

POLYPERIOD ANALYSIS OF CAPITAL ACCUMULATION AND  
GROWTH PROCESS OF FARM FIRMS, ROLLING PLAINS  
OF OKLAHOMA AND TEXAS

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POLYPERIOD ANALYSIS OF CAPITAL ACCUMULATION AND  
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## Preface

Joint research efforts by personnel in the Department of Agricultural Economics, Oklahoma State University, and the Economic Research Service, United States Department of Agriculture are directed towards adjustment problems in agriculture. This study is a report of the Oklahoma Agricultural Experiment Station Project 1040, "An Economic Appraisal of Farming Adjustment Opportunities to Meet Changing Conditions in Southwestern Oklahoma," which contributes to the Southern Regional Project S-42, "An Economic Appraisal of Farming Adjustment Opportunities in the Southern Region to Meet Changing Conditions."

Indebtedness is acknowledged to Dr. James S. Plaxico, my Graduate Committee Chairman. Without his previous research, counsel and encouragement I could not have conducted the study. I am also indebted to Mr. William F. Lagrone who gave me a great deal of assistance and encouragement during the early stages of the study. I am certainly indebted to the Economic Research Service, United States Department of Agriculture, for allowing me to continue my graduate work and for making this study possible.

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## TABLE OF CONTENTS

Chapter	Page
I. INTRODUCTION . . . . .	1
Problem Setting . . . . .	2
Purposes and Objectives . . . . .	3
Scope of Study . . . . .	4
II. CONCEPTUAL DEVELOPMENT . . . . .	7
Dynamic Nature of the Problem . . . . .	7
Development of the Deterministic Model . . . . .	10
Theory of the Dynamic Model . . . . .	10
The Deterministic Model of the Study . . . . .	13
Specification of Goals and Objectives of Farm Operators . . . . .	15
III. METHODS OF ANALYSIS . . . . .	19
Representative Resource Situation and Enterprise	
Organization . . . . .	20
Structural Framework of the Model . . . . .	24
Operational Restrictions and Activities . . . . .	24
Land Restriction and Acquisition Methods . . . . .	29
Labor Restriction and Hired Labor . . . . .	32
Capital Restrictions and Borrowing . . . . .	32
Equipment Complement and Increasing Overhead Costs . . . . .	33
Investment Restriction and Buy Livestock Activity . . . . .	35
Annual Fixed Cost and Capital Withdrawal . . . . .	35
Accounting Equations and Consume Activities . . . . .	36
Objective Functions . . . . .	36
Minimum Equity Model . . . . .	38
IV. EFFECT OF SELECTED VARIABLES ON THE CAPITAL ACCUMULATION PROCESS . . . . .	40
Criterion Functions . . . . .	40
Maximum Present Value of Net Returns (and other criteria which result in the same growth process) . . . . .	40
Maximum Present Value of Consumption . . . . .	44
Maximum Present Value of Land Investment . . . . .	45
Effect of Different Methods of Land Acquisition . . . . .	48
Effect of Capital Rationing . . . . .	50
Borrowed Capital Restriction 25 Percent of Owned Land Value . . . . .	50

TABLE OF CONTENTS (Continued)

Chapter	Page
Capital Restriction 12.5 Percent of Owned Land Value . . . . .	52
Capital Use Restricted to Owned Capital . . . . .	52
Effects of Higher Consumption Levels . . . . .	55
Marginal Propensity to Consume Equal to 25 Percent of Net Returns . . . . .	56
Marginal Propensity to Consume Equal to 50 Percent of Net Returns . . . . .	58
Marginal Propensity to Consume Equal to 75 Percent of Net Returns . . . . .	58
V. SIMULATION OF FARM FIRM GROWTH SITUATIONS . . . . .	62
Land Acquisition Through Renting . . . . .	62
Land Acquisition Through Purchase . . . . .	68
Effect of Consumption and Capital Borrowing Levels . . . . .	71
VI. MINIMUM STARTING EQUITY AND CAPITAL ACCUMULATION REQUIREMENTS FOR SPECIFIC GROWTH OBJECTIVES . . . . .	82
Minimum Starting Equity and Capital Accumulation Requirements for Specified Consumption Levels . . . . .	83
Rented Land Unlimited . . . . .	83
Rented Land Limited . . . . .	88
Minimum Starting Equity and Capital Accumulation Requirements for Specific Ending Equity Growth Conditions . . . . .	95
Requirements for \$3,000 Annual Retirement Income . . . . .	96
Requirements to Meet "Opportunity Costs" of Nonfarm Job and 6 Percent Return on Starting Equity . . . . .	100
Minimum Equity and Capital Accumulation Requirements Under Conditions of Increasing Land Values . . . . .	110
Rented Land Unlimited . . . . .	110
Operations Limited to Owned Land . . . . .	111
VII. CONCLUSIONS AND RECOMMENDATIONS . . . . .	118
Results . . . . .	119
Criteria and Growth Rates . . . . .	119
Simulated Growth Situations . . . . .	122
Minimum Equity Requirements . . . . .	124
Implications . . . . .	126
Limitations . . . . .	133
Need for Further Research . . . . .	135
SELECTED BIBLIOGRAPHY . . . . .	138
APPENDICES . . . . .	140

## LIST OF TABLES

Table	Page
I. Representative Farm Resource and Enterprise Organization, Per Acre Returns and Cash Costs Describing One Operating Unit Used in the Analysis . . . . .	21
II. Resource Levels, Activities and Restriction Requirements of Capital Accumulation Model . . . . .	25
III. Farm Organization, Capital Accumulation and Growth Process Resulting from Maximum Present Value of Net Returns . . .	42
IV. Farm Organization, Capital Accumulation and Growth Process Resulting from Maximum Present Value of Land Principal Payments . . . . .	47
V. Farm Organization, Capital Accumulation and Growth Process Resulting from Maximum Present Value of Net Returns, Expansion Without Renting Land Alternative . . . . .	49
VI. Farm Organization, Capital Accumulation and Growth Process Resulting from Maximum Present Value of Net Returns, Borrowed Capital Restricted to 25 Percent of Owned Land Value . . . . .	51
VII. Farm Organization, Capital Accumulation and Growth Process Resulting from Maximum Present Value of Net Returns, Borrowed Capital Restricted to 12.5 Percent of Owned Land Value . . . . .	53
VIII. Farm Organization, Capital Accumulation and Growth Process Resulting from Maximum Present Value of Net Returns, Capital Use Restricted to Owned Capital . . . . .	54
IX. Farm Organization, Capital Accumulation and Growth Process Resulting from Maximum Present Value of Net Returns, Propensity to Consume Equal to 25 Percent of Net Returns	57
X. Farm Organization, Capital Accumulation and Growth Process Resulting from Maximum Present Value of Net Returns, Propensity to Consume Equal to 50 Percent of Net Returns	59
XI. Farm Organization, Capital Accumulation and Growth Process Resulting from Maximum Present Value of Net Returns, Propensity to Consume Equal to 75 Percent of Net Returns	60

LIST OF TABLES (Continued)

Table	Page
XII. Farm Organization, Capital Accumulation and Growth Process Resulting from Maximum Present Value of Net Returns, Starting Farm Size of 426 Acres, Rented Land Unlimited, Consumption Levels 50 Percent of Net Returns and Borrowed Capital Limit 12.5 Percent of Unmortgaged Owned Land Value . . . . .	63
XIII. Farm Organization, Capital Accumulation and Growth Process 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 . . . . .	66
XIV. Farm Organization, Capital Accumulation and Growth Process 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 . . . . .	69
XV. Farm Organization, Capital Accumulation and Growth Process 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 . . . . .	72
XVI. Farm Size After 30 Year Growth Period for Specified Methods of Land Acquisition, Capital Borrowing and Consumption Levels . . . . .	73
XVII. Value of Net Worth Accumulated During the 30 Year Growth Period for Specified Methods of Land Acquisition, Capital Borrowing and Consumption Levels . . . . .	74
XVIII. Present Value of the Stream of Net Returns After 30 Year Growth Period for Specified Methods of Land Acquisition, Capital Borrowing and Consumption Levels . . . . .	75
XIX. Undiscounted Value of the Stream of Net Returns After 30 Year Growth Period for Specified Methods of Land Acqui- sition, Capital Borrowing and Consumption Levels . . . . .	76



LIST OF TABLES (Continued)

Table	Page
XX. Farm Organization, Capital Accumulation and Growth Process Resulting from Minimum Starting Level of Owned Capital Necessary to Obtain \$3,000 Consumption Level Over Time, Rented Land Unlimited . . . . .	84
XXI. Farm Organization, Capital Accumulation and Growth Process Resulting from Minimum Starting Level of Owned Capital Necessary to Obtain Increasing Consumption Levels Over Time, Rented Land Unlimited . . . . .	87
XXII. Farm Organization, Capital Accumulation and Growth Process 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 . . . . .	89
XXIII. Farm Organization, Capital Accumulation and Growth Process Resulting from Minimum Starting Level of Owned Capital Necessary to Obtain \$3,000 Consumption Level Over Time, Land Acquisition Limited to Purchasing Land Only . . . . .	92
XXIV. Farm Organization, Capital Accumulation and Growth Process Resulting from Minimum Starting Level of Owned Capital Necessary to Obtain Increasing Consumption Levels Over Time, Land Acquisition Limited to Purchasing Land Only . . . . .	94
XXV. Farm Organization, Capital Accumulation and Growth Process 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 . . . . .	97
XXVI. Farm Organization, Capital Accumulation and Growth Process 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 . . . . .	99
XXVII. Farm Organization, Capital Accumulation and Growth Process 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 . . . . .	102

LIST OF TABLES (Continued)

Table	Page
XXVIII. Farm Organization, Capital Accumulation and Growth Process 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 . . . . .	104
XXIX. Farm Organization, Capital Accumulation and Growth Process 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 . . . . .	106
XXX. Farm Organization, Capital Accumulation and Growth Process 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 . . . . .	108
XXXI. Farm Organization, Capital Accumulation and Growth Process 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 . . . . .	112
XXXII. Farm Organization, Capital Accumulation and Growth Process 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 . . . . .	115

LIST OF FIGURES

Figure	Page
1. Map of Oklahoma and Texas Outlining Counties of the Rolling Plains . . . . .	5
2. Resource Allocation Problem in a Static Framework . . . . .	11
3. Resource Allocation Problem in a Dynamic Framework . . . . .	12

## CHAPTER I

### INTRODUCTION

The changes which have occurred in agriculture in the United States in the relatively short history of the country have been phenomenal. One of the more pronounced adjustments in recent times has been the movement to fewer and larger farms. After reaching a peak of about 716,000 in 1935, the number of farms in Oklahoma and Texas has decreased to about 300,000 in 1960. During the same time period, the average farm size has increased from 240 acres to over 600 acres.<sup>1</sup>

The present trend to fewer and larger farms will continue. However, many farmers will likely find themselves unable to adjust to developing technology, particularly to the larger scale of farm business. The capital structure of many small farms and land values that continue to remain high will likely impede the expansion of the land base. On the other hand, farm operators of larger farms with more favorable capital structures may find that they can expand their land base with little difficulty.

There may be many incentives motivating farm operators to expand their operations with respect to their land base. Acquiring additional land may be consistent with a profit maximization goal, in that this

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<sup>1</sup>United States Department of Commerce, Oklahoma Census of Agriculture and Texas Census of Agriculture, Bureau of the Census (Washington, 1961), p. 3.

action may lead to greater efficiency and reduce the cost of inputs relative to the value of outputs. An attempt to obtain greater efficiency would also apply when the goal of farm production is that of maximizing family satisfaction rather than profits alone.<sup>2</sup> Farm operators may also expand their land base as a defensive measure in attempting to remain in farming. Much of the existing farm technology is uneconomical on the smaller farm units; however, the larger farms that have profitably adopted innovations exert pressures on tardy adopters to use the technology for minimizing losses.<sup>3</sup> Another possible incentive for farmers to expand their land base results from the fact that purchasing land represents a form of capital accumulation.

#### Problem Setting

Whatever the reasons for expanding a farm operator's land base may be, the trend to fewer and larger farms has continued for a long time; and in more recent years the trend shows no sign of leveling off. This raises many questions with respect to farm growth problems, the answers to which may offer some insight as to the structural characteristics of the farm producing units of the future. 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? Must the small or beginning farmer rely on inheritance, marriage,

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<sup>2</sup>Earl O. Heady, Economics of Agricultural Production and Resource Use, (New York, 1952), p. 706.

<sup>3</sup>Luther G. Tweeten and James S. Plaxico, "Long Run Outlook for Agricultural Adjustments Based on National Growth," Journal of Farm Economics, Vol. 46 No. 1 (1964), p. 45.

and gifts as the only means of becoming established in a "going" farm firm? The adjustment in size of farm is characterized as a major problem associated with the economic growth of U. S. agriculture.<sup>4</sup>

### Purposes and Objectives

Very little tangible evidence is available with respect to what constitutes adequate farm capital or equity structures for purposes of land expansion or capital accumulation. Even after a given capital structure is known to be adequate for capital accumulation, the most questions become: Is it possible to move from a given size of operation to a larger operation? What is the maximum level of capital accumulation? What is the effect of different variables on the capital accumulation process? The agricultural industry, suppliers, and, of course, individual farmers have much at stake in answers to these questions raised by farm capital accumulation problems. This study was designed to shed some light on these problems.

This study is directed to an analysis of the capital accumulation and growth problems of farm firms in Southwestern Oklahoma. Knowledge is gained by testing the hypotheses that different levels of specific variables affect the growth process. The knowledge gained is utilized to simulate various growth possibilities and establish hypotheses concerning minimum starting equity levels for specific growth situations. More specifically, the objectives of this study include:

- (1) An analysis of the effect and importance of different

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<sup>4</sup>E. L. Baum and K. L. Bachman, "The Economic Growth Problem," Capital and Credit Needs in a Changing Agriculture, ed. E. L. Baum, Howard G. Deisslin, and Earl O. Heady (Ames, 1961), p. 32.

variables including farm operator objectives, land acquisition methods, capital rationing, and different family consumption levels or capital withdrawals on the growth process of farm firms,

(2) Simulate different growth models to determine possible growth rates under different farm resource use conditions,

(3) Determine minimum starting farm equity situations required to obtain specified growth rates over time.

### Scope of Study

The scope of this study includes farms of level loam soils in the Rolling Plains of Oklahoma and Texas. The area is located in the Southwestern part of Oklahoma and a Northcentral area of Texas which includes the Southwestern part of the Texas Panhandle (Figure 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.<sup>5</sup>

The Rolling Plains area is composed of three broad groups of soil resources: clay soils, loam soils, and sandy soils, each of which is found in relatively homogeneous blocks. The loam soils are found mostly in the northern counties of the Rolling Plains area and are commonly found in two different phases designated as level loam and rolling loam. The level loam phase is predominantly bottomland, medium textured soils

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<sup>5</sup>United States Department of Commerce, Oklahoma Census of Agriculture and Texas Census of Agriculture, Bureau of the Census (Washington, 1961).

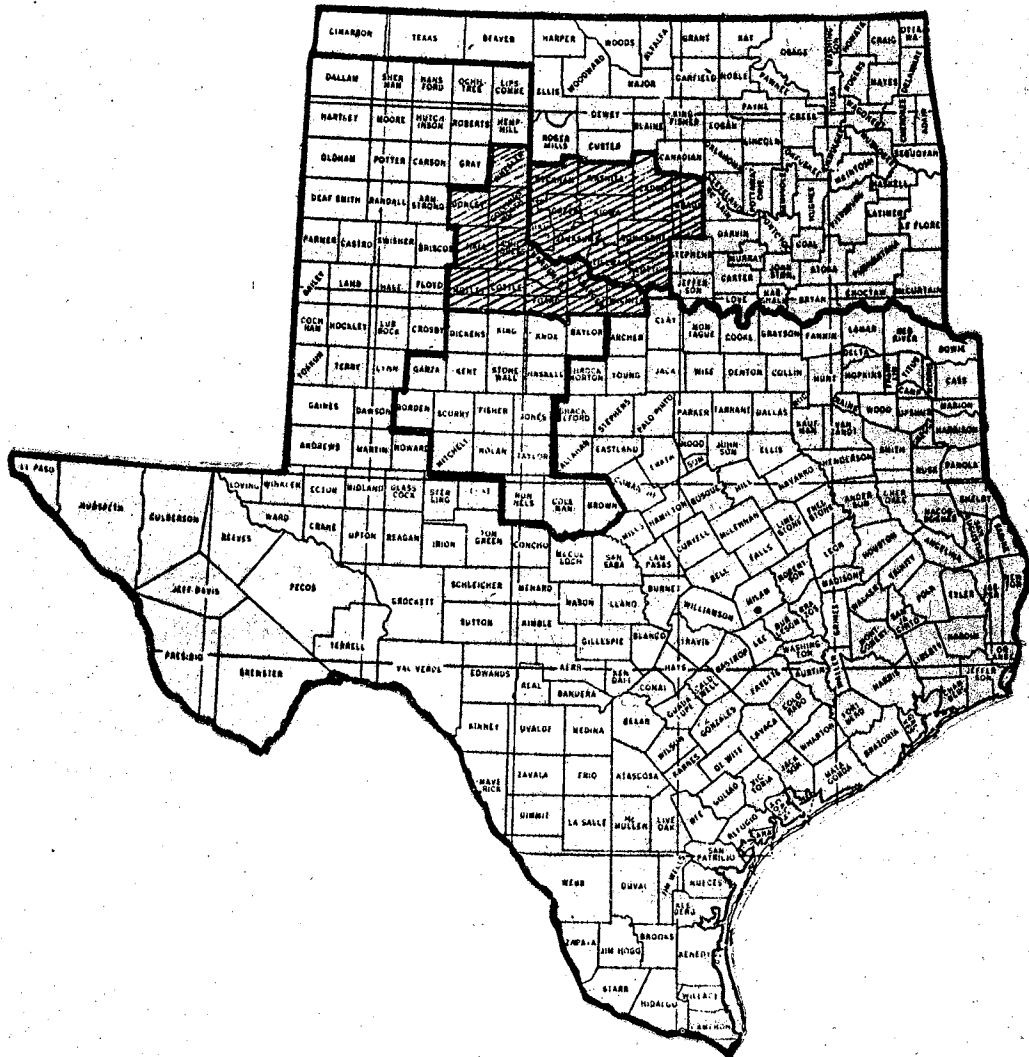


Figure 1. Map of Oklahoma and Texas Outlining Counties of the Rolling Plains. Shaded counties contain loam soils for which this publication is applicable.



with moderately permeable subsoils. This soil type is most representative with respect to cropland acres, and farms in the area with this type of soil account for a large proportion of the total farm production in the area.<sup>6</sup>

The analysis of this study deals with representative farms which are assumed to have level loam type of soils. Thus, the study is applicable to level loam farms within the Rolling Plains area of Oklahoma.<sup>7</sup>

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<sup>6</sup>John W. Goodwin, James S. Plaxico, and William F. Lagrone, Aggregation of Normative Microsupply Relationships for Dryland Crop Farms in the Rolling Plains of Oklahoma and Texas, Oklahoma Agricultural Experiment Station Technical Bulletin T-103, (Stillwater, Oklahoma, August, 1963).

<sup>7</sup>For complete description of soil type and area, see L. J. Connor, W. F. Lagrone, and J. S. Plaxico, Resource Requirements, Costs and Expected Returns: Alternative Crop and Livestock Enterprises; Loam Soils of the Rolling Plains of Southwestern Oklahoma, Oklahoma Agricultural Experiment Station P-368 (Stillwater, Oklahoma, 1961).

## CHAPTER II

### CONCEPTUAL DEVELOPMENT

The conceptual development of the study may be summarized under two major headings: (1) the dynamic nature of the problem and (2) development of the deterministic model used in the analysis and specification of goals and objectives of farm operators. These two subjects will be discussed in this section. Relevant literature related to each subject will be briefly reviewed in an attempt to describe the transition from the conceptual to the analytical phase of the study.

#### Dynamic Nature of the Problem

The traditional static theory of the firm has been very useful in dealing with most microeconomic problems. The very nature of growth and capital accumulation problems, however, renders static theory somewhat unrealistic. In developing a dynamic model, Plaxico 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.<sup>8</sup>

Important contributions to understanding the dynamic process were

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<sup>8</sup>James S. Plaxico, "Dynamic Programming and Management Strategies in the Great Plains," Management Strategies in Great Plains Farming, Nebraska Agricultural Experiment Station MP 7 (Lincoln, 1961), p. 12.

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made by J. R. Hicks in his Value and Capital, Paul A. Samuelson's Foundations of Economic Analysis, R. F. Harrod's Toward a Dynamic Economics, and William J. Baumol's Economic Dynamics.<sup>9</sup> A review of portions of these works reveals somewhat different concepts of economic dynamics.

Paul A. Samuelson has commented that in order to understand many problems of the real world the economist has no choice but to study dynamics.<sup>10</sup> 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.<sup>11</sup>

Most economists are familiar with Hick's dynamic model.<sup>12</sup> According to Hicks, economic statics is not troubled about dating, which implies that dynamics involves time as an explicit variable. Hicks 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

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<sup>9</sup>Kenneth E. Boulding, Economic Analysis, (3rd ed., New York, 1955), p. 893.

<sup>10</sup>Paul A. Samuelson, "Dynamic Process Analysis," A Survey of Contemporary Economics, ed. Howard S. Ellis (Philadelphia, 1948), p. 374.

<sup>11</sup>Ibid., p. 354.

<sup>12</sup>J. R. Hicks, Value and Capital (London, 1953). The comments about Hicks's dynamic model are condensed from Chapters IX and XV.

the same is true of future receipts...."<sup>13</sup>

William J. Baumol 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.<sup>14</sup> Baumol's concept of economic dynamics emphasizes the structural aspects of dynamics: "Economic dynamics is the study of economic phenomena in relation to preceding and succeeding events."<sup>15</sup>

R. F. Harrod also emphasizes the changing structural relationship in economic dynamics. According to Harrod, statics is concerned with a state of rest, and in a static equilibrium certain values remain stationary in the absence of a disturbing force. 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 unknown in the equations to be solved will not be specific magnitudes per time period but increases or decreases in the magnitudes per time period.<sup>16</sup>

While economists may detect distinct differences among eminent economists with respect to concepts of economic dynamics, the layman would be struck with the high degree of similarities. The general agreement and, perhaps, a precise definition is given by the statement, "...

---

<sup>13</sup>Ibid., p. 179.

<sup>14</sup>William J. Baumol, Economic Dynamics (New York, 1959), p. 5.

<sup>15</sup>Baumol, p. 4.

<sup>16</sup>R. F. Harrod, Towards a Dynamic Economics (London, 1948), pp. 1-10.

how the various variables move through time...."<sup>17</sup>

### Development of the Deterministic Model

#### Theory of the Dynamic Model

A graphic illustration of a dynamic model is given by Plaxico and compared to a usual static model.<sup>18</sup> Figure 2 shows the usual static resource use problem. Theory suggests that the point of 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 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 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.

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<sup>17</sup>Boulding, p. 416.

<sup>18</sup>Plaxico, pp. 13-14.

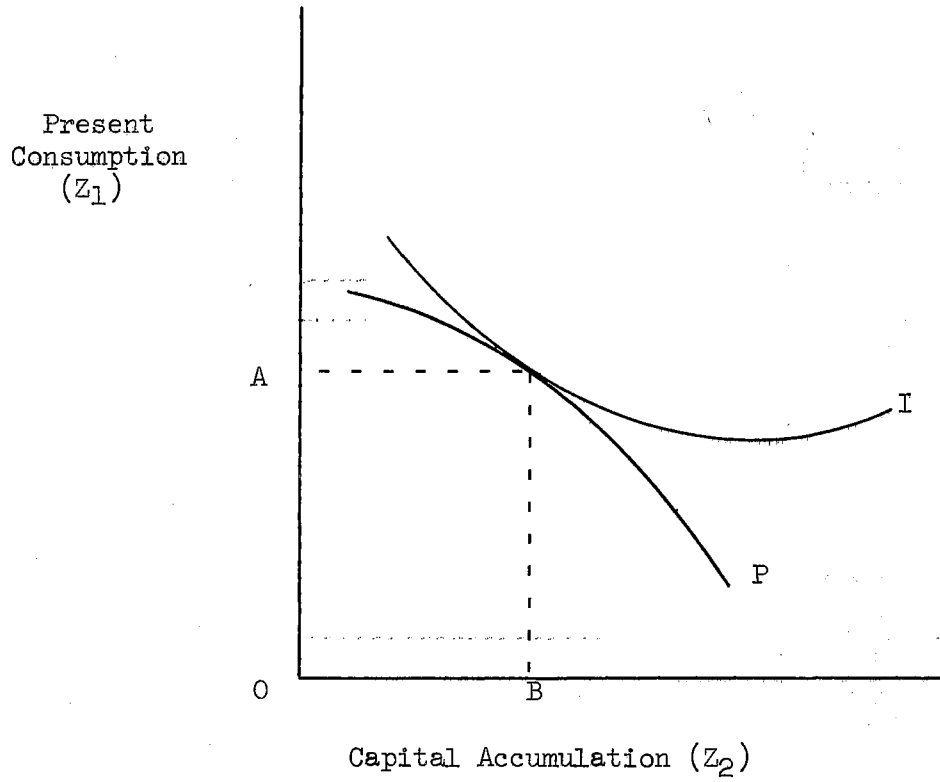


Figure 2. Resource Allocation Problem in a Static Framework

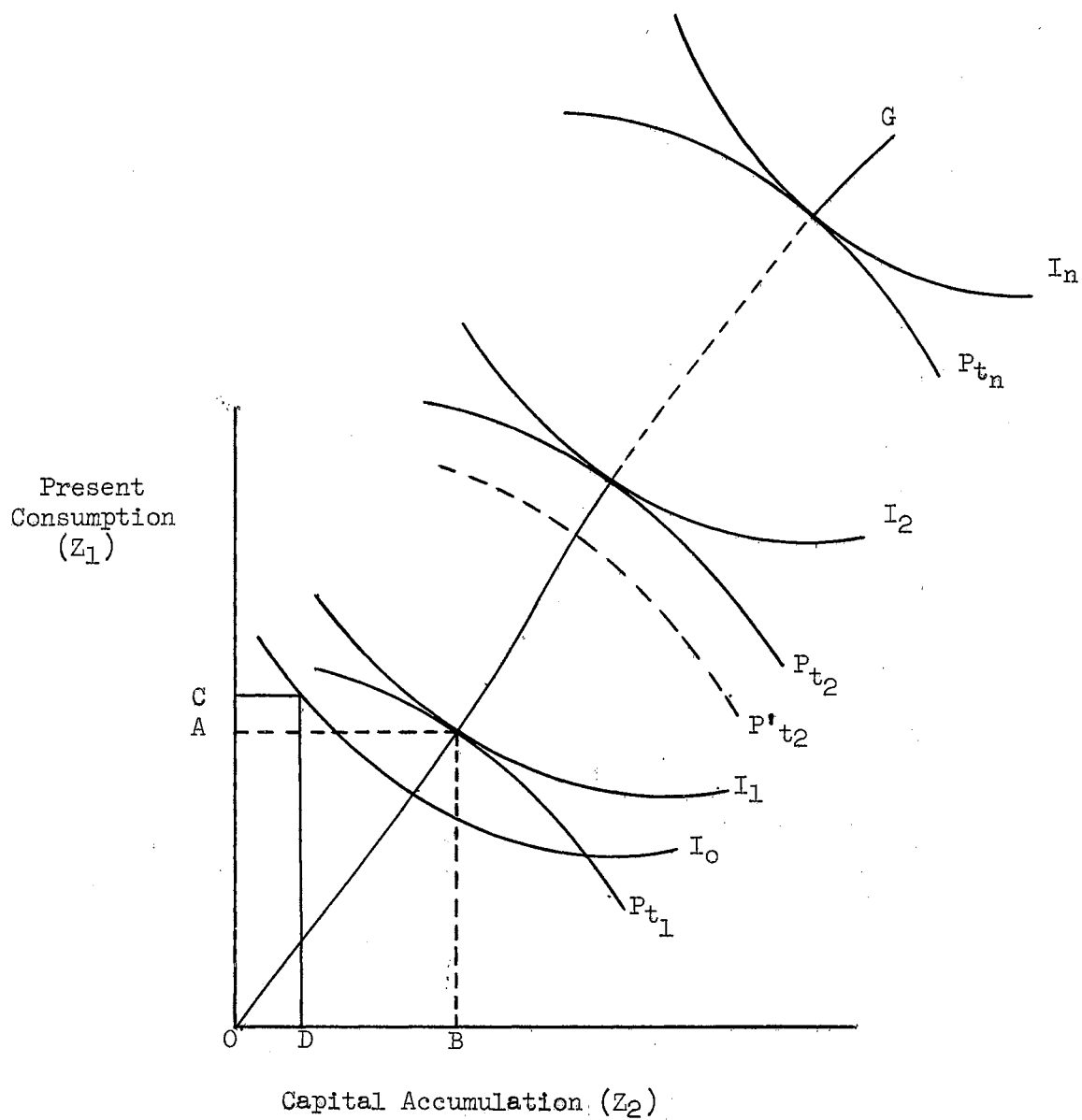


Figure 3. Resource Allocation Problem in a Dynamic Framework

The model described above 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  $t_1$  such that quantities OA for present consumption and OB for capital accumulation were produced in  $t_1$ . Therefore, there is only one optimum growth path 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 production 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  $P_{t_2}$  such as curve  $P'_{t_2}$ . 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.

#### The Deterministic Model of the Study

"Dynamic linear programming" is a deterministic model developed to solve problems such as the one illustrated 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.<sup>19</sup> The usual linear programming problem may be stated as:<sup>20</sup>

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<sup>19</sup>George Morton, "Dynamic Programming." The Structural Independence of the Economy, ed. Tybor Barna (New York, 1954), p. 107.

<sup>20</sup>Plaxico, p. 13.



Maximize  $C'X = Z$

Subject to:

$$B \geq AX$$

$$X \geq 0$$

In this formulation  $A$  is a matrix of input-output coefficients which describes technology. It contains the input coefficients (requirements) necessary for the per unit production of the various alternative products considered. 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.<sup>21</sup> The input-output matrix  $A$  above may be transformed into:

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

where the submatrices  $A_1, A_2, \dots, A_t$  are the input-output coefficients for products produced in time periods  $1, 2, \dots, t$ , 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

<sup>21</sup>Morton, p. 108.

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 would not likely 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 with respect to 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 and Objectives 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 or end.<sup>22</sup> Is the typical objective one of maximizing income, the control of resources, the ownership of resources, the size of operation, total sales over time, or other possible objectives?

A great deal of economic literature is devoted to relevant goals, objectives, and ends. In a detailed analysis of long-run adjustments of farm operators, Connor discusses various hypotheses concerning the motives

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<sup>22</sup>Heady, Economics of Agricultural Production and Resource Use, p. 98.

of decision makers.<sup>23</sup> The following objectives were discussed:

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

A goal of maximizing profits is a common and useful assumption in economic studies. However, production at some level below the profit maximizing output may be rational, for this action may be consistent with a desired level of leisure. A decision maker may also decide to produce at a level above the profit maximization output in an attempt to obtain a large firm, power, and prestige. A decision maker may have an established plan of production and be very reluctant to change. This condition leads to a status quo objective.

In planning under dynamic conditions and uncertainty, decision makers may be faced with a probability distribution containing several parameters relevant to decisions. It has also been suggested that the profit maximization motive is appropriate only after some minimum profit level has been obtained. It also seems reasonable that decision makers

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<sup>23</sup>Larry J. Connor, "Long-run Adjustments for Farm Operators in a Sparsely Populated, High Risk Area of the Great Plains", (unpub. Ph.D. dissertation, Oklahoma State University, 1964), pp. 18-22.

select a course of action consistent with a "satisfactory" outcome, and the profit maximization principle is replaced by this "satisficing" motive.<sup>24</sup>

Finally, a convincing argument can be made supporting the relevance of income goals or targets as decision criteria. This criteria is consistent with desired levels of living, the maximum efficiency, and the opportunity cost concept in economics.

Connor points out that certain characteristics of present resource use in agriculture indicate that farmers do have goals other than profit maximization. This is deduced from the fact that economic studies have shown that farm operators could increase net returns through various adjustments in resource uses.<sup>24</sup>

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

Hicks deals explicitly with entrepreneurial objectives in a "dynamic system." He states that the relevant criterion for an entrepreneur

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<sup>24</sup>Connor, p. 21.

within this framework is the maximization of the present value of prospective net receipts or prospective surpluses.<sup>25</sup> This objective is analytically convenient but still is 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)?

Goals or objectives of farm operators may have a bearing on the decision of how resources are organized and thus affect the production plan. For this reason, objectives or criteria are considered as growth variables, and this study will attempt to test the importance of this variable.

The typical 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.<sup>26</sup> 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 purposes.

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<sup>25</sup>Hicks, p. 196

<sup>26</sup>Heady, Economics of Agricultural Production and Resource Use, p. 423.

## CHAPTER III

### METHOD OF ANALYSIS

The procedure used to establish the framework for this polyperiod linear programming analysis involved 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) selection of objective functions to establish criteria for production overtime. The methods of resolving the problem posed in each of the above procedural points are reviewed in this section of the report.

In general, the framework of the analysis and the construction of the model used in this study must 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 farm work, 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 farm land. 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

A large number of farm enterprise alternatives exist. In practice, however, a relatively small number of alternative enterprises are relevant to a typical farm. The usual static linear programming problem is easily solved for a large number of alternative enterprises. Utilizing the linear programming technique within a polyperiod analysis, however, presents computational problems. The selection of several dozen enterprise alternatives and an analysis over a number of time periods not only presents computational problems, but increases the problem to such proportions that the model becomes difficult to work with. 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 I was chosen as a representative farm for purposes of this study. The organization shows the minimum land requirement and optimum combination of enterprises to obtain a \$3,000 return to operator labor and

TABLE I

REPRESENTATIVE FARM RESOURCE AND ENTERPRISE ORGANIZATION,  
PER ACRE RETURNS AND CASH COSTS DESCRIBING ONE  
OPERATING UNIT USED IN THE ANALYSIS

Item	Unit	Organization	
		Representative Farm	Per Land Unit
Total land	Acres	426	1.00
Cropland	Acres	333	.78
Native pasture	Acres	78	.18
Cotton allotment	Acres	67	.15
Wheat allotment	Acres	97	.23
Cropland organization			
Cotton	Acres	67	.15
Wheat	Acres	97	.23
Alfalfa	Acres	76	.19
Grain sorghum	Acres	70	.16
Small grain hay	Acres	9	.02
Small grain grazing	Acres	15	.03
Cows	Animal	4	.01
Feeders	Animal	36	.08
Operator labor	Hours	1,339	3.14
Hired labor	Hours	213	.50
Investment			
Land and buildings	Dollars	102,240	
Machinery	Dollars	9,170	
Operating capital <sup>a</sup>	Dollars	11,486	
Total capital requirements	Dollars	122,896	
Gross receipts	Dollars	18,351	43.08
Enterprise operating costs <sup>b</sup>	Dollars	7,713	18.11
Overhead costs <sup>c</sup>	Dollars	565	
Machinery depreciation costs <sup>d</sup>	Dollars	967	

<sup>a</sup>Includes the total capital required to operate the farm for one year, enterprises expense and investments, equipment depreciation expense, overhead costs and taxes.

<sup>b</sup>Includes \$426 land taxes.

<sup>c</sup>Includes transportation, telephone, bookkeeping and insurance costs; overhead costs increase by \$1.25 an acre for a farm size over 700 acres.

<sup>d</sup>Includes \$807 depreciation on farm equipment and \$160 depreciation on pickup.



management, and was determined by linear programming computations.<sup>27</sup>

The enterprise requirements on a per acre basis are used to represent a farm operation activity used in the model of this analysis (P<sub>1</sub>, Table II). The enterprise operating costs are actual cash expenditures incurred during the year.

Overhead and machinery depreciation costs in this analysis also represent annual cash costs but are somewhat lumpy regardless of the acres operated and, therefore, cannot be computed on a per land unit basis when the acres operated are variable. The constant charges for these items are made on an annual basis as will be explained in following paragraphs.

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 the capital accumulation process.

Used within this framework, one unit of the operation requires one acre of land, more than 3 hours of labor, \$18.11 enterprise operating costs, adequate equipment, fixed costs of \$1,532, and returns \$43.08 gross receipts. 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.

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<sup>27</sup>Noncash costs not shown included \$275 annual interest charge on equipment, \$72 interest on investment in pickup, and \$225 interest on annual operating capital. See Percy L. Strickland, Jr., et al., Minimum Land Requirements and Adjustments for Specified Income Levels, Southwestern Oklahoma, Bulletin B-608, Oklahoma Agricultural Experiment Station, May, 1963, p. 52.

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 process of a farm, enterprises may be organized in a manner to minimize capital requirements (assuming limited capital) and combined differently in later time periods when more capital is available. This is a valid criticism of the model; however, the advantages in this study of such an activity assumption compensates for the loss of generality. Several valid arguments may be given defending the use of this activity representing a combination of enterprises.

Previous static linear programming studies using the same representative resource situation of this study were conducted to determine optimum organizations for different income targets. 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.<sup>28</sup> These results appear to be logical, because the type-of-farming area is one that calls for a high degree of specialized operation. This is especially true for a particular farm resource situation within this type-of-farming area. The opportunity costs for not producing crops and livestock suited to the area are quite high. The conventional method of allowing the combination of enterprises to be solved in each time period would limit the number of enterprises which could be considered to a very small number. The resulting optimum combination of enterprises determined from this very small number of alternatives would be unrealistic.

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<sup>28</sup>Ibid., pp. 52-57, 82.

## 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 level of owned land and capital and security values available over the number of years considered must not be the present level available but must include resources added or subtracted by the choice of the alternative activities consistent with some optimum condition with respect to a specific criterion.

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 to such an extent that a large number of different assumptions can be made, and many different problems can be solved.

### 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 II).

Two additional rows in each time period, rent restriction and net worth  $t_1$  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 be maintained at a level equal to or greater than the net worth

TABLE II

RESOURCE LEVELS, ACTIVITIES AND RESTRICTION REQUIREMENTS OF CAPITAL ACCUMULATION MODEL

ITEM	UNIT	RESOURCE OR RESTRICTION LEVEL		OPERATING ACTIVITY P1	LAND ACQUISITION			HIRE LABOR P5
		P <sub>0</sub> (B1)	P <sub>0</sub> (B2)		CASH BUY P2	AMORTIZED LOAN P3	RENT LAND P4	
<b>PRODUCTION PERIOD 1</b>								
LAND	Ac.	426	0	1.00	-1.00	-1.00	-1.00	0
LABOR	HR.	1,900	1,900	3.14	0	0	0	-1.00
CAPITAL	DOL.	6,106	-1,085	18.11	242.00	16.05	12.00	1.00
SECURITY	DOL.	102,240	0	0	-240.00	285.53	0	0
EQUIPMENT	Ac.	700	700	1.00	0	0	0	0
LIVESTOCK INVESTMENT	Ac.	426	0	1.00	0	0	0	0
FIXED COST	DOL.	4,535	4,535	0	0	0	0	0
NET RETURNS	DOL.	0	-854	-124.85	2.00	64.94	60.00	5.00
REINVESTMENT CAPITAL	DOL.	6,106	-5,425	-124.85	242.00	80.25	60.00	5.00
RENT RESTRICTION	Ac.	1/	0	0	-1.00	-1.00	1.00	0
NET WORTH T <sub>1</sub> ≤ N.W. T <sub>2</sub>	DOL.	1/	-4,571	0	240.00	15.30	0	0
<b>PRODUCTION PERIOD 2</b>								
LAND	Ac.	426	0	0	-1.00	-1.00	0	0
LABOR	HR.	1,900	1,900	0	0	0	0	0
CAPITAL	DOL.	6,106	-1,085	0	0	16.05	0	0
SECURITY	DOL.	102,240	4,571	0	-240.00	252.33	0	0
EQUIPMENT	Ac.	700	700	0	0	0	0	0
LIVESTOCK INVESTMENT	Ac.	426	0	0	0	0	0	0
FIXED COST	DOL.	4,535	4,535	0	0	0	0	0
NET RETURNS	DOL.	0	0	0	0	60.25	0	0
REINVESTMENT CAPITAL	DOL.	6,106	-5,425	-124.85	242.00	160.50	60.00	5.00
RENT RESTRICTION	Ac.	1/	0	0	-1.00	-1.00	0	0
NET WORTH T <sub>1</sub> ≤ N.W. T <sub>3</sub>	DOL.	1/	-4,571	0	240.00	35.30	0	0
<b>SUBSEQUENT TIME PERIODS</b>								
:								
:								
:								
<b>OBJECTIVE FUNCTION VALUES:</b>								
No. 1	DOL.			124.85	-2.00	-282.96	-60.00	-5.00
No. 2	DOL.			105.18	-2.00	-148.43	-50.55	-4.21
No. 3	DOL.			0	240.00	72.50	0	0
No. 4	UNITS			1.00	0	0	0	0
No. 5	DOL.			181.38	0	0	0	0
No. 6	DOL.			0	0	0	0	0

TABLE II (CONTINUED)

ITEM	UNIT	BORROW	BUY	FIXED	BUY	CONSUME	ACQUIRE	TRANSFER
		CAPITAL	EQUIPMENT	COST	LIVESTOCK	25% OF NET RETURNS 1/	CAPITAL 1/	SAVINGS 1 To CAPITAL 2
		P <sub>6</sub>	P <sub>7</sub>	P <sub>8</sub>	P <sub>9</sub>	P <sub>10</sub>	P <sub>11</sub>	P <sub>12</sub>
PRODUCTION PERIOD 1								
LAND	Ac.	0	0	0	0	0	0	0
LABOR	HR.	0	0	0	0	0	0	0
CAPITAL	DOL.	-1.00	3.95	1.00	5.26	.05	-1.00	0
SECURITY	DOL.	2.00	0	0	-5.26	0	0	0
EQUIPMENT	Ac.	0	-1.00	0	0	0	0	0
LIVESTOCK INVESTMENT	Ac.	0	0	0	-1.00	0	0	0
FIXED COST	DOL.	0	0	1.00	0	0	0	0
NET RETURNS	DOL.	.30	13.22	1.69	0	1.00	0	0
REINVESTMENT CAPITAL	DOL.	.30	19.75	5.00	5.26	.25	-1.00	1.00
RENT RESTRICTION	Ac.	0	0	0	0	0	0	0
NET WORTH T <sub>1</sub> ≤ N.W. T <sub>2</sub>	DOL.	0	6.53	0	5.26	0	-1.00	1.00
PRODUCTION PERIOD 2								
LAND	Ac.	0	0	0	0	0	0	0
LABOR	HR.	0	0	0	0	0	0	0
CAPITAL	DOL.	0	2.40	0	0	0	0	-1.00
SECURITY	DOL.	0	-6.53	0	-5.26	0	0	0
EQUIPMENT	Ac.	0	-1.00	0	0	0	0	0
LIVESTOCK INVESTMENT	Ac.	0	0	0	-1.00	0	0	0
FIXED COST	DOL.	0	0	0	0	0	0	0
NET RETURNS	DOL.	0	12.00	0	0	0	0	0
REINVESTMENT CAPITAL	DOL.	.30	31.75	5.00	5.26	.25	-1.00	0
RENT RESTRICTION	Ac.	0	0	0	0	0	0	0
NET WORTH T <sub>1</sub> ≤ N.W. T <sub>3</sub>	DOL.	0	6.53	0	5.26	0	-1.00	0
SUBSEQUENT TIME PERIODS								
:		:	:	:	:	:	:	:
:		:	:	:	:	:	:	:
:		:	:	:	:	:	:	:
OBJECTIVE FUNCTION VALUES:								
No. 1	DOL.	-1.30	-73.22	-1.69	0	0	0	0
No. 2	DOL.	-2.53	-39.16	-1.46	0	0	-9999	0
No. 3	DOL.	0	0	0	0	0	0	0
No. 4	UNITS	0	0	0	0	0	0	0
No. 5	DOL.	0	0	0	0	0	0	0
No. 6	DOL.	0	0	0	0	0	0	0

1/ THESE ROWS OR COLUMNS WERE UTILIZED ONLY IN PARTS OF THE ANALYSIS.

at the beginning of the first production period. This restriction was included when determining minimum starting equity levels. 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. In this part of the analysis it is assumed that the operation of the farm continues beyond the 30 year planning period depicted, and accumulated net worth should, therefore, not be used up.

Two other rows or equations in each time period include net returns and reinvestment capital. Their function is accounting rather than restrictional.

Land renting, land buying, labor hiring, capital borrowing, equipment and livestock purchasing activities in each time period allow resources to be expanded if they can be profitably purchased at the specified price level.

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 period or 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 subsequent period). The same effect would result from a model with annual production periods where resources are allowed to expand only every fifth year.

The annual requirements for the operating activity include one acre of land, 3.14 hours of labor, \$18.11 capital, one unit of equipment and

one unit of investment in livestock and livestock equipment (Table II,  $P_1$  and Table I). With gross sales of \$43.08, the net capital generated on an annual basis is \$24.97 or \$124.85 on a 5 year or production period basis.

The function of the coefficients in the reinvestment capital rows is to accumulate the amount of net capital generated. As an example, if \$124.85 of capital is generated during or through the first production period, the amount of owned capital available at the end of the first production period is the \$124.85 generated plus the amount of capital owned at the beginning of the first production period. With \$6,106 of owned capital available at the beginning of the first production period, \$6,106 plus \$124.85 or \$6,230.85 would be available at the end of production period 1 (this is the purpose of the \$6,106 coefficient in column  $P_0$  of the reinvestment capital row). For the reinvestment capital row of production period 2, the question is: how much owned capital is available? The amount of reinvestment capital available at the end of production period 2 is the capital generated during production period 2 plus the amount of owned capital available at the beginning of production period 2 which, as noted above, was \$124.85 plus \$6,106 or \$6,230.85. 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. The complete linear program tableau is given in Appendix Table II.

The basic study model illustrated in Table II and Appendix Table II is actually a combination of two different models each of which is used to analyze different types of capital accumulation problems. The vector

$B_1$  and  $P_0$  represent the starting resource levels and restrictions of an established farm firm. All activities in the input-output matrix with the exception of  $P_{11}$ , the acquire capital activity, are used with the vector  $B_1$ . Certain coefficients of the  $B_1$  vector such as land are changed where specified to analyze specific problems, but the starting situation for these problems is an established farm with certain specified land, capital, etc. resource ratios. The vectors  $B_2$  or  $P_0'$  and  $P_{11}$  are used in the analysis of growth problems where the starting situation (farm size, etc.) is not specified, but is to be solved as part of the problem being analyzed. These vectors will be discussed in detail in a later section of this chapter.

#### Land Restriction and Acquisition Methods

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  $P_0$ ). This same land 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. Thus, with a current farm land value of \$240 per acre, annual land renting costs equal \$12 per acre (the annual capital requirement). This is approximately equal to the cost that would be associated with the conventional 1/4 cotton, 1/3 grain rental cost agreement that prevails within the study area. The total



cost of renting an acre of land over the 5 year production period is \$60. Net returns are decreased by \$60 each production period when an acre is rented, and the level of reinvestment capital is also decreased by \$60.

The purchase of an acre of land adds an acre of land to the land resource of the production period in which it is purchased and also makes the same acre available in all subsequent 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 includes land purchases through a real estate loan where payments are amortized over a 33 year period. This type of land purchase activity requires an equal annual installment payment. Part of the annual installment is applied to interest payments at  $5\frac{1}{2}$  percent interest, and the balance of the installment is payment of principal (Appendix Table I).

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 if land is purchased through this activity. 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 mortgage value of the land being purchased is only a fraction of the market value. However, it is common practice for farm mortgage lenders to finance an amount equal to the entire purchase price of the land if the buyer has additional owned land to offer as security. The amortized land buying activity involves this type of real estate loan. It requires that owned land be used to secure the real estate loan. The security requirement for this type of land buying activity is measured in terms of the current per acre market prices of land (\$240 per acre). 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.<sup>29</sup> The real estate loan for the purchase of one acre (\$242) less the mortgage value of the land being purchased (\$110.42) leaves \$131.58 of additional security needed to meet the security requirements of 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 requirements require that more than an acre of owned land be

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<sup>29</sup>This type of real estate loan was patterned after a Federal Land Bank type loan. The security value is also equal to 68.25 percent of a "normal agricultural value" of the land equal to \$161.79 per acre.

mortgaged to secure a real estate loan for the land buy 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 requirements for land purchased through an amortized loan at a given time decreases in subsequent years and production periods.

Farm owners also purchase land by making cash down payments 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 represents 3 methods of purchasing land.

The resource and restriction requirements for the land buying and other activities for production period 2 are not shown in Table II. However, all of the requirements for resources and restrictions of period 2 of activities in production period 2 would be the same as the corresponding requirements of activities in period 1 on the resource and restrictions of period 1 (see Appendix Table II).

#### Labor Restriction and Hired Labor

It is assumed that 1,900 hours of family labor is available annually to perform actual farm work. It is assumed that the farm operator is available to perform actual farm labor as well as management duties throughout the year. The operator would, therefore, furnish most, if not all, of the available family labor. 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 (see Table I). 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 borrow capital activity (P6, Table II). It is assumed that capital is borrowed at an annual interest rate of 6 percent. The amount of capital that can be borrowed is restricted by the unmortgaged value of owned resources. The level of security available in the beginning for purposes of purchasing land and borrowing capital depends upon the assumed level of owned resources at the beginning of the first production period. It is assumed that borrowed capital or short term credit is limited to 50 percent of the unmortgaged value of the amount of security available unless otherwise specified.

It is assumed that the same level of capital is borrowed each year during a given production period. Therefore, at an annual interest charge of 6 percent or \$.06 on the dollar, the total charge for a given production period would be \$.30 (5 x \$.06). This amount is deducted from the stream of net capital generated in a given production period for each unit of capital borrowed.

#### 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 I, which

is included as part of the fixed cost restriction, P<sub>0</sub> Table II). 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 required at a constant level regardless of the acres operated. However, some of the overhead expenses are associated with the size of the farm. The level 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 buy equipment activity (P<sub>7</sub> in Table II) 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 equal to \$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, make 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 which total \$13.22.

The total capital investments plus costs for purchasing equipment and increasing overhead costs total \$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 (P7, Table II).

#### Investment Restriction and Buy Livestock Activity

Part of the analysis assumes that an investment in livestock and livestock equipment equal to \$2,241 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 above 426 acres operated. The required per acre investment is \$5.26 which is the average per acre investment required. The buy livestock activity (P9, Table II) 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 is written into the program model. This restriction specifies that \$3,000 be withdrawn from the capital stream annually. In addition, a fixed cost of \$1,532 is withdrawn as capital expenditures for overhead and machinery depreciation costs. The fixed cost activity (P8, Table II) is required to withdraw the capital in each production period. The activity is forced into each production period to the required level.

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 a level of \$4,532 to account for \$7,659 total fixed cost in each production period. The total withdrawal from the capital stream (reinvestment capital) during each production

period is equal to 5 times the annual withdrawal.

#### Accounting Equations and Consume 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 levels equal to \$3,000 plus 25 percent of the net returns. This consume activity ( $P_{10}$ , Table II) 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 which is also equal to 25 percent of the annual net returns. 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 reinvestment capital rows are formulated to accumulate the net capital generated or the level of owned capital throughout each of the production periods. Each of the activities within a production period contribute to or deduct from net capital generated (if any) in the period. The amount of owned capital at the end of any production period is equal to the net capital generated during that period plus the level of capital owned at the beginning of the production period.

The capital transfer activity ( $P_{12}$ , Table II) 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. Some of the objective function values, those which are relevant to activities of production period 1, are shown in Table II.

Objective function values No. 1 are the undiscounted net return coefficients associated with the activities of production period 1. The coefficients were computed by summing the annual costs or returns over the relevant time that returns are forthcoming or costs are incurred. In the complete linear programming model (see Appendix Table II), objective function No. 1 is the undiscounted net returns to resources over the 30 year period or for the entire period covered by the analysis.

The objective function values of No. 2 (with the exception of coefficient for  $P_{11}$ ) represent annual costs or returns discounted, at a 6 percent rate, over the relevant time that the returns are forthcoming or costs are incurred.

The coefficients of objective function No. 3 are the discounted value of land purchases. With respect to the cash land buy activity of production period 1, it is assumed that land is purchased at the beginning of the period; therefore, the land value (capital purchase of \$240) is not discounted. The cash land buy activity of production period 2 is discounted by 6 percent over 5 years. The coefficient of the amortized land buy activity, \$72.50, is the discounted value of principal payments which would be made over the period covered by the analysis.

The coefficient of objective function No. 4 (with similar coefficients for the operating activities for each of the production periods) is used for the assumed objective of maximizing the number of acres operated over the 30 year time period.

Objective function No. 5 is the discounted value (6 percent discount rate) of gross sales over the 5 year production period. With similar coefficients of the operating activities of other production periods, the objective function allows sales to be maximized over the 30 year



period.

Coefficients of other objective functions, such as maximize owned capital generated through the last production period and land operated during the last time period, are not shown in Table V because these coefficients are not associated with any of the activities of production period 1. The capital accumulation process with respect to various other objective functions are analyzed and will be explained when presented in the following sections of the report.

#### Minimum Equity Model

The vector  $B_2$  or  $P_0'$  with all of the activities in the tableau, including the vector  $P_{11}$ , (Table II and Appendix Table II) is used to analyze minimum starting farm equity requirements to fulfill specified growth conditions. The starting specified level of resources with respect to the minimum equity model is 1,900 hours of operator labor and nothing else ( $B_2$  or  $P_0'$ ). The negative level of resources and restrictions in  $B_2$  result from the fact that at least a minimum complement of farm equipment must be purchased initially 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 (the - \$1,084 capital level of period 1) with total interest payments over the 5 year period equal to \$854 (the - \$854 initial net return level 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 initial complement of equipment purchased is adequate for a size of operation of 700 acres of land. (the 700 in the equipment row of  $B_2$ ). The buy equipment activity,  $P_7$ , is not used to purchase initial equipment because annual per acre costs of increased overhead expenses are included in

this activity (required when the size of operation exceeds 700 acres).

The acquire capital activity,  $F_{11}$ , is used in the minimum equity model with vector  $B_2$ . In the minimum model, this activity is the only source of initial 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 also during the capital accumulation process of any production period. Whatever level the acquire capital activity reaches becomes a restriction in  $B_2$ , row - 1RESC; that must be fulfilled by resource purchases or cash capital generated and transferred to the next production period. This process maintains the initial level of net worth but allows capital to be converted into any farm resource.

Minimum equity problems are analyzed by maximizing the present value of net returns subject to very high costs for each unit of equity (the - 9999 coefficient in the No. 1 objective function). 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.

## CHAPTER IV

### EFFECT OF SELECTED VARIABLES ON THE CAPITAL ACCUMULATION PROCESS

The specific purpose of this chapter is to present the results of the analysis of the effect of different criterion functions on the capital accumulation process. Also, the importance of certain restrictions, land acquisition, and capital use alternatives on the capital accumulation process are evaluated. The assumptions of the model used in the analysis were presented in detail in Chapter III. These assumptions and their limitations should be borne in mind when interpreting the results given in this chapter.

#### Criterion Functions

What shall be the relevant criterion function to portray the capital accumulation process? This problem is not new in the realm of economics, but the problem is perhaps compounded in a polyperiod or dynamic framework. The problem of establishing the criterion function in a capital accumulation problem is one which cannot be avoided. The effect of different criterion functions may be great, and the criterion function of entrepreneurs may be quite variable in any given segment of the economy. If these situations exist, generalization is impossible, and certain economic aggregation problems could be very difficult.

#### Maximum Present Value of Net Returns

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 by time periods of applying this criterion to the capital accumulation model is presented in Table III. A discount rate of 6 percent was used to compute the present value of returns.

All expansion of operations occurs through the renting of additional land. Over 1,000 acres of land are rented during the first production period. Expansion with respect to land rented and acres operated occurs at an increasing rate within each successive production period. The maximum amount of capital, \$51,000, is borrowed annually.

As specified, capital withdrawals for consumption purposes (or assumed to be withdrawn from the capital generating stream for purposes other than reinvestment in the farm firm) are equal to \$3,000 annually or \$15,000 in each production period. Total capital withdrawals include investment in machinery and livestock and withdrawal for consumption.

The conditions of capital accumulation portrayed seems to be unrealistic or atypical as much with respect to the small levels of investments in farm resources as with the increase in total acres operated. The investment in resources, machinery, and livestock is small relative to the level of net capital generated. Also, although the level of ending capital is sizeable, the large levels of capital generated in each time period are plowed into capital of the subsequent periods which is used to rent additional land and defray expenses while capital withdrawals remain relatively small. An assumption of constant consumption levels over time does not appear to be realistic.

The criterion function of maximizing discounted net returns gave the same results with respect to depicting the conditions of capital

TABLE III

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS RESULTING FROM  
MAXIMUM PRESENT VALUE OF NET RETURNS<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	1,524	2,866	5,306	9,721	17,710	32,168
Land Owned	ac.	426	426	426	426	426	426
Land Rented	ac.	1,098	2,440	4,880	9,295	17,284	31,742
Gross Sales	dol.	65,657	123,462	228,588	418,782	762,963	1,385,797
Oper. and Overhead Cap.	dol.	50,441	98,403	185,666	343,539	629,232	1,146,224
Borrowed Capital	dol.	51,120	51,120	51,120	51,120	51,120	51,120
Consumption Capital	dol.	3,000	3,000	3,000	3,000	3,000	3,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	56,028	150,504	321,344	630,507	1,189,971
Net Returns	dol.	76,079	125,296	214,610	376,215	668,658	1,197,868
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	5,381	8,762	15,935	28,829	52,170	94,408
Livestock Purchases	dol.	5,776	7,058	12,835	23,223	42,024	76,047
Capital Consumed	dol.	15,000	15,000	15,000	15,000	15,000	15,000
Total	dol.	26,157	30,820	43,770	67,052	109,194	185,455
Net Cash Capital Generated	dol.	49,922	94,476	170,840	309,163	559,464	1,012,413
Ending Owned Cash Capital	dol.	56,028	150,504	321,344	630,507	1,189,971	2,202,384
Value of Controlled Resources	dol.	439,771	872,147	1,657,357	3,078,172	5,649,190	10,301,978
Net Worth (End of Period)	dol.	176,251	286,547	486,157	847,372	1,501,030	2,683,898
Present Value of Net Returns	\$	742,945	(Criterion Function Value)				
Undiscounted Level of Net Returns	\$	2,658,726					
Starting Level of Owned Capital	\$	115,172					

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.

accumulation and growth as several other different objectives. Other criterion functions which gave the same growth conditions include:

1. Maximize discounted value of gross sales,
2. Maximize undiscounted value of net returns,
3. Maximize the level of owned capital at the end of the last production period,
4. Maximize the level of land operated in the last production period,
5. Maximize the level of land operated throughout the planning horizon.

Most of these objective functions were discussed in Chapter III. The value of the objective function to maximize the discounted value of gross sales equals \$4,301,063, and the results with respect to farm operation, organization, growth, etc. are the same as those presented in Table III.

The maximized undiscounted value of net returns is \$2,658,726 and as an objective function results in the same growth situation as the objective of maximizing the present value of net returns. Since the growth problem is formulated to include a minimum level of capital withdrawal or a "family living expense," it might be argued that discounting future returns is not relevant. The irrelevance stems from the idea that since the consumption level is specified and assured by the solution to the problem, there is no sacrifice involved.

A criterion function to maximize the level of owned capital at the end of the planning horizon is made operational by including an activity in the model which requires one unit of owned capital in the last production period. The coefficient of this activity which is maximized is the

only coefficient in the criterion function (Appendix Table II). The maximum value of this criterion is \$2,202,383 which is also the level of ending capital of production period 6 as shown in Table III.

The criterion function simply to maximize the level of operations in the last production period gave the same growth situation and results as all of the objectives above. The value of this criterion function equals 32,168, the acres of land operated during production period 6 (Table III).

The criterion function to maximize the level of land operated throughout the planning horizon also gave the same farm operation and growth situations over the 30 year planning horizon. This criterion function is another way of depicting a management strategy of operating the largest possible unit. The objective function is the sum of the acres operated in each of the production periods. The maximum value of this criterion function equals 69,295, which is also the sum of the acres operated within each production period in the organization of operations as shown in Table III.

#### Maximum Present Value of Consumption

Maximizing the present value of consumption may be a way of depicting the strategy or actions of farm operators or managers who are more interested in satisfaction from consumption rather than profit maximization. In constructing the criterion function, it is assumed that postponement of consumption is a sacrifice. Therefore, future possible consumption is discounted. The relevant discount rate is assumed to be 6 percent. The criterion function is constructed by including a consume capital activity in each production period which deducts annual capital and, therefore, reduces the level of net capital generated. No restrictions,

including those of minimum fixed costs and \$3,000 annual consumption levels, are relaxed as consumption is maximized. An additional alternative of capital withdrawal is simply added in each production period, and the coefficient of these activities formed the criterion function.

The effect of this criterion function on the capital accumulation process is the same as that 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 are different. Additional capital is withdrawn for consumption purposes only in the last production period. The difference in the organization which results in the last production period is a matter of how the problem is framed. As formulated, consumption occurs during a production period rather than at the end of a production period. In constructing the method in which capital is withdrawn, it is hypothesized that additional consumption reduces the ability to generate capital over time.

This criterion and its method of construction might be more relevant under an assumption of a discount rate high enough to bring about consumption in earlier production periods. However, with consumption in addition to the minimum level the problem might be formulated such that capital is 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.

#### Maximum Present Value of Land Investments

The organization of production and the capital accumulation process



with the criterion function of maximizing the present value of land purchases are the same as all other criterion functions discussed above through the first half of the planning horizon (Table IV). Even though their values are discounted, land purchases are maximized by accumulating capital through renting all land operated and then using the capital during the later part of the planning horizon to purchase land.

The capital accumulation process with the objective of maximizing owned land is a case where the operation is above, in terms of land investment, the profit maximizing level. Profits are sacrificed in order to make land purchases. The objective function or the present value of land purchases equals \$321,895. The present value of net returns under these conditions equal \$458,088. This compares to \$742,945 which is the maximum present value of net returns possible (see Table III). There is more than \$1,403,800 difference between the undiscounted value of the stream of net returns over the 30 year planning horizon with respect to the two different objectives of maximizing returns and maximizing land purchases.

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

TABLE IV

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS RESULTING FROM  
MAXIMUM PRESENT VALUE OF LAND PRINCIPAL PAYMENTS<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	1,524	2,866	5,306	5,306	5,306	3,721
Land Owned	ac.	426	426	426	1,241	2,760	5,073
Land Rented	ac.	1,098	2,440	4,880	4,065	2,546	0
Gross Sales	dol.	65,657	123,462	228,588	228,588	228,588	160,314
Oper. and Overhead Cap.	dol.	50,441	98,403	185,666	175,616	163,542	110,559
Borrowed Capital	dol.	51,120	51,120	51,120	51,120	148,920	331,200
Consumption Capital	dol.	3,000	3,000	3,000	3,000	3,000	3,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	56,028	150,503	321,343	375,595	321,347
Net Returns	dol.	76,079	125,295	214,610	264,859	325,230	248,774
<u>Capital Withdrawals</u>							
Land Purchases	dol.	0	0	0	195,607	364,478	555,115
Machinery Purchases	dol.	5,381	8,762	15,935	0	0	0
Livestock Purchases	dol.	5,776	7,058	12,835	0	0	0
Capital Consumed	dol.	15,000	15,000	15,000	15,000	15,000	15,000
Total	dol.	26,157	30,820	43,770	210,607	379,478	570,115
Net Cash Capital Generated	dol.	49,922	94,475	170,840	54,252	-54,248	-321,341
Ending Owned Cash Capital	dol.	56,028	150,503	321,343	375,595	321,347	6
Value of Controlled Resources	dol.	439,771	872,147	1,657,357	1,711,609	1,657,361	1,280,020
Net Worth (End of Period)	dol.	176,251	286,547	486,157	736,016	1,046,246	1,280,020
Present Value of Land Principal Payments	\$	321,895 (Criterion Function)					
Present Value of Net Returns	\$	458,088					
Undiscounted Level of Net Returns	\$	1,254,847					
Starting Level of Owned Capital	\$	115,172					

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.

value of the stream of net returns.

#### Effect of Different Methods of Land Acquisition

The absence of an alternative to rent land is quite restrictive upon the capital accumulation process. This is true with respect to size of operations as well as the level of net returns. The acres operated range from 672 acres in the first production period to 2,843 acres in production period 6 (Table V). Land purchases occur both on a cash basis and through the 33 year amortized real estate loan purchase. However, in the first period all land bought, 246 acres, is purchased through the real estate loan. This purchase required a mortgage on owned land equal to about \$70,000. The value of owned land is equal to more than \$102,000 at the beginning of production period 1. The \$70,000 mortgage to purchase land restricted the level of borrowed capital to about \$16,000 annually (50 percent of the unmortgaged value of owned land) or \$80,000 total during the first 5 year production period. In the second production period, after \$40,000 of owned capital is accumulated through the first period, 141 acres of land are purchased through real estate loan, and 48 acres are purchased on a cash basis. The real estate loan requires that all of the remaining unmortgaged value of owned land be mortgaged. Since all collateral is mortgaged, no capital may be borrowed.

Additional cash land purchases include 156 acres in production period 3 and 195, 260, and 346 acres in production periods 4, 5, and 6, respectively. Cash land purchase adds additional collateral or security that may be used either to borrow capital or obtain additional real estate loans. No capital is borrowed in any production period other than

TABLE V

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS RESULTING FROM MAXIMUM PRESENT  
VALUE OF NET RETURNS, EXPANSION WITHOUT RENTING LAND ALTERNATIVE<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	672	861	1,111	1,518	2,073	2,843
Land Owned	ac.	672	861	1,111	1,518	2,073	2,843
Gross Sales	dol.	28,938	37,088	47,865	65,412	89,317	122,478
Oper. and Overhead Cap.	dol.	18,061	23,162	29,935	41,723	57,680	79,821
Borrowed Capital	dol.	16,037	0	0	0	0	0
Consumption Capital	dol.	3,000	3,000	3,000	3,000	3,000	3,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	40,443	74,372	97,984	132,591	179,799
Net Returns	dol.	54,389	69,628	89,650	118,444	158,187	213,287
<u>Capital Withdrawals</u>							
Land Purchases	dol.	3,760	18,653	48,088	64,035	89,446	124,771
Machinery Purchases	dol.	0	1,051	1,634	2,660	3,624	5,026
Livestock Purchases	dol.	1,292	995	1,316	2,142	2,919	4,049
Capital Consumed	dol.	15,000	15,000	15,000	15,000	15,000	15,000
Total	dol.	20,052	35,699	66,038	83,837	110,989	148,846
Net Cash Capital Generated	dol.	34,337	33,929	23,612	34,607	47,198	64,441
Ending Owned Cash Capital	dol.	40,443	74,372	97,984	132,591	179,799	244,230
Value of Controlled Resources	dol.	209,841	291,131	377,693	514,782	701,733	960,039
Net Worth (End of Period)	dol.	154,561	209,189	283,839	387,283	530,480	728,757
Present Value of Net Returns		\$253,493	(Criterion Function Value)				
Undiscounted Level of Net Returns		\$703,585					
Starting Level of Owned Capital		\$115,172					

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.

the first. Additional real estate loans, utilizing all collateral added through cash land purchases, include 94 acres in production period 3, 212, 295, and 424 acres in period 4, 5, and 6, respectively. The security or collateral value of owned land is fully utilized in each production period.

The present value of the stream of net returns over the 30 year planning period equals \$253,493. This is about 1/3 the present value of net returns that occurs when expansion in operations occurs through renting land (Table III). The difference in the level of ending net worth is large in favor of land renting.

#### Effect of Capital Rationing

It is assumed that the maximum level of borrowed capital is an amount equal to 50 percent of the unmortgaged value of owned land. This assumption is relaxed to analyze the effect of more limited capital borrowing. Three additional levels of capital rationing are analyzed: (1) maximum level equal to 25 percent of the unmortgaged value of owned land, (2) maximum level equal to 12.5 percent of the unmortgaged value of owned land, and (3) no borrowed capital. All assumptions outlined in the previous chapter apply in the analysis with the exception of capital borrowing. Expansion of operations may occur through renting land as well as purchases on a cash or loan basis.

#### Borrowed Capital Restriction 25 Percent of Owned Land Value

With capital limited to a level equal to 25 percent of the unmortgaged value of owned land, all expansion in operations occurs through renting land. More than 900 acres is operated during the first production period. (Table VI). The maximum level of capital is borrowed in

TABLE VI

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS RESULTING FROM MAXIMUM PRESENT  
VALUE OF NET RETURNS, BORROWED CAPITAL RESTRICTED TO 25 PERCENT OF OWNED LAND VALUE<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	922	2,006	3,912	7,365	13,614	24,922
Land Owned	ac.	426	426	426	426	426	426
Land Rented	ac.	496	1,580	3,486	6,939	13,188	24,496
Gross Sales	dol.	39,723	86,406	168,513	317,287	586,494	1,073,655
Oper. and Overhead Cap.	dol.	27,300	66,141	134,288	257,780	481,239	885,615
Borrowed Capital	dol.	25,560	25,560	25,560	25,560	25,560	25,560
Consumption Capital	dol.	3,000	3,000	3,000	3,000	3,000	3,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	49,164	122,711	256,365	498,181	935,777
Net Returns	dol.	62,117	101,323	171,125	297,532	526,272	940,202
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	1,450	7,076	12,446	22,551	40,806	73,843
Livestock Purchases	dol.	2,609	5,700	10,025	18,165	32,870	59,482
Capital Consumed	dol.	15,000	15,000	15,000	15,000	15,000	15,000
Total	dol.	19,059	27,776	37,471	55,716	88,676	148,325
Net Cash Capital Generated	dol.	43,058	73,547	133,654	241,816	437,596	791,877
Ending Owned Cash Capital	dol.	49,164	122,711	256,365	498,181	935,777	1,727,654
Value of Controlled Resources	dol.	281,329	627,812	1,241,377	2,352,629	4,363,661	8,002,783
Net Worth (End of Period)	dol.	162,289	248,612	404,737	687,269	1,198,541	2,123,743
Present Value of Net Returns	\$	591,218	(Criterion Function Value)				
Undiscounted Level of Net Returns	\$	2,098,570					
Starting Level of Owned Capital	\$	115,172					

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.

each production period equal to a level of \$25,560 annually.

Limiting borrowed capital to half of its original limit reduces present value of the stream of net returns by about 20 percent. The value of the stream of undiscounted net returns is reduced by 21 percent.

#### Capital Restriction 12.5 Percent of Owned Land Value

With capital limited to a level equal to 12.5 percent of the unmortgaged value of owned land, the level of capital borrowed annually is \$12,780 (Table VII). All expansion of operations again occurs through renting land. Only 187 acres of land is rented in the first production period, but growth in terms of acres operated increases rapidly.

Limiting the level of borrowed capital to one-fourth of its original level (from \$51,120 annually to \$12,780 annually) reduces the value of the stream of net returns by about one-third. Reducing the level of borrowed capital by a half, from \$25,560 annually to \$12,780 annually, reduces the net returns by only 15 percent.

#### Capital Use Restricted to Owned Capital

Without an alternative of borrowing capital the specified levels of consumption (\$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 \$9,080 capital is withdrawn for consumption purposes during the first production period (Table VIII). This is equal to an annual consumption level of only \$1,816. Under these conditions, only 152 acres of the 426 acres of owned land can be operated in the first production period. The level of net capital generated during the first production period is \$2,274. This capital plus the level of starting capital (\$6,106) makes \$8,380 owned capital available at the beginning of production period 2.

TABLE VII

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS RESULTING FROM MAXIMUM PRESENT  
VALUE OF NET RETURNS, BORROWED CAPITAL RESTRICTED TO 12.5 PERCENT OF OWNED LAND VALUE<sup>1</sup>

Item	Unit	Production Period						
		1	2	3	4	5	6	
<u>Annual Situation</u>								
Land Operated	ac.	613	1,532	3,151	6,072	11,357	20,922	
Land Owned	ac.	426	426	426	426	426	426	
Land Rented	ac.	187	1,106	2,725	5,646	10,931	20,496	
Gross Sales	dol.	26,408	66,017	135,755	261,564	489,260	901,299	
Oper. and Overhead Cap.	dol.	15,669	48,441	106,343	210,771	399,774	741,792	
Borrowed Capital	dol.	12,780	12,780	12,780	12,780	12,780	12,780	
Consumption Capital	dol.	3,000	3,000	3,000	3,000	3,000	3,000	
<u>Production Period Totals</u>								
Starting Owned Cash Capital	dol.	6,106	43,818	106,427	219,402	423,934	794,050	
Net Returns	dol.	53,696	87,881	147,061	253,963	447,431	797,533	
<u>Capital Withdrawals</u>								
Machinery Purchases	dol.	0	5,436	10,571	19,070	34,514	62,456	
Livestock Purchases	dol.	984	4,836	8,515	15,361	27,801	50,310	
Capital Consumed	dol.	15,000	15,000	15,000	15,000	15,000	15,000	
Total	dol.	15,984	25,272	34,086	49,431	77,315	127,766	
Net Cash Capital Generated	dol.	37,712	62,609	112,975	204,532	370,116	669,767	
Ending Owned Cash Capital	dol.	43,818	106,427	219,402	423,934	794,050	1,463,817	
Value of Controlled Resources	dol.	198,748	492,189	1,012,810	1,952,813	3,653,644	6,731,777	
Net Worth (End of Period)	dol.	153,868	226,749	358,810	597,773	1,030,204	1,812,737	
Present Value of Net Returns	\$	506,383	(Criterion Function Value)					
Undiscounted Level of Net Returns	\$	1,787,565						
Starting Level of Owned Capital	\$	115,172						

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.



TABLE VIII

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS, RESULTING FROM MAXIMUM PRESENT  
VALUE OF NET RETURNS, CAPITAL USE RESTRICTED TO OWNED CAPITAL<sup>1</sup>

Item	Unit	Production Period						
		1	2	3	4	5	6	
<u>Annual Situation</u>								
Land Operated	ac.	152	212	426	1,184	2,638	5,225	
Land Owned	ac.	426	426	426	426	426	426	
Land Rented	ac.	0	0	0	758	2,212	4,799	
Gross Sales	dol.	6,548	9,133	18,352	51,007	113,645	225,093	
Oper. and Overhead Cap.	dol.	4,277	5,360	9,247	35,167	87,232	179,733	
Consumption Capital	dol.	1,816	3,000	3,000	3,000	3,000	3,000	
<u>Production Period Totals</u>								
Starting Owned Cash Capital	dol.	6,106	8,380	12,247	42,773	99,813	199,707	
Net Returns	dol.	11,354	18,867	45,526	79,197	132,066	226,802	
<u>Capital Withdrawals</u>								
Machinery Purchases	dol.	0	0	0	3,170	9,524	16,945	
Livestock Purchases	dol.	0	0	0	3,987	7,648	13,608	
Capital Consumed	dol.	9,080	15,000	15,000	15,000	15,000	15,000	
Total	dol.	9,080	15,000	15,000	22,157	32,172	45,553	
Net Cash Capital Generated	dol.	2,274	3,867	30,526	57,040	99,894	181,249	
Ending Owned Cash Capital	dol.	8,380	12,247	42,773	99,813	199,707	380,956	
Value of Controlled Resources	dol.	117,446	121,313	151,839	397,956	863,982	1,696,664	
Net Worth (End of Period)	dol.	117,446	121,313	151,839	216,036	333,102	544,904	
Present Value of Net Returns		\$146,586	(\$ Criterion Function Value)					
Undiscounted Level of Net Returns		\$513,812						
Starting Level of Owned Capital		\$115,172						

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.

With this level of capital available, only 212 acres can be operated during period 2. This level of operation generates enough capital so that the specified level of consumption may be withdrawn during the period. The level of net capital generated during the second production period is \$3,867 which brings the level of ending capital to \$12,247. This level of capital is just sufficient to operate all of the 426 acres of owned land. The capital accumulation process 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 quite restrictive on the process of capital accumulation when the level of owned capital is insufficient to cover all operating expenses. These results can also be used to determine the approximate effect of no capital borrowing when owned capital is sufficient to cover operating expenses. The ending capital of production period 2 is the level of capital 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 4 production periods is \$542,600. The difference over the 20 years is \$59,000. The alternative of borrowing \$12,780 annually increased net returns, on an average, by almost \$3,000.

#### Effects of Higher Consumption Levels

Higher levels of capital withdrawals are specified to determine the effect of high consumption levels on capital accumulation. The consumption function is of the type  $C = a + bY$ . The value of  $a$  is equal to

\$3,000 and Y is the level of net returns. In the previous analyses b is equal zero. In addition to the required minimum level of consumption (\$3,000), three different capital withdrawal levels (assumed to be for consumption purposes) are analyzed. These levels are where b is equal to 25, 50, and 75. The method of specifying these capital withdrawals were discussed earlier (see Table II). The capital withdrawals occur on an annual basis rather than at the end of a production period.

#### Marginal Propensity to Consume Equal to 25 Percent of Net Returns

With capital withdrawals for consumption purposes equal to \$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 IX). All expansion of operations occurs through renting land. The maximum level of operations, 14,114 acres, is less than half of the maximum level of operations when only the minimum level of capital withdrawals are specified (see Table III).

The minimum level of capital withdrawal for consumption purposes which occurs in the first production period is equal to about \$6,650 annually. The total value of capital withdrawn for consumption purposes over all of the planning period is \$450,452. The level of total capital withdrawals, which includes 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.

TABLE IX

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS RESULTING FROM MAXIMUM PRESENT  
VALUE OF NET RETURNS, PROPENSITY TO CONSUME EQUAL TO 25 PERCENT OF NET RETURNS<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	1,438	2,252	3,568	5,645	8,928	14,114
Land Owned	ac.	426	426	426	426	426	426
Land Rented	ac.	1,012	1,826	3,142	5,219	8,502	13,688
Gross Sales	dol.	61,954	97,017	153,716	243,199	384,605	608,049
Oper. and Overhead Cap.	dol.	47,356	76,390	123,433	197,668	314,980	500,351
Borrowed Capital	dol.	51,120	51,120	51,120	51,120	51,120	51,120
Consumption Capital	dol.	6,650	8,157	10,571	14,383	20,406	29,924
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	35,705	88,460	171,505	302,755	510,149
Net Returns	dol.	72,990	103,135	151,416	227,653	348,125	538,487
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	4,820	5,315	8,594	13,564	21,434	33,869
Livestock Purchases	dol.	5,323	4,281	6,923	10,926	17,266	27,282
Capital Consumed	dol.	33,248	40,784	52,854	71,913	102,031	149,622
Total	dol.	43,391	50,380	68,371	96,403	140,731	210,773
Net Cash Capital Generated	dol.	29,599	52,755	83,045	131,250	207,394	327,714
Ending Owned Cash Capital	dol.	35,705	88,460	171,505	302,755	510,149	837,863
Value of Controlled Resources	dol.	397,794	655,505	1,069,907	1,724,127	2,758,141	4,391,646
Net Worth (End of Period)	dol.	154,914	217,265	315,827	471,567	717,661	1,106,526
Present Value of Net Returns		\$ 453,960	(\$ Criterion Function Value)				
Undiscounted Level of Net Returns		\$1,441,806					
Starting Level of Owned Capital		\$ 115,172					

<sup>1</sup>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 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 the level of capital accumulation. Under these conditions of higher consumption levels, the maximum size of operation is reduced to 5,425 acres in the last production period (Table X). Land expansion, which occurs through renting land, ranges from 933 acres in the first period to almost 5,000 in the last period.

Capital withdrawals for consumption ranges 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 equal to \$479,401 which is only about \$29,000 more than the total value of consumption when a level equal to 25 percent of net returns is specified. The higher specified level of consumption (in terms of percentage of net returns) increases the consumption levels in the first 4 production periods but decreases the levels of consumption in the last 2 periods.

### 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 level of operations with this specified level of consumption is only 1,441 acres. This level is only 214 acres more than the level of operation in the first production period (Table XI). The level of rented land increases slowly in subsequent periods,

TABLE X

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS RESULTING FROM MAXIMUM PRESENT  
VALUE OF NET RETURNS, PROPENSITY TO CONSUME EQUAL TO 50 PERCENT OF NET RETURNS<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	1,359	1,722	2,268	3,011	4,030	5,425
Land Owned	ac.	426	426	426	426	426	426
Land Rented	ac.	933	1,296	1,842	2,585	3,604	4,999
Gross Sales	dol.	58,540	74,170	97,687	129,710	173,595	233,709
Oper. and Overhead Cap.	dol.	44,511	57,374	76,879	103,428	139,811	189,649
Borrowed Capital	dol.	51,120	51,120	51,120	51,120	51,120	51,120
Consumption Capital	dol.	10,014	11,398	13,404	16,141	19,892	25,030
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	16,968	39,682	70,266	112,209	169,660
Net Returns	dol.	70,143	83,983	104,040	131,414	168,922	220,302
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	4,302	2,370	3,565	4,854	6,652	9,112
Livestock Purchases	dol.	4,908	1,908	2,871	3,910	5,358	7,340
Capital Consumed	dol.	50,071	56,991	67,020	80,707	99,461	125,151
Total	dol.	59,281	61,269	73,456	89,471	111,471	141,603
Net Cash Capital Generated	dol.	10,862	22,714	30,584	41,943	57,451	78,699
Ending Owned Cash Capital	dol.	16,968	39,682	70,266	112,209	169,660	248,359
Value of Controlled Resources	dol.	359,164	473,276	641,336	870,363	1,184,384	1,614,335
Net Worth (End of Period)	dol.	135,244	162,236	199,256	249,963	319,424	414,575
Present Value of Net Returns		\$285,984	(Criterion Function Value)				
Undiscounted Level of Net Returns		\$778,804					
Starting Level of Owned Capital		\$115,172					

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.

TABLE XI

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS RESULTING FROM MAXIMUM PRESENT  
VALUE OF NET RETURNS, PROPENSITY TO CONSUME EQUAL TO 75 PERCENT OF NET RETURNS<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	1,227	1,261	1,295	1,336	1,385	1,441
Land Owned	ac.	426	426	426	426	426	426
Land Rented	ac.	801	835	869	910	959	1,015
Gross Sales	dol.	52,879	54,329	55,810	57,574	59,648	62,089
Oper. and Overhead Cap.	dol.	39,635	40,875	42,100	43,561	45,279	47,301
Borrowed Capital	dol.	48,459	51,120	51,120	51,120	51,120	51,120
Consumption Capital	dol.	12,933	13,091	13,283	13,510	13,777	14,091
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	1	1,423	3,156	5,189	7,582
Net Returns	dol.	66,220	67,275	68,551	70,064	71,843	73,938
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	3,444	220	224	267	314	370
Livestock Purchases	dol.	4,216	177	181	216	253	298
Capital Consumed	dol.	64,665	65,456	66,413	67,548	68,883	70,454
Total	dol.	72,325	65,853	66,818	68,031	69,450	71,122
Net Cash Capital Generated	dol.	-6,105	1,422	1,733	2,033	2,393	2,816
Ending Owned Cash Capital	dol.	1	1,423	3,156	5,189	7,582	10,398
Value of Controlled Resources	dol.	308,967	318,946	329,244	341,600	356,320	373,244
Net Worth (End of Period)	dol.	116,727	118,546	120,684	123,200	126,160	129,644
Present Value of Net Returns		\$186,040	(Criterion Function Value)				
Undiscounted Level of Net Returns		\$417,891					
Starting Level of Owned Capital		\$115,172					

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.

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 its effect on capital accumulation, the consumption levels with a propensity to consume equal to 75 percent are lower in the last 4 production periods than the consumption levels when the marginal propensity to consume is 50 percent. The consumption levels are also lower in the last 3 production periods than consumption levels when the marginal propensity to consume is a low 25 percent.

Higher levels of marginal propensity to consume increases consumption levels in the early part of the planning period (early growth stages), but restricts capital accumulation and results in lower consumption levels during later years, and in this case lower total consumption levels 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.



## CHAPTER V

### SIMULATION OF FARM FIRM GROWTH SITUATIONS

The analysis reported in the preceding chapters establishes some knowledge with respect to the effect of certain variables on the capital accumulation or growth process of the farm firm. This knowledge is utilized to simulate different growth situations with respect to farm sizes, tenure situations, consumption levels, and capital rationing.

Growth simulation results are first presented for two different farm sizes and tenure situations with specified consumption and borrowed capital levels equal to 50 percent of net returns and 12.5 percent of the unmortgaged value of owned land, respectively. Finally, consumption and borrowed capital levels are varied and the different growth results compared to illustrate different growth possibilities.

#### Land Acquisition Through Renting

The capital accumulation process, which results from the maximum present value of net returns with a starting farm size of 426 acres of owned land, a maximum borrowed capital level equal to 12.5 percent of the unmortgaged value of owned land, and consumption levels equal to 50 percent of net returns, is presented in Table XII. Other assumptions include a complement of equipment which is adequate for a size of operation of 700 acres. Additional equipment must be purchased if the acres operated exceeds this level. Livestock and livestock equipment must

TABLE XII

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS RESULTING FROM MAXIMUM PRESENT VALUE OF NET RETURNS, STARTING FARM SIZE OF 426 ACRES, RENTED LAND UNLIMITED, CONSUMPTION LEVELS 50 PERCENT OF NET RETURNS AND BORROWED CAPITAL LIMIT 12.5 PERCENT OF UNMORTGAGED OWNED LAND VALUE<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	557	1,111	1,855	2,859	4,234	6,118
Land Owned	ac.	426	426	426	426	426	426
Land Rented	ac.	131	685	1,429	2,433	3,808	5,692
Gross Sales	dol.	23,982	47,870	79,932	123,146	182,407	263,580
Oper. and Overhead Cap.	dol.	13,949	33,321	59,934	95,758	144,890	212,187
Borrowed Capital	dol.	12,780	12,780	12,780	12,780	12,780	12,780
Consumption Capital	dol.	5,017	7,274	9,999	13,694	18,758	25,697
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	30,502	61,273	102,492	159,134	236,709
Net Returns	dol.	50,167	72,745	99,987	136,937	187,586	256,965
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	0	2,685	4,860	6,550	8,983	12,304
Livestock Purchases	dol.	687	2,917	3,915	5,276	7,236	9,911
Capital Consumed	dol.	25,084	36,372	49,993	68,469	93,792	128,483
Total	dol.	25,771	41,974	58,768	80,295	110,011	150,698
Net Cash Capital Generated	dol.	24,396	30,771	41,219	56,642	77,575	106,267
Ending Owned Cash Capital	dol.	30,502	61,273	102,492	159,134	236,709	342,976
Value of Controlled Resources	dol.	171,695	341,028	569,582	879,010	1,302,804	1,883,446
Net Worth (End of Period)	dol.	140,255	176,628	226,622	295,090	388,884	517,366
Present Value of Net Returns		\$274,828	(Criterion Function Value)				
Undiscounted Level of Net Returns		\$804,387					
Starting Level of Owned Capital		\$115,172					

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.

also be purchased as expansion in acres operated occurs above the starting level of owned land. Of course, additional hired labor is required as expansion takes place. Overhead costs, \$1,532 for a size of operation of 700 acres or less, must be met. These costs increase when the size of operation exceeds 700 acres. The starting level of owned capital is \$6,106.

Although the alternative of purchasing additional land exists, maximum growth and capital accumulation occurs as all additional land operated is rented. The level of land rented ranges from 131 to over 5,500 acres. The acres operated range from 557 acres in the first production period to 6,118 acres in the last production period. The increase in total acres operated and owned capital accumulated increases at an increasing rate with most of the growth occurring during the last 15 year period or last 3 production periods. The maximum level of capital, \$12,780, is borrowed annually.

No investment in equipment is required during the first production period since the starting complement of equipment is adequate for a size of operation of 700 acres of land operated. However, additional equipment purchases are required in all other periods, and these investments range from \$2,685 in period 2 to more than \$12,300 in period 6. Investments in additional livestock and livestock equipment are required as expansion in land operated occurs. These investments range from a low of only \$687 to almost \$10,000 in the last period.

Consumption levels or annual capital withdrawals for purposes other than reinvestment into the firm, specified to be 50 percent of the forthcoming net returns, range from \$5,017 in the first period to \$25,696 in the last. The level of consumption during production period 3, when

1,855 acres of land are operated (a little less than 3 sections of land), is about \$10,000 annually.

The net capital generated during each production period increases at an increasing rate, and the maximum generated is \$106,267 or \$21,253 annually during the last production period. The level of ending net worth increases to \$402,194 at the end of production period 6. This is \$287,022 above the starting level of net worth equal to \$115,172. The present value of the stream of net returns over the 30 year period is equal to \$274,828.

With the starting level of owned land equal to 213 acres (half of the starting level previously assumed), growth both in terms of acres operated and additional value of net worth accumulated at the end of the 30 year period is decreased by about 37 percent (Table XIII). The starting level of all other resources is the same as the previous level with the exception of security value or collateral which is decreased to half since this value is based upon the value of owned land. The total acres operated increases from 342 acres in period 1 to 3,800 (about 6 sections of land) during production period 6. The maximum level of capital is borrowed each year equal to about \$6,400 annually. The level of net cash capital generated ranges from \$12,016 in the first period to \$66,513 in the last. On an annual basis this is equal to \$2,403 during the first production period and \$13,303 during the last period.

Investment in additional equipment is unnecessary until the third production period or after 10 years of operation since the size of operation is less than 700 acres during this time. Livestock investments are required in each period. Consumption levels, specified to be 50 percent

TABLE XIII

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	342	644	1,129	1,760	2,621	3,800
Land Owned	ac.	213	213	213	213	213	213
Land Rented	ac.	129	431	916	1,547	2,408	3,587
Gross Sales	dol.	14,739	27,743	48,627	75,819	112,898	163,705
Oper. and Overhead Cap.	dol.	9,661	18,872	36,124	58,676	89,416	131,538
Borrowed Capital	dol.	6,390	6,390	6,390	6,390	6,390	6,390
Consumption Capital	dol.	2,539	4,435	6,251	8,572	11,741	16,083
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	18,122	38,712	64,619	100,035	148,592
Net Returns	dol.	25,390	44,355	62,513	85,716	117,410	160,835
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	0	0	2,800	4,122	5,620	7,701
Livestock Purchases	dol.	679	1,588	2,550	3,320	4,527	6,204
Capital Consumed	dol.	12,695	22,177	31,256	42,858	58,706	80,417
Total	dol.	13,374	23,765	36,606	50,300	68,853	94,322
Net Cash Capital Generated	dol.	12,016	20,590	25,907	35,416	48,557	66,513
Ending Owned Cash Capital	dol.	18,122	38,712	64,619	100,035	148,592	215,105
Value of Controlled Resources	dol.	106,586	201,244	348,901	543,199	808,543	1,171,921
Net Worth (End of Period)	dol.	75,626	97,804	129,061	171,919	230,623	311,041
Present Value of Net Returns		\$167,047 (Criterion Function Value)					
Undiscounted Level of Net Returns		\$496,219					
Starting Level of Owned Capital		\$115,172					

<sup>1</sup>Starting situation 213 acres of owned land, \$4,585 average value of equipment, \$1,120 investment in livestock and \$6,106 owned capital.

of net returns, for a starting farm size of 213 acres and the resulting level of capital accumulated appear to be low. Withdrawals for consumption purposes on an annual basis equal \$2,539 during the first production period. During the second production period, when about a section of land is operated, annual consumption levels are less than \$5,000. Annual consumption levels increase over \$10,000 only after 20 years of operations during the last two production periods.

The present value of net returns over the 30 year period (6 percent discount rate) equals \$167,047. This is about 40 percent of the value of the stream of net returns resulting with a starting farm size of 426 acres of owned land.

Several significant points are revealed by these simulated growth situations. Competition for farm resources, especially land, is not an explicit part of the model. Competition may increase the price of land (whether renting or purchasing) and also cause farm land 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 projections are not phenomenal. Starting with sizeable assets, 426 acres of owned land, only 557 acres of land are operated during the first 5 year production period with an annual consumption level of about \$5,000. Less than 3 sections of land are operated through the third production period (first 15 years of the planning horizon) with a consumption level of about \$10,000.

With a starting farm size of 213 acres of owned land and a total net worth of \$62,931, 1 section of land is operated through the second period with a consumption level less than \$5,000, and less than 2

sections is 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 and with a consumption level of about \$2,500 each year results in an annual increase in net worth of \$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 situation with respect to size of assets at the end of each 5 year production period would be the same as the starting situation.

#### Land Acquisition Through Purchase

Capital accumulation and growth is significantly less when land acquisition is limited to purchasing all additional land operated. With a starting farm size of 426 acres of owned land, the size of operations range from 493 acres in the first period to about 1,600 in the last production period. Land purchases range from 67 acres to 283 acres in the same period (Table XIV).

The total interest and principal payments for land on an amortized basis requires 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, the present value of net returns are maximum when 67 acres of land are purchased and \$10,404 is borrowed annually during the first production period. Consumption during this period, equal to 50 percent of the net returns, is less than \$5,000.

TABLE XIV

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	493	761	906	1,106	1,344	1,627
Land Owned	ac.	493	761	906	1,106	1,344	1,627
Gross Sales	dol.	21,220	32,768	39,024	47,636	57,868	70,071
Oper. and Overhead Cap.	dol.	11,941	20,307	24,332	30,176	37,108	45,368
Borrowed Capital	dol.	10,404	1,113	0	0	0	0
Consumption Capital	dol.	4,639	6,231	7,346	8,730	10,380	12,352
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	27,933	51,847	61,197	71,541	83,121
Net Returns	dol.	46,392	62,306	73,460	87,302	103,801	123,515
<u>Capital Withdrawals</u>							
Land Purchases	dol.	1,018	5,433	25,668	30,950	37,520	45,784
Machinery Purchases	dol.	0	396	948	1,306	1,551	1,849
Livestock Purchases	dol.	350	1,410	764	1,051	1,249	1,490
Capital Consumed	dol.	23,197	31,153	36,730	43,651	51,901	61,758
Total	dol.	24,565	38,392	64,110	76,958	92,221	110,881
Net Cash Capital Generated	dol.	21,827	23,914	9,350	10,344	11,580	12,634
Ending Owned Cash Capital	dol.	27,933	51,847	61,197	71,541	83,121	95,755
Value of Controlled Resources	dol.	153,429	243,469	289,331	350,032	421,532	505,425
Net Worth (End of Period)	dol.	138,367	169,520	206,250	249,901	301,801	363,558
Present Value of Net Returns		\$193,481 (Criterion Function Value)					
Undiscounted Level of Net Returns		\$496,776					
Starting Level of Owned Capital		\$115,172					

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.



During the second production period, 268 acres of land are purchased through an amortized loan and only \$1,113 of capital is borrowed on an annual basis. Under these conditions, all collateral or security value is utilized during this period as it is during all production periods. 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.

During the third period, 72 acres of land are purchased on an amortized basis. At this point, all owned security is used to obtain real estate loans. However, additional owned capital is available, and 73 additional acres of land are also purchased on a cash basis. In the next production period, period 4, the increase in assets or net worth increases the level of security value which is utilized to purchase 124 acres through another real estate loan. In addition, 76 acres are purchased on a cash basis. Similarly, 106 and 209 acres of land are purchased on an amortized basis in periods 5 and 6 while 78 and 74 acres are purchased on a cash basis in each of the respective periods.

Annual consumption levels, 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 under conditions where land may be rented. However, during subsequent periods the differences become large.

The present value of net returns, under the condition that additional land operated must be purchased, is \$193,481. This is about 30 percent below the value forthcoming when land may be rented.

With the starting level of owned land equal to 213 acres and land

acquisition limited to purchasing land only, growth in terms of acres operated is limited to the purchase of about a section of land during the 30 year planning period (Table XV). Land purchases range from 66 acres in the first production period to 165 acres in the last period. Total acres operated range from 279 to 870 acres in the same period. 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 on an annual basis, 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.

#### Effect of Consumption and Capital Borrowing Levels

Since the simulated growth situations above are made with arbitrary consumption and capital borrowing levels, these factors are varied to determine different growth possibilities. 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 XVI through XIX. The total acres operated during each year of the last production period is shown in Table XVI, the accumulated value of net worth during the 30 year growth period in Table XVII, the present value of the stream of net returns in Table XVIII, and the undiscounted stream of net returns in Table XIX. Least growth, in terms of acres operated (or any of the other criteria) during the last production period, occurs for the smallest starting farm size, lower capital borrowing level, higher consumption level, and where the method of land

TABLE XV

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>.

Item	Unit	Production Period						
		1	2	3	4	5	6	
<u>Annual Situation</u>								
Land Operated	ac.	279	400	464	572	705	870	
Land Owned	ac.	279	400	464	572	705	870	
Gross Sales	dol.	12,010	17,240	19,981	24,619	30,357	37,480	
Oper. and Overhead Cap.	dol.	7,678	11,143	12,434	14,981	18,420	23,266	
Borrowed Capital	dol.	4,042	0	0	0	0	0	
Consumption Capital	dol.	2,166	3,049	3,773	4,819	5,968	7,107	
<u>Production Period Totals</u>								
Starting Owned Cash Capital	dol.	6,106	15,584	26,903	31,528	38,422	45,982	
Net Returns	dol.	21,660	30,486	37,734	48,192	59,683	71,073	
<u>Capital Withdrawals</u>								
Land Purchases	dol.	1,006	3,285	13,907	16,635	21,551	26,737	
Machinery Purchases	dol.	0	0	0	0	30	1,080	
Livestock Purchases	dol.	346	639	335	566	701	870	
Capital Consumed	dol.	10,830	15,243	18,867	24,097	29,841	35,536	
Total	dol.	12,182	19,167	33,109	41,298	52,123	64,223	
Net Cash Capital Generated	dol.	9,478	11,319	4,625	6,894	7,560	6,850	
Ending Owned Cash Capital	dol.	15,584	26,903	31,528	38,422	45,982	52,832	
Value of Controlled Resources	dol.	88,595	129,593	149,913	183,293	223,504	271,904	
Net Worth (End of Period)	dol.	73,761	89,004	107,871	131,966	161,808	197,345	
Present Value of Net Returns		\$101,509	(\$101,509 (Criterion Function Value))					
Undiscounted Level of Net Returns		\$268,828						
Starting Level of Owned Capital		\$115,172						

<sup>1</sup>Starting situation 213 acres of owned land, \$4,585 average value of equipment, \$1,120 investment in livestock and \$6,106 owned capital.

TABLE XVI

FARM SIZE AFTER 30 YEAR GROWTH PERIOD FOR SPECIFIED METHODS OF LAND ACQUISITION,  
CAPITAL BORROWING AND CONSUMPTION LEVELS

Method Of Land Acquisition	Starting Farm Size	Capital Borrowing Limit <sup>1</sup>	Consumption Level	
			50 Percent Of Net Returns Acres	25 Percent Of Net Returns Acres
Purchase Only	213 Acres	12.5 Percent	870	1,337
		25.0 Percent	882	1,357
	426 Acres	12.5 Percent	1,627	2,459
		25.0 Percent	1,652	2,504
Rent	213 Acres	12.5 Percent	3,800	8,624
		25.0 Percent	4,460	10,111
	426 Acres	12.5 Percent	6,118	14,143
		25.0 Percent	7,122	16,078

<sup>1</sup>Capital borrowing limit is expressed as a portion of the value of unmortgaged owned land.

TABLE XVII

VALUE OF NET WORTH ACCUMULATED DURING THE 30 YEAR GROWTH PERIOD FOR  
SPECIFIED METHODS OF LAND ACQUISITION, CAPITAL BORROWING  
AND CONSUMPTION LEVELS<sup>1</sup>

Method Of Land Acquisition	Starting Farm Size	Capital Borrowing Limit <sup>2</sup>	Consumption Level	
			50 Percent Of Net Returns	25 Percent Of Net Returns
Purchase Only	213 Acres	12.5 Percent	\$134,414	\$ 265,405
		25.0 Percent	\$136,868	\$ 270,149
	426 Acres	12.5 Percent	\$248,386	\$ 481,757
		25.0 Percent	\$253,725	\$ 492,231
Rent	213 Acres	12.5 Percent	\$248,111	\$ 639,426
		25.0 Percent	\$284,632	\$ 743,111
	426 Acres	12.5 Percent	\$402,194	\$1,051,216
		25.0 Percent	\$455,733	\$1,180,664

<sup>1</sup>The starting value of net worth for the 213 acre situation is \$62,931 and \$115,172 for the 426 acre situation.

<sup>2</sup>Capital borrowing limit is expressed as a portion of the value of unmortgaged owned land.

TABLE XVIII

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	Starting Farm Size	Capital Borrowing Limit <sup>1</sup>	Consumption Level	
			50 Percent Of Net Returns	25 Percent Of Net Returns
Purchase Only	213 Acres	12.5 Percent	\$101,509	\$126,143
		25.0 Percent	\$104,020	\$129,003
	426 Acres	12.5 Percent	\$193,481	\$234,645
		25.0 Percent	\$199,193	\$241,134
Rent	213 Acres	12.5 Percent	\$167,047	\$256,228
		25.0 Percent	\$194,397	\$299,683
	426 Acres	12.5 Percent	\$274,828	\$424,905
		25.0 Percent	\$311,898	\$476,882

<sup>1</sup>Capital borrowing limit is expressed as a portion of the value of unmortgaged owned land.

TABLE XIX

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	Starting Farm Size	Capital Borrowing Limit <sup>1</sup>	Consumption Level	
			50 Percent Of Net Returns	25 Percent Of Net Returns
Purchase Only	213 Acres	12.5 Percent	\$268,828	\$ 353,873
		25.0 Percent	\$273,736	\$ 360,200
	426 Acres	12.5 Percent	\$496,776	\$ 642,343
		25.0 Percent	\$507,449	\$ 656,308
Rent	213 Acres	12.5 Percent	\$496,220	\$ 852,570
		25.0 Percent	\$571,263	\$ 990,817
	426 Acres	12.5 Percent	\$804,387	\$1,401,622
		25.0 Percent	\$911,467	\$1,574,221

<sup>1</sup>Capital borrowing limit is expressed as a portion of the value of unmortgaged owned land.

acquisition is limited to purchasing land only. This size of operation, 870 acres, is small compared to the 16,078 acres operated, where maximum growth occurred.

Maximum growth occurred under conditions of the larger starting farm size, higher capital borrowing level, lower consumption level, and where the alternative of renting land exists. The complete situation with respect to organization of resources, farm operation, consumption levels, and capital accumulated for each of the situations represented in Tables XVI through XIX is presented in Appendix Tables III through XIV. 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.

The effect of different capital borrowing levels, measured in terms of acres operated (Table XVI), 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 capital are borrowed over the 30 year growth period. Capital is borrowed only at the first part of the planning period where owned capital levels are comparatively low. During the rest of the planning period the security value of collateral used to secure capital loans 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 capital borrowing; and quite different levels of capital are actually borrowed (Appendix Tables X and XIII). Under these conditions, differences in farm sizes range from 660 to 1,935 acres for situations of equal starting farm sizes and consumption levels (Table XVI). Annual differences in borrowed capital levels 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. Over a 30 year period the total amount of these differences is quite substantial.

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. 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 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 purposes.

The different levels of consumption, where other factors are held constant, result in significantly different growth rates during the 30 year period. The lower 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 and farm family living 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.

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 that occurs when additional land operated must be purchased is much less than the growth that occurs when additional land operated may be rented (Tables XVI through XIX).

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 differences in capital requirements between renting and purchasing land on an amortized basis are \$4 per acre. The total land payment, which includes interest and principal, is \$4 per acre more than the annual cost of renting. To 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 Table XII. During production period 3, 1,429 acres of land is 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 on an annual basis or \$28,500 difference for the 5 year production period. The effect of these additional capital withdrawals on the growth and capital accumulation process is apparent from observing the growth differences for the different consumption levels shown in Tables XVI through XIX. 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 the growth process 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 levels once they are committed to secure real estate loans, 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 incurred reduces the maximum level of cash capital that may be borrowed. Limiting cash capital borrowing affects the rate of firm growth. Therefore, purchasing land reduces the growth process both by increasing capital withdrawals and by reducing the level of capital borrowing.

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.

CHAPTER VI  
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 level of 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; all other resources may be purchased at their average value to establish the farm if capital is available. 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 II). Thus,

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 situation 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.

#### Minimum Starting Equity and Capital Accumulation Requirements 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 will be analyzed in a later section.

#### Rented Land Unlimited

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 XX). Capital withdrawals for consumption purposes 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 level. Total starting capital requirements are about \$19,000; \$18,025 owned capital and about \$1,000 borrowed capital. The \$19,000 includes almost \$2,000 investment in livestock, one-fifth

TABLE XX

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS RESULTING FROM MINIMUM STARTING LEVEL OF OWNED CAPITAL NECESSARY TO OBTAIN \$3,000 CONSUMPTION LEVEL OVER TIME, RENTED LAND UNLIMITED<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	379	365	364	364	362	357
Land Rented	ac.	379	365	364	364	362	357
Gross Sales	dol.	16,327	15,704	15,696	15,704	15,597	15,359
Oper. and Overhead Cap.	dol.	13,174	12,705	12,699	12,715	12,630	12,464
Borrowed Capital	dol.	997	3,282	3,282	3,282	3,282	3,282
Consumption Capital	dol.	3,000	3,000	3,000	3,000	3,000	3,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	18,025	12,226	12,222	12,206	12,190	12,025
Net Returns	dol.	15,766	14,994	14,984	14,947	14,834	14,476
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	4,571	0	0	0	0	0
Livestock Purchases	dol.	1,994	0	0	0	0	0
Capital Consumed	dol.	15,000	15,000	15,000	15,000	15,000	15,000
Total	dol.	21,565	15,000	15,000	15,000	15,000	15,000
Net Cash Capital Generated	dol.	-5,799	- 5	- 16	- 53	-166	-524
Ending Owned Cash Capital	dol.	12,226	12,220	12,204	12,151	11,985	11,461
Value of Controlled Resources	dol.	109,751	106,385	106,129	107,076	105,430	103,706
Net Worth (End of Period)	dol.	18,791	18,785	18,767	18,718	18,522	18,028
Present Value of Net Returns		\$42,590					
Undiscounted Level of Net Returns		\$90,000					
Starting Level of Owned Capital		\$18,025					

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

of a complement of equipment (plus the associated interest payments), \$3,000 consumption capital, and about \$13,000 operating and overhead capital. The operating capital includes renting the 379 acres of land at \$12 per acre. The \$997 borrowed capital is secured by the \$1,994 investment in livestock. The complement of equipment is purchased over a five year period and remains under mortgage until full payment is made after five years.

The net returns during the first five years is \$15,766 which is only slightly more than the \$15,000 capital consumed during the same period. Other capital withdrawals include equipment and livestock purchases for a total of \$21,565. The level of owned capital at the end of the first production period is \$12,226. The ending level of equity or net worth after the first five 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 capital to borrowed 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 total \$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 became, of course, a part of the farm firm. The \$18,025 starting equity level is maintained at the end of the 30 year planning period and includes \$11,461 of owned cash capital and the \$6,565 invested in livestock and equipment (production period 6, Table XX).

Increasing consumption levels over time increases the starting level of capital somewhat and requires farm growth to increase substantially. Although the specified annual consumption level during the first production period is the same as the former situation with constant consumption levels over time, the minimum starting level of owned capital is increased by about \$1,800 to a level of \$19,811 (Table XXI). The starting size of operation increases by 55 acres. The increased size of operation is required so that the farm may grow in order to satisfy the higher annual capital withdrawals for consumption in the subsequent production periods. Increases in annual capital withdrawals by \$1,000 each production period is roughly equivalent to increasing consumption levels 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 the former situation analyzed, the acres of 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 XX and XXI). 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.

TABLE XXI

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS RESULTING FROM MINIMUM STARTING LEVEL OF OWNED CAPITAL NECESSARY TO OBTAIN INCREASING CONSUMPTION LEVELS OVER TIME, RENTED LAND UNLIMITED<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	434	496	571	637	664	580
Land Rented	ac.	434	496	571	637	664	580
Gross Sales	dol.	18,677	21,385	24,615	27,454	28,622	25,004
Oper. and Overhead Cap.	dol.	14,825	16,694	18,964	21,059	21,965	19,350
Borrowed Capital	dol.	1,140	3,591	3,788	3,962	4,033	4,033
Consumption Capital	dol.	3,000	4,000	5,000	6,000	7,000	8,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	19,811	17,218	20,343	23,206	24,833	22,975
Net Returns	dol.	19,258	23,456	28,257	31,974	33,285	28,770
Capital Withdrawals							
Machinery Purchases	dol.	4,571	0	0	0	0	0
Livestock Purchases	dol.	2,280	331	394	347	143	0
Capital Consumed	dol.	15,000	20,000	25,000	30,000	35,000	40,000
Total	dol.	21,851	20,331	25,394	30,347	35,143	40,000
Net Cash Capital Generated	dol.	-2,593	3,125	2,863	1,627	-1,858	-11,230
Ending Owned Cash Capital	dol.	17,218	20,343	23,206	24,833	22,975	11,745
Value of Controlled Resources	dol.	128,229	146,565	167,822	185,636	190,401	159,011
Net Worth (End of Period)	dol.	24,069	27,525	30,782	32,756	31,041	19,811
Present Value of Net Returns		\$ 62,925					
Undiscounted Level of Net Returns		\$165,000					
Starting Level of Owned Capital		\$ 19,811					

<sup>1</sup>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.

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 level of capital withdrawals during these periods. The starting level of capital is minimized when the accumulated net worth is used in this way. Since all capital withdrawals except capital consumed is 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 is equal to the level of 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 on the growth process of the farm was previously established. Therefore, it is important to analyze minimum starting equity requirements and the growth process under conditions of purchasing land operated rather than renting. The high proportion of owner operated farms in the area of study may indicate 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 One-Half Acres Operated

The starting level of equity increases sharply when at least half of the total acres operated has to be owned. Under this condition and with consumption capital withdrawals equal to \$3,000 annually, the required starting level of owned capital is \$34,527 (Table XXII). The

TABLE XXII

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	311	301	311	319	336	368
Land Owned	ac.	155	155	155	160	168	184
Land Rented	ac.	155	146	155	160	168	184
Gross Sales	dol.	13,381	12,966	13,381	13,755	14,471	15,842
Oper. and Overhead Capt.	dol.	10,281	9,922	10,215	10,449	10,904	11,785
Borrowed Capital	dol.	8,428	11,532	12,431	13,011	14,270	16,888
Consumption Capital	dol.	3,000	3,000	3,000	3,000	3,000	3,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	34,527	865	255	0	0	0
Net Returns	dol.	15,499	15,219	15,829	16,528	17,833	20,283
<u>Capital Withdrawals</u>							
Land Purchases	dol.	27,956	829	1,084	1,482	2,746	5,116
Machinery Purchases	dol.	4,571	0	0	0	0	0
Livestock Purchases	dol.	1,634	0	0	46	87	167
Capital Consumed	dol.	15,000	15,000	15,000	15,000	15,000	15,000
Total	dol.	49,161	15,829	16,084	16,528	17,833	20,283
Net Cash Capital Generated	dol.	-33,662	-610	-255	0	0	0
Ending Owned Cash Capital	dol.	865	255	0	0	0	0
Value of Controlled Resources	dol.	81,710	78,700	80,845	82,811	86,978	94,825
Net Worth (End of Period)	dol.	35,026	35,245	36,074	37,602	40,435	45,718
Present Value of Net Returns	\$	47,386					
Undiscounted Level of Net Returns	\$	101,191					
Starting Level of Owned Capital	\$	34,527					

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

required starting size of operations is 311 acres. This is 68 acres less than the required starting size under conditions where all land operated may be rented. The net returns on a per acre basis are higher under conditions where land is owned rather than rented. Although land purchases affect the capital accumulation process, land payments (down payments and principal payments) are not costs and 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 on a per acre basis 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 starting level of 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 is not consistent with minimum starting equity requirements. The required starting level of equity increases sharply (Table XXIII). The starting level of owned capital, \$47,000, compares to \$34,500 when half of the acres operated may be rented. Although equity requirements are much higher, the average level of annual operating and overhead capital requirements 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 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 above the required starting level of owned capital is more than \$19,000. The level of 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 to the operator (also the owner in this case) equal to about \$3,000. The starting equity

TABLE XXIII

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS RESULTING FROM MINIMUM STARTING LEVEL  
OF OWNED CAPITAL NECESSARY TO OBTAIN \$3,000 CONSUMPTION LEVEL OVER TIME,  
LAND ACQUISITION LIMITED TO PURCHASING LAND ONLY<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	262	262	269	282	301	332
Land Owned	ac.	262	262	269	282	301	332
Gross Sales	dol.	11,269	11,270	11,602	12,129	12,964	14,289
Oper. and Overhead Cap.	dol.	8,118	8,031	8,214	8,503	8,957	9,677
Borrowed Capital	dol.	2,992	7,114	8,435	9,986	11,739	13,602
Consumption Capital	dol.	3,000	3,000	3,000	3,000	3,000	3,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	47,032	3,933	2,916	1,806	753	0
Net Returns	dol.	15,757	16,197	16,941	18,132	20,034	23,060
<u>Capital Withdrawals</u>							
Land Purchases	dol.	37,909	2,214	3,010	4,121	5,685	7,898
Machinery Purchases	dol.	4,571	0	0	0	0	0
Livestock Purchases	dol.	1,376	0	41	64	102	162
Capital Consumed	dol.	15,000	15,000	15,000	15,000	15,000	15,000
Total	dol.	58,856	17,214	18,051	19,185	20,787	23,060
Net Cash Capital Generated	dol.	-43,099	-1,017	-1,110	-1,053	-753	0
Ending Owned Cash Capital	dol.	3,933	2,916	1,806	753	0	0
Value of Controlled Resources	dol.	72,760	71,743	72,354	74,485	78,394	85,996
Net Worth (End of Period)	dol.	47,789	48,986	50,928	54,060	59,094	67,154
Present Value of Net Returns	\$	48,339					
Undiscounted Level of Net Returns	\$	110,121					
Starting Level of Owned Capital	\$	47,032					

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

requirements for a similar retirement income under conditions where all land operated may be rented, will be presented in a later section.

Starting equity requirements increase by more than \$13,000 to over \$60,000 under the conditions where all land operated must be owned and where annual capital withdrawals for consumption are increased by \$1,000 each production period (Table XXIV). 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 level at the end of the 30 year planning period is more than 50 percent greater. The ending equity level (\$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 land-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 level reduces collateral and, therefore, decreases the ability to borrow capital. This would actually increase the starting level of



TABLE XXIV

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS RESULTING FROM MINIMUM STARTING LEVEL  
OF OWNED CAPITAL NECESSARY TO OBTAIN INCREASING CONSUMPTION LEVELS OVER TIME,  
LAND ACQUISITION LIMITED TO PURCHASING LAND ONLY<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	357	398	442	484	521	553
Land Owned	ac.	357	398	442	484	521	553
Gross Sales	dol.	15,396	17,150	19,043	20,830	22,451	23,818
Oper. and Overhead Cap.	dol.	10,623	11,417	12,424	13,381	14,256	15,009
Borrowed Capital	dol.	16,971	15,249	11,983	10,680	11,985	16,769
Consumption Capital	dol.	3,000	4,000	5,000	6,000	7,000	8,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	60,393	0	5,784	9,491	10,452	7,721
Net Returns	dol.	23,865	28,665	33,095	37,246	40,973	44,047
<u>Capital Withdrawals</u>							
Land Purchases	dol.	62,807	2,667	4,157	6,067	8,506	11,601
Machinery Purchases	dol.	4,571	0	0	0	0	0
Livestock Purchases	dol.	1,880	214	231	218	198	167
Capital Consumed	dol.	15,000	20,000	25,000	30,000	35,000	40,000
Total	dol.	84,258	22,881	29,388	36,285	43,704	51,768
Net Cash Capital Generated	dol.	-60,393	5,784	3,707	961	-2,731	-7,721
Ending Owned Cash Capital	dol.	0	5,784	9,491	10,452	7,721	0
Value of Controlled Resources	dol.	92,131	107,961	122,467	133,726	140,073	140,119
Net Worth (End of Period)	dol.	69,258	77,923	86,018	93,264	99,237	103,284
Present Value of Net Returns			\$ 79,085				
Undiscounted Level of Net Returns			\$207,891				
Starting Level of Owned Capital			\$ 60,393				

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

owned capital because borrowed capital will substitute for owned capital. As an example, the \$60,393 minimum equity requirements 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 to bring the total operation up to 357 acres. This situation would require 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 owned land land-mortgaged land ratio above (with respect to the situation illustrated in Table XXIV). 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 XXIV). In other words, the borrowed capital could not be repaid.

Minimum Starting Equity and Capital Accumulation Requirements  
for 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 just to fulfill consumption

specifications.

Under conditions where all land may be rented, growth occurs only to fulfill the consumption requirements, and the ending equity levels are equal to the starting equity levels. Ending equity levels are specified to be equal to or greater than starting equity levels. Without this specification, starting equity would be "used up" for consumption purposes where all land operated may be rented, and the ending equity level would be much lower than the starting level. In order to better 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 levels over time, the ending equity level is \$67,154 (Table XXIII). If invested at 4.5 percent interest, this equity would return \$3,021 annually. The starting equity level of \$47,032, therefore, is the minimum required to satisfy a \$3,000 annual consumption capital withdrawal and an ending equity level which would insure the owner operator of an annual \$3,000 retirement income (at 4.5 percent interest).

An ending equity level of \$66,667 would return \$3,000 annually if invested at 4.5 percent. A minimum starting equity level of \$18,107 is required for a \$3,000 consumption level when all land operated may be rented if the ending level of net worth is specified to equal \$66,667 (Table XXV). This starting equity level is only slightly higher than the one required only to maintain an annual consumption level of \$3,000 (see Table XX). Through the growth process, it is possible to accumulate much more capital (relatively) with only slightly higher levels of

TABLE XXV

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	381	372	388	435	572	922
Land Rented	ac.	381	372	388	435	572	922
Gross Sales	dol.	16,434	16,038	16,724	18,728	24,653	39,710
Oper. and Overhead Cap.	dol.	13,249	12,939	13,420	14,827	18,990	31,150
Borrowed Capital	dol.	1,003	3,289	3,306	3,429	3,791	4,710
Consumption Capital	dol.	3,000	3,000	3,000	3,000	3,000	3,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	18,107	12,453	12,950	14,437	18,695	31,286
Net Returns	dol.	15,924	15,497	16,522	19,503	28,314	42,800
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	4,571	0	0	0	0	1,449
Livestock Purchases	dol.	2,007	0	35	245	723	1,838
Capital Consumed	dol.	15,000	15,000	15,000	15,000	15,000	15,000
Total	dol.	21,578	15,000	15,035	15,245	15,723	18,287
Net Cash Capital Generated	dol.	-5,654	497	1,487	4,258	12,519	24,513
Ending Owned Cash Capital	dol.	12,453	12,950	14,437	18,695	31,286	55,799
Value of Controlled Resources	dol.	110,471	108,808	114,170	129,953	176,147	287,947
Net Worth (End of Period)	dol.	19,031	19,528	21,050	25,553	38,867	66,667
Present Value of Net Returns	\$	54,258					
Undiscounted Level of Net Returns	\$	138,558					
Starting Level of Owned Capital	\$	18,107					

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

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 size of operation during the 30 year planning period where the growth objective is only to maintain the required \$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 the value 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 XXIII and XXV). The reason for this difference is that as a land owner the operator receives any returns that might be considered "returns to land" whereas the renter must forfeit these returns to the land owner as production costs.

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

TABLE XXVI

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	441	520	637	794	973	1,181
Land Rented	ac.	441	520	637	794	973	1,181
Gross Sales	dol.	19,017	22,391	27,457	34,190	41,909	50,896
Oper. and Overhead Cap.	dol.	15,064	17,401	21,062	26,531	32,986	40,498
Borrowed Capital	dol.	1,161	3,652	3,962	4,373	5,150	6,283
Consumption Capital	dol.	3,000	4,000	5,000	6,000	7,000	8,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	20,070	17,942	22,481	28,839	35,703	43,207
Net Returns	dol.	19,765	24,951	31,976	38,297	44,617	51,992
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	4,571	0	0	611	1,170	1,363
Livestock Purchases	dol.	2,322	412	618	822	942	1,097
Capital Consumed	dol.	15,000	20,000	25,000	30,000	35,000	40,000
Total	dol.	21,893	20,412	25,618	31,433	37,113	42,460
Net Cash Capital Generated	dol.	-2,128	4,539	6,358	6,864	7,504	9,532
Ending Owned Cash Capital	dol.	17,942	22,480	28,839	35,703	43,207	52,739
Value of Controlled Resources	dol.	130,675	154,585	189,642	235,619	288,195	350,106
Net Worth (End of Period)	dol.	24,835	29,785	36,762	45,059	54,675	66,667
Present Value of Net Returns	\$	83,031					
Undiscounted Level of Net Returns	\$	211,597					
Starting Level of Owned Capital	\$	20,070					

<sup>1</sup>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.

the structure and number of producing units under the situation 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 former 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 profitability of a business operation must be compared with alternatives that are foregone.<sup>29</sup> 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 return as much in farming as it could be invested in other alternatives such as stocks, bonds, etc. It may be assumed that the returns to operator's labor and management is the capital consumed or the consumption level over the 30 year planning horizon. 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 nonfarm occupations. Also, since consumption capital is capital that is actually withdrawn annually and not included as equity, the ending level of equity may be considered returns to starting owned capital.

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<sup>29</sup>William Fellener, Modern Economic Analysis, (York, Pa., 1960), p. 207.

With these simplifying assumptions, if returns to starting equity are measured in terms of ending equity, the "opportunity costs" principle may be applied by determining the minimum level of starting equity necessary to satisfy specified consumption levels and return 6 percent compounded annually. In other words, the starting level of 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 amount that \$1 left at 6 percent compound interest will grow over a 30 year period.

This is not an exorbitant requirement in an analysis of capital accumulation because a farm operation earns no surplus of returns if it merely recovers opportunity costs.<sup>30</sup>

#### 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 XXVII). The equity level at the end of the 30 year 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

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<sup>30</sup>Ibid.



TABLE XXVII

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	385	383	421	531	821	1,425
Land Rented	ac.	385	383	421	531	821	1,425
Gross Sales	dol.	16,588	16,519	18,125	22,871	35,380	61,403
Oper. and Overhead Cap.	dol.	13,358	12,916	14,404	17,738	27,526	49,298
Borrowed Capital	dol.	1,013	3,298	3,392	3,682	4,445	6,430
Consumption Capital	dol.	3,000	3,000	3,000	3,000	3,000	3,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	18,223	12,779	13,996	17,415	27,500	49,449
Net Returns	dol.	16,152	16,217	18,607	25,664	39,268	60,525
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	4,571	0	0	0	792	3,945
Livestock Purchases	dol.	2,025	0	188	579	1,527	3,177
Capital Consumed	dol.	15,000	15,000	15,000	15,000	15,000	15,000
Total	dol.	21,596	15,000	15,188	15,579	17,319	22,122
Net Cash Capital Generated	dol.	-5,444	1,217	3,419	10,085	21,949	38,403
Ending Owned Cash Capital	dol.	12,779	13,996	17,415	27,500	49,449	87,852
Value of Controlled Resources	dol.	111,775	112,512	125,239	162,303	256,171	446,656
Net Worth (End of Period)	dol.	19,375	20,592	24,199	34,863	59,136	104,656
Present Value of Net Returns	\$	63,893					
Undiscounted Level of Net Returns	\$	176,433					
Starting Level of Owned Capital	\$	18,223					

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

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 or deal with risks. Further research is needed because the inclusion of risk in the analysis might alter this situation by a large extent.

In terms of starting capital, the requirements to meet the "opportunity 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 XX and XXVII). This appears to be unreasonable. 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 XXVIII). 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 levels, the increase in net worth is 28 percent between production periods 1 and 2 and 43 percent between production periods 5 and 6. With

TABLE XXVIII

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	454	557	734	988	1,332	1,852
Land Rented	ac.	454	557	734	988	1,332	1,852
Gross Sales	dol.	19,557	23,989	31,606	42,565	57,384	79,770
Oper. and Overhead Cap.	dol.	15,443	18,524	24,368	33,538	45,927	64,644
Borrowed Capital	dol.	1,194	3,750	4,215	4,994	6,729	9,219
Consumption Capital	dol.	3,000	4,000	5,000	6,000	7,000	8,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	20,480	19,089	25,874	35,914	48,052	66,283
Net Returns	dol.	20,568	27,326	36,190	45,137	57,287	75,630
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	4,571	0	220	1,661	2,247	3,393
Livestock Purchases	dol.	2,388	541	930	1,338	1,809	2,733
Capital Consumed	dol.	15,000	20,000	25,000	30,000	35,000	40,000
Total	dol.	21,959	20,541	26,150	32,999	39,056	46,126
Net Cash Capital Generated	dol.	-1,391	6,785	10,040	12,138	18,231	29,504
Ending Owned Cash Capital	dol.	19,089	25,874	35,914	48,052	66,283	95,787
Value of Controlled Resources	dol.	135,008	167,054	220,640	296,821	401,668	562,098
Net Worth (End of Period)	dol.	26,048	33,374	44,564	59,701	81,988	117,618
Present Value of Net Returns	\$	96,709					
Undiscounted Level of Net Returns	\$	262,138					
Starting Level of Owned Capital	\$	20,480					

<sup>1</sup>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.

constant consumption levels over time, the increase in net worth is only 6 percent between production periods 1 and 2 but is almost 77 percent between production periods 5 and 6 (Table XXVII).

To satisfy increasing consumption levels over time, \$2,257 additional starting capital is required. The ending equity level is \$12,962 higher which is the amount that \$2,257 would return compounded annually at 6 percent interest over a 30 year period. Although the starting owned capital level is only \$2,257 more for increasing consumption levels than it is for constant consumption levels, the total amount of resources required to support the higher consumption levels are much greater. An additional operation of 69 acres in the first production period and an additional 427 acres in the last production period is required to support the higher consumption levels. 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 level of 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 levels. Each dollar of starting capital returns \$5.74 in terms of ending equity which totals \$443,504 at the end of the 30 year period (Table XXIX). 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 percent net worth increases slightly through production period 4 and then decreases to about 70 percent at the end of period 6.

TABLE XXIX

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	474	601	804	1,090	1,432	1,903
Land Owned	ac.	474	601	804	1,090	1,432	1,903
Gross Sales	dol.	20,400	25,902	34,645	46,973	61,680	81,973
Oper. and Overhead Cap.	dol.	13,606	19,835	22,690	31,487	41,200	54,634
Borrowed Capital	dol.	29,403	46,238	63,442	85,997	51,417	0
Consumption Capital	dol.	3,000	3,000	3,000	3,000	3,000	3,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	77,225	0	0	0	0	65,415
Net Returns	dol.	33,971	46,006	59,776	77,430	102,401	136,695
<u>Capital Withdrawals</u>							
Land Purchases	dol.	89,134	30,334	43,028	59,056	17,961	23,440
Machinery Purchases	dol.	4,571	0	680	1,869	2,229	3,076
Capital Consumed	dol.	15,000	15,000	15,000	15,000	15,000	15,000
Total	dol.	111,196	46,006	59,776	77,430	36,986	43,994
Net Cash Capital Generated	dol.	-77,225	0	0	0	65,415	92,701
Ending Owned Cash Capital	dol.	0	0	0	0	65,415	158,116
Value of Controlled Resources	dol.	120,822	151,971	202,442	274,456	425,976	637,271
Net Worth (End of Period)	dol.	96,196	127,202	171,978	234,408	321,809	443,504
Present Value of Net Returns		\$165,671					
Undiscounted Level of Net Returns		\$456,279					
Starting Level of Owned Capital		\$ 77,225					

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

Unlike the situation where land is rented, the operating overhead capital is a relatively small proportion of the equity or net worth (see Tables XXVII and XXIX). This has implications with respect to risks. This does not mean, however, that net worth is not used to its full extent for collateral purposes. As an example, all of the equity or 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 \$2.00 equity for \$1.00 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 level of cash capital is generated during the period and more than 35 percent of the ending level of 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 levels increased by \$1,000 each production period. That is, with increasing consumption levels and land acquisition limited to owned land, \$144,372 is the minimum level of starting capital that will return 6 percent compounded annually over the 30 year planning period (Table XXX). The required operation ranges from 859 acres operated in production period 1 to 3,617 acres operated in the last production period.

TABLE XXX

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	859	1,190	1,626	2,162	2,779	3,617
Land Owned	ac.	859	1,190	1,626	2,162	2,779	3,617
Gross Sales	dol.	36,995	51,267	70,069	93,134	119,739	155,818
Oper. and Overhead Cap.	dol.	23,860	34,144	47,841	64,119	81,587	105,520
Borrowed Capital	dol.	0	50,083	113,381	149,457	82,171	0
Consumption Capital	dol.	3,000	4,000	5,000	6,000	7,000	8,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	144,372	68,875	43,058	8,839	11,653	129,570
Net Returns	dol.	65,675	85,615	111,142	145,077	190,762	251,490
Capital Withdrawals							
Land Purchases	dol.	116,047	87,526	115,215	105,951	30,564	52,755
Machinery Purchases	dol.	5,608	2,163	2,850	3,496	4,033	5,469
Livestock Purchases	dol.	4,517	1,743	2,296	2,816	3,248	4,405
Capital Consumed	dol.	15,000	20,000	25,000	30,000	35,000	40,000
Total	dol.	141,172	111,432	145,361	142,263	72,845	102,629
Net Cash Capital Generated	dol.	-75,497	-25,817	-34,219	2,814	117,917	148,861
Ending Owned Cash Capital	dol.	68,875	43,058	8,839	11,653	219,570	278,431
Value of Controlled Resources	dol.	285,160	342,689	418,256	556,022	829,300	1,189,155
Net Worth (End of Period)	dol.	195,047	260,662	346,804	461,881	617,643	829,133
Present Value of Net Returns		\$307,239					
Undiscounted Level of Net Returns		\$849,761					
Starting Level of Owned Capital		\$144,372					

<sup>1</sup>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.

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. In order 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 and near the end of the 30 year planning period to meet the specified growth requirements (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 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.

It should be pointed out that the model used in this analysis assumes that land is available for acquisition purposes. That is, the framework of growth does not consider many of the knotty institutional problems associated with the availability of farmland for expansion purposes. As an 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 XXX).



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 is probably a relevant variable with respect to farm firm capital accumulation problems. There are undoubtedly many facets and implications which should be considered in an analysis of increasing land values. A detailed study in this respect 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 would change the growth process in that land appreciation might increase equity levels to such an extent that significantly larger levels of capital might be borrowed. It was also felt that 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, as an example, the minimum starting capital requirements of \$18,025, required to fulfill \$3,000 annual consumption over time (Table XX). Purchasing any land operated over the planning period increases the starting level of owned capital. (The minimum starting level of owned capital is \$34,527 when half of the land operated must be purchased, see Table XXII). 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 farm land 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 under the condition where farm land operated must be owned or purchased. The minimum level of starting owned capital required to meet annual \$3,000 consumption levels over time with land values increasing 5 percent annually is \$47,306 (Table XXXI). This is \$274 higher than the minimum starting requirements under the same conditions with constant land values (See Table XXIII). The ending level of equity, \$290,298, represents a return in terms of equity on starting owned capital between 6 and 7 percent compounded annually. However, the question of whether farm land values might ever reach the level assumed may well be raised.

TABLE XXXI

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	267	308	308	308	308	308
Land Owned	ac.	267	308	308	308	308	308
Gross Sales	dol.	11,498	13,261	13,261	13,261	13,261	13,261
Oper. and Overhead Cap.	dol.	8,297	9,711	9,542	9,322	9,033	8,657
Borrowed Capital	dol.	7,081	12,510	12,510	12,510	12,510	12,510
Consumption Capital	dol.	3,000	3,000	3,000	3,000	3,000	3,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	47,306	215	0	0	0	0
Net Returns	dol.	16,005	17,750	18,594	19,695	21,139	23,021
<u>Capital Withdrawals</u>							
Land Purchases	dol.	42,121	2,750	3,594	4,695	6,139	8,021
Machinery Purchases	dol.	4,571	0	0	0	0	0
Livestock Purchases	dol.	1,404	215	0	0	0	0
Capital Consumed	dol.	15,000	15,000	15,000	15,000	15,000	15,000
Total	dol.	63,096	17,965	18,594	19,695	21,139	23,021
Net Cash Capital Generated	dol.	-47,091	-215	0	0	0	0
Ending Owned Cash Capital	dol.	215	0	0	0	0	0
Value of Controlled Resources	dol.	87,975	126,596	159,863	202,321	256,508	325,666
Net Worth (End of Period)	dol.	59,948	78,998	106,115	145,391	202,864	290,298
Present Value of Net Returns		\$ 51,125					
Undiscounted Level of Net Returns		\$116,204					
Starting Level of Owned Capital		\$ 47,306					

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

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 in view of the required level of capital withdrawals for consumption purposes 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 sufficient so that the required capital withdrawals may be made. Although annual land payments are 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 levels of security or collateral is available but unused. In other words, a real estate loan could be obtained or additional capital could be borrowed for expansion purposes. However, purchasing additional land withdraws more capital than can be generated even when land is purchased by means of a 33

year amortized basis. The additional capital generated from an additional acre of land would not be sufficient to meet the required level of land payments. It is not proper to say that it would not be profitable to purchase more land for it might well be, 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 down payment is required) would amount to \$26.06 per acre. A down payment would reduce the level of these payments or land might be purchased on a cash basis, but this would require that some consumption be foregone or a higher starting level of owned capital. 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 down payment, this payment would purchase \$375 per acre land. However, additional resources would likely have to be purchased in addition to land.

In the absence of land appreciation values or if land values remained at the same level as when land was purchased, the ending level of 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 XXXII). This is about \$3,000 higher

TABLE XXXII

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	378	475	475	475	475	475
Land Owned	ac.	378	475	475	475	475	475
Gross Sales	dol.	16,289	20,482	20,482	20,482	20,482	20,482
Oper. and Overhead Cap.	dol.	11,155	14,098	13,437	12,877	12,445	12,182
Borrowed Capital	dol.	19,190	18,305	11,350	7,308	7,053	11,723
Consumption Capital	dol.	3,000	4,000	5,000	6,000	7,000	8,000
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	63,397	0	7,443	12,485	13,739	10,070
Net Returns	dol.	25,669	31,922	35,226	38,027	40,185	41,500
<u>Capital Withdrawals</u>							
Land Purchases	dol.	67,506	3,967	5,184	6,773	8,854	11,570
Machinery Purchases	dol.	4,571	0	0	0	0	0
Livestock Purchases	dol.	1,989	512	0	0	0	0
Capital Consumed	dol.	15,000	20,000	25,000	30,000	35,000	40,000
Total	dol.	89,066	24,479	30,184	36,773	43,854	51,570
Net Cash Capital Generated	dol.	-63,397	7,443	5,042	1,254	-3,669	-10,070
Ending Owned Cash Capital	dol.	0	7,443	12,485	13,739	10,070	0
Value of Controlled Resources	dol.	122,345	200,207	256,553	323,286	403,184	499,770
Net Worth (End of Period)	dol.	92,717	130,265	169,815	237,787	320,949	439,641
Present Value of Net Returns	\$	91,012					
Undiscounted Level of Net Returns	\$	212,529					
Starting Level of Owned Capital	\$	63,397					

<sup>1</sup>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.

than the minimum starting requirements under the same consumption conditions with constant land values (Table XXIV). The returns to starting owned capital, in terms of ending capital, are again between 6 and 7 percent, assuming that the value of land would appreciate to the level assumed. If land values remained at the price at which they were purchased, the level of ending equity would be \$110,926, an increase in equity of \$47,529. This would represent a return on starting owned capital of about 1.5 percent if compounded annually.

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 level of 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 levels over time, the net returns after period 2 are just equal to the total capital withdrawals (Table XXXI). With increasing annual consumption levels, the growth, before land values increase too much to be purchased, is great enough so that capital is generated 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 horizon.

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" or 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 its "productivity value," current farm owner operators would gain little after considering the "opportunity costs." Under conditions of increasing land values, both with 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, land values reached the "break even" point and remained there, the returns in terms of ending equity would be low.



## CHAPTER VII

### CONCLUSIONS AND RECOMMENDATIONS

The objectives of this study were directed to an analysis of capital accumulation and growth process of farm firms in the Rolling Plains of Oklahoma and Texas. Since the growth process of a firm was involved, the analysis had to be conducted in a nonstatic economic environment. Very little tangible knowledge is available with respect to firm growth process. For this reason, the analysis was conducted within a piecemeal framework. First, the effect of different farm operator objectives on the growth process was investigated. Following this, the effect and importance of variables such as tenure situations, capital rationing, and consumption levels on the capital accumulation process were analyzed. The knowledge gained with respect to these variables was utilized to obtain information about growth rates by simulating growth situations and analyzing the variance of these growth situations by changing the conditions or assumptions under which the simulations were made. Finally, the minimum starting farm equity situation required to obtain various growth conditions over time was determined.

Linear programming techniques in a polyperiod framework were used to depict the firm growth process. This framework is appropriate since it incorporates all the important aspects of the problem including resources, their use and development, alternatives by which resources may be developed or used over time, objectives to be fulfilled, and a

structural framework relating the component parts of the problem which makes previous decisions binding on alternatives in subsequent production periods.

## Results

### Criteria and Growth Rates

A criterion function, or an objective of maximizing the present value of the stream of net returns over the 30 year planning period with an annual discount rate of 6 percent, results in maximum capital accumulation and farm growth. This is true when capital accumulation is measured in terms of discounted net returns or ending owned capital or when growth is measured in terms of gross sales or acres of land operated. Capital accumulation and growth was 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. Thus, a criterion function of maximizing discounted net returns depicted the conditions of capital accumulation and growth for objectives of maximum present value of gross sales, undiscounted value of net returns, ending owned capital, and acres of land operated both through and at the end of the planning period.

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. The difference results from the way in which the problem was formulated. 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 occurred and additional consumption occurred 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, because maximum net returns resulted from a policy of renting land only. Although the average cost of purchasing land (interest payments over the 30 year planning horizon) is less than renting, the total capital outlays for purchasing land (interest payments plus principal payments) is higher when land is purchased and, therefore, results in slower growth rates 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. Maximum land purchases occur towards the end of the planning period. No liquid capital is available at the end of the period since all capital generated is used to purchase land (satisfy the criterion function).

Additional analysis attempted to determine the importance of certain restrictions, land acquisition, and capital use alternatives on the capital accumulation process. In assessing the effects of these variables, it was assumed that the management strategy was one that maximized the present value of net returns.

With respect to the effect of land acquisition methods, it was previously determined that renting all additional land operated resulted in maximum capital accumulation. The absence of an alternative to rent land was quite restrictive upon the capital accumulation process both with respect to size of operations and the level of net returns.

Capital rationing, in terms of limiting the level of borrowed

capital, is also restrictive on the growth process. When borrowed capital was restricted to half of its original level (from 50 percent of the unmortgaged value of owned land to 25 percent), the growth process decreased within the 30 year period by about 20 percent, both in terms of land operated and net returns. Reducing the level of borrowed capital again by a half or to one-fourth of its original level (to 12.5 percent of the unmortgaged owned land value) reduced growth by about one-third its original level. 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 five year period. In fact, capital was generated for a period of 10 years before enough capital was available to operate all owned land, 426 acres. However, the growth rate increased quite rapidly during the last half of the 30 year planning period.

The effect of higher consumption levels or capital withdrawals on the growth process is 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 acres 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 increases consumption levels in the early part of the growth period but restricts capital accumulation and results 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 comes close to effecting a non-growth situation.

#### Simulated Growth Situations

Utilizing the knowledge gained by the analysis to this point, various growth situations were simulated of farm firms. The simulations were based upon different starting farm sizes, tenure, capital rationing, and consumption situations. With a starting farm size of 426 acres of owned land, the additional value of equity accumulated over the 30 year period was \$402,194. The farm size reached a level of about 6,100 acres. Annual consumption levels (at 50 percent of the net returns), with a starting farm size of 426 acres, ranged from \$5,000 in the first part of the planning horizon 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 is about 62 percent of the additional value of equity accumulated with the starting farm size equal to 426 acres of owned land. The size of operation reached 3,800 acres at the end of the 30 year period. Annual consumption levels ranged from \$2,539 and increased above \$10,000 only after 20 years.

The present value of net returns was maximized by a policy of renting all additional land operated under both conditions of starting farm sizes. Capital accumulation and growth were significantly less when

land acquisition was limited to purchasing all additional land operated. Under these conditions, a starting farm size of 426 acres resulted in a maximum present value of net returns over the 30 year period of \$193,481. The growth process proceeded to reach a maximum size of 1,627 acres in the last production period. Land purchases were on an amortized basis during the early part of the planning period and included both cash and amortized purchases during the latter part of the period. With the capital borrowing limit restricted to 12.5 percent of the unmortgaged owned land value, capital was borrowed only during the early stages of the growth process. Security or collateral values were utilized in the form of real estate loans rather than capital borrowing during the later stages of the growth period. With a starting equity of \$115,172, about \$248,386 additional equity was accumulated over the 30 year period. On an annual basis, this is an average of \$8,279. Annual consumption levels, specified as 50 percent of the net returns, ranged from \$4,600 in the early stages of growth to about \$12,000 after 25 years.

With a starting farm size of 213 acres of owned land, the capital accumulation and growth process were very similar but on a smaller scale. Growth in terms of acres operated was limited to the purchase of about a section of land during the 30 year planning period. Consumption levels were a little more than \$2,000 on an annual basis during the first periods and less than \$5,000 for the first 20 years. The maximum present value of net returns was \$101,500 for the 30 year period and the amount of equity accumulated was about \$134,414, an annual average of about \$4,480.

Other farm firm growth situations were simulated. Borrowed capital

levels were doubled, consumption levels were halved, and the growth process analyzed with respect to different methods of land acquisition and starting farm sizes. The effect of borrowed capital levels was significant, but different consumption levels had more effect on the growth and capital accumulation process. The method of land acquisition for situations of equal starting farm sizes, consumption, and capital borrowing levels accounted for the greatest differences in growth rates. However, the effect of this factor on the capital accumulation process is similar to the effect of different consumption levels. Both represent capital withdrawals. Although the average cost of purchasing land (interest payments) was less than renting land, total capital withdrawals when purchasing land (interest plus principal payments) were greater than the withdrawals associated with renting land. The additional capital withdrawals restricted the growth process.

#### Minimum Equity Requirements

Minimum starting farm equity levels required to maintain family consumption and accumulate different levels of capital over time range 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 farm equity requirements begin at about \$18,000, which is the level required to maintain a \$3,000 annual family consumption over time. The starting equity level increases to about \$20,500 for a growth situation that can support an annual consumption level which increases from \$3,000 to \$8,000 over time and returns, in terms of increases and net worth, 6 percent annually to starting equity capital. Although minimum starting equity

requirements for different farm growth situations are not large with all farmland rented, the difference in required growth rates over time is quite significant. The different growth rates, in terms of acres operated, amounts to almost 1,500 acres.

When rented land is restricted to a level equal to or less than half of the total acres operated, minimum starting farm equity levels increase to \$34,500. Excluding the alternative to rent land altogether increases minimum starting farm equity requirements from about \$47,000 upward, 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 are important, especially for owner operated situations. Minimum starting equity requirements increased by more than \$13,000 when annual consumption levels were raised from \$3,000 over time to 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 land operated rather than purchasing it, with respect to achieving minimum starting farm equity requirements. Although increasing land values tended to satisfy growth objectives, in terms of increasing levels of net worth when land acquisition occurred through purchase rather than renting, increasing land values raised minimum starting equity requirements with respect to obtaining comparable annual consumption levels over time. As land values are increased, growth, in terms of additional acres purchased, ceases because the additional capital generated from an additional acre of land becomes insufficient to meet the



required level of land payments.

### Implications

This study has examined the process of capital accumulation and growth of representative farm firms in an important agricultural area. The current analysis 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 quite effective in terms of maximizing capital accumulation and growth, even when the growth process is measured in several different ways. However, this criterion or objective is not unique with respect to depicting the maximum rate of capital accumulation. Other objectives were just as effective in terms of resulting in maximum growth.

The structure of the firm with respect to resource restrictions, alternative methods of expanding resource levels, consumption requirements or capital withdrawals, etc. are most important with respect to capital accumulation over time. Thus, the environment within which farm operations occur tend to overwhelm specific operator objectives whether they be 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 tend to maximize capital accumulation. Since there is but 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 result in very different growth rates.

The required capital withdrawals are of the utmost importance with respect to farm growth and capital accumulation process. Costs are important only to the extent that they involve capital withdrawals. Small costs associated with large capital withdrawals would be very restrictive upon the growth process. As an example, renting versus purchasing additional land operated is a case in point. 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, is 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 lower capital withdrawals allowed the firm to grow larger and increased the volume of operations. 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 owned capital.

The importance of capital withdrawals and their effect upon the growth process also has important implications with respect to capital requirements for farm resources in relation to prices received for farm products. With respect to 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 is certain to have significant effects on farm firm growth.

Farm firm capital accumulation and growth simulations over a 30 year period with a constant cost-price relationship do not show enormous growth rates, especially for the smaller starting size farm. The analysis did not consider the effect of competition between 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. This is especially true with respect to the smaller farms.

This study illustrates that capital accumulation increases at an increasing rate. This situation has implications with respect to farm sizes and competition for farmland resources. Under these conditions, the larger farms are most likely to command the use of farm resources.

This analysis also emphasizes the important role that security or collateral value plays in capital accumulation and firm growth. This is a resource which should be utilized the same as other farm resources. The analysis indicates that considerable value is lost if the resource is not utilized.

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.

Minimum equity levels required to meet capital withdrawals over time for farm family consumption purposes are significantly different under conditions of renting or owning the land that is operated. The different equity levels result from the amount of capital outlay associated with renting land versus owning or purchasing it. In the analysis, an acre of land may 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 is associated with purchasing one acre of land.

Minimum starting equity requirements are not significantly different for various growth requirements over a 30 year period when all land operated may be rented. Large growth differences over a 30 year period can result with only small differences in starting equity requirements. However, differences with respect to acres operated and the value of controlled resources are large as the growth differences occur. Thus, 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 do require significantly different starting equity levels. A minimum of about \$47,000 is required only to meet \$3,000 family consumption levels over time, but more than \$77,000 starting equity is required to satisfy the "opportunity cost" of investing

equity at 6 percent and securing a nonfarm job to obtain consumption capital.

Annual capital withdrawals to satisfy consumption levels are more relevant variables with respect to 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 is 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 are required for a constant consumption over time when land is rented, and only 262 acres are required when land is owned; however, in terms of equity requirements, more than \$29,000 additional owned capital is required when land must be purchased. This has implications with respect to the structural characteristics and tenure problems of farm producing units. It also has implications with respect to economic models designed to analyze minimum resource requirements. In this analysis, minimum equity requirements are not consistent with minimum land requirements.

Net returns are higher on a per acre basis, when land is owned rather than rented, because resource purchases, such as land, require capital but are not associated with costs as are rental costs. 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 area of study 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 obtain increasing family living levels and 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 reveals that starting equity is minimized when specified farm firm growth conditions are fulfilled by renting land operated rather than owning it, even though the appreciated land values tend to satisfy the growth conditions. Sizeable 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 must be owned or purchased, increasing land values raise the minimum starting level of owned capital required to meet specified family consumption levels. Starting owned capital requirements are higher because additional capital must be withdrawn to purchase land at its higher value.

The analysis also leads to the conclusion that land values in the area of study 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 area of study, 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 a paradoxical situation 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 will be little gains to farm owner operators over the next 30 year planning horizon. The returns to starting equity or owned capital, if measured in terms of ending equity, would be less than 2 percent.

### Limitations

Much has been said and written about capital accumulation and the growth process. However, few studies have attempted to analyze the growth problems on a firm basis. 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 is compatible with a better understanding of risks and farm adjustments in general. The limitations of this study should be considered in interpreting the results of the analysis.

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 only dynamic with respect to time and growth properties. In the real world, many more variables typically change over a time space of 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 model is largely inadequate and renders the necessary assumptions unrealistic.

In a static analysis, an important problem is what criterion should be used to determine a solution to an economic problem? An analysis which covers several or many time periods compounds this problem. The introduction of time raises not only the question of what shall be maximized, but also what shall be the planning horizon. 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 its analysis, 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.

Other serious limitations of this study include the assumptions of pure competition within the capital accumulation or growth environment of the farm firm. The users of linear programming have for too long been concerned only with the special case of production decisions and not with marketing decisions.<sup>31</sup> A serious limitation with respect to the assumption of pure competition in this study is that the aggregate aspects of growing firms are not considered. It is common knowledge that farm firms are growing both with respect to product output and physical size. This study assumes that land is available for firm growth without the competition of many firms for the use of land and other resources. The analysis also does not deal with formidable institutional problems associated with the land market. These are serious limitations with respect to depicting firm growth.

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<sup>31</sup>Hans Brems, "Nonpure Competition in Linear Programming," Money Growth, and Methodology, Hugo Hegeland (ed.) CWK Gleerup Publishers, Sweden, 1961, pp. 351-360.

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.<sup>32</sup> Also, progress in refining and utilizing dynamic models can only come from attempts to apply these techniques to real problems.<sup>33</sup>

The arbitrary selection of important variables on the capital accumulation process, especially consumption and capital borrowing levels, is a limitation the seriousness of 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 the capital accumulation process are much too complicated to be solved straightforwardly by the deductive process. When this situation exists, 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 non constant cost relationships on the growth process of

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<sup>32</sup>Thomas L. Saaty, Mathematical Methods of Operation Research, (New York, 1959), pp. 126-127).

<sup>33</sup>Morton, p. 117.

farm firms should be made. While the model used in this study leaves much to be desired, useful information about the growth process 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 with respect to the 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, this problem is of such importance that an analysis dealing specifically with this problem 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 the knotty 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 compensates for the loss of generality. This type of simplifying assumption may have much promise when working

with problems in farming areas where a high degree of specialized operations exists. 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 towards 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.

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A P P E N D I X

## APPENDIX TABLE I

AMORTIZATION SCHEDULE FOR BORROWING \$242.00 FOR  
33 YEARS AT 5½ PERCENT INTEREST

Year	Outstanding Principal at the Beginning of the Year	Interest on the Principal at 5½%	Annual Payment	Principal Repaid	
				Year	Cumulative
1	242.00	13.31	16.05	2.74	2.74
2	239.26	13.16	16.05	2.89	5.63
3	236.37	13.00	16.05	3.05	8.68
4	233.32	12.83	16.05	3.22	11.90
5	230.10	12.65	16.05	3.40	15.30
6	226.70	12.47	16.05	3.58	18.88
7	223.12	12.27	16.05	3.78	22.66
8	219.34	12.06	16.05	3.99	26.65
9	215.35	11.84	16.05	4.21	30.86
10	211.14	11.61	16.05	4.44	35.30
11	206.70	11.37	16.05	4.68	39.98
12	202.02	11.11	16.05	4.94	44.92
13	197.08	10.84	16.05	5.21	50.13
14	191.87	10.55	16.05	5.50	55.63
15	186.37	10.25	16.05	5.80	61.43
16	180.57	9.93	16.05	6.12	67.55
17	174.47	9.60	16.05	6.45	74.00
18	168.02	9.24	16.05	6.81	80.81
19	161.21	8.87	16.05	7.18	87.99
20	154.03	8.47	16.05	7.58	95.57
21	146.45	8.05	16.05	8.00	103.57
22	138.45	7.61	16.05	8.44	112.01
23	130.01	7.15	16.05	8.90	120.91
24	121.11	6.66	16.05	9.39	130.30
25	111.72	6.14	16.05	9.91	140.21
26	101.81	5.60	16.05	10.45	150.66
27	91.36	5.02	16.05	11.03	161.69
28	80.33	4.42	16.05	11.63	173.32
29	68.70	3.78	16.05	12.27	185.59
30	56.43	3.10	16.05	12.95	198.54
31	43.48	2.39	16.05	13.66	212.20
32	29.82	1.64	16.05	14.41	226.61
33	15.41	.85	16.26	15.41	242.02





APPENDIX TABLE 11 (CONTINUED)

		Production Period 3										Production Period 4															
		3BPR	3BLU	3BEM	3BLAN	3BLAB	3BRAF	3BYER	3FIX	3INVE	3MPC3	3MPC4	4BPR	4BLU	4BEM	4BLAN	4BLAB	4BRAF	4BYER	4FIX	4INVE	4MPC3	4MPC4				
		124.85	-2.00	-225.43	-60.00	-5.00	-30	-49.52	-1.69	0	0	0	124.85	-2.00	-179.38	-60.00	-5.00	-30	-47.22	-1.69	0	0	0				
		58.73	-1.12	-75.17	-28.23	-6.35	-141	-18.23	-79	0	0	0	43.89	-0.83	-49.38	-21.09	-1.75	-11.05	-11.05	-59	0	0	0				
		0	132.90	27.62	0	0	0	0	0	0	0	0	0	99.31	15.66	0	0	0	0	0	0	0	0				
		1.00	0	0	0	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0				
		101.33	0	0	0	0	0	0	0	0	0	0	75.72	0	0	0	0	0	0	0	0	0	0				
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
Row ID 2/	Operating Activity	Land Acquisition										Consume 25% of Returns	Transfer Savings 3	Land Acquisition										Consume 25% of Returns	Transfer Savings 4		
		Debt	Amortized	Rent	Hire	Borrow	Buy	Fixed	Buy	Consume	Transfer			Debt	Amortized	Rent	Hire	Borrow	Buy	Fixed	Buy	Consume	Transfer				
		P25	P26	P27	P28	P29	P30	P31	P32	P33	P34	P35	P36	P37	P38	P39	P40	P41	P42	P43	P44	P45					
+ 1LAND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
+ 1LAAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 1GCAPT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 1SSCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 1SRPT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 1BINV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 1FIXC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 1MPCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 1SAVE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 1RENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 1RESC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 2LAND	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 2LAAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 2GCAPT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 2SSCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 2SRPT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 2BINV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 2FIXC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 2MPCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 2SAVE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 2RENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 2RESC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 3LAND	1.00	-1.00	-1.00	-1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 3LAAR	3.14	0	0	0	0	-1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 3GCAPT	15.11	242.00	16.05	12.00	1.00	-1.00	3.95	1.00	5.26	-0.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 3SSCR	0	-240.00	285.53	0	0	2.00	0	0	-5.26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 3SRPT	1.00	0	0	0	0	0	-1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 3BINV	1.00	0	0	0	0	0	0	0	-1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 3FIXC	0	0	0	0	0	0	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 3MPCR	-124.85	2.00	64.94	60.00	5.00	.30	13.22	1.69	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 3SAVE	-124.85	242.00	80.25	60.00	5.00	.30	19.75	5.00	5.26	-25	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 3RENT	0	-1.00	-1.00	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 3RESC	0	240.00	15.30	0	0	0	6.53	0	5.26	0	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 4LAND	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0	1.00	-1.00	-1.00	-1.00	0	0	0	0	0	0	0	0	0	0	0
+ 4LAAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 4GCAPT	0	0	16.05	0	0	0	2.40	0	0	0	-1.00	0	15.11	0	0	0	-1.00	0	0	0	0	0	0	0	0	0	0
+ 4SSCR	0	-240.00	292.33	0	0	0	-6.53	0	-5.26	0	0	0	0	-240.00	285.53	0	2.00	0	0	0	0	0	0	0	0	0	0
+ 4SRPT	0	0	0	0	0	0	-1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 4BINV	0	0	0	0	0	0	0	0	-1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 4FIXC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 4MPCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 4SAVE	-124.85	242.00	160.50	60.00	5.00	.30	31.75	5.00	5.26	.25	0	0	-124.85	242.00	160.50	60.00	5.00	.30	13.22	1.69	0	0	0	0	0	0	0
+ 4RENT	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0	0	-1.00	-1.00	1.00	0	0	0	0	0	0	0	0	0	0	0
+ 4RESC	0	240.00	35.30	0	0	0	6.53	0	5.26	0	0	0	0	240.00	15.30	0	0	0	0	0	0	0	0	0	0	0	0
+ 5LAND	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0	0	0	0
+ 5LAAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 5GCAPT	0	0	16.05	0	0	0	2.40	0	0	0	0	0	0	0	16.05	0	0	0	0	0	0	0	0	0	0	0	0
+ 5SSCR	0	-240.00	292.33	0	0	0	-6.53	0	-5.26	0	0	0	0	-240.00	292.33	0	0	0	0	0	0	0	0	0	0	0	0
+ 5SRPT	0	0	0	0	0	0	-1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 5BINV	0	0	0	0	0	0	0	0	-1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 5FIXC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 5MPCR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 5SAVE	-124.85	242.00	240.75	60.00	5.00	.30	43.75	5.00	5.26	.25	0	0	-124.85	242.00	160.50	60.00	5.00	.30	31.75	5.00	5.26	.25	0	0	0	0	0
+ 5RENT	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0	0	0	0
+ 5RESC	0	240.00	61.43	0	0	0	6.53	0	5.26	0	0	0	0	240.00	35.30	0	0	0	0	0	0	0	0	0	0	0	0
+ 6LAND	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0	0	-1.00	-1.00	0	0	0	0	0	0	0	0	0	0	0	0
+ 6LAAR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
+ 6GCAPT	0	0	16.05	0	0	0	2.40																				



APPENDIX TABLE II (Continued)

- 
- 1/ Objective functions:
- No. 1 Maximize the undiscounted value of gross sales (6 percent discount rate).
  - No. 2 Maximize the present value of the stream of net returns (6 percent discount rate).
  - No. 3 Maximize the present value of land ownership (6 percent discount rate)
  - No. 4 Maximize the number of acres operated over all production periods.
  - No. 5 Maximize the discounted value of gross sales (6 percent discount rate).
  - No. 6 Maximize the number of acres operated in the last production period.
- 2/ When + appears in the Row I.D.  $b_i \geq a_{ij}x_j$ ; when - appears in the Row I.D.  $b_i \leq a_{ij}x_j$ ; and when a blank appears  $b_i = a_{ij}x_j$ .
- 3/ These rows were not used in the maximizing model.

APPENDIX TABLE III

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	293	429	551	746	1,005	1,337
Land Owned	ac.	293	429	551	746	1,005	1,337
Gross Sales	dol.	12,603	18,481	23,755	32,149	43,279	57,588
Oper. and Overhead Cap.	dol.	8,076	11,683	14,343	19,444	26,946	36,587
Borrowed Capital	dol.	3,551	0	0	0	0	0
Consumption Capital	dol.	1,132	1,699	2,353	3,176	4,083	5,250
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	21,445	36,315	48,120	63,729	80,974
Net Returns	dol.	22,633	33,939	47,061	63,523	81,663	105,005
<u>Capital Withdrawals</u>							
Land Purchases	dol.	1,218	9,904	22,847	30,706	40,956	52,384
Machinery Purchases	dol.	0	0	0	302	1,687	2,169
Livestock Purchases	dol.	418	718	644	1,025	1,359	1,747
Capital Consumed	dol.	5,658	8,497	11,765	15,881	20,416	26,251
Total	dol.	7,294	19,119	35,256	47,914	64,418	82,551
Net Cash Capital Generated	dol.	15,339	14,870	11,805	15,609	17,245	22,454
Ending Owned Cash Capital	dol.	21,445	36,315	48,120	63,729	80,974	103,428
Value of Controlled Resources	dol.	97,888	146,116	187,845	251,581	334,032	440,082
Net Worth (End of Period)	dol.	79,906	105,398	140,694	188,336	249,583	328,337
Present Value of Net Returns	\$126,143	(Criterion Function Value)					
Undiscounted Level of Net Returns	\$353,874						
Starting Level of Owned Capital	\$115,172						

<sup>1</sup>Starting situation 213 acres of owned land, \$4,585 average value of equipment, \$1,120 investment in livestock and \$6,106 owned capital.

APPENDIX TABLE IV

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	314	405	470	579	714	882
Land Owned	ac.	314	405	470	579	714	882
Gross Sales	dol.	13,518	17,428	20,238	23,947	30,774	37,985
Oper. and Overhead Cap.	dol.	8,859	11,242	12,574	15,158	18,702	23,607
Borrowed Capital	dol.	5,586	0	0	0	0	0
Consumption Capital	dol.	2,329	3,093	3,832	4,875	6,036	7,189
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	15,681	27,087	31,758	38,684	46,098
Net Returns	dol.	23,294	30,930	38,321	48,945	60,358	71,888
<u>Capital Withdrawals</u>							
Land Purchases	dol.	1,541	3,582	14,147	16,971	21,960	27,148
Machinery Purchases	dol.	0	0	0	0	94	1,093
Livestock Purchases	dol.	531	477	343	575	711	880
Capital Consumed	dol.	11,647	15,465	19,160	24,473	30,179	35,944
Total	dol.	13,719	19,524	33,650	42,019	52,944	65,065
Net Cash Capital Generated	dol.	9,575	11,406	4,671	6,926	7,414	6,823
Ending Owned Cash Capital	dol.	15,681	27,087	31,758	38,684	46,098	52,921
Value of Controlled Resources	dol.	97,277	131,000	151,614	185,275	225,894	275,010
Net Worth (End of Period)	dol.	74,578	90,043	109,204	133,676	163,855	199,799
Present Value of Net Returns	\$104,020	(Criterion Function Value)					
Undiscounted Level of Net Returns	\$273,736						
Starting Level of Owned Capital	\$115,172						

<sup>1</sup>Starting situation 213 acres of owned land, \$4,585 average value of equipment, \$1,120 investment in livestock and \$6,106 owned capital.

APPENDIX TABLE V

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	324	434	560	758	1,020	1,357
Land Owned	ac.	324	434	560	758	1,020	1,357
Gross Sales	dol.	13,955	18,713	24,133	32,668	43,956	58,457
Oper. and Overhead Cap.	dol.	9,131	11,799	14,547	19,793	27,402	37,170
Borrowed Capital	dol.	4,862	0	0	0	0	0
Consumption Capital	dol.	1,206	1,728	2,397	3,219	4,138	4,435
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	21,914	36,735	48,774	64,339	81,778
Net Returns	dol.	24,119	34,569	47,933	64,376	82,769	106,434
<u>Capital Withdrawals</u>							
Land Purchases	dol.	1,696	10,525	23,249	31,294	41,549	53,235
Machinery Purchases	dol.	0	0	0	381	1,711	2,198
Livestock Purchases	dol.	584	581	662	1,042	1,378	1,771
Capital Consumed	dol.	6,031	8,642	11,983	16,094	20,692	26,609
Total	dol.	8,311	19,748	35,894	48,811	65,330	83,813
Net Cash Capital Generated	dol.	15,808	14,821	12,039	15,565	17,439	22,621
Ending Owned Cash Capital	dol.	21,914	36,735	48,774	64,339	81,778	104,399
Value of Controlled Resources	dol.	105,963	147,765	190,706	255,214	338,622	446,092
Net Worth (End of Period)	dol.	81,019	106,946	142,896	191,178	253,255	333,080
Present Value of Net Returns	\$129,003	(Criterion Function Value)					
Undiscounted Level of Net Returns	\$360,200						
Starting Level of Owned Capital	\$115,172						

<sup>1</sup>Starting situation 213 acres of owned land, \$4,585 average value of equipment, \$1,120 investment in livestock and \$6,106 owned capital.

APPENDIX TABLE VI

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	522	842	1,073	1,430	1,880	2,459
Land Owned	ac.	522	842	1,073	1,430	1,880	2,459
Gross Sales	dol.	22,490	36,283	46,239	61,603	80,979	105,948
Oper. and Overhead Cap.	dol.	12,795	22,630	28,897	39,303	52,330	69,118
Borrowed Capital	dol.	9,351	0	0	0	0	0
Consumption Capital	dol.	2,424	2,844	4,335	5,575	7,162	9,208
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	40,487	71,694	89,858	114,835	146,034
Net Returns	dol.	48,475	68,265	86,706	111,498	143,246	184,154
Capital Withdrawals							
Land Purchased	dol.	1,470	17,397	44,140	54,441	70,933	92,400
Machinery Purchases	dol.	0	929	1,509	2,329	2,937	3,785
Livestock Purchases	dol.	507	1,684	1,216	1,876	2,366	3,049
Capital Consumed	dol.	12,119	17,066	21,677	27,875	35,811	46,038
Total	dol.	14,094	37,058	68,542	86,521	112,047	145,272
Net Cash Capital Generated	dol.	34,381	31,207	18,164	24,977	31,199	38,882
Ending Owned Cash Capital	dol.	40,487	71,694	89,858	114,835	146,034	184,916
Value of Controlled Resources	dol.	173,098	283,718	360,047	474,909	619,411	804,087
Net Worth (End of Period)	dol.	151,528	202,727	267,756	351,379	458,814	596,930
Present Value of Net Returns		\$234,645	(Criterion Function Value)				
Undiscounted Level of Net Returns		\$642,344					
Starting Level of Owned Capital		\$115,172					

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.



APPENDIX TABLE VII

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	583	782	920	1,123	1,364	1,652
Land Owned	ac.	583	782	920	1,123	1,364	1,652
Gross Sales	dol.	25,101	33,677	39,641	48,383	58,775	71,171
Oper. and Overhead Cap.	dol.	14,982	21,022	24,748	30,679	37,719	46,110
Borrowed Capital	dol.	14,377	1,467	0	0	0	0
Consumption Capital	dol.	5,060	6,328	7,447	8,852	10,528	12,531
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	28,184	52,062	61,532	71,751	83,188
Net Returns	dol.	50,598	63,277	74,467	88,519	105,280	125,309
<u>Capital Withdrawals</u>							
Land Purchases	dol.	2,397	6,180	26,131	31,649	38,359	46,870
Machinery Purchases	dol.	0	534	904	1,325	1,575	1,879
Livestock Purchases	dol.	824	1,047	728	1,067	1,269	1,514
Capital Consumed	dol.	25,299	31,638	37,234	44,259	52,640	62,654
Total	dol.	28,520	39,399	64,997	78,300	93,843	112,917
Net Cash Capital Generated	dol.	22,078	23,878	9,470	10,219	11,437	12,392
Ending Owned Cash Capital	dol.	28,184	52,062	61,532	71,751	83,188	95,580
Value of Controlled Resources	dol.	175,754	248,973	293,195	354,526	426,647	511,552
Net Worth (End of Period)	dol.	140,471	172,110	209,343	253,603	306,243	368,898
Present Value of Net Returns		\$199,193	(\$199,193 (Criterion Function Value))				
Undiscounted Level of Net Returns		\$507,450					
Starting Level of Owned Capital		\$115,172					

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.

APPENDIX TABLE VIII

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	605	856	1,094	1,456	1,914	2,504
Land Owned	ac.	605	856	1,094	1,456	1,914	2,504
Gross Sales	dol.	26,050	36,882	47,144	62,748	82,464	107,877
Oper. and Overhead Cap.	dol.	15,572	23,011	29,510	40,072	53,326	70,412
Borrowed Capital	dol.	12,804	0	0	0	0	0
Consumption Capital	dol.	2,619	3,468	4,408	5,669	7,285	9,366
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	41,723	72,452	90,949	116,157	147,629
Net Returns	dol.	52,389	69,354	88,169	113,381	145,691	187,325
<u>Capital Withdrawals</u>							
Land Purchases	dol.	2,735	18,944	44,822	55,558	72,399	94,339
Machinery Purchases	dol.	0	1,020	1,555	2,365	2,989	3,852
Livestock Purchases	dol.	940	1,322	1,253	1,905	2,408	3,103
Capital Consumed	dol.	13,097	17,339	22,042	28,345	36,423	46,831
Total	dol.	16,772	38,625	69,672	88,173	114,219	148,125
Net Cash Capital Generated	dol.	35,617	30,729	18,497	25,208	31,472	39,200
Ending Owned Cash Capital	dol.	41,723	72,452	90,949	116,157	147,629	186,829
Value of Controlled Resources	dol.	194,689	288,000	366,425	482,783	629,572	817,327
Net Worth (End of Period)	dol.	154,464	206,479	272,606	357,642	466,910	607,404
Present Value of Net Returns		\$241,134	(Criterion Function Value)				
Undiscounted Level of Net Returns		\$656,309					
Starting Level of Owned Capital		\$115,172					

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.

APPENDIX TABLE IX

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	375	878	1,764	3,113	5,249	8,624
Land Owned	ac.	213	213	213	213	213	213
Land Rented	ac.	162	665	1,551	2,900	5,036	8,411
Gross Sales	dol.	16,156	37,817	76,001	134,116	226,136	371,527
Oper. and Overhead Cap.	dol.	10,651	27,117	58,888	107,093	183,435	304,053
Borrowed Capital	dol.	6,390	6,390	6,390	6,390	6,390	6,390
Consumption Capital	dol.	1,376	2,675	4,278	6,756	10,675	16,869
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	25,896	62,213	115,933	201,362	336,307
Net Returns	dol.	27,523	53,497	85,561	135,112	213,506	337,372
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	0	1,161	5,788	8,809	13,948	22,038
Livestock Purchases	dol.	852	2,645	4,662	7,096	11,236	17,752
Capital Consumed	dol.	6,881	13,374	21,391	33,788	53,377	84,343
Total	dol.	7,733	17,180	31,841	49,683	78,561	124,133
Net Cash Capital Generated	dol.	19,790	36,317	53,720	85,429	134,945	213,239
Ending Owned Cash Capital	dol.	25,896	62,213	115,933	201,362	336,307	549,546
Value of Controlled Resources	dol.	122,453	283,296	560,106	985,200	1,657,969	2,720,998
Net Worth (End of Period)	dol.	83,573	123,696	187,866	289,200	449,329	702,358
Present Value of Net Returns		\$256,228	(\$256,228 (Criterion Function Value))				
Undiscounted Level of Net Returns		\$852,571					
Starting Level of Owned Capital		\$115,172					

<sup>1</sup>Starting situation 213 acres of owned land, \$4,585 average value of equipment, \$1,120 investment in livestock and \$6,106 owned capital.

APPENDIX TABLE X

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	499	880	1,421	2,135	3,116	4,460
Land Owned	ac.	213	213	213	213	213	213
Land Rented	ac.	286	667	1,208	1,922	2,903	4,247
Gross Sales	dol.	21,514	37,911	61,213	91,987	134,246	192,132
Oper. and Overhead Cap.	dol.	14,779	27,579	46,951	72,459	107,494	155,479
Borrowed Capital	dol.	12,780	12,780	12,780	12,780	12,780	12,780
Consumption Capital	dol.	3,367	5,166	7,131	9,764	13,375	18,323
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	21,435	44,087	73,366	113,764	169,077
Net Returns	dol.	33,671	51,659	71,313	97,639	133,756	183,225
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	0	1,175	3,532	4,665	6,406	8,773
Livestock Purchases	dol.	1,507	2,002	2,845	3,757	5,160	7,067
Capital Consumed	dol.	16,835	25,830	35,657	48,819	66,877	91,613
Total	dol.	18,342	29,007	42,034	57,241	78,443	107,453
Net Cash Capital Generated	dol.	15,329	22,652	29,279	40,398	55,313	75,772
Ending Owned Cash Capital	dol.	21,435	44,087	73,366	113,764	169,077	244,849
Value of Controlled Resources	dol.	148,407	265,676	431,172	651,352	953,671	1,367,843
Net Worth (End of Period)	dol.	79,767	105,596	141,252	190,072	256,951	348,563
Present Value of Net Returns		\$194,397	(Criterion Function Value)				
Undiscounted Level of Net Returns		\$571,263					
Starting Level of Owned Capital		\$115,172					

<sup>1</sup>Starting situation 213 acres of owned land, \$4,585 average value of equipment, \$1,120 investment in livestock and \$6,106 owned capital.

APPENDIX TABLE XI

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	543	1,176	2,178	3,740	6,209	10,111
Land Owned	ac.	213	213	213	213	213	213
Land Rented	ac.	330	963	1,965	3,527	5,996	9,898
Gross Sales	dol.	23,392	50,683	93,836	161,112	267,496	435,593
Oper. and Overhead Cap.	dol.	16,092	38,221	74,059	129,869	218,127	357,582
Borrowed Capital	dol.	12,780	12,780	12,780	12,780	12,780	12,780
Consumption Capital	dol.	1,825	3,116	4,944	7,811	12,342	19,503
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	31,744	72,034	134,387	233,137	389,158
Net Returns	dol.	36,499	62,311	98,884	156,216	246,848	390,059
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	0	3,111	6,541	10,198	16,126	25,480
Livestock Purchases	dol.	1,735	3,332	5,269	8,214	12,989	20,524
Capital Consumed	dol.	9,126	15,578	24,721	39,054	61,712	97,515
Total	dol.	10,861	22,021	36,531	57,466	90,827	143,519
Net Cash Capital Generated	dol.	25,638	40,290	62,353	98,750	156,021	246,540
Ending Owned Cash Capital	dol.	31,744	72,034	134,387	233,137	389,158	635,698
Value of Controlled Resources	dol.	169,504	368,157	682,800	1,174,842	1,952,538	3,181,562
Net Worth (End of Period)	dol.	90,304	137,037	211,200	328,362	513,498	806,042
Present Value of Net Returns		\$299,683	(Criterion Function Value)				
Undiscounted Level of Net Returns		\$990,817					
Starting Level of Owned Capital		\$115,172					

<sup>1</sup>Starting situation 213 acres of owned land, \$4,585 average value of equipment, \$1,120 investment in livestock and \$6,106 owned capital.

APPENDIX TABLE XII

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	621	1,543	2,943	5,149	8,635	14,143
Land Owned	ac.	426	426	426	426	426	426
Land Rented	ac.	195	1,117	2,517	4,723	8,209	13,717
Gross Sales	dol.	26,740	66,470	126,768	221,800	371,986	609,302
Oper. and Overhead Cap.	dol.	15,925	48,819	98,853	177,691	302,287	499,167
Borrowed Capital	dol.	12,780	12,780	12,780	12,780	12,780	12,780
Consumption Capital	dol.	2,704	4,413	6,979	11,027	17,425	27,534
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	45,637	101,475	189,656	329,056	549,324
Net Returns	dol.	54,073	88,258	139,577	220,544	348,495	550,676
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	0	5,504	9,140	14,405	22,765	35,972
Livestock Purchases	dol.	1,024	4,851	7,362	11,603	18,338	28,976
Capital Consumed	dol.	13,518	22,065	34,894	55,136	87,124	137,669
Total	dol.	14,542	32,420	51,396	81,144	128,227	202,617
Net Cash Capital Generated	dol.	39,531	55,838	88,181	139,400	220,268	348,059
Ending Owned Cash Capital	dol.	45,637	101,475	189,656	329,056	549,324	897,383
Value of Controlled Resources	dol.	202,527	490,000	930,683	1,625,531	2,723,542	4,458,469
Net Worth (End of Period)	dol.	155,727	221,920	326,603	492,011	753,382	1,166,389
Present Value of Net Returns	\$	424,905	(Criterion Function Value)				
Undiscounted Level of Net Returns	\$	1,401,623					
Starting Level of Owned Capital	\$	115,172					

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.

APPENDIX TABLE XIII

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period					
		1	2	3	4	5	6
<u>Annual Situation</u>							
Land Operated	ac.	852	1,483	2,308	3,442	4,995	7,122
Land Owned	ac.	426	426	426	426	426	426
Land Rented	ac.	426	1,057	1,882	3,016	4,569	6,696
Gross Sales	dol.	36,719	63,873	99,426	148,277	215,182	306,833
Oper. and Overhead Cap.	dol.	24,797	47,385	76,853	117,354	172,822	248,806
Borrowed Capital	dol.	25,560	25,560	25,560	25,560	25,560	25,560
Consumption Capital	dol.	5,961	8,244	11,287	15,461	21,180	29,013
<u>Production Period Totals</u>							
Starting Owned Cash Capital	dol.	6,106	32,674	66,465	113,167	177,105	264,694
Net Returns	dol.	59,611	82,444	112,865	154,615	211,799	290,133
<u>Capital Withdrawals</u>							
Machinery Purchases	dol.	995	4,116	5,389	7,405	10,141	13,892
Livestock Purchases	dol.	2,243	3,315	4,341	5,965	8,169	11,190
Capital Consumed	dol.	29,805	41,222	56,433	77,307	105,900	145,067
Total	dol.	33,043	48,653	66,163	90,677	124,210	170,149
Net Cash Capital Generated	dol.	26,568	33,791	46,702	63,938	87,589	119,984
Ending Owned Cash Capital	dol.	32,674	66,465	113,167	177,105	264,694	384,678
Value of Controlled Resources	dol.	247,218	439,880	694,312	1,043,780	1,522,399	2,177,945
Net Worth (End of Period)	dol.	144,978	186,200	242,632	319,940	425,839	570,905
Present Value of Net Returns	\$311,898	(Criterion Function Value)					
Undiscounted Level of Net Returns	\$911,467						
Starting Level of Owned Capital	\$115,172						

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.

APPENDIX TABLE XIV

FARM ORGANIZATION, CAPITAL ACCUMULATION AND GROWTH PROCESS 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<sup>1</sup>

Item	Unit	Production Period						
		1	2	3	4	5	6	
<u>Annual Situation</u>								
Land Operated	ac.	920	1,946	3,510	5,985	9,897	16,078	
Land Owned	ac.	426	426	426	426	426	426	
Land Rented	ac.	494	1,520	3,084	5,559	9,471	15,652	
Gross Sales	dol.	39,620	83,829	151,193	257,852	426,371	692,660	
Oper. and Overhead Cap.	dol.	27,214	63,995	119,872	208,358	348,163	569,079	
Borrowed Capital	dol.	25,560	25,560	25,560	25,560	25,560	25,560	
Consumption Capital	dol.	3,101	4,959	7,830	12,374	19,552	30,895	
<u>Production Period Totals</u>								
Starting Owned Cash Capital	dol.	6,106	48,598	110,876	209,894	366,306	613,467	
Net Returns	dol.	62,031	99,170	156,606	247,470	391,040	617,906	
<u>Capital Withdrawals</u>								
Machinery Purchases	dol.	1,435	6,701	10,211	16,167	25,544	40,364	
Livestock Purchases	dol.	2,597	5,397	8,225	13,023	20,576	32,513	
Capital Consumed	dol.	15,507	24,794	39,152	61,868	97,759	154,477	
Total	dol.	19,539	36,892	57,588	91,058	143,879	227,354	
Net Cash Capital Generated	dol.	42,492	62,278	99,018	156,412	247,161	390,552	
Ending Owned Cash Capital	dol.	48,598	110,876	209,894	366,306	613,467	1,004,019	
Value of Controlled Resources	dol.	280,256	600,872	1,093,686	1,873,288	3,105,449	5,052,318	
Net Worth (End of Period)	dol.	161,696	236,072	353,526	539,128	832,409	1,295,838	
Present Value of Net Returns	\$	476,885	(Criterion Function Value)					
Undiscounted Level of Net Returns	\$	1,574,223						
Starting Level of Owned Capital	\$	115,172						

<sup>1</sup>Starting situation 426 acres of owned land, \$4,585 average value of equipment, \$2,241 investment in livestock and \$6,106 owned capital.



VITA

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