worth (end of period)................do....	26,048	33,374	44,564	59,701	81,988	117,618
Present value of net returns..............do....	96,709					
Undiscounted level of net returns..........do....	262,138					
Starting level of owned capital.............do....	20,480					

[1] The starting situation is the ability to manage; all other farm resources must be purchased with the minimum owned capital ($20,480). The required annual consumption level is indicated by consumption capital shown in the table.

capital returns $5.74 in terms of ending equity, which totals $443,504 at the end of the 30-year period (table 22). A high proportion of the total value of controlled resources is owned when land operated cannot be rented. Net worth at the end of production period 1 is 80 percent of the value of all controlled resources. The percentage increases slightly through production period 4 and then decreases to about 70 percent at the end of period 6.

Unlike the situation where land is rented, the operating overhead capital is a relatively small proportion of the equity or net worth (see tables 21 and 22). Net worth is used to its full extent for collateral. As an example, all of the equity of net worth at the end of production period 1 is invested in land, equipment, and livestock. Therefore, all of the capital required annually during production period 2 is borrowed capital. At a ratio of $2 equity for $1 of borrowed capital, some $92,000 of equity is required as security for the borrowed capital.

All annual capital requirements are met through borrowed capital in all subsequent periods except period 6. In period 6, the equity is utilized to secure a real estate loan to purchase an additional 471 acres of land. The maximum amount of equity is obtained in period 6 by using the available collateral to purchase real estate rather than borrow annual capital. With the relatively large additional land operated, a large amount of cash capital is generated during the period and more than 35 percent of the ending net worth is in the form of cash capital.

A much larger minimum starting level of capital is required to meet the same growth requirements with annual consumption increased by $1,000 each production period. That is, with increasing consumption and with land acquisition limited to owned land, $144,372 is the minimum starting capital that will return 6 percent compounded annually over the 30-year planning period (table 23). The required operation ranges from 859 acres operated in production period 1 to 3,617 acres operated in the last production period.

The proportion of the value of controlled resources owned at the end of the first production period is 68 percent, which is less than the former situation by 12 percent. To acquire the large number of acres needed for the operations, starting capital is minimized by using collateral to secure a large real estate loan rather than borrowing all annual cash needed. The greatest need for a large real estate loan is in the beginning to get established; another is needed near the end of the 30-year planning period to meet the requirement that ending equity be 5.74 times greater than starting capital. All available collateral in the first and last production periods is utilized to secure real estate loans. Also, the required expansion (to meet the increasing annual consumption levels) is

Table 22.--Farm organization, capital accumulation, and growth resulting from minimum starting level of owned capital necessary to obtain $3,000 consumption level over time, starting level of owned capital required to return 6 percent compounded over the 30-year planning period, land acquisition limited to purchasing land only[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated.............................acres..	474	601	804	1,090	1,432	1,903
Land owned...............................do....	474	601	804	1,090	1,432	1,903
Gross sales..............................dollars..	20,400	25,902	34,645	46,973	61,680	81,973
Operating and overhead capital............do....	13,606	19,835	22,690	31,487	41,200	54,634
Borrowed capital.........................do....	29,403	46,238	63,442	85,997	51,417	0
Consumption capital......................do....	3,000	3,000	3,000	3,000	3,000	3,000
Production period totals:						
Starting owned cash capital...............do....	77,225	0	0	0	0	65,415
Net returns.............................do....	33,971	46,006	59,776	77,430	102,401	136,695
Capital withdrawals:						
Land purchases.........................do....	89,134	30,334	43,028	59,056	17,961	23,440
Machinery purchases....................do....	4,571	0	680	1,869	2,229	3,076
Livestock purchases....................do....	2,491	672	1,068	1,505	1,796	2,478
Capital consumed.......................do....	15,000	15,000	15,000	15,000	15,000	15,000
Total................................do....	11,196	46,006	59,776	77,430	36,986	43,994
Net cash capital generated................do....	-77,225	0	0	0	65,415	92,701
Ending owned cash capital.................do....	0	0	0	0	65,415	158,116
Value of controlled resources.............do....	120,822	151,971	202,442	274,456	425,976	637,271
Net worth (end of period)................do....	96,196	127,202	171,978	234,408	321,809	443,504
Present value of net returns..............do....	165,671					
Undiscounted level of net returns..........do....	456,279					
Starting level of owned capital............do....	77,225					

[1] The starting situation is the ability to manage; all other farm resources must be purchased with the minimum owned capital ($77,225).

Table 23.--Farm organization, capital accumulation, and growth resulting from minimum starting level of owned capital necessary to obtain increasing consumption level over time, starting level of owned capital necessary to return 6 percent compounded over the 30-year planning period, land acquisition limited to purchasing land only[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated..........................acres..	859	1,190	1,626	2,162	2,779	3,617
Land owned.............................do....	859	1,190	1,626	2,162	2,779	3,617
Gross sales...........................dollars..	36,995	51,267	70,069	93,134	119,739	155,818
Operating and overhead capital..........do....	23,860	34,144	47,841	64,119	81,587	105,520
Borrowed capital........................do....	0	50,083	113,381	149,457	82,171	0
Consumption capital.....................do....	3,000	4,000	5,000	6,000	7,000	8,000
Production period totals:						
Starting owned cash capital.............do....	144,372	68,875	43,058	8,839	11,653	129,570
Net returns............................do....	65,675	85,615	111,142	145,077	190,762	251,490
Capital withdrawals:						
Land purchases........................do....	116,047	87,526	115,215	105,951	30,564	52,755
Machinery purchases...................do....	5,608	2,163	2,850	3,496	4,033	5,469
Livestock purchases...................do....	4,517	1,743	2,296	2,816	3,248	4,405
Capital consumed......................do....	15,000	20,000	25,000	30,000	35,000	40,000
Total...............................do....	141,172	111,432	145,361	142,263	72,845	102,629
Net cash capital generated..............do....	-75,497	-25,817	-34,219	2,814	117,917	148,861
Ending owned cash capital...............do....	68,875	43,058	8,839	11,653	129,570	278,431
Value of controlled resources...........do....	285,160	342,689	418,256	556,022	829,300	1,189,155
Net worth (end of period)...............do....	195,047	260,662	346,804	461,881	617,643	829,133
Present value of net returns............do....	307,239					
Undiscounted level of net returns.......do....	849,761					
Starting level of owned capital.........do....	144,372					

[1] The starting situation is the ability to manage; all other farm resources must be purchased with the minimum owned capital ($144,372). The required annual consumption level is indicated by consumption capital shown in the table.

greater than the former situation (with constant consumption levels), and a larger proportion of the available collateral is used to purchase real estate throughout the entire planning period.

The model used in this analysis assumes that land is available for acquisition. That is, the framework of growth does not consider many of the institutional problems associated with the availability of farmland for expansion. For example, because of the present structure of producing units in the area of study, a large operating unit may have to be separated into various units throughout an area. This may have significantly more effects on increasing overhead and production costs than is accounted for in designing the model used in this analysis, especially when the results indicate a farm size of over 3,500 acres (table 23).

Minimum Equity and Capital Accumulation Requirements Under Conditions of Increasing Land Values

Land values have increased rather steadily in the United States as a whole for several decades. Farmland values in the area of study are no exception. Increasing land values are probably relevant variables with respect to problems of farm firm capital accumulation, but a detailed analysis of increasing land values is beyond the scope of this study. However, useful knowledge may be gained about capital accumulation problems by simply increasing land values over time. In an attempt to analyze the effect of increasing land values, the analytical model was adjusted to represent increases in land values of 5 percent annually, beginning with the current value of $240 per acre. All other costs and prices, including the cost of renting land, were held constant.

RENTED LAND UNLIMITED

It was hypothesized that increasing land values might change the growth process by increasing equity levels to such an extent that significantly larger amounts of capital might be borrowed. Also, the increasing value of owned land might satisfy part of the ending equity growth requirements and, therefore, lower starting capital requirements.

With increasing land values, the minimum starting capital requirements to fulfill different growth conditions under the assumption of unlimited rented land are the same as those under the conditions of constant land values. Increasing land values had no effect on minimum equity requirement because no land is purchased

over the entire 30-year planning period when rented land is unlimited. The reason for this is easily understood. Consider, for example, the minimum starting capital of $18,025 required to fulfill $3,000 annual consumption over time (table 13). Purchasing any land operated over the planning period increases the starting level of owned capital. (The minimum starting owned capital is $34,527 when half of the land operated must be purchased; see table 15). Since a unit of starting owned capital, in effect, has an infinite cost level, any addition to starting owned capital increases costs more than returns regardless of the increase in returns (ending equity or net worth). In other words, starting owned capital is minimized when farmland operated is rented rather than when any is purchased. The secondary objective of maximum growth does not matter under the condition where starting owned capital is the most limiting factor of production.

OPERATIONS LIMITED TO OWNED LAND

Increasing land values affect minimum starting capital requirements and the growth process where farmland operated must be owned or purchased. The minimum starting owned capital required to meet annual $3,000 consumption levels over time with land values increasing 5 percent annually is $47,306 (table 24). This is $274 higher than the minimum starting requirements under the same conditions with constant land values (see table 16). The ending equity, $290,298, represents a return in terms of equity on starting owned capital between 6 and 7 percent compounded annually.

During the first production period, 267 acres of land are owned and operated. An additional 41 acres are purchased at the beginning of period 2. However, a static situation exists with respect to growth in farm size and acres operated after the second production period. Additional land cannot be purchased after production period 2 because the amount of capital that can be generated within the farm firm, above that required to meet consumption and other financial obligations, is not sufficient to purchase the land at its appreciated value.

Land values at the beginning of period 1 are $240 per acre. With an assumed annual increase of 5 percent, the value at the beginning of the second period is $306.36 per acre. At the beginning of period 3, the value of land reaches $390.93. At this price, additional land cannot be purchased because of the required capital withdrawals for consumption and annual payments for land purchased through real estate loans in production periods 1 and 2. The net returns of periods 3 through 6 are just enough to permit the required capital withdrawals. Although annual land payments are

72

Table 24.--Farm organization, capital accumulation, and growth resulting from minimum starting level of owned capital necessary to obtain $3,000 consumption level over time, land acquisition limited to purchasing land only, land values increasing by 5 percent per year[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated............................acres..	267	308	308	308	308	308
Land owned..............................do....	267	308	308	308	308	308
Gross sales............................dollars..	11,498	13,261	13,261	13,261	13,261	13,261
Operating and overhead capital............do....	8,297	9,711	9,542	9,322	9,033	8,657
Borrowed capital.........................do....	7,081	12,510	12,510	12,510	12,510	12,510
Consumption capital......................do....	3,000	3,000	3,000	3,000	3,000	3,000
Production period totals:						
Starting owned cash capital..............do....	47,306	215	0	0	0	0
Net returns.............................do....	16,005	17,750	18,594	19,695	21,139	23,021
Capital withdrawals:						
Land purchases..........................do....	42,121	2,750	3,594	4,695	6,139	8,021
Machinery purchases......................do....	4,571	0	0	0	0	0
Livestock purchases......................do....	1,404	215	0	0	0	0
Capital consumed........................do....	15,000	15,000	15,000	15,000	15,000	15,000
Total.................................do....	63,096	17,965	18,594	19,695	21,139	23,021
Net cash capital generated...............do....	-47,091	-215	0	0	0	0
Ending owned cash capital................do....	215	0	0	0	0	0
Value of controlled resources............do....	87,975	126,596	159,863	202,321	256,508	325,666
Net worth (end of period)................do....	59,948	78,998	106,115	145,391	202,864	290,298
Present value of net returns.............do....	51,125					
Undiscounted level of net returns........do....	116,204					
Starting level of owned capital..........do....	47,306					

[1] The starting situation is the ability to manage; all other farm resources must be purchased with the minimum owned capital ($47,306).

equal, the net returns in each subsequent period increase because as amortized land payments are made, interest payments decrease and principal payments increase. Therefore, capital withdrawals in the form of land purchases (principal payments) increase with each production period by the amount that costs (interest payments) decrease.

In production periods 3 through 6, large amounts of security or collateral are available but unused. Purchasing additional land withdraws more capital than can be generated even when the purchase is made on a 33-year amortized basis. The additional capital generated from an additional acre of land would not be sufficient to meet the required land payments. However, it might well be profitable to purchase more land, considering its appreciating value. This is a paradoxical situation for it is not a matter of costs and returns; it is a matter of capital generation.

At $391 an acre, the price of land at the beginning of period 3, annual payments (assuming owned land is used for security and no downpayment is required) would amount to $26.06 per acre. A downpayment would reduce these payments, or land might be purchased on a cash basis, but this would require that some consumption be foregone or that starting owned capital be larger. The break-even annual land payment is about $25 per acre, assuming that no additional equipment or livestock must be purchased and that no operating capital would have to be borrowed to operate the additional unit. On the basis of a 33-year amortized loan with no downpayment, $25 per year would purchase an acre priced at $375. However, additional resources would likely have to be purchased in addition to land.

If land values remained the same as when land was purchased, ending net worth would only be $73,510. This would represent an increase in equity of $26,204 which is, of course, the value of net returns accumulated over the 30-year period minus the value of capital withdrawals for consumption.

The minimum level of starting owned capital required to meet increasing annual consumption levels over time with land values increasing 5 percent annually is $63,397 (table 25). This is about $3,000 higher than the minimum starting requirements under the same consumption conditions with constant land values (table 17). The returns to starting owned capital, in terms of ending capital, are again between 6 and 7 percent, assuming that the value of land does appreciate 5 percent annually. If land values remained at the original purchase price, ending equity would be $110,926, an increase of $47,529. This would represent a return on starting owned capital of about 1.5 percent if compounded annually.

Table 25.--Farm organization, capital accumulation, and growth resulting from minimum starting level of owned capital necessary to obtain increasing consumption levels over time, land acquisition limited to purchasing land only, land values increasing by 5 percent per year[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated..........................acres..	378	475	475	475	475	475
Land owned................................do....	378	475	475	475	475	475
Gross sales...........................dollars..	16,289	20,482	20,482	20,482	20,482	20,482
Operating and overhead capital............do....	11,155	14,098	13,437	12,877	12,445	12,182
Borrowed capital..........................do....	19,190	18,305	11,350	7,308	7,053	11,723
Consumption capital.......................do....	3,000	4,000	5,000	6,000	7,000	8,000
Production period totals:						
Starting owned cash capital...............do....	63,397	0	7,443	12,485	13,739	10,070
Net returns..............................do....	25,669	31,922	35,226	38,027	40,185	41,500
Capital withdrawals:						
Land purchases..........................do....	67,506	3,967	5,184	6,773	8,854	11,570
Machinery purchases.....................do....	4,571	0	0	0	0	0
Livestock purchases.....................do....	1,989	512	0	0	0	0
Capital consumed........................do....	15,000	20,000	25,000	30,000	35,000	40,000
Total...................................do....	89,066	24,479	30,184	36,773	43,854	51,570
Net cash capital generated................do....	-63,397	7,443	5,042	1,254	-3,669	-10,070
Ending owned cash capital.................do....	0	7,443	12,485	13,739	10,070	0
Value of controlled resources............do....	122,345	200,207	256,553	323,286	403,184	499,770
Net worth (end of period)................do....	92,717	130,265	169,815	237,787	320,949	439,641
Present value of net returns.............do....	91,012					
Undiscounted level of net returns........do....	212,529					
Starting level of owned capital..........do....	63,397					

[1] The starting situation is the ability to manage; all other farm resources must be purchased with the minimum owned capital ($63,397). The required annual consumption level is indicated by consumption capital shown in the table.

The situation with respect to growth in terms of farm size is very similar to the former situation with increasing land values. A static situation, in terms of land purchases, exists after production period 2, because the additional capital generated from an additional acre of land is not sufficient to meet the required land payment. However, because additional land cannot be purchased to satisfy the increasing consumption levels, the method of capital accumulation is somewhat different from the situation with constant returns over time. With constant annual consumption over time, the net returns after period 2 are just equal to the total capital withdrawals (table 24). With increasing annual consumption, the growth, before land appreciates too much to be purchased, is great enough to generate capital in periods 2 through 4. In other words, since capital cannot be generated by purchasing additional land in the later periods, it must be generated in the earlier production periods to satisfy increasing consumption levels during the later stages of the planning period.

These results indicate that if a farm operator has an established farm or equity situation to grow from, land values in the area of study might increase by about 50 percent (from $240 to more than $360), considering only the productivity and returns associated with farm production. However, if land values advanced above this level, unless product prices increased relative to land values and costs, outside capital--capital other than that created in farming--would have to enter the land market in order to drive land values higher. It would not be possible for farm operators with no source of capital outside of farm production to purchase additional farmland even though they might have much to gain through the appreciation of land values. Also, even if land values continued to rise above the productivity value, current farm owner-operators would gain little after considering the opportunity costs. Under conditions of increasing land values, with both constant and increasing consumption levels, the returns to starting owned capital, measured in terms of ending equity, are only between 6 and 7 percent. In the event that land values reached the break-even point and remained there, the returns in terms of ending equity would be low.

SIGNIFICANT FINDINGS

Criteria and Growth Rates

Within the framework of the econometric model used in this analysis, a number of objective functions were tested to determine their effect upon growth of the farm firm. A criterion function--or an objective of maximizing the present value of the stream of net

returns over a 30-year planning period, with an annual discount rate of 6 percent--resulted in maximum capital accumulation and farm growth. This occurred when capital accumulation was measured in terms of discounted net returns or ending owned capital, or when growth was measured in terms of undiscounted net returns, gross sales, or acres of land operated. Capital accumulation and growth were measured in all of these terms; each was maximized; and each resulted in the same farm organization and land acquisition over the planning period considered.

A criterion function of maximizing the present value of consumption resulted in the same capital accumulation and growth process as the objective of maximizing the present value of net returns, with the exception of the last production period. A discount rate of 6 percent was not great enough to bring about additional consumption before the last production period. Consumption remained at the minimum (required) level so that maximum growth could occur, with all additional consumption taking place at the end of the growth period.

A criterion function of maximizing the present value of land investments resulted in a slower rate of growth than an objective of maximizing net returns. This occurred because maximum net returns resulted from renting land only. Although the average cost of buying land (interest payments over the 30-year planning horizon) is less than renting, the total capital outlays (interest plus principal payments) are higher. Therefore, buying land results in slower rates of growth and lower total net returns. With the objective function of maximizing land investments, the maximum size of operation is achieved through renting land during the first half of the 30-year planning period and buying at the end of this period.

Effect of Other Variables

Additional analyses were made to determine the effects of certain restrictions, land acquisition, and capital use alternatives on capital accumulation. In assessing the effects of these variables, it was assumed that the strategy of management was one to maximize the present value of net returns.

Renting all additional land operated resulted in maximum capital accumulation. The absence of an alternative to renting land restricted capital accumulation with respect to both size of operations and level of net returns.

The capital accumulation and growth process of farms with small starting sizes were similar but on a smaller scale than farms with larger starting sizes. Starting with a farm size of 426 acres of

owned land and renting all additional land operated, the farm size reached a level of about 6,100 acres over the 30-year period. Annual consumption levels (at 50 percent of the net returns) ranged from $5,000 in the first part of the planning period to about $25,700 at the last of the period. A starting farm size of 213 acres of owned land resulted in an accumulation of equity above the starting owned level of $248,111. This was about 62 percent of the additional value of equity accumulated with the starting size equal to 426 acres of owned land. The size of operation reached 3,800 acres at the end of the 30 years. Annual consumption levels ranged from $2,539 to more than $10,000, a level reached only after 20 years.

With land acquisition limited to purchasing all additional land operated, a starting farm size of 426 acres resulted in a maximum size of operation of 1,627 acres in the last production period. When the starting farm size was decreased to 213 acres, growth, in terms of acreage operated, was limited to the purchase of about a section of land during the 30-year planning period. Consumption levels for the 213-acre farm were a little more than $2,000 per year during the first part of the period and less than $5,000 for the first 20 years.

Capital rationing also restricted growth. With the alternative of renting land when borrowed nonland capital was restricted to half its original level, growth decreased 12 to 15 percent, both in terms of land operated and net returns, depending upon the starting farm size and consumption level. The effect of different capital borrowing levels did not appear to be significant where the method of land acquisition was limited to purchasing land, because where land is purchased relatively small amounts of nonland capital are borrowed over the 30-year growth period. This capital is borrowed only at the first part of the planning period where owned capital levels are comparatively low. During later production periods collateral is utilized to secure land purchases rather than to obtain nonland capital. When capital use was restricted to owned capital only, starting with a level of $6,106, the minimum specified level of consumption, $3,000 annually, could not be met during the first 5 years. In fact, capital was generated for a period of 10 years before enough capital was available to operate all owned land, 426 acres.

The effect of higher consumption levels or capital withdrawals on the growth process was also significant. Rather than a minimum of $3,000 annually, a consumption function equal to $3,000 plus 25 percent of the net returns reduced the growth process by about 56 percent of its original level in terms of maximum acreage operated and by about 39 percent in terms of the present value of net returns. A consumption function equal to $3,000 plus 50 percent of the value

of net returns reduced capital accumulation and growth further to about 61 percent in terms of the present value of net returns. A consumption function of $3,000 plus 75 percent of the net returns reduced capital accumulation further to 75 percent of its original level. Higher levels of marginal propensity to consume increase consumption levels in the early part of the growth period but restrict capital accumulation and result in lower consumption levels during the later years. With a marginal propensity to consume equal to 75 percent of the net returns, total consumption levels over the 30-year period were less than consumption when the marginal propensity to consume was 50 or 25 percent. A marginal propensity to consume of 75 percent came close to effecting a nongrowth situation.

Minimum Equity Requirements

Minimum starting equity levels required to maintain family consumption and accumulate different levels of capital over time ranged from a low of $18,000 to more than $144,000. Various factors considered in determining minimum starting equity requirements were tenure situations, consumption levels, growth objectives, and increasing land values.

With all land operated rented, minimum starting equity began at about $18,000, which was the level required to maintain $3,000 annual family consumption over time. The starting equity increased to about $20,500 for a growth situation which would (1) permit annual consumption to rise from $3,000 to $8,000 over time and (2) return 6 percent annually to starting equity capital. Although minimum starting equity requirements for different farm-growth situations were not large with all farmland rented, the difference in required growth rates over time was significant. The different growth rates, in terms of acres operated, amouted to almost 1,500 acres.

When rented land was restricted to a level equal to or less than half of the total acreage operated, minimum starting farm equity levels increased to $34,500. Excluding the alternative to rent land altogether, minimum starting farm equity requirements increased by $47,000 or more depending upon the growth objective.

The most relevant variable, with respect to minimum starting equity requirements, was tenure situation. However, growth objectives and annual consumption levels were important, especially for owner-operated farms. Minimum starting equity requirements increased by more than $13,000 when annual consumption levels were raised at an increasing rate from $3,000 to $8,000 over a 30-year period.

Increasing land values from their current level by 5 percent annually did not change the optimum growth situation of renting farmland rather than purchasing it. Although increasing land values tended to satisfy growth objectives, they also raised minimum starting equity requirements. As land values were increased, growth, in terms of additional acreage purchased, ceased because the additional capital generated from an additional acre of land became insufficient to meet the required level of land payments.

IMPLICATIONS

This study examined the process of capital accumulation and growth of representative farm firms in an important agricultural area. It established the following points with respect to the general characteristics of capital accumulation and growth of farm firms.

A management strategy or criterion function of maximizing the present value of net returns is effective in terms of maximizing capital accumulation and growth, even when the growth process is measured in several ways. However, this criterion is not unique in depicting the maximum rate of capital accumulation.

The structure of the firm--in resource restrictions, alternative methods of expanding resource levels, consumption requirements or capital withdrawals, etc.--were most important with respect to capital accumulation over time. Thus, the environment within which farm operations occur may tend to overwhelm specific operator objectives whether they are to maximize returns, sales, farm size, owned capital or reinvestment capital, or even consumption. The point is that any of these objectives, criteria, or choice indicators maximize capital accumulation. Since there is only one maximum rate, these objectives result in the same conditions. The structure of the system is the important factor. Different objectives result in the same growth rates for the same structural relationship of the firm. However, different structural relationships resulted in different growth rates.

The required capital withdrawals are of the utmost importance in farm growth and capital accumulation. Costs are important only to the extent that they involve capital withdrawals. Small costs associated with large capital withdrawals would be restrictive upon growth. An example is the cost of renting versus that of purchasing additional farmland. In this analysis, land could be rented at a cost of $12 per acre, which required a capital withdrawal of $12. Land could be purchased on an amortized basis at a cost, which is interest payment, much less than $12 per acre. However, the total capital withdrawal, which includes interest payment plus principal payment,

was about $16 per acre. Under conditions of constant farm size, greater net returns would be associated with payments to purchase land (assuming other returns and costs are constant). In a growth situation, however, renting land, with lower capital requirements and higher costs, resulted in maximum returns over time because the firm grew larger and the volume of operations increased. A more obvious case is where land must be purchased on a cash basis. No costs (other than transfer costs) are associated with the purchase. However, the large capital requirements (withdrawals) significantly retarded growth and resulted in lower net returns over time. This situation has implications with respect to criteria and choice indicators in static economic analyses. Where capital withdrawals would be significantly different from costs over time, an objective of maximizing returns in a static analysis may not lead to a maximum capital accumulation situation. Under these conditions, a better criterion may be one that maximizes net worth.

The importance of capital withdrawals and their effect upon the growth process also has important implications regarding capital requirements for farm resources in relation to prices received for farm products. For capital accumulation and farm firm growth, a parity ratio showing the relationship between capital requirements and prices is most relevant. Increasing capital requirements for resource purchases in the future and their relationship to commodity prices are certain to have significant effects on farm firm growth.

Farm firm capital accumulation and growth situations over a 30-year period with a constant cost-price relationship did not show enormous growth rates, especially for the smaller starting size farm. The analysis did not consider the effect of competition among farm operators for land resources. Competition would probably increase land costs and the capital withdrawals associated with land acquisition. Under these conditions, if farm firm growth is limited to the utilization of capital generated within the firm, the growth rate of farms is likely to be slow, especially that of the smaller farms.

This study illustrates that capital accumulation increases at an increasing rate. Under this condition, the larger farms are most likely to command the use of farm resources.

This analysis also emphasizes the importance of security or collateral value in capital accumulation and firm growth. It is a resource which should be utilized the same as other farm resources. If it is not, the analysis indicates that considerable value is lost.

The foregoing analysis of minimum starting equity and capital accumulation requirements for specific growth objectives leads to the following conclusions concerning capital accumulation problems of farm firms in the area of study.

81

Minimum equity levels required to meet capital withdrawals over time for farm family consumption were significantly different under conditions of renting or owning the land that was operated. The different equity levels resulted from the amount of capital outlay associated with renting land versus owning or purchasing it. In the analysis, an acre of land could be rented for $12. However, with land priced at $240 per acre, current lending policies are such that a minimum of about $139 equity or capital outlay was associated with purchasing 1 acre.

However, minimum starting equity requirements were not significantly different for various growth requirements when all land operated could be rented. Large growth differences over time resulted with only small differences in starting equity requirements. However, differences in acreage operated and the value of controlled resources were large as the growth differences occurred. These differences indicated that the problem of land availability may be more acute than the problem of additional starting capital requirements in the fulfillment of different growth objectives.

Under conditions where land operated must be owned or purchased, different growth objectives did require significantly different starting equity levels. A minimum of about $47,000 was required only to meet constant $3,000 family consumption levels over time, but more than $77,000 starting equity was required to satisfy the opportunity cost of investing equity at 6 percent and having a nonfarm job to obtain consumption capital.

Annual capital withdrawals to satisfy consumption levels were more relevant variables for minimum starting equity requirements than different growth conditions over time. Whereas, a difference of only $200 in starting equity resulted in large growth differences over time with constant consumption levels, increasing consumption levels over time required almost $1,800 more starting equity. More than $13,000 additional starting equity was required to satisfy the higher consumption level where no land operated may be rented.

In terms of the starting level of acres operated, 379 acres were required for a constant consumption over time when land was rented, and only 262 acres when land was owned. However, in terms of equity requirements, more than $29,000 additional owned capital was required when land had to be purchased.

Net returns were higher on a per acre basis when land was owned rather than rented because resource purchases, such as land, require capital but are not associated with costs as are rent. In other words, principal payments are not costs; however, the fact that principal payments require capital investments is important in a dynamic model. The cost of owning resources in a static model may be only the interest cost on the investment. In a dynamic model,

the capital withdrawals associated with the resource purchases are more relevant than costs.

In the absence of increases in prices received for farm products relative to prices paid for production items, including land and other resources, farm operators in the study area with less than $18,000 equity or owned capital have little chance of obtaining adequate family living levels in farming. On the other hand, operators with slightly higher levels of capital have the opportunity to increase family living levels and to accumulate capital in farming if farmland may be rented rather than purchased. If farm operators must own or purchase land operated, then more than $47,000 equity in farming is required to provide for basic family consumption levels and more than $60,000 starting equity is required to support increases in family consumption levels.

Even though farmers may obtain increasing levels of family living at nonfarm jobs and can invest owned capital at a return of 6 percent compounded annually, farm operators are "as well off" in farming from the standpoint of opportunity costs if they can start their operations with more than $144,000 owned equity.

The analysis of minimum starting equity requirements with increasing land values over time showed that starting equity is minimized when specified conditions for farm firm growth are fulfilled by renting rather than owning land operated, even though the appreciated land values tend to satisfy the growth conditions. Sizable values may be accumulated through the appreciation of land values when land is owned. However, starting equity requirements are higher and within a framework where starting owned capital or equity is the most limited resource, renting rather than owning minimizes the most limiting factor.

When land had to be owned or purchased, increasing land values raised the minimum starting level of owned capital required to meet specified family consumption levels. Requirements of starting owned capital were higher because additional capital had to be withdrawn to purchase land at its higher value.

The analysis also indicates that land values in the study area might increase substantially if the returns to all owned resources, other than those returns used to satisfy minimum consumption levels, are used to purchase land. That is, through the productivity of a farm firm's bundle of resources, additional land may be purchased, if a farm operator has an established equity, until land values reach a break-even point. In the study area, this break-even point, in terms of land values, may be more than 40 percent higher than the current selling price.

In the event that land values do increase from their current level by 5 percent annually relative to returns, the break-even value is

reached in about 8 to 10 years. Beyond this point, the additional capital generated from an additional acre of land is not sufficient to purchase land even through a long-time amortized basis. This is paradoxical because, regardless of the gains that might be forthcoming from appreciated land values, savings or "outside capital" would have to be used to purchase additional land.

If land values increase, but only to the break-even point, then from the standpoint of opportunity costs there would be little gain to farm owner-operators over the next 30 years. The returns to current starting equity or owned capital, if measured in terms of ending equity, would be less than 2 percent.

LIMITATIONS OF THE STUDY AND SUGGESTED RESEARCH

Limitations

Much has been said and written about capital accumulation and growth. However, few studies have attempted to analyze the growth problems of the firm. This study merely scratches the surface in a very important area of research dealing with farm firm growth. A better knowledge of the growth process might enable a better understanding of risks and farm adjustments in general.

Even though the analytical model used in this study is somewhat more inclusive with respect to changing variables than static models, it is not without limitations. The model is dynamic only with respect to time and growth properties. In the real world, many more variables typically change over several production periods. Many production periods are considered in the analysis, and the model can only be classified as a dynamic certainty model since the input-output and price coefficients over all periods are assumed to be known with certainty. As a consequence, the necessary assumptions in the model are largely inadequate and unrealistic.

In a static analysis, an important problem is to decide what criterion should be used for solving an economic problem. An analysis which covers several time periods compounds this problem. The introduction of time raises not only the question of what shall be maximized, but also how long the planning period shall be. This study attempts to analyze the effects of different objectives or criteria, but it does not come to grips with the effects of different planning horizons. The economic consequences of

different horizons may be more important than is generally believed, and the absence of an analysis of them is, therefore, a serious limitation to this study. Since the model does not deal with uncertainty, it cannot adequately deal with the effects of different planning horizons. In fact, since uncertainty is greater as the time period is extended, the results of this analysis with respect to some distant production period should be heavily discounted.

Another limitation of the model results from the necessary assumption that few variables are relevant for any given production period. Any practical problem is solved within the framework of many different variables. Many of these important variables cannot even be accurately specified for an individual, much less for a typical situation.

The assumption of pure competition within the capital accumulation or growth environment of the farm firm is another serious limitation. The users of linear programming have for too long been concerned only with the special case of production decisions and not with marketing decisions. When pure competition is assumed, the aggregate aspects of growing firms are not considered. It is common knowledge that farm firms are growing with respect to both product output and physical size. This study assumes that land and other resources are available for growth of the firm without the competition of other firms. The analysis also does not deal with formidable institutional problems associated with the land market.

The programming model used in the analysis defines the optimum only with respect to the specific assumptions made. As a result of the limitations, a true optimum for the situation that the model is intended to portray is not obtained. However, the model is defended on the grounds that it at least provides a rational technique for approaching the true optimum. Also, progress in refining and utilizing dynamic models can only come from attempts to apply these techniques to real problems.

The arbitrary selection of important variables which affect capital accumulation, especially consumption and capital borrowing levels, is a limitation which is difficult to assess. The arbitrary selection was done in the spirit of simulation and should not be interpreted as a value judgment indicating what ought to be. Problems relating to capital accumulation are much too complicated to be solved in a straightforward manner by the deductive process. However, the answer may be approximated through simulation. This technique has met with much success in other scientific fields and probably holds much promise in the social sciences.

Need for Further Research

This analysis attempts to evaluate the farm growth process very generally and over a fairly long period of time. A constant cost for farm resources is assumed in the analysis. Further study to determine the effect of nonconstant cost relationships on growth of farm firms should be made. While the model used in this study leaves much to be desired, useful information about growth could be gained simply by varying costs (capital withdrawal requirements) over time. The same is true with respect to product prices and technology. Although little is known about specific effects of changes in technology, general relationships between technological innovations, prices, and capital requirements are known or at least can be simulated. Simulating probable or possible changes over time could establish probable minimum and maximum growth rates over time. The divergence of these growth rates over time might help to establish a relevant planning horizon.

Varying the price of land resources tends to account for competition among farm operators for farm resources. However, an analysis dealing specifically with the problem of accounting for competition and investigating every facet of it should be undertaken. The same is true with respect to the institutional problems relating to land ownership and operation. More research efforts need to be directed to problems of land availability and their effects on adjustment problems.

The model used in the analysis to depict capital accumulation problems is a growth model rather than a decision model with respect to the organization of farm enterprises. The organization of enterprises is assumed to remain constant as growth occurs. The effect of this assumption should be evaluated; for a growth model should also be a decision model. However, it is felt that the advantages of such a simplifying assumption compensate for the loss of generality. This type of simplifying assumption may have much promise when working with problems in farming areas where many operations are specialized. In such areas, the opportunity costs of not producing a specific organization of crops and livestock suited to the area are quite high. Even if the several types of organizations, perhaps with quite different capital requirements, are relevant, several aggregated activities could be included in the model rather than complicating the model and computing procedures by including a wide range of individual enterprise activities. Further research evaluating this possibility should be undertaken.

It is very important that research efforts be directed toward evaluating credit use, resource investments, and capital withdrawals in the growth process within an environment of risk and uncertainty. The circumstances surrounding the use of these items are such that they may only be evaluated properly within this framework. It is, therefore, important that methods of introducing risk and uncertainty into dynamic analyses be found. Such an analysis might utilize a model that includes the stochastic process in a linear program framework to introduce risk. A "hybrid" between the linear program model used in this study and the recursive linear program model might be utilized to introduce uncertainty. Such a model might deal with random income-generating variables and expected values. The model might also consider different planning horizons for different types of input purchases. The relevant planning horizon for different types of resources might be solved for rather than arbitrarily selected.

SELECTED REFERENCES

(1) Barr, Alfred L., and Plaxico, James S.
    1961. Optimum Cattle Systems and Range Improvement Practices for Northeastern Oklahoma: Dynamic and Static Analyses. Okla. Agr. Expt. Sta. MP-62.
(2) Baum, E. L., and Bachman, K. L.
    1961. The Economic Growth Problem. In Capital and Credit Needs in a Changing Agriculture, pp. 3-18. Iowa State Univ. Press, Ames.
(3) Baumol, William J.
    1959. Economic Dynamics. The Macmillan Co., New York.
(4) Bellman, Richard.
    1957. Dynamic Programming. Princeton Univ. Press, Princeton.
(5) Brems, Hans.
    1961. Nonpure Competition in Linear Programming. In Money, Growth, and Methodology, pp. 351-360. Ed. Hugh Hegeland. Gleerup: CWK Gleerup Publishers, Sweden.
(6) Boulding, Kenneth E.
    1955. Economic Analysis. 3d. ed. Harper and Brothers, New York.
(7) Connor, L. J., Lagrone, W. F., and Plaxico, J. S.
    1961. Resource Requirements, Costs and Expected Returns; Alternative Crop and Livestock Enterprises: Loam Soils of the Rolling Plains of Southwestern Oklahoma. Okla. Agr. Expt. Sta. Proc. Ser. P-368.
(8) Connor, Larry J.
    1954. Long-run Adjustments for Farm Operators in a Sparsely Populated, High Risk Area of the Great Plains. Unpublished Ph.D. Dissertation, Okla. State Univ., Stillwater.
(9) Dorfman, R., Samuelson, P. A., and Solow, R. M.
    1958. Linear Programming and Economic Analysis. McGraw-Hill Book Co., Inc., New York.

(10) Fellner, William.
     1960. Modern Economic Analysis. McGraw-Hill Book Co., Inc., New York.
(11) Goodwin, John W., Plaxico, James S., and Lagrone, William F.
     1963. Aggregation of Normative Microsupply Relationships for Dryland Crop Farms in the Rolling Plains of Oklahoma and Texas. Okla. Agr. Expt. Sta. Tech. Bul. T-103.
(12) Harrod, R. F.
     1948. Towards A Dynamic Economics. Macmillan and Co., Ltd., London.
(13) Heady, Earl O.
     1952. Economics of Agricultural Production and Resource Use. Prentice-Hall Inc., New York.
(14) Hicks, J. R.
     1953. Value and Capital. 2d ed. Oxford Univ. Press, London.
(15) Loftsgard, Laurel D.
     1959. Application of Dynamic Programming Models for Optimal Farm and Home Plans. Jour. Farm Econ. 41(1): 61-62, Feb.
(16) Morton, George.
     1954. Dynamic Programming. In The Structural Independence of the Economy. Ed. Tybor Barna. John Wiley and Sons, New York.
(17) Plaxico, James S.
     1961. Dynamic Programming and Management Strategies in the Great Plains. In Management Strategies in Great Plains Farming, pp. 12-22. Univ. Nebr. Agr. Expt. Sta.
(18) Saaty, Thomas L.
     1959. Mathematical Methods of Operations Research. McGraw-Hill Book Co., Inc., New York.
(19) Samuelson, Paul A.
     1948. Dynamic Process Analysis. In A Survey of Contemporary Economics, pp. 352-387. Ed. Howard S. Ellis. The Blakeston Co., Philadelphia.
(20) _____
     1947. The Foundations of Economic Analysis. Harvard Univ. Press, Cambridge.
(21) Stigler, George J.
     1960. The Theory of Price. The Macmillan Co., New York.
(22) Strickland, Percy L., Jr., et al.
     1963. Minimum Land Requirements and Adjustments for Specified Income Levels, Southwestern Oklahoma. Okla. Agr. Expt. Sta. Bul. B-608.
(23) Tweeten, Luther G., and Plaxico, James S.
     1964. Long Run Outlook for Agricultural Adjustments Based on National Growth. Jour. Farm Econ. 46(1): 39-55, Feb.
(24) U.S. Department of Commerce.
     1961. Oklahoma Census of Agriculture. U.S. Bur. Census.
(25) _____
     1961. Texas Census of Agriculture. U.S. Bur. Census.
(26) _____
     1961. U.S. Census of Agriculture, 1959, Color, Race, and Tenure of Farm Operator. U.S. Bur. Census.
(27) Vajda, S.
     1961. Mathematical Programming. Addison-Wesley Publishing Co., Reading, Mass.

Table 26.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size of 213 acres, rented land limited, consumption levels 50 percent of net returns, and borrowed capital limit 12.5 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated...........................acres..	279	400	464	572	705	870
Land owned................................do....	279	400	464	572	705	870
Gross sales...........................dollars..	12,010	17,240	19,981	24,619	30,357	37,480
Operating and overhead capital............do....	7,678	11,143	12,434	14,981	18,420	23,266
Borrowed capital..........................do....	4,042	0	0	0	0	0
Consumption capital.......................do....	2,166	3,049	3,773	4,819	5,968	7,107
Production period totals:						
Starting owned cash capital...............do....	6,106	15,584	26,903	31,528	38,422	45,982
Net returns..............................do....	21,660	30,486	37,734	48,192	59,683	71,073
Capital withdrawals:						
Land purchases........................do....	1,006	3,285	13,907	16,635	21,551	26,737
Machinery purchases......................do....	0	0	0	0	30	1,080
Livestock purchases......................do....	346	639	335	566	701	870
Capital consumed.........................do....	10,830	15,243	18,867	24,097	29,841	35,536
Total..................................do....	12,182	19,167	33,109	41,298	52,123	64,223
Net cash capital generated................do....	9,478	11,319	4,625	6,894	7,560	6,850
Ending owned cash capital.................do....	15,584	26,903	31,528	38,422	45,982	52,832
Value of controlled resources.............do....	88,595	129,593	149,913	183,293	223,504	271,904
Net worth (end of period).................do....	73,761	89,004	107,871	131,966	161,808	197,345
Criterion function:						
Present value of net returns..............do....	101,509					
Undiscounted level of net returns..........do....	268,828					
Starting level of owned capital............do....	115,172					

[1] Starting situation 213 acres of owned land, $4,585 average value of equipment, $1,120 investment in livestock, and $6,106 owned capital.

Table 27.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size 213 acres, rented land limited, consumption levels 25 percent of net returns, and borrowed capital limit 12.5 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated............................acres..	293	429	551	746	1,005	1,337
Land owned................................do....	293	429	551	746	1,005	1,337
Gross sales............................dollars..	12,603	18,481	23,755	32,149	43,279	57,588
Operating and overhead capital............do....	8,076	11,683	14,343	19,444	26,946	36,587
Borrowed capital..........................do....	3,551	0	0	0	0	0
Consumption capital.......................do....	1,132	1,699	2,353	3,176	4,083	5,250
Production period totals:						
Starting owned cash capital...............do....	6,106	21,445	36,315	48,120	63,729	80,974
Net returns...............................do....	22,633	33,939	47,061	63,523	81,663	105,005
Capital withdrawals:						
Land purchases..........................do....	1,218	9,904	22,847	30,706	40,956	52,384
Machinery purchases.....................do....	0	0	0	302	1,687	2,169
Livestock purchases.....................do....	418	718	644	1,025	1,359	1,747
Capital consumed........................do....	5,658	8,497	11,765	15,881	20,416	26,251
Total...................................do....	7,294	19,119	35,256	47,914	64,418	82,551
Net cash capital generated................do....	15,339	14,870	11,805	15,609	17,245	22,454
Ending owned cash capital.................do....	21,445	36,315	48,120	63,729	80,974	103,428
Value of controlled resources.............do....	97,888	146,116	187,845	251,581	334,032	440,082
Net worth (end of period).................do....	79,906	105,398	140,694	188,336	249,583	328,337
Criterion function:						
Present value of net returns..............do....	126,143					
Undiscounted level of net returns.........do....	353,874					
Starting level of owned capital...........do....	115,172					

[1] Starting situation 213 acres of owned land, $4,585 average value of equipment, $1,120 investment in livestock, and $6,106 owned capital.

Table 28.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size 213 acres, rented land limited, consumption levels 50 percent of net returns, and borrowed capital limit 25 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated.............................acres..	314	405	470	579	714	882
Land owned................................do....	314	405	470	579	714	882
Gross sales.............................dollars..	13,518	17,428	20,238	23,947	30,774	37,985
Operating and overhead capital............do.....	8,859	11,242	12,574	15,158	18,702	23,607
Borrowed capital..........................do....	5,586	0	0	0	0	0
Consumption capital.......................do....	2,329	3,093	3,832	4,875	6,036	7,189
Production period totals:						
Starting owned cash capital...............do....	6,106	15,681	27,087	31,758	38,684	46,098
Net returns...............................do....	23,294	30,930	38,321	48,945	60,358	71,888
Capital withdrawals:						
Land purchases..........................do....	1,541	3,582	14,147	16,971	21,960	27,148
Machinery purchases.....................do....	0	0	0	0	94	1,093
Livestock purchases.....................do....	531	477	343	575	711	880
Capital consumed........................do....	11,647	15,465	19,160	24,473	30,179	35,944
Total...................................do....	13,719	19,524	33,650	42,019	52,944	65,065
Net cash capital generated................do....	9,575	11,406	4,671	6,926	7,414	6,823
Ending owned cash capital.................do....	15,681	27,087	31,758	38,684	46,098	52,921
Value of controlled resources.............do....	97,277	131,000	151,614	185,275	225,894	275,010
Net worth (end of period).................do....	74,578	90,043	109,204	133,676	163,855	199,799
Criterion function:						
Present value of net returns..............do....	104,020					
Undiscounted level of net returns.........do....	273,736					
Starting level of owned capital...........do....	115,172					

[1] Starting situation 213 acres of owned land, $4,585 average value of equipment, $1,120 investment in livestock, and $6,106 owned capital.

Table 29.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size 213 acres, rented land limited, consumption levels 25 percent of net returns, and borrowed capital limit 25 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated..........................acres..	324	434	560	758	1,020	1,357
Land owned..............................do....	324	434	560	758	1,020	1,357
Gross sales..........................dollars..	13,955	18,713	24,133	32,668	43,956	58,457
Operating and overhead capital..........do....	9,131	11,799	14,547	19,793	27,402	37,170
Borrowed capital........................do....	4,862	0	0	0	0	0
Consumption capital.....................do....	1,206	1,728	2,397	3,219	4,138	4,435
Production period totals:						
Starting owned cash capital.............do....	6,106	21,914	36,735	48,774	64,339	81,778
Net returns............................do....	24,119	34,569	47,933	64,376	82,769	106,434
Capital withdrawals:						
Land purchases........................do....	1,696	10,525	23,249	31,294	41,549	53,235
Machinery purchases...................do....	0	0	0	381	1,711	2,198
Livestock purchases...................do....	584	581	662	1,042	1,378	1,771
Capital consumed......................do....	6,031	8,642	11,983	16,094	20,692	26,609
Total.............................do....	8,311	19,748	35,894	48,811	65,330	83,813
Net cash capital generated..............do....	15,808	14,821	12,039	15,565	17,439	22,621
Ending owned cash capital...............do....	21,914	36,735	48,774	64,339	81,778	104,399
Value of controlled resources...........do....	105,963	147,765	190,706	255,214	338,622	446,092
Net worth (end of period)...............do....	81,019	106,946	142,896	191,178	253,255	333,080
Criterion function:						
Present value of net returns............do....	129,003					
Undiscounted level of net returns.......do....	360,200					
Starting level of owned capital.........do....	115,172					

[1] Starting situation 213 acres of owned land, $4,585 average value of equipment, $1,120 investment in livestock, and $6,106 owned capital.

Table 30.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size of 426 acres, rented land limited, consumption levels 50 percent of net returns, and borrowed capital limit 12.5 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated.........................acres..	493	761	906	1,106	1,344	1,627
Land owned.................................do....	493	761	906	1,106	1,344	1,627
Gross sales.............................dollars..	21,220	32,768	39,024	47,636	57,868	70,071
Operating and overhead capital............do....	11,941	20,307	24,332	30,176	37,108	45,368
Borrowed capital..........................do....	10,404	1,113	0	0	0	0
Consumption capital.......................do....	4,639	6,231	7,346	8,730	10,380	12,352
Production period totals:						
Starting owned cash capital...............do....	6,106	27,933	51,847	61,197	71,541	83,121
Net returns...............................do....	46,392	62,306	73,460	87,302	103,801	123,515
Capital withdrawals:						
Land purchases............................do....	1,018	5,433	25,668	30,950	37,520	45,784
Machinery purchases.......................do....	0	396	948	1,306	1,551	1,849
Livestock purchases.......................do....	350	1,410	764	1,051	1,249	1,490
Capital consumed..........................do....	23,197	31,153	36,730	43,651	51,901	61,758
Total...............................do....	24,565	38,392	64,110	76,958	92,221	110,881
Net cash capital generated................do....	21,827	23,914	9,350	10,344	11,580	12,634
Ending owned cash capital.................do....	27,933	51,847	61,197	71,541	83,121	95,755
Value of controlled resources.............do....	153,429	243,469	289,331	350,032	421,532	505,425
Net worth (end of period)................do....	138,367	169,520	206,250	249,901	301,801	363,558
Criterion function:						
Present value of net returns..............do....	193,481					
Undiscounted level of net returns...........do....	496,776					
Starting level of owned capital............do....	115,172					

[1] Starting situation 426 acres of owned land, $4,585 average value of equipment, $2,241 investment in livestock, and $6,106 owned capital.

Table 31.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size 426 acres, rented land limited, consumption levels 25 percent of net returns, and borrowed capital limit 12.5 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated.............................acres..	522	842	1,073	1,430	1,880	2,459
Land owned...............................do....	522	842	1,073	1,430	1,880	2,459
Gross sales.............................dollars..	22,490	36,283	46,239	61,603	80,979	105,948
Operating and overhead capital............do....	12,795	22,630	28,897	39,303	52,330	69,118
Borrowed capital.........................do....	9,351	0	0	0	0	0
Consumption capital......................do....	2,424	2,844	4,335	5,575	7,162	9,208
Production period totals:						
Starting owned cash capital..............do....	6,106	40,487	71,694	89,858	114,835	146,034
Net returns.............................do....	48,475	68,265	86,706	111,498	143,246	184,154
Capital withdrawals:						
Land purchased........................do....	1,470	17,397	44,140	54,441	70,933	92,400
Machinery purchases...................do....	0	929	1,509	2,329	2,937	3,785
Livestock purchases...................do....	507	1,684	1,216	1,876	2,366	3,049
Capital consumed......................do....	12,119	17,066	21,677	27,875	35,811	46,038
Total.............................do....	14,094	37,058	68,542	86,521	112,047	145,272
Net cash capital generated..................do....	34,381	31,207	18,164	24,977	31,199	38,882
Ending owned cash capital...................do....	40,487	71,694	89,858	114,835	146,034	184,916
Value of controlled resources..............do....	173,098	283,718	360,047	474,909	619,411	804,087
Net worth (end of period).................do....	151,528	202,727	267,756	351,379	458,814	596,930
Criterion function:						
Present value of net returns.............do....	234,645					
Undiscounted level of net returns..........do....	642,344					
Starting level of owned capital.............do....	115,172					

[1] Starting situation 426 acres of owned land, $4,585 average value of equipment, $2,241 investment in livestock, and $6,106 owned capital.

Table 32.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size 426 acres, rented land limited, consumption levels 50 percent of net returns, and borrowed capital limit 25 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated.............................acres..	583	782	920	1,123	1,364	1,652
Land owned...............................do....	583	782	920	1,123	1,364	1,652
Gross sales.............................dollars..	25,101	33,677	39,641	48,383	58,775	71,171
Operating and overhead capital............do....	14,982	21,022	24,748	30,679	37,719	46,110
Borrowed capital.........................do....	14,377	1,467	0	0	0	0
Consumption capital......................do....	5,060	6,328	7,447	8,852	10,528	12,531
Production period totals:						
Starting owned cash capital...............do....	6,106	28,184	52,062	61,532	71,751	83,188
Net returns..............................do....	50,598	63,277	74,467	88,519	105,280	125,309
Capital withdrawals:						
Land purchases..........................do....	2,397	6,180	26,131	31,649	38,359	46,870
Machinery purchases.....................do....	0	534	904	1,325	1,575	1,879
Livestock purchases.....................do....	824	1,047	728	1,067	1,269	1,514
Capital consumed........................do....	25,299	31,638	37,234	44,259	52,640	62,654
Total.................................do....	28,520	39,399	64,997	78,300	93,843	112,917
Net cash capital generated.................do....	22,078	23,878	9,470	10,219	11,437	12,392
Ending owned cash capital..................do....	28,184	52,062	61,532	71,751	83,188	95,580
Value of controlled resources..............do....	175,754	248,973	293,195	354,526	426,647	511,552
Net worth (end of period)..................do....	140,471	172,110	209,343	253,603	306,243	368,898
Criterion function:						
Present value of net returns...............do....	199,193					
Undiscounted level of net returns..........do....	507,450					
Starting level of owned capital............do....	115,172					

[1] Starting situation 426 acres of owned land, $4,585 average value of equipment, $2,241 investment in livestock, and $6,106 owned capital.

Table 33.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size 426 acres, rented land limited, consumption levels 25 percent of net returns, and borrowed capital limit 25 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated..........................acres..	605	856	1,094	1,456	1,914	2,504
Land owned...............................do....	605	856	1,094	1,456	1,914	2,504
Gross sales..........................dollars..	26,050	36,882	47,144	62,748	82,464	107,877
Operating and overhead capital.............do....	15,572	23,011	29,510	40,072	53,326	70,412
Borrowed capital...........................do....	12,804	0	0	0	0	0
Consumption capital........................do....	2,619	3,468	4,408	5,669	7,285	9,366
Production period totals:						
Starting owned cash capital................do....	6,106	41,723	72,452	90,949	116,157	147,629
Net returns................................do....	52,389	69,354	88,169	113,381	145,691	187,325
Capital withdrawals:						
Land purchases...........................do....	2,735	18,944	44,822	55,558	72,399	94,339
Machinery purchases......................do....	0	1,020	1,555	2,365	2,989	3,852
Livestock purchases......................do....	940	1,322	1,253	1,905	2,408	3,103
Capital consumed.........................do....	13,097	17,339	22,042	28,345	36,423	46,831
Total................................do....	16,772	38,625	69,672	88,173	114,219	148,125
Net cash capital generated.................do....	35,617	30,729	18,497	25,208	31,472	39,200
Ending owned cash capital..................do....	41,723	72,452	90,949	116,157	147,629	186,829
Value of controlled resources..............do....	194,689	288,000	366,425	482,783	629,572	817,327
Net worth (end of period).................do....	154,464	206,479	272,606	357,642	466,910	607,404
Criterion function:						
Present value of net returns...............do....	241,134					
Undiscounted level of net returns..........do....	656,309					
Starting level of owned capital............do....	115,172					

[1] Starting situation 426 acres of owned land, $4,585 average value of equipment, $2,241 investment in livestock, and $6,106 owned capital.

Table 34.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size of 213 acres, rented land unlimited, consumption levels 50 percent of net returns, and borrowed capital limit 12.5 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated..........................acres..	342	644	1,129	1,760	2,621	3,800
Land owned.................................do....	213	213	213	213	213	213
Land rented................................do....	129	431	916	1,547	2,408	3,587
Gross sales............................dollars..	14,739	27,743	48,627	75,819	112,898	163,705
Operating and overhead capital.............do....	9,661	18,872	36,124	58,676	89,416	131,538
Borrowed capital...........................do....	6,390	6,390	6,390	6,390	6,390	6,390
Consumption capital........................do....	2,539	4,435	6,251	8,572	11,741	16,083
Production period totals:						
Starting owned cash capital................do....	6,106	18,122	38,712	64,619	100,035	148,592
Net returns................................do....	25,390	44,355	62,513	85,716	117,410	160,835
Capital withdrawals:						
Machinery purchases......................do....	0	0	2,800	4,122	5,620	7,701
Livestock purchases......................do....	679	1,588	2,550	3,320	4,527	6,204
Capital consumed.........................do....	12,695	22,177	31,256	42,858	58,706	80,417
Total.................................do....	13,374	23,765	36,606	50,300	68,853	94,322
Net cash capital generated.................do....	12,016	20,590	25,907	35,416	48,557	66,513
Ending owned cash capital..................do....	18,122	38,712	64,619	100,035	148,592	215,105
Value of controlled resources..............do....	106,586	201,244	348,901	543,199	808,543	1,171,921
Net worth (end of period)..................do....	75,626	97,804	129,061	171,919	230,623	311,041
Criterion function:						
Present value of net returns...............do....	167,047					
Undiscounted level of net returns...........do....	496,219					
Starting level of owned capital.............do....	115,172					

[1] Starting situation 213 acres of ownedland, $4,585 average value of equipment, $1,120 investment in livestock, and $6,106 owned capital.

Table 35.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size 213 acres, rented land unlimited, consumption levels 25 percent of net returns, and borrowed capital limit 12.5 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated..........................acres..	375	878	1,764	3,113	5,249	8,624
Land owned................................do....	213	213	213	213	213	213
Land rented..............................do....	162	665	1,551	2,900	5,036	8,411
Gross sales............................dollars..	16,156	37,817	76,001	134,116	226,136	371,527
Operating and overhead capital............do....	10,651	27,117	58,888	107,093	183,435	304,053
Borrowed capital.........................do....	6,390	6,390	6,390	6,390	6,390	6,390
Consumption capital......................do....	1,376	2,675	4,278	6,756	10,675	16,869
Production period totals:						
Starting owned cash capital...............do....	6,106	25,896	62,213	115,933	201,362	336,307
Net returns..............................do....	27,523	53,497	85,561	135,112	213,506	337,372
Capital withdrawals:						
Machinery purchases......................do....	0	1,161	5,788	8,809	13,948	22,038
Livestock purchases......................do....	852	2,645	4,662	7,096	11,236	17,752
Capital consumed.........................do....	6,881	13,374	21,391	33,788	53,377	84,343
Total....................................do....	7,733	17,180	31,841	49,683	78,561	124,133
Net cash capital generated................do....	19,790	36,317	53,720	85,429	134,945	213,239
Ending owned cash capital.................do....	25,896	62,213	115,933	201,362	336,307	549,546
Value of controlled resources.............do....	122,453	283,296	560,106	985,200	1,657,969	2,720,998
Net worth (end of period).................do....	83,573	123,696	187,866	289,200	449,329	702,358
Criterion function:						
Present value of net returns..............do....	256,228					
Undiscounted level of net returns.........do....	852,571					
Starting level of owned capital...........do....	115,172					

[1] Starting situation 213 acres of owned land, $4,585 average value of equipment, $1,120 investment in livestock, and $6,106 owned capital.

Table 36.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size 213 acres, rented land unlimited, consumption levels 50 percent of net returns, and borrowed capital limit 25 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated..............................acres..	499	880	1,421	2,135	3,116	4,460
Land owned................................do....	213	213	213	213	213	213
Land rented...............................do....	286	667	1,208	1,922	2,903	4,247
Gross sales............................dollars..	21,514	37,911	61,213	91,987	134,246	192,132
Operating and overhead capital.............do....	14,779	27,579	46,951	72,459	107,494	155,479
Borrowed capital..........................do....	12,780	12,780	12,780	12,780	12,780	12,780
Consumption capital.......................do....	3,367	5,166	7,131	9,764	13,375	18,323
Production period totals:						
Starting owned cash capital................do....	6,106	21,435	44,087	73,366	113,764	169,077
Net returns...............................do....	33,671	51,659	71,313	97,639	133,756	183,225
Capital withdrawals:						
Machinery purchases.......................do....	0	1,175	3,532	4,665	6,406	8,773
Livestock purchases.......................do....	1,507	2,002	2,845	3,757	5,160	7,067
Capital consumed..........................do....	16,835	25,830	35,657	48,819	66,877	91,613
Total...................................do....	18,342	29,007	42,034	57,241	78,443	107,453
Net cash capital generated.................do....	15,329	22,652	29,279	40,398	55,313	75,772
Ending owned cash capital..................do....	21,435	44,087	73,366	113,764	169,077	244,849
Value of controlled resources..............do....	148,407	265,676	431,172	651,352	953,671	1,367,843
Net worth (end of period)..................do....	79,767	105,596	141,252	190,072	256,951	348,563
Criterion function:						
Present value of net returns...............do....	194,397					
Undiscounted level of net returns...........do....	571,263					
Starting level of owned capital.............do....	115,172					

[1] Starting situation 213 acres of owned land, $4,585 average value of equipment, $1,120 investment in livestock, and $6,106 owned capital.

Table 37.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size 213 acres, rented land unlimited, consumption levels 25 percent of net returns, and borrowed capital limit 25 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated..............................acres..	543	1,176	2,178	3,740	6,209	10,111
Land owned...............................do....	213	213	213	213	213	213
Land rented..............................do....	330	963	1,965	3,527	5,996	9,898
Gross sales............................dollars..	23,392	50,683	93,836	161,112	267,496	435,593
Operating and overhead capital.............do....	16,092	38,221	74,059	129,869	218,127	357,582
Borrowed capital..........................do....	12,780	12,780	12,780	12,780	12,780	12,780
Consumption capital.......................do....	1,825	3,116	4,944	7,811	12,342	19,503
Production period totals:						
Starting owned cash capital...............do....	6,106	31,744	72,034	134,387	233,137	389,158
Net returns..............................do....	36,499	62,311	98,884	156,216	246,848	390,059
Capital withdrawals:						
Machinery purchases.....................do....	0	3,111	6,541	10,198	16,126	25,480
Livestock purchases.....................do....	1,735	3,332	5,269	8,214	12,989	20,524
Capital consumed.........................do....	9,126	15,578	24,721	39,054	61,712	97,515
Total...................................do....	10,861	22,021	36,531	57,466	90,827	143,519
Net cash capital generated................do....	25,638	40,290	62,353	98,750	156,021	246,540
Ending owned cash capital.................do....	31,744	72,034	134,387	233,137	389,158	635,698
Value of controlled resources.............do....	169,504	368,157	682,800	1,174,842	1,952,538	3,181,562
Net worth (end of period)................do....	90,304	137,037	211,200	328,362	513,498	806,042
Criterion function:						
Present value of net returns..............do....	299,683					
Undiscounted level of net returns..........do....	990,817					
Starting level of owned capital.............do....	115,172					

[1] Starting situation 213 acres of owned land, $4,585 average value of equipment, $1,120 investment in livestock, and $6,106 owned capital.

Table 38.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size 426 acres, rented land unlimited, consumption levels 50 percent of net returns, and borrowed capital limit 12.5 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated..............................acres..	557	1,111	1,855	2,859	4,234	6,118
Land owned..............................do....	426	426	426	426	426	426
Land rented..............................do....	131	685	1,429	2,433	3,808	5,692
Gross sales.............................dollars..	23,982	47,870	79,932	123,146	182,407	263,580
Operating and overhead capital.............do....	13,949	33,321	59,934	95,758	144,890	212,187
Borrowed capital..............................do....	12,780	12,780	12,780	12,780	12,780	12,780
Consumption capital.........................do....	5,017	7,274	9,999	13,694	18,758	25,697
Production period totals:						
Starting owned cash capital................do....	6,106	30,502	61,273	102,492	159,134	236,709
Net returns...................................do....	50,167	72,745	99,987	136,937	187,586	256,965
Capital withdrawals:						
Machinery purchases........................do....	0	2,685	4,860	6,550	8,983	12,304
Livestock purchases........................do....	687	2,917	3,915	5,276	7,236	9,911
Capital consumed..........................do....	25,084	36,372	49,993	68,469	93,792	128,483
Total...................................do....	25,771	41,974	58,768	80,295	110,011	150,698
Net cash capital generated.................do....	24,396	30,771	41,219	56,642	77,575	106,267
Ending owned cash capital..................do....	30,502	61,273	102,492	159,134	236,709	342,976
Value of controlled resources..............do....	171,695	341,028	569,582	879,010	1,302,804	1,883,446
Net worth (end of period)..................do....	140,255	176,628	226,622	295,090	388,884	517,366
Criterion function:						
Present value of net returns...............do....	274,828					
Undiscounted level of net returns............do....	804,387					
Starting level of owned capital.............do....	115,172					

[1] Starting situation 426 acres of owned land, $4,585 average value of equipment, $2,241 investment in livestock, and $6,106 owned capital.

Table 39.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size 426 acres, rented land unlimited, consumption levels 25 percent of returns, and borrowed capital limit 12.5 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated............................acres..	621	1,543	2,943	5,149	8,635	14,143
Land owned................................do....	426	426	426	426	426	426
Land rented...............................do....	195	1,117	2,517	4,723	8,209	13,717
Gross sales............................dollars..	26,740	66,470	126,768	221,800	371,986	609,302
Operating and overhead capital.............do....	15,925	48,819	98,853	177,691	302,287	499,167
Borrowed capital..........................do....	12,780	12,780	12,780	12,780	12,780	12,780
Consumption capital.......................do....	2,704	4,413	6,979	11,027	17,425	27,534
Production period totals:						
Starting owned cash capital...............do....	6,106	45,637	101,475	189,656	329,056	549,324
Net returns...............................do....	54,073	88,258	139,577	220,544	348,495	550,676
Capital withdrawals:						
Machinery purchases.......................do....	0	5,504	9,140	14,405	22,765	35,972
Livestock purchases.......................do....	1,024	4,851	7,362	11,603	18,338	28,976
Capital consumed..........................do....	13,518	22,065	34,894	55,136	87,124	137,669
Total.................................do....	14,542	32,420	51,396	81,144	128,227	202,617
Net cash capital generated................do....	39,531	55,838	88,181	139,400	220,268	348,059
Ending owned cash capital.................do....	45,637	101,475	189,656	329,056	549,324	897,383
Value of controlled resources.............do....	202,527	490,000	930,683	1,625,531	2,723,542	4,458,469
Net worth (end of period)................do....	155,727	221,920	326,603	492,011	753,382	1,166,389
Criterion function:						
Present value of net returns..............do....	424,905					
Undiscounted level of net returns.........do....	1,401,623					
Starting level of owned capital...........do....	115,172					

[1] Starting situation 426 acres of owned land, $4,585 average value of equipment, $2,241 investment in livestock, and $6,106 owned capital.

Table 40.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size 426 acres, rented land unlimited, consumption levels 50 percent of net returns, and borrowed capital limit 25 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated..........................acres..	852	1,483	2,308	3,442	4,995	7,122
Land owned..............................do....	426	426	426	426	426	426
Land rented.............................do....	426	1,057	1,882	3,016	4,569	6,696
Gross sales..........................dollars..	36,719	63,873	99,426	148,277	215,182	306,833
Operating and overhead capital..........do....	24,797	47,385	76,853	117,354	172,822	248,806
Borrowed capital........................do....	25,560	25,560	25,560	25,560	25,560	25,560
Consumption capital.....................do....	5,961	8,244	11,287	15,461	21,180	29,013
Production period totals:						
Starting owned cash capital.............do....	6,106	32,674	66,465	113,167	177,105	264,694
Net returns............................do....	59,611	82,444	112,865	154,615	211,799	290,133
Capital withdrawals:						
Machinery purchases.....................do....	995	4,116	5,389	7,405	10,141	13,892
Livestock purchases.....................do....	2,243	3,315	4,341	5,965	8,169	11,190
Capital consumed........................do....	29,805	41,222	56,433	77,307	105,900	145,067
Total...............................do....	33,043	48,653	66,163	90,677	124,210	170,149
Net cash capital generated..............do....	26,568	33,791	46,702	63,938	87,589	119,984
Ending owned cash capital...............do....	32,674	66,465	113,167	177,105	264,694	384,678
Value of controlled resources...........do....	247,218	439,880	694,312	1,043,780	1,522,399	2,177,945
Net worth (end of period)...............do....	144,978	186,200	242,632	319,940	425,839	570,905
Criterion function:						
Present value of net returns............do....	311,898					
Undiscounted level of net returns.......do....	911,467					
Starting level of owned capital.........do....	115,172					

[1] Starting situation 426 acres of owned land, $4,585 average value of equipment, $2,241 investment in livestock, and $6,106 owned capital.

Table 41.--Farm organization, capital accumulation, and growth resulting from maximum present value of net returns, starting farm size 426 acres, rented land unlimited, consumption levels 25 percent of net returns, and borrowed capital limit 25 percent of unmortgaged owned land value[1]

Item	Production period					
	1	2	3	4	5	6
Annual situation:						
Land operated.............................acres..	920	1,946	3,510	5,985	9,897	16,078
Land owned.............................. do....	426	426	426	426	426	426
Land rented.............................do....	494	1,520	3,084	5,559	9,471	15,652
Gross sales.............................dollars..	39,620	83,829	151,193	257,852	426,371	692,660
Operating and overhead capital.............do....	27,214	63,995	119,872	208,358	348,163	569,079
Borrowed capital.............................do....	25,560	25,560	25,560	25,560	25,560	25,560
Consumption capital.........................do....	3,101	4,959	7,830	12,374	19,552	30,895
Production period totals:						
Starting owned cash capital.................do....	6,106	48,598	110,876	209,894	366,306	613,467
Net returns......................................do....	62,031	99,170	156,606	247,470	391,040	617,906
Capital withdrawals:						
Machinery purchases.......................do....	1,435	6,701	10,211	16,167	25,544	40,364
Livestock purchases.......................do....	2,597	5,397	8,225	13,023	20,576	32,513
Capital consumed.........................do....	15,507	24,794	39,152	61,868	97,759	154,477
Total......................................do....	19,539	36,892	57,588	91,058	143,879	227,354
Net cash capital generated.................do....	42,492	62,278	99,018	156,412	247,161	390,552
Ending owned cash capital...................do....	48,598	110,876	209,894	366,306	613,467	1,004,019
Value of controlled resources...............do....	280,256	600,872	1,093,686	1,873,288	3,105,449	5,052,318
Net worth (end of period)..................do....	161,696	236,072	353,526	539,128	832,409	1,295,838
Criterion function:						
Present value of net returns...............do....	476,885					
Undiscounted level of net returns...........do....	1,574,223					
Starting level of owned capital.............do....	115,172					

[1] Starting situation 426 acres of owned land, $4,585 average value of equipment, $2,241 investment in livestock, and $6,106 owned capital.