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thesis entitled

A Conceptualization and Analysis of the
Distributional Impacts of Alternative
Agricultural Credit Policies

presented by

Glenn Darwin Pederson

has been accepted towards fulfillment
of the requirements for

Ph.D. degree in Agr. Economics

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Major professor

Date February 28, 1980

O-7639

A CONCEPTUALIZATION AND ANALYSIS OF THE DISTRIBUTIONAL IMPACTS OF ALTERNATIVE AGRICULTURAL CREDIT POLICIES

By

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A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Agricultural Economics

1980

ABSTRACT

A CONCEPTUALIZATION AND ANALYSIS OF THE DISTRIBUTIONAL IMPACTS OF ALTERNATIVE AGRICULTURAL CREDIT POLICIES

By

Glenn Darwin Pederson

Concern over the distributional impacts of agricultural credit has grown in view of; (1) the increased demand for financial capital on farms in developed countries and (2) the committment of massive resources to governmentally sponsored and funded credit programs in developing countries. This study was made in response to the need for a more thorough understanding of the distribution of benefits from credit. It focused on a firm-level analysis of the financial impacts which arise under various conditions on loan extension, use, and repayment. Those financial impacts include changes in current household income, consumption levels, and growth in operator's net worth.

In the absence of an adequate theoretical foundation the following three objectives were formulated to provide a basis for policy evaluation. First, develop a conceptualization of the process which carries the distributional consequences of credit policies. Second, formulate a theoretical-mathematical model of the relationships between credit institutions and the farm firm-household. Third, construct a numerical simulation model to evaluate the financial, distributional impacts of specific credit policies over time.

Credit policies, rules, and practices theoretically affect the distribution of potential benefits from credit by establishing rights over various financial returns. In addition real and potential costs are associated with the use of credit. The distribution of net benefits from credit depends upon the ability of firms in different resource situations to gain access to credit and productively use it over time. A modified cash flow analysis was performed for nine firm-household resource situations over a fifteen year period using a computer simulation model which was developed for corn grain farmers in southern Michigan.

Numerical results were obtained under different lending criteria and rules concerning access to and repayment of credit. Three single criteria for making investment credit available were contrasted; (1) ability to make the required down payment out of available liquid assets, (2) ability to repay out of net reinvestment income, and (3) ability to bear financial risk as indicated by the borrower's debt/asset position.

No single lending policy provided all farm situations with the greatest growth and income potential. Large, well-established farms obtained relatively greater growth in income and equity when the net capital ratio was emphasized. Small and intermediate sized units captured greater benefits when income-generating capacity and cash for down payment were utilized.

Three credit rules were varied within the context of a basic lending model to evaluate their relative distributional effects. Small and intermediate sized farms obtained relatively greater benefits in the form of increased net worth from an extension of the loan repayment period. A reduction of the down payment percentage requirement led to qualitatively similar results. Primarily due to model construction these two credit rule changes were capitalized into land values. A maximum allowable debt/asset ratio limitation was most restrictive for small, highly-leveraged operations as expected.

Consumption behavior modifies firm growth potential to a significant degree. Household consumption expenditures directly reduce net reinvestment income and the rate at which the farm business potentially expands.

An implication for lenders and policymakers is that over time the size distribution of farms may be significantly changed by credit policy actions. Conditions for loan extension and repayment greatly influence borrowers' benefits. The analysis suggests that time spent negotiating these aspects of the loan agreement has a potentially large return for the farmer using debt financing for expansion.

A third implication occurs during periods of rapid price increases, when rapid cost increases decrease net income. The greater need for increased cash flow is especially problematic for small operations. Off-farm earnings become essential to supplement reduced farm income to meet expanding household requirements, debt-service committments, and other cash needs.

DEDICATION

To my father, Harvey. His memory remains a constant source of personal inspiration and gratitude

ACKNOWLEDGMENTS

During my graduate study several faculty members have given encouragement, advice, and direction beyond that needed to satisfy the requirements of their position. To these men I owe a debt of gratitude.

The greatest debt of gratitude is due Dr. John R. Brake who served as my curriculum and thesis advisor. His assistance, counsel, and understanding were invaluable to me and helped me attain a primary objective -- that of becoming a better researcher and economist.

A special thanks is due to Dr. Lindon Robison whose insights and criticisms of this manuscript greatly improved its quality. I am also indebted to the other members of my thesis and guidance committees, Dr. James Shaffer, Dr. Stanley Thompson, and Dr. Norman Obst for their support.

I would like to acknowledge the generous financial support of the Michigan State University Agricultural Experiment Station and the Department of Agricultural Economics.

No undertaking that is worthwhile is also easy. In recognition of that fact I want to thank my wife, Mary, and my children, Patrick and Karyn, for their understanding during my graduate work and completion of the thesis. A special thanks to my mother, Dorothy, whose attitude of perseverance shaped my character and career.

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CHAPTER I

Introduction

The past three decades have marked a period of substantial structural change in U.S. agriculture. Changes in financial structure have been of special significance. To accomodate the process of structural change, financial institutions and policies were required to adapt to the changing economic conditions. This process of development through structural and institutional change has implications for development strategies in developing countries, as well as the organization and control of U.S. agriculture in the future. These implications arise in part from the distributional impacts which either directly or indirectly flow from deliberate policy choices.

Agricultural policy analysts have found considerable evidence for this structural change in the decline of farm numbers, increase in average farm size, increase in specialization and output of farm operations, substitution among factors of production, and shifts toward more purchased inputs. All of these factors have contributed to the need for increased financial capital and credit.

Changes in financial structure have accompanied the general pattern of structural change. Growth in the physical size of farms through acquisition of land and durable assets has changed the size, structure, and liquidity of farm assets and liabilities. Meanwhile, the percentage of capital financed internally from farm earnings and savings has gradually declined. As these changes in financial structure of farms have occurred and as the distribution of assets has become more skewed, questions about the distributional impacts of credit have taken on increasing importance.

The importance of these questions derives from a need to know more about the process by which credit distribution leads to other distributional consequences. A study of alternative credit policies would be useful in providing that needed understanding.

There are four general policy questions which relate directly to the nature of such a study. This study will attempt to provide answers to the following questions,

1. Does credit have important distributional impacts?
2. How do credit policies, rules, and practices affect the distribution of benefits from credit?
3. How do changes in credit policies, rules, and practices bring about a redistribution of those benefits?
4. What credit policy design and implementation considerations are most effective in the redistribution of benefits from credit?

The first question asks if in fact credit is a determinant of distribution. The second question seeks to identify the process. The third question asks how the process works. The fourth question asks how the process can be most effectively designed and managed at the policy level.

As an illustration of the kinds of policy choices being referred to above, the following comparison can be made. A dichotomy is noted between the traditional lending criterion which emphasizes the risk-bearing capacity of the farm (i.e., the net capital ratio) and an alternative lending criterion which emphasizes the debt-servicing capacity of the farm (i.e., expected repayment potential). Under identical conditions, but where the distribution of assets and productive opportunities of farms systematically vary, these two credit policies are hypothesized to lead over time to quite different distributions of credit, and ultimately to quite different financial impacts.

There is clearly a need to describe and analyze the benefits of credit and the extent to which the rules and policies of credit extension and various borrower circumstances affect the distribution of benefits among borrowers.

A realistic evaluation of the distributional impacts of credit policies begins with an identification of the forms in which these impacts are realized. Both monetary and nonmonetary impacts are likely to occur. To keep the study of these impacts analytically tractable the focus will be upon the monetary or financial impacts. Nonpecuniary effects may well be important considerations, but including them greatly increases the level of analytical complexity without significantly adding to a better understanding of the distributional process.

Two forms of distributional impacts are identified. First credit is potentially of value in augmenting the flow of returns to the farm enterprise. The use of credit provides leverage and leverage acts as a multiplier with respect to the marginal value product of productive resources. Second, the use of credit has potentially favorable impacts by enhancing the stock of assets which can be controlled. These stock and flow dimensions represent the two primary means by which credit policies and their distributional impacts can be linked. The emphasis here is on the use of credit, although credit held in reserve will also be considered in the analysis.

1.1 Research Objectives

The analysis of the distributional impact of credit policies, rules, and practices represents an important part of the evaluation of credit policy implementation and design. Such an analysis should provide a better understanding of the institutional and economic factors involved in the distributional process. This research is oriented toward an assessment of alternative credit policies. This orientation has yielded the following set of objectives:

1. To develop a conceptualization of the distributional process which carries the distributional consequences of alternative credit policies.

2. To formulate a theoretical-mathematical model of the relationships between credit institutions and the farm firm-household. This model will accomodate alternative lending criteria and explicitly consider the effects of different initial levels of equity, downpayment requirements, terms of repayment, taxes, and consumption requirements.
3. To construct a numerical simulation model consistent with the above theoretical model to evaluate the financial, distributional impacts of specific credit policies over time.

1.2 Lack of a Theoretical Foundation

An obstacle to the evaluation of the distributional impact of credit policies is the lack of a unified theory of the distributional process. Distribution theories have traditionally been concerned with functional distribution (as it has been incorporated into contemporary growth theories). More recent has been the concern with personal distribution theories, essentially all of which are piecemeal or partial theories.

The growth models which have been advanced in recent years are theoretical-mathematical models of growth and, therefore, should not be considered as theories of growth nor as theories of distribution. These models are static equilibrium models with dynamic exogeneous elements and do not serve as dynamic theories of the distributional process (H. Johnson, 1973).

The personal theories of distribution come closer to being dynamic theories. Most of these theories have been developed in recognition of the need for endogenizing several of the variables which were formerly left exogenous (Sahota, 1978).

The lack of a theory of financial institutions compounds the problem of evaluating the distributional impact of credit policies. The need for such a theory becomes apparent when we consider that credit policies are interpreted through various lending institutions and the various rules and practices they follow in the distribution of credit and loans.

The lack of a theoretical foundation has not prevented policy analysts from undertaking analysis of the impacts of financial constraints and strategies on the financial and physical growth of the farm. The use of dynamic programming and simulation models has provided a number of useful qualitative insights into the growth process at the micro-economic level.

1.3 Research Methodology

This research is problem-solving in nature. The theoretical work presented here is required to pass the tests of coherence (internal consistency) and correspondence (external consistency). These tests require that the conclusions follow from the assumptions and propositions advanced, and that the results agree with our experience in the area of agricultural credit policy and programs. A simulation model will be constructed to numerically make the consistency checks. In addition the tests of clarity and workability are necessary. To achieve clarity we require that the approach and results be communicable. Although no specific prescriptions are made, the conclusions which result should pass the test of workability if the implied actions are taken.

1.4 Analytical Framework

An evaluation of agricultural credit policies along the lines already identified requires a synthetic analytical approach which is consistent with the financial aspects of the distributional process. A modified cash flow approach to the research problem is both consistent with that process and essential to an analysis of the anticipated financial impacts.

This modified cash flow approach at the farm firm-household level is comparable to the sources and uses of funds statement. The sources and uses of funds accounts for flows to and from the farm business and serves as a means for going from one balance sheet to a subsequent one. Both cash withdrawals and injections are considered. In credit, as an example, new borrowings provide a major new source of operating and investment funds while the repayment of debt represents a use of those funds. Other important uses of funds are cash withdrawals for household consumption and income taxes. This modified cash flow approach is described in the mathematical model and employed in the development of a numerical simulation model.

1.5 Format of the Dissertation

The next chapter provides a selective historical review of the literature in the areas of distribution theory, financial theory, and credit policy. This review emphasizes those elements of the existing body of theory which most directly relate to the research problem.

Chapter III is a formal statement of the economic problem under investigation. The chapter also identifies the distributional impacts of credit.

The conceptualization of the distribution process is presented in Chapter IV. This chapter looks at the distributional process as a working financial system.

A theoretical-mathematical model of the distribution process is specified in Chapter V. The mathematical model employs a modified cash flow approach.

In Chapter VI a numerical simulation model consistent with the mathematical model is constructed and used to determine the distributional consequences of alternative credit policy choices.

Chapter VII provides for a review of the basic results of the simulation model under alternative credit policies, scenarios about inflation, technological change, and other exogenous factors.

Chapter VIII presents a brief summary of the primary research results and conclusions concerning the conceptual approach.

CHAPTER II

A Selective Review of the Literature

2.1 Introduction

The previous chapter identified the need for a unified theory of the distributional process. The economic literature contains an expanding number of alternative theories of distribution. These theoretical contributions have been partial theories which have not been integrated into a comprehensive theory of distribution.

Given the proliferation of theories of distribution, what principles might be employed in the selection and/or construction of a theoretical approach to distributional issues?

> Distributional theories are judged by their ability to explain and predict what has occurred, what is, and what will be. But it is also important to know their implications for how the economic game should be played. If alternative specifications do not have different policy implications, the choice between any two alternatives is ultimately not very important. In that case, no matter which theory is correct, the same actions and policies will be optimal... Which of our current policies are based upon incorrect distributional assumptions and need to be replaced? How should individual economic actors change their actions if they believe in alternative theories of distribution? (Thurow, 1975, p. 182)

The concern which Thurow expresses appears to emphasize a need to develop theories which make a difference in which policy choices are made.

2.2 Historical Development of the Literature on Distribution

The evolution of the literature on distribution has progressed along two generally distinct paths. The first and earliest branch of thought was concerned with functional distribution. Functional distribution focuses on how the economic returns are distributed among the factors of production. The first political economist to apply abstract and theoretical analysis to derive basic principles of functional distribution was David Ricardo. The theoretical work of Ricardo, Adam Smith, and J.S. Mill provided for the original separation of distribution theory from value theory. This separation was not accomplished in Marxian theory.

The classical version of functional distribution was greatly altered by the emergence of marginal productivity theory as developed by Alfred Marshall and other neoclassical theorists. Marginal productivity theorists contended that the theory of factor prices and the theory of functional distribution comprise only one aspect of the general economic theory of pricing. This theoretical development represented a major shift away from the classical approach which regarded distributional issues as problems of class distribution. The break from the classical perspective was not complete, however, since the marginal productivity theory retained many of the institutional ideas of the classical theorists.

As already stated, the marginal productivity theory has merged with modern growth theories. These growth theories were built on the classical theoretical principle that if there are diminishing returns, due to the quantity of one of the factors being fixed relative to the others, there is a limit to the increase in output which will be realized from increasing the relative amounts of the variable factors.

The emergence of the marginal productivity theory of functional distribution gave rise to a skepticism about the need for a theory of distribution distinct from the general theory of prices. Johnson (1973) made the following justifications for a separate distribution theory.

> First, a literature exists containing many special problems and pieces of analysis. Second, from a historical and cultural point of view, a folklore of distribution theory has grown up, particularly associated with the Marxian tradition, with which economists frequently have to deal. Third, economists have recently become interested in the problems of economic growth and capital accumulation - the 'locus classicus' of theoretical work on these problems has been distribution theory. Fourth, economists have recently become concerned with problems of inequality of personal income distribution and poverty. (p. 3)

The second and most recent branch of thought has been in the area of personal distribution. Personal distribution refers to the distribution of, say, income among persons, families, or households. Modern economic literature is replete with writings in this particular area. This proliferation may be explained in two ways. First, not all of the recent work has been theoretical in nature. A great deal of research has been undertaken to empirically investigate problems of personal distribution (or, maldistribution). Second, the development of theories of personal distribution have been partial theories in recognition of the fact that personal distribution problems are complex and defy simple explanation.

In the classical approach to distribution there existed an equivalence of functional and personal distribution since the ownership of factors of production (land, labor, capital) correspond closely with the three general social classes of the time (landlords, laborers, and capitalists). The distribution of income shares among these three classes led essentially to the same distributional pattern as might be obtained if income had been allocated to the factors themselves.

The high degree of correlation between factors and ownership by class which held for classical theory is not found in the modern economy. As a partial consequence, there has been a fragmentation of the theoretical arguments which have been formulated to explain and analyze the secular changes which have occurred in personal distribution over time.

The following two sections present a selective review of the literature on pure theories of personal distribution and applied work on problems of personal distribution.

2.3 Pure Theories of Personal Distribution

Existing theories of personal distribution can be classified in a number of useful ways. For our purposes they can be arranged into two basic classes as suggested by Sahota (1978); (1) theories which are based on the belief that people and societies can consciously determine the relative income positions of their members and (2) theories that believe that these positions are preordained. This section will concentrate on the former class of pure theories. Four theories will be reviewed in roughly chronological order.

2.3.1 Individual Choice Theory

The individual choice theory of distribution as written by Milton Friedman (1953) focuses on individual risk preferences and chance opportunities. Individual choice affects personal distribution in two ways. First, there may be differences in the profiles of cash income over time, or the relative combinations of cash and non-cash advantages which compensate individuals for selecting one action choice over another. Second, the possible alternatives which an individual may consider differ in the probability distribution of income they promise. The theory applies under certainty or uncertainty.

Friedman's view of the personal distribution process is consistent with the Bernoullian expected utility hypothesis. In this framework the individual makes choices involving risk so as to maximize his expected utility of income. It is Friedman's contention that the personal distribution is largely produced by individuals who seek to optimize their set of risk-return preferences as specified by their utility functions.

2.3.2 Inheritance Theory

The inheritance theory of distribution concentrates on the importance of property and the intergenerational transfer of wealth in contrast with other theories which look primarily at earned incomes. James Meade (1964), a major proponent of the inheritance theory approach, contends that two factors contribute to greater skewness in property and incomes from property, than found in labor earnings. First, the rich are better able to save a high proportion of their current income. Second, they are able to obtain a high rate of return on the property they own.

Mead's inheritance theory identifies "fortunes" or endowments as genetic and social factors, and inherited property itself. The observed pattern of incomes, savings, and accumulation of property result from an interaction of these endowments and feedback on these endowments. Feedback provides for both higher rates of return on larger property and higher propensities to save out of current income. The emphasis of Meade's work lies in the link between savings behavior and the rate of growth of income from property.

The inheritance mechanism remains an important component of the long run distribution process. More theoretical and applied work has potential for contributing greatly to an integrated theory of personal distribution.

2.3.3 Human Capital Theory

The most widely recognized theory of personal distribution has evolved from the placement of human skill distribution within the capital theory framework - the human capital theory of distribution. The human capital theory is not particularly new, the "old vintage" theory of human capital originated with Adam Smith in the treatise on The Wealth of Nations (1892). The "modern vintage" of the human capital theory is largely credited to T.W. Schultz.

Under Schultz (1963, 1971) and Zvi Griliches (1974) the human capital framework was used to explore the sources of increased agricultural productivity and growth. Gary Becker (1962, 1967) and others developed further the general theory and earnings distribution theory of human capital. The modern theory of human capital is characterized by the principle that individuals make intertemporal optimizing decisions in investing in education. The development of the theory served to broaden capital theory to include human investments. Becker (1967) attempted to extend the theory as an analytical approach which could consider both earnings and property income.

2.3.4 Public Choice Theory

The public choice theory of personal distribution represents a fourth theoretical framework. Actually, this is not so much a theory of distribution as it is a theory of redistribution. We will concentrate on that part of the public choice theory which deals with the issue of distributional bias of public finance.

The distributional effects of certain forms of tax policy have been demonstrated theoretically. However, for most taxes and almost all categories of public expenditure there are virtually no theoretical works on their net redistributional effects. In the absence of a pure public choice theory of personal redistribution, some concepts and principles have been advanced which would be relevant to such a theoretical approach.

G. Stigler (1970) presented a formal statement of Director's law which is basically a philosophical view of the public expenditure process. Under Director's law public expenditures primarily benefit those coalitions who control the state and its powers of taxation and spending. Stigler claims support for this proposition in farm policy, minimum wage laws, social security, public housing, and tax exempt institutions.

A set of concepts advanced by Hochman (1974) and others looks at the transitional effects which occur as a consequence of a change in public policy. Rule changes and changes in institutions lead to a redistribution of the benefits and costs as controlled by those rules and institutions. No consistent set of theoretical principles can at this time be distilled from the diverse collection of works which comprise the suggested public choice theory of distribution.

2.4 Applied Research on Personal Distribution

Developing parallel to the pure theories reviewed above has been an expanding body of applied, empirical work on personal distribution. The genesis of applied work on the size distribution of personal income was Pareto's (1897) empirical findings which has since become known as Pareto's Law. It basically states that the number of income receiving units and the size of income are log-linearly related, therefore, the size distribution is lognormal.

More recently other statistical - theoretical studies have been done in search of a descriptive model which yields the best statistical fit to the observed size distributions. Salem and Mount (1973) made an empirical comparison of the lognormal and gamma distributions and found the gamma density function to provide superior fit to U.S. personal income data. Thurow (1970) advocated the beta distribution as the most flexible and found it to provide excellent statistical fit to U.S. household time-series income data.

A less descriptive, more analytical track has been followed in the models which have attempted to develop a synthesis of the factors which influence the distribution process in a growth and development context. In his survey of the literature Cline (1975) suggested that the question be divided into two parts; the influence which growth has on the distribution process, and the influence which distribution (or, redistribution) has on the growth process. Four studies shall be reviewed which deal with the effects of growth on distribution.

Bruce Gardner (1968) advocated a long run, equilibrium model of personal distribution. Gardner classified the determinants of distribution as "long run" when they related to resource ownership, and "short run" when the contributed to transitory variations in rates of return to comparable resources. The two-levels of analysis allowed Gardner to consider aspects of the marginal productivity theory (in the short run analysis), and aspects of changing ownership patterns and institutions (in the long run analysis) within the same model.

Gardner's model is useful in two ways. First, it looks at the distributional process more realistically by disaggregating distributional effects into equilibrium effects and momentary disequilibrium or transitory effects.

Second, the model attempts to integrate the theoretical tools of the marginal productivity approach with various facets of the theories of personal distribution reviewed above.

In the context of a neoclassical growth model Joseph Stiglitz (1969) investigated the implications of various assumptions about savings, inheritance, labor skills, and reproduction for the distribution of wealth and income among groups. Stiglitz used a mathematical model to illustrate how certain economic forces tend to equalize wealth, while others (class savings behavior, heterogeneous labor force, primogeniture) tend to disequalize it.

The model which Stiglitz developed is interesting in the synthesis it achieves between functional distribution (in the growth theory context) and aspects of changing institutions and behavior.

Lee Martin (1975) makes the assumption that market forces (supply and demand factors) play an important role in the inducement of institutional change and ultimately income distribution. He developed a macromodel embodying production, demand, human capital, and asset ownership to determine the influence which agricultural development has on distribution in a developed country.

Changes in production technology analytically lead to growth rate expressions for agricultural output and the marginal products of labor and land. Excess supply and slowly expanding, highly inelastic demand create downward pressure on output prices and returns to agriculture. Government supply control programs have quite often biased the distribution of benefits toward assets and away from labor.

The model employed by Martin also represents a synthesis. Although primarily a model concerned with functional distribution, the model incorporates aspects of human capital theory and the theory of public choice (as they have been identified above).

Fei, Ranis, and Kuo (1978) decomposed the distribution of income into three independent effects in investigating the interaction between growth and family income distribution in a developing country. The analytical technique called for a factoring of the Gini ratio into the following components: (1) a functional distribution effect due to changes in the relative shares of capital and labor, (2) a factor Gini effect due to changes in family asset ownership patterns, and (3) a reallocation effect due to a shift of the economy from primarily agricultural acitivities. This factoring was accomplished by identifying types of family income streams.

The model presented by Fei, Ranis, and Kuo synthesizes aspects of functional distribution and changing asset ownership patterns. The authors see the advocated model as a first step toward a more deterministic theory of distribution.

2.5 Overview of the Literature on Personal Distribution

The basic criterion identified at the start of this chapter was to select a theory, or theoretical approach which would make a difference in policy selection. That criterion can be extended to applied work on the distribution process. The usefullness of any approach should be assessed in terms of its intended purpose. A two-way classification scheme is suggested below as a means of identifying distribution studies as they relate to the need to make better policy choices.

		FUNCTION	
		Developmental	Impact
APPROACH	Instrumental		
	Non-Instrumental		

Developmental approaches primarily seek to identify the major economic forces or processes at work which lead to a particular distributional outcome. These approaches perform a design function as they identify strategies and alternative institutions which contribute, or act as a barrier to the realization of a target distribution. Developmental approaches focus on the macrodistribution process at the sector level of analysis.

Impact studies perform a "what if" analysis function. In the event that a particular policy or set of policies is changed, impact studies attempt to determine the distribution (or, redistribution) of benefits which results either directly or indirectly. Although impact studies have been used at the sector, subsector levels, they have been more appropriate for the study of the microdistribution process at the individual, family, or household level.

The instrumental/noninstrumental distinction relates directly to the problem of policy selection. Instrumental approaches attempt to identify the instrumentalities for change in the distribution process. Instrumental theories focus on the leverage points in the personal distribution process to provide policy makers with control variables which can be used to direct or redirect the flow of benefits. Noninstrumental approaches would not attempt to identify specific control variables in the system.

We consider this particular research to perform an impact analysis function, and to represent an instrumental approach to the problem.

2.6 Literature on Financial Theory and Credit

The review of literature on the distribution process has led to a better understanding of the complexity and the dynamic nature of the process being studied. Analysis of the impact of credit policies requires a dynamic approach to modeling.

A dynamic approach to the distribution process considers the influence of: (1) imperfect knowledge, (2) changes in technology, (3) financial management, (4) changes in institutional (including financial) structure, (5) changes in human behavior, and (6) changes which occur over time. A limited dynamic approach would consider some, but not all, of the above aspects of dynamics.

We concur with Shubik's (1975) belief that, "economic dynamics is 'financial dynamics'. The financial system is the neural network and dynamic guidance system of the real economy" (p. 185).

Shubik's major contention is that we live in a "process world" and to begin to adequately model that world there is a need for more adequate microeconomic models of financial control. These models begin by differentiating between the "real sector" of goods and services and the "paper sector" which consists of money, ownership claims, and contracts.

Shubik makes an insightful comment on the issue of financial control and management.

> Instead of guidance by the budget constraint the world appears to run by predominant use of spot markets with trade in money, financial paper, and other contracts which permit a limited extension into the future. (p. 185)

A cash flow approach to planning embodies these ideas and is essentially a partial dynamic approach to financial management and control. For example, a projected cash flow analysis represents a technique for financial management over time under imperfect knowledge and changing financial institutions.

The whole area of financial planning and progress of the firm is well-researched. The literature contains both theoretical and empirical studies on the firm growth process. We shall review static approaches and dynamic approaches to growth to determine how financial variables and relationships influence that process.

2.6.1 Static Approaches

Three comparative static analytical contributions are most relevant to our review of the literature on firm growth. First, Baumol (1962) and later Halter (1966) used a simple growth equilibrium model to assess the impact of financial variables on the rate of growth of output.

Second, Baker and Hopkin (1969) formulated a mathematical model of levered growth to look at the impact of financial variables on the rate of growth of equity capital.

The model developed by Baumol assumes both pure competition and a linear, homogeneous production function (this latter restriction eliminates the need for financial management in the model). The firm is assumed to maximize profits. Baumol divides costs into production costs and costs associated with expansion of the firm. Present value techniques and differential calculus are used to analytically determine the effects of changes in interest rates and the introduction of a government subsidy on the firm's growth rate.[1]

A.N. Halter employed many of the same basic assumptions and techniques used by Baumol, only in the context of a farm firm-household unit. Once again management played no role and the rate of growth of output, and hence revenues, was assumed constant over time.

Halter's hypothesis is that there exists a limit to the rate of growth in any given period. Conceptually, growth is defined as an internal process of the firm in which the "productive opportunities" of the firm are exploited to expand its size. Halter used the same analytical techniques as Baumol to determine the impact of the rate of earnings retention on the rate of firm growth.

Halter's view of growth as an internal process of the farm firm appears to be inconsistent with his choice of a static framework for analysis. Although borrowing as a source of funds for expansion is explicitly part of the model, Halter does not consider potential impacts of farmer control over his borrowing strategy or the rates of return

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[1]Baumol's use of present value techniques in the purely static framework points to an interesting conceptual problem in the literature. Present values imply the passage of time, since they represent a stream of cash or income payments over time evaluated at a single point in time. While it is necessary to use present values to determine the consequences of changes in financial variables over time, it is not strictly correct to call it a static analysis of firm growth. The assumption that the revenue stream is constant over time (as an annuity) is not sufficient to make the analysis static.

earned on his investments. Consequently, the internal process to which Halter refers is not really a process in the dynamic sense.

C.B. Baker and John A. Hopkin demonstrated that a mathematical expression for growth in equity could be derived from an accounting identity. In this derived model the rate of growth is a linear function of the rate of consumption, and the financial leverage ratio.

Baker and Hopkin's model allows for a purely static investigation of the impacts of changing any of the above variables on the growth rate. This particular model is useful in the wealth of information which can be gained about the impact of financial variables on growth. Additionally, the growth expression is completely derived from information which is available from the balance sheet, the income statement, and the cash flow (sources and uses of funds) statement.

2.6.2 Partially Dynamic Approaches

No completely dynamic financial theories of firm growth exist. Several partially dynamic conceptualizations of the firm growth process have been advanced. We shall undertake a selective review of the work which has been done, either of a theoretical or applied nature.

The principles of two-period consumption and investment behavior first established by Irving Fisher (1930) and later generalized to the multiperiod case by Hirschleifer (1958) represent an important first step toward dynamics. Under the Fisherian approach the problem of intertemporal investment/consumption choices is solved by equating the rate of time preference (for consumption) with the rate of return on the available investment opportunities of the firm in the context of a perfect capital market.

Hirschleifer extended Fisher's analysis in two ways. First, he dropped Fisher's assumption that borrowing and lending rates were equal. Second, he generalized the two-period case to a multiperiod analysis. In the first extension Hirschleifer shows that either the lending or the borrowing activity is redundant depending upon the rate of return on the investment opportunities. Somewhat less-satisfying was Hirschleifer's resolution of the problem of multiperiod analysis which he made theoretically equivalent to the two-period case by assuming that all investment options of the firm were independent.

The theoretical contributions made by Fisher and Hirschleifer to a dynamic approach to firm growth can be summarized in two parts. First, they redefine the concept of investment as not an end in itself but rather a dynamic process for distributing consumption over some time horizon. Secondly they look at the financing (lending/borrowing) activities of the firm-household unit over time. These activities represent cash transactions and the analysis constitutes a kind of optimizing cash flow approach.

Douglas Vickers (1968) attempted to integrate the economic theories of production, capital, and finance to formulate a broader theory of the firm. Vickers' theoretical proposition was that the availability and use of capital will influence the optimum relationships of the relative use of capital and other factors in the production process. This situation in turn influences the growth or expansion path of the firm.[2]

Vickers advocates an approach in which the objective is to optimize the "economic position" of the owners of the firm. This requires that the firm maximize the capitalized value of owner equity. The analytical approach is essentially comparative statics (a single period optimization problem is solved) with two dynamic elements. Imperfect knowledge is integrated through a risk-adjusted capitalization rate function. Financial control is exercised over the capital structure to determine the optimal amount of debt to employ.

Peter J. Barry and John R. Brake (1971) explore alternative financial management strategies for farm firms in various phases of growth. Financial strategies are important in long term problems of capital management in activities such as investment, financing, reinvestment, and risk management.

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[2]This proposition was analytically shown by C.B. Baker (1968).

To evaluate alternative financial strategies Barry and Brake suggest that a cash flow approach is instrumental for analyzing the productivity of resources and the liquidity position of the firm over time.

> In addition, cash flow analysis aids in evaluating the impact of both alternative investment choices and alternative financing strategies used in acquiring resources on liquidity position, income expectations, and the present worth of the firm. Hence, the growth process requires information about the uses of farm income as well as the productivity of resources. (p. 9)

The core of this growth process is acquisition of control over durable assets which generate sufficient returns to cover costs and add to the present value of the firm. Barry and Brake suggest that the economic incentive to growth may be in the existence of economies of size in the production activities of the farm firm.

Peter Barry (1977a) identifies three general strategies which have typically been used to finance control of additional resources:

1. lease of fixed capital, and purchase of working capital with credit,
2. invest in assets which appreciate in value over time, and
3. attract equity capital from outside the firm.

Barry finds that the first financing strategy represents a more austere consumption strategy than do the other two alternatives.

Barry (1977b) contends that a truly dynamic framework for study of firm growth and adjustment over time has been lacking. He suggests that a more adequate theoretical base for such work is provided by optimal control theory.

Barry recognizes that the mathematical requirements of control theory restrict its complete adoption to growth of the farm firm. He does see control theory as a powerful framework to aid in identification of the elements of growth and conceptualization of the growth process. The elements of growth include state variables (capital structure and organization of enterprises), and rate variables (investments, rates of return, and cash withdrawals).

2.6.3 Synthetic Approaches to Modeling Firm Growth and Expansion

The above review of dynamic approaches to farm firm growth focused primarily on conceptualizations of the growth process. Paralleling these theoretical contributions have been applied models which have employed programming and simulation techniques. We shall review one dynamic programming, one multi-period programming, and two simulation applications. Irwin (1968) provides a review of several such firm growth models.

Michael Boehlje and T. Kelley White (1968) develop a dynamic programming model of a hypothetical Indiana farm to investigate the interdependence of production and investment decisions over time. Growth, as measured by the change in net worth and disposable income, is facilitated by the generation of investable funds through retained earnings and new borrowings. Boehlje and White make a comparison of two optimizing criteria: (1) maximization of the discounted stream of disposable income over the planning period, and (2) maximization of net worth at the end of the planning period.

Specifically, Boehlje and White find that under the first criterion all the assets purchased are depreciable assets, while under the second objective function the major asset purchased is land. An inspection of the shadow prices on credit restrictions and capital resources reveals that in the early years expansion is limited by institutional credit restrictions based on collateral rather than the expected profitability of the investment. Additionally, they find that optimal firm growth is not scale growth, rather, substantial substitution of capital for labor on the hog/corn farm modelled.

Richard Duvick (1970) applies a multiperiod programming model to the study of financing strategies on a Michigan dairy farm. Duvick evaluates the effects of the following financial variables on growth: (1) levels of beginning equity, (2) downpayment requirements for short term and long term loans, and (3) repayment terms on long term debt. Alternative optimizing criteria, appreciation of land values, investment credit, and lower milk prices are also examined for their financial impacts.

Duvick finds that greater initial equity leads to proportionally higher ending net worth. Initial equity requirements and down payment requirements are found to vary in direct proportion. Alternative lengths of repayment have almost no impact on growth in net worth or consumption. Flexibility is gained under longer repayment periods and this facilitates ownership control over a larger dairy operation. Various weighting schemes on the objective function lead to only small differences in the end of period position.

George Patrick and Ludwig Eisgruber (1968) construct a simulation model of farm firm adjustment and managerial behavior under uncertainty. Although the variances of prices and yields do not enter the model, their expected values are considered. Patrick and Eisgruber outline the major elements of a behavioral theory of the farm firm which integrates factors internal to the firm (goals, expectations, and resource endowment) and those external to the firm (random events and government actions).

The simulation model is implemented to control for capital structure and managerial ability of the operator on a hypothetical Indiana farm. Patrick and Eisgruber find that the level of managerial ability is an important factor in determining the rate of financial growth. Limits on long term loans are also influential in the timing of land purchases. Farmers who were able to acquire land sooner accumulated greater final net worth. Refinancing of long term loans provides needed credit, but limitations on intermediate term loans is not an important growth factor.

A second application of computer simulation analyzes the financial impacts of recent proposals to index government price supports to the costs of production. The simulation model is developed by Michael Boehlje and Steven Griffin (1979). The model evaluates the impact of various levels of indexation on the cash flow of the farm business, debt-carrying capacity, financial leverage, and rates of growth for farms in different financial circumstances.

The model explicitly considers the mean and variance of the supported price distribution, and a risk-adjusted capitalization rate. Three farm situations are analyzed varying from a young farmer with low equity to a well-established farmer with a sizeable operation and high equity. Alternative policy simulations indicate that proportionately more of the guaranteed cash flow benefits of such a support program would accrue to farms which begin at a lower leverage ratio position due to their greater ability to acquire land. As a consequence, high-equity, large resource base operators derive greater benefits in terms of the value of their land and higher levels of consumption than do similarly leveraged, but smaller operations.

2.7 Literature on Credit Policies and Institutions

The most comprehensive review of the role of small farmer credit policies and programs was assembled in the Agency for International Development Spring Review of Small Farmer Credit (1973). We shall review three of the analytical papers in that series for the insights they provide concerning the institutional aspects of credit policies, programs, and practices.

C.B. Baker (1973) contends that small farm credit programs in developing countries have failed to realize their expectation for success because they have not been designed with an adequate knowledge of small farmer behavior and the small farmer's financial environment. Limited equity and restricted means of repayment (due to low volume of cash flow) limit small farmers to higher cost sources of credit. The small farmer must solve problems of cash flow and risk management without large flows of cash. In addition to production credit small farmers have a need for loans to finance consumption and marketing activities as well.

Judith Tendler (1973) reviews the dilemma of multiple goals which confront credit institutions and, therefore, policy makers. She identifies three broad categories of goals; (1) efficiency, (2) equity, and (3) institutional viability. These goals take on varying importance in the context of specific policy issues. For instance, in the case of evaluating a borrower's repayment capacity the efficiency goal requires the existence and adoption of a profitable technology. However, when the repayment issue is evaluated by some combination of equity and institutional viability, Tendler suggests that institutional behavior will be determinant. This latter situation calls for the use of equity-oriented criteria by lenders to prevent the outright exclusion of less-established borrowers, according to Tendler. She generally finds that small farmer programs suffer from goal addiction and that goals have sometimes become overly fixed.

John R. Brake (1973) looks at the problem of evaluating credit institutions. Brake finds that no precise evaluation is possible in view of the number of criteria for success, and he suggests that clientele benefits and institutional integrity are most useful. Relative to the implementation of credit policies and programs Brake makes the following assertions; (1) the institutional objectives must be clear, (2) the lending institution needs to be efficient, and (3) the credit institution should fit the purpose and cultural situation.

Claudio Gonzalez-Vega's dissertation (1976) dealt extensively with the role which interest rate policies play in overall credit policy. Gonzalez-Vega formulates the "iron law of interest rate restrictions" which can be described in the following way. The imposition of a ceiling on interest rates on loans and the lowering of that ceiling leads to a redistribution of the credit portfolio of formal lending institutions away from small operators and toward well-established, large operators. His maintained hypothesis is that interest rates affect resource allocation and income distribution.

2.8 Summary

Lack of a comprehensive theory of distribution necessitates that one of two possible approaches be taken in developing a framework for analyzing the distributional impacts of credit. One approach would be to develop such a theory. The formal requirements of the implied theory are great and doubtless go beyond the scope of the problem being addressed. A second strategy is to develop a conceptual approach which selectively draws from existing theory. This latter approach allows for a consideration of various structural and behavioral aspects of distribution and the role which financial institutions play in the more general distributional process.

There is a need to consider more directly the distributional aspects of credit policies, rules, and practices. These institutional factors are expected to affect long term changes in the distribution of benefits from credit.

CHAPTER III

Statement of the Economic Problem

3.1 Introduction

The broad issue of distributional effects of public programs has received increasing attention from policy analysts in recent years. Bonnen (1969) and others have contended that information on the distributional impacts of public programs is an essential part of a comprehensive review and evaluation of programs and policies. It seems consistent that due to the quasi-public nature of several major lending agencies in this country and the importance of governmentally sponsored and funded credit programs in developing countries, evaluation of credit policy distributional effects is in order.

There are a number of views concerning the distribution of and benefits from credit, some of them opposing. A systematic consideration of the underlying assumptions is needed. Consider the following two views on the distribution of credit. First, credit is a means of self-help by which a borrower potentially improves his income and financial situation. While credit involves neither a permanent transfer of funds nor an outright gift, it does carry the connotation of providing financial assistance to the less-well-off. Provision of credit on the basis of expected income-generating capacity and ability to repay redistributes access to and benefits from credit. An alternative view is that debt is a resource like any other. It is demanded in relation to its expected productivity and is supplied by lenders in hopes of repayment. Unique to this view, however, is the interpretation given to repayment capacity which requires that credit be distributed in direct relation to the existing pattern of asset ownership. Those who already have substantial assets are entitled to credit, and those without substantial assets who most need credit cannot get it.

Partly in response to the above controversies concerning credit, Brake and Melichar (1977) made several suggestions for future research in the area of agricultural finance and capital markets. One suggestion was for additional evaluative and analytical research on how credit institutions operate given the continous increase in the capital and credit needs of American agriculture. A second suggestion was that research be done on the distribution of income and other benefits of credit programs to assist policymakers in making informed choices among alternative programs.

The problem area identified in this chapter is likely to be of interest to two clientele groups: (1) government planners and policy makers who <u>design</u> credit policies and programs, and (2) the quasi-public and commercial lending agencies which <u>implement</u> credit policies. Government planners design credit programs and policies to facilitate an overall development strategy. Questions of growth and distribution are linked and must be dealt with at the policy level. Quasi-public and commercial lending agencies which implement those policies are concerned with their impact upon borrowers' ability to repay. Lending agencies concerned with their performance cannot neglect the distributional consequences which are an implicit part of their lending strategies.

Credit has been suggested to perform an allocative function and a distributive function (Gonzalez-Vega, 1977). When a loan in sufficient amount is provided to a farm with productive opportunities but limited capital, an improvement in the allocation of existing resources within that firm can potentially occur. Credit may, therefore, facilitate greater allocative efficiency within the firm.

If the farmer is also able to realize a sufficient gain in income to provide not only for a greater level of consumption but also savings and/or reinvestment, the distribution of income may be changed. This distributive property of credit is hypothesized to be more pronounced within a dynamic situation where productive opportunities of the firm improve due to technological change factors. Control over additional resources as facilitated by the loan allows for both a fuller exploitation of existing productive opportunities and the possibility of improving those opportunities through investment in new production technologies.

The distributional gains to which we refer have an important time-related dimension. Immediate distributional effects flow from subsidized credit policies in which the loan recipient receives a benefit through a lower interest rate. If the market rate of interest is r and the actual rate charged is i, then the amount of the transfer to the loan recipient is proportional to the reduction in the cost of credit (r-i).

The deferred distributional effects arise over time from credit policies which facilitate within-firm changes in financial management, production, and investment activities and a realization of greater net returns from farming. The distributional gains which accrue as deferred benefits are hypothesized to depend upon the quantity of credit a firm can obtain and on other characteristics of the firm situation. The distributional gains which accrue to borrowers over time are the primary focus of this study. Accordingly, the credit policies to be considered will relate to the distribution of credit. Although, those policies may imply different interest rates.

3.2 Restatement of the General Problem

The general problem of lack of knowledge about the distributional impact of credit policies can be subdivided into two problem areas for research. This redefinition of the problem recognizes that firms differ in their beginning resource base and in their abilities to use resources productively.

3.2.1 The Problem of Access to Initial Resources and Information

A low resource farmer may experience unsatisfactory income levels either due to an inadequate resource base or poor financial decisions. To explore this problem situation, consider a representative farm which makes decisions on production, investment, and consumption interdependently.

A farmer's production activities may be limited by several factors. From Hirshleifer's (1970) extension of Fisher's model of intertemporal choice, three factors are influential:

1. the farmer's internal production opportunity,
2. the farmer's initial endowment of inputs or resources, and
3. the farmer's access to external financial resources.

The internal production opportunity set defines the existing potential which a farm enterprise holds for the profitable use of resources. The production opportunities are a function of the situational elements of the farm (institutional, biological, climatological, and technological factors) including the farmer's intelligence capacity and available family labor resources. A final important element in the production opportunity is the riskiness of the production activities and how the farmer interprets the relative risk.

A useful summary of a farmer's production opportunities is obtained by deriving a gross returns function (by interjecting prices into an evaluation of the production function at various levels of the variable inputs). The extent to which a farmer is able to realize the production potential, and therefore potential returns, is greatly affected by his control over resources -- his initial endowment of the variable factors and his ability to obtain external financing.

The initial endowment at the start of the production cycle is equal to the current inventory of variable inputs plus cash. The farm business competes internally for the variable resources with the consumption requirements of the household. In the absence of money and capital markets, the initial endowment defines the extent to which the internal production opportunities of the farm can be exploited.

To the extent that the exploitation of existing profitable production opportunities is determined by external financing, access to credit is a determinant of the distribution of returns among farms. Credit policies designed to improve the credit access of low resource farmers, theoretically, at least, remove the resource constraint. Given sufficient financial management capacity, the additional capital generates income in excess of debt servicing requirements. The surplus can be allocated to increased consumption and/or retained earnings.

The core of the growth process is acquisition and control over resources which continue to generate returns in excess of costs and thus add present value to the firm. In this way, credit is often suggested as a means of overcoming or offsetting an uneven initial distribution of factor ownership. On the other hand, credit policies which confer relatively greater benefits on rapidly growing, large resource base farms may, over time, bias the distribution of resource ownership and the distribution of income in favor of the wealthy.

3.2.2 The Problem of Cumulative Impacts

The ability to use resources productively is certainly an important factor to consider when we compare the growth paths of farms over time. As already noted, growth is a cumulative process and in that sense is dependent upon past financial behavior and experiences of the farm. Financial growth of a farm business can be regarded as a function of the financial strategy employed by the farm operator. For example, it has been shown that a strategy in which the operator assumes a heavy debt load and the amount of disposable income available to satisfy farm family consumption is restricted, there will be an acceleration in the growth of net worth (Boehlje and White, 1969).

An implication of the above observations concerning growth is that farmers can manage credit and other financial resources to approximate their desired rate of growth. That implication is essentially correct, but presents only half of the picture of the growth process. The other half of the equation depends upon how credit policies (more specifically, lending criteria) take alternative financial strategies and past growth performance into account in distributing credit.

Different lending criteria place different emphasis on the various financial assets, amount of equity, and past rates of growth of income and net worth of the farm. By changing the relative weights which alternative lending criteria receive, credit policies implicitly alter the economic value of certain financial characteristics of individual assets in the farmer's portfolio. The econmomic value of a financial asset, or portfolio of assets, derives in part from the amount of credit which can be obtained either due to its collateral value or its income-generating, debt-servicing capacity.

It is hypothesized that credit policies which place greater emphasis upon asset value for those assets which have skewed distribution of ownership will redistribute relatively greater amounts of credit towards large resource-base farmers and confer relatively greater benefits on those farms in the form of greater asset ownership and returns from farming. Conversely, those credit policies which deemphasize asset values, and increase the weight is placed on repayment capacity of the farmer, will confer relatively greater amounts of credit, and hence benefits from the use of credit, on less-well-endowed, yet efficient, farms.

How does a consideration of alternative firm growth paths constitute a problem? Growth is a cumulative process and it is not clear that the cumulative impacts of credit policies which evolve over a number of years are of the same relative orders of magnitude as the immediate impacts of those policies. The recursive nature of firm financial growth in conjunction with technological change and other dynamic elements sufficiently obscures the deferred distributional benefits from credit that these cumulative impacts should be modeled and evaluated.

The two problem issues we have identified are to a degree interrelated and in formulating credit policies decisionmakers need to consider both aspects of the distributional problem. The hypotheses which have been proposed require that we take a closer look at the theoretical bases of the problem issues which have been identified.

3.3 Financial Impacts of Short Term Credit

The first problem issue, access to resources, has been analyzed within the context of access to operating credit. Gonzalez-Vega (1976) employed a single period model of production to examine a specific set of assumptions about farmers' relative internal productive opportunities and initial resource endowments. Within that framework fixed and variable inputs play important roles in the determination of access to, and benefits from credit.

Fixed inputs include family labor, human and physical capital, technology and land resources. These fixed factors are among the determinants of each farmer's internal production opportunity set. Variable inputs include seeds, fuels, fertilizers, pesticides, and herbicides. Credit and cash reserves are the primary means for purchasing these variable inputs. The level at which variable inputs are used determines the extent to which the productive opportunity can be exploited during the single period of production.

3.3.1 Assumptions Underlying the Short Run Model

Specific patterns of distributional impacts result when certain assumptions are made concerning the conditions under which production occurs. Two farmers are assumed to produce an homogeneous product using both fixed and variable inputs. Both farmers are assumed to attempt to maximize net returns. Initially, neither farmer is able to attain that maximizing level of production since both farms possess less than the necessary endowment of the variable inputs. The initial endowment of these inputs is assumed to vary systematically between farms.

Gonzalez-Vega suggested, for instance, that there is such a systematic variation in productive opportunities and initial resource endowments between farms in Latin America.[3] A large farm operator theoretically faces a greater overall productive opportunity due to his set of fixed inputs (better land, more productive technology, and greater accumulation of human and physical capital). This large farmer also quite possibly controls a significantly larger initial endowment of the variable factors of production than does the small farmer.

In the above context the small farmer's marginal rate of return from additional units of operating inputs is assumed to fall more rapidly than for the large farm operator, due to the farmer's limited capacity to use large amounts of those inputs. This limited capacity to handle large amounts of short term credit reflects a small endowment of the fixed inputs and a relatively limited managerial capacity. Under these assumed conditions Gonzalez-Vega illustrated some basic distributional impacts using marginal value product curves and various limitations on access to operating credit.

A key underlying assumption of the short run model concerns rural capital markets. These financial markets are assumed to be highly fragmented. Frictions which exist (due to risky lending situations, behavior towards risk, interest rate restrictions, and customary patterns

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[3]Op. cit.

and arrangements in lending) act as barriers to the free flow of funds between lenders and certain potential borrowers. Presence of these barriers theoretically place upward pressure on the transactions and real costs of borrowing.

It is these rural financial market characteristics which bring about differential access to operating credit across farms with different resource situations. Accompanying this pattern of restricted access to credit in which the agricultural lender acts as a monopolist, credit flows to large farm operators due to their superior initial resource endowment. Gross and net returns on large farms, as a consequence, are greatly augmented by credit but may be little changed on small, subsistence units.

3.3.2 Limitations and Uses of the Short Run Model

Clearly, the short run model of production is rather limited as an analytical approach to the broad question of distributional impacts from credit. It focuses upon operating credit and the one period production horizon. Additionally, several restrictive assumptions are made about productive opportunities and resource endowments of farmers and their rural financial markets to define the set of distributional impacts. In this regard, a more sufficient empirical base appears to be required to document and verify these borrower, lender, and financial market characteristics.

One of the significant attributes of the short run production model is, however, that it focuses on two key aspects of credit (its extension, use, and repayment) which may be important determinants of the distribution of associated benefits. Productive opportunities and asset position or endowment of the borrower are both important borrower characteristics which represent criteria for evaluating potential repayment capacity.

The short run model provides a useful point of departure for this study to broaden the set of factors which might be taken into account. Conceivably, broadening the analysis to incorporate; individual farm total resource situations over a longer period of time, consumption, and investment behavior will generate other distributional effects which accompany the extension of both operating and investment credit.

3.4 Cumulative Impacts of Credit

Some of the assumptions employed in the short run model of production need to be relaxed to explore the problem of cumulative impacts of credit in a partially dynamic framework. The maintained hypothesis is that the distributional impacts of credit are more pronounced within a dynamic situation where; (1) productive opportunities can be improved through investment in technologically improved inputs, and (2) the abilities of farmers to exploit those opportunities and realize certain other benefits from asset ownership are contingent upon the credit policies which are implemented.

Two forms of cumulative distributional impacts of credit will be identified: (1) an income redistribution effect which follows from an extension of the short-run model, and (2) an asset redistribution effect which has not been considered up to this point. Both of these effects are hypothesized to evolve through the growth and credit distribution processes over time.

3.4.1 Income Redistribution Effect of Credit

Production opportunities are not stationary, therefore, growth rates are not expected to be constant over time. The production function may shift upward due to the adoption of improved inputs, or improvement in the managerial abilities of the operator.

The adoption of an improved technology requires that a new set of factors be employed which differs in some way from those formerly used. T.W. Schultz (1964) suggests that the essence of technological change is the addition, deletion, or change, of at least one of the factors of production. Credit may facilitate three means of adoption of technological change: (1) purchase of highly divisible inputs, (2) purchase of complementary divisible inputs, or (3) purchase of lumpy, indivisible inputs.

The increased need for credit in this context arises from the increase in cash flow for purchasing and the increase in credit reserves for risk-bearing. When highly complementary, divisible inputs are required for successful adoption, significant increases in cash outlays may be necessary to acquire the entire package of inputs at a discrete point in time (e.g., at seeding time). The need for credit is somewhat more obvious in the case of indivisible inputs. Large cash outlays may be required to invest in such items as; buildings, tractors, implements, and improvements to land.

Adoption of technologically improved inputs and practices may also increase the riskiness of returns due to greater variability in yields. To meet the possibility that returns may be inadequate, credit reserves may be substituted for cash reserves. The level of those credit reserves is expected to vary depending upon what is assumed about operator risk preferences.

Each farm may generate growth in net returns by two means. First, the marginal productivity of the variable inputs increases as the production function shifts upward as new inputs are added to the firm. Second, when more debt is employed, financial leverage is increased. Leverage acts as a multiplier with respect to the value marginal product of added resources, therefore, the marginal rate of return.

The expanded net returns to the farm may improve the debt-servicing capacity of the farmer. However, ability to service debts is contingent upon consumption expenditures and taxes. Increased net returns may be insufficient to meet all of the above uses of those funds. Depending upon what is assumed about the consumption function (increasing or decreasing marginal propensity to consume as income increases), the cumulative income redistributional impact of credit may be diminished or enhanced.

Parallel to the consumption behavior of the household and the progressivity of the tax structure, the cumulative impact of credit depends upon how debt-servicing capacity is taken into account in the design of credit policy. In the context of a technologically dynamic environment credit policies which redefine a borrower's credit ability to place greater weight on repayment capacity are hypothesized to lead to potentially important cumulative income redistribution effects.

3.4.2 Asset Redistribution Effect of Credit

The value of assets and the asset distribution are not expected to remain constant over time. Several economic forces may act to change the market value of an asset. An important example is the increases in farmland values during inflationary periods and changes which occur in the distribution of asset ownership and control.

An increase in the price level is an important variable to consider as it affects both the price of assets and the growth process. It derives this importance by the way it affects purchasing power of an asset or a source. Boyne (1964) suggests that the magnitude and incidence of changes in the purchasing power of a price-sensitive asset arise from three potential sources; (1) changes in the discount rate, (2) changes in the size of the expected income stream, and (3) changes in the value of money.[4] More recently, Plaxico and Kletke (1979) illustrated the implications of using increases in the purchasing power of real estate for growth in farm assets under three alternative approaches to the valuation of capital gains. The mechanism used was credit. Asset value appreciation represented an improved equity position and reduced financial risk which could be utilized to obtain more credit under their assumption about lender behavior.

The amount of credit which a given set of farm assets can service may be significantly affected by changes in the price level depending upon one's assumptions. Price changes may be net income increasing (output prices more affected than input prices) or net income decreasing (input prices rise faster than output prices). Generally leverage, as shown by debt asset ratios, tends to decrease as price-sensitive assets rise in value relative to the

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[4]Price - sensitive assets include; real estate, durable capital, livestock, and crop inventories.

debt used in acquiring them. Unless the change in prices is of the net income decreasing variety, it may be that total firm risk is not appreciably changed. While business risk rises with the value of assets owned, financial risk falls (due to the lower leverage position).[5]

Growth in farmland values increases the downpayment requirement. Consider an amortized real estate loan for which repayment is in the form of fixed annual installments. The downpayment on the land purchased is the difference between the market value of the land and the sum of the discounted stream of loan payments. As price levels increase, assuming the market value of land escalates faster than the amortized loan, the downpayment, which is theoretically the difference beween those two amounts, must also increase.

Two financial impacts are worth summarizing with reference to increasing prices: If price changes are net income decreasing a farmer may find a cash flow problem developing as his receipts cannot keep up with expenditures for purchased inputs and consumption needs. A second financial impact is the potentially increased risk when price level changes are net income decreasing. It may be

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[5]The above usage of the terms business and financial risk makes the following distinction: Business risk refers to the variability in income resulting from the type of business in which the firm is engaged. Business risks relate to the kinds of investments made, enterprise selection, and organization of the firm. Financial risk refers to the probability of incurring relatively greater losses as the proportion of borrowed capital relative to equity capital increases (Nelson, Lee, and Murray 1973).

that few if any financial strategies are effective in dealing with long term price level adjustments of the net income decreasing type. Yet, it is expected that those strategies which are successful involve some combination of credit and managerial ability.

It may be that in an inflationary economic environment that the firm which controls greater assets has a greater capacity for bearing increased risk. Yet, even if this were not necessarily true (say, managerial capacity and value of assets are positively, but not perfectly, correlated), the practice of lending on the basis of the magnitude of the net capital ratio is expected to have important cumulative impacts.[6] In a situation of increasing prices, credit policies which redefine a borrower's credit ability to place greater weight on risk-bearing capacity by employing rules of thumb which emphasize asset values are hypothesized to lead to important cumulative asset redistribtuion effects.

3.5 Additional Comments on the Nature of the Research Problem

The usefulness of credit, and a major part of its distributional properties, has to do with the assumed nature of the production function. A number of alternative assumptions may be consistent with observed data in

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[6]The net capital ratio is calculated by dividing total farm assets by total farm debt.

various development contexts.

1. Low income traditional farmers are on production functions so poor that additional funds via credit will be consumed rather than put into production.
2. For credit to be profitable for a small farmer in a developing country, there must exist a profitable new technology for adoption. There must be a new, higher production function to be attained. If credit is used to purchase improved intermediate inputs, their productivity may be highest on small farms where a ready reserve of complementary labor exists in greater amounts.
3. Better managers have higher return production, investment alternatives than poor managers (i.e., good managers can use a given amount of credit more productively).
4. Large size farm firms have higher return (and probably numerically more) alternatives for investment than small, limited resource farms. If land and credit are complements, a larger land base may result in higher returns to credit (when credit is used to purchase lumpy assets such as machines and implements).
5. Large size farm firms and small, limited-resource farms face the same production function, but the latter do not control the resources needed to

operate at the optimal level; hence their returns to use of credit will be greater than for large size firms.

6. Small or limited-resource farmers will have the greatest return to additional resources because they are most likely to have an imbalance of factors of production. That is, they have a given amount of labor with too little land and too little operating capital for the labor to be used effectively and earn a favorable rate of return.
7. Small or limited-resource farmers are less knowledgeable about new production technology, hence, they receive lower returns to additional invested capital and management. Credit coupled with education will lead to higher returns for this group than for large farm operations.

The above hypotheses illustrate the results that might be expected under different assumptions concerning production functions and investment alternatives of farm firms.

In a realistic representation, farmers probably face dissimilar investment-return alternatives for increments to credit because:

1. some operators are aware of opportunities not known to others,
2. substantially different initial resource endowments provide different investment-return alternatives,

3. ability to acquire lumpy inputs, as opposed to additional divisible inputs, suggests producers face discontinuities in investment opportunity curves, and
4. differences in investment risk, risk-bearing ability and risk preferences suggest different investment strategies, and hence, returns.

The assumptions one makes about the perceived investment opportunities and consumption behavior of a given firm-household clearly have important impacts on the eventual benefits, and distributional aspects, which accrue to credit.

3.6 Summary

Controversy over the role of credit in promoting growth and development has indicated that there is a lack of knowledge concerning the distributional impacts of credit. That general problem has been disaggregated into two researchable economic issues: the problems associated with access to initial resources and information, and the problems of cumulative impacts.

A short run model of production opportunities is useful for looking at the first problem issue, but inadequate for evaluating the role of credit over time. The need for a partially-dynamic approach is motivated by two observations; (1) production functions, hence opportunities, are not stationary over time due to technological change, and (2) asset values, hence the distribution of asset ownership, are not expected to remain stationary in the presence of changing price levels. A growth model approach can be utilized to evaluate both problem issues as they relate to the distribution of credit and the distribution of benefits from credit.

Two research methodologies could be followed in evaluating the role of credit. One methodology would use financial data from individual farm firm-households over a number of years and compare the income and net worth positions of these units assuming their objectives were the same. Several limitations make that approach difficult to implement chief of which is the lack of useful data. A second methodology which potentially yields greater insights into credit policy impacts is to build a synthetic model of the growth process which can be implemented at the firm level. This approach allows consideration of different assumptions about initial resource positions, production-investment opportunities, and consumption behavior under varied credit policies.

The synthetic methodology is consistent with the need to develop a conceptualization of the distributional process to evaluate credit policies. Moreover, the synthetic approach allows the modeler to identify the instrumentalities of distribution in the growth process. Those instrumentalities can then be utilized to design and implement credit policies with more knowledge about what their potential distributional impacts will be.

CHAPTER IV

A Conceptualization of the Distribution Process

4.1 Introduction

Theoretical economic literature provides no unified theory of the distribution process. However, a couple of theoretical approaches can be integrated to develop a useful conceptual framework for analysis and design. Those approaches are the approach of institutional economics and the approach of marginal productivity theory. An integrative approach provides greater insights and analytical capabilities in the area of policy analysis.

Marginal productivity theory is useful as it provides the functional relationships (vis. production, cost functions) which are necessary for translating relatively scarce resources into relative incomes.[7] Marginal productivity theory cannot, however, determine those relative scarcities. The use of marginal productivity theory can lead to a determination of the distribution of income within an existing distribution of ownership.

An institutional approach is useful since it explicitly considers how it is that institutional arrangements, or rules of the game, lead to different distributional patterns. This approach allows the ownership and control

[7]Marginal productivity theory in this usage is generic for those theoretical approaches which focus on issues concerning functional distribution.

of resources to be an important component of the analysis. Ownership becomes a variable in the analysis to evaluate the performance implications of alternative institutional and policy designs. To the extent that institutional arrangements affect the dynamic performance of the economic system, these institutions may become important factors in determining the distributional impacts of credit policies.

The following four general premises can serve as conceptual guidelines in the formulation of an integrative approach:

1. Distributional impacts are both definable and measurable. Their consideration is a necessary part of statements and decisions concerning credit policies.
2. Distributional impacts represent a dynamic process which should be modeled in a growth framework.
3. Distributional impacts are functions of variables which are themselves distributions.
4. A conceptual framework for evaluating distributional impacts should attempt to incorporate aspects of both personal and functional distribution within the same analytical framework.

4.2 A General Framework for Analysis and Design

Once credit policies have been determined for an economic system what remains is a management problem, a problem of control where credit is allocated by established rules and practices among competing uses. However, in a situation where the credit policies and lending criteria are not predetermined (they are the variables under analysis), the problem is one of design in which alternative policies need to be evaluated.

The "systems approach" advocated by C.W. Churchman (1968) provides a general framework for the analysis and design of alternative credit policies. This approach has the capability for incorporating tools of analysis from both the institutional approach and the approach of marginal productivity theory. It also allows sufficient flexibility to consider alternative credit policy designs. In addition a systems approach provides some relative advantages in going from a conceptual, theoretical model to an empirical representation of the model.

This approach has commonly been employed to undertake policy experimentation by first identifying the operative system (its structure and behavioral interactions) and then constructing a logical, mathematical representation of it. Performance consequences of policy actions are evaluated by simulating the system's actual behavior. The approach places a great deal of emphasis on the construction of models which adequately capture the important elements of the real system.

As an integrative approach the systems view allows the policy analyst to undertake analysis and design through an iterative process. In the design mode the analyst must determine the structural makeup of the operative system. System structure becomes the variable to be determined, while system outputs and inputs are prespecified. In the analysis mode the policy analyst must determine which system outputs flow from a predetermined system structure and set of inputs. Analysis and design functions can be alternately executed to determine which set of policy actions lead to which set of performances.

4.3 Outline of the Conceptual Framework

The conceptual framework which follows attempts to build upon selected concepts and terms. To avoid unnecessary confusion, several terms are now briefly defined.

Credit refers to financial trustworthiness. It is the ability to borrow. Credit distribution is believed to be a function of lending decision rules and borrower characteristics.

A credit policy is a deliberate course or method of action selected to guide and determine present and future decisions with regard to credit allocation.

A credit practice is commonly applied policy or procedure.

A credit rule refers to a specific application of policy.

A lending agency is any financial entity (usually a financial intermediary, but not necessarily so) which can allocate funds for the purpose of creating a loan.

Debt service costs are required payments to fulfill a loan contract. These payments include principal and interest.

A property right is an established practice, law or custom which helps an individual form certain expectations which he can hold in his transactions with others (Demsetz, 1968).

Lending can similarly be defined as a transaction which follows certain established practices, laws, and customs which legitimize, or make binding, a credit transaction between financial entities.

The above definitions start to clarify the view that the extension of credit is a special form of property right. The process of lending includes all of the protective covenants between the lender and the borrower. These agreements preserve each party's rights and establish certain conditions on control over financial assets which are transferred in the process.

4.3.1 Benefits and Costs of Credit

In listing the potential benefits from credit under the traditional arrangements, interest rates are assumed to be set at market levels with a legal force backing the credit contract. In this context credit is viewed as including four rights which provide for the internalization of the benefits.

First, the borrower gains the limited right to purchase additional assets or to otherwise invest the loan proceeds within limits specified in the loan contract. Included are the rights to reallocate resources within the firm, to purchase needed productive inputs, or to invest the loan proceeds for business purposes subject to any restrictive covenants specified by the lender in granting the credit.

The second benefit is the right to income from such assets and investments, or from related productivity increases above debt service costs, which come from the credit. This includes rights to future income from reinvestment of savings accomplished by the original purchase or investment. Therefore, one must consider the dynamic nature of investing, paying debt service costs, generating savings, and reinvesting the earnings to generate additional income. This suggests that a growth model may be advantageous for evaluating the cumulative benefits of credit. Further, it suggests that debt service is an influential factor affecting cumulative benefits in that repayment terms will affect returns over the debt service commitment.

The third benefit is the right to appreciation or depreciation of assets or investments so long as the terms of the loan are met. In an inflationary situation this right can have particular importance in terms of the capital gains or appreciation accruing to some investments as well as for depreciation write-offs, investment credit and other possible tax advantages.

The fourth benefit is the right to sell, lease, collateralize or otherwise use the property acquired with credit subject to loan repayment terms. This is to say that one can realize a profit on the sale of the item purchased by credit, and that profit accrues to the owner rather than to the lending institution as long as loan terms are met. Such capital gains are conceived as separate from the income produced by use of the asset.

Finally, if the two assumptions made above are dropped (i.e., that market rates of interest are charged and legal force backs the loan contract) then the borrower may obtain two additional rights. One is the right to a reduced cost because interest is subsidized at below market rates. Secondly, the borrower may realize a direct transfer of funds from the lender through nonrepayment. These latter two are not uncommon in small farmer credit programs in developing countries.

There are at least three real or potential costs to the borrower associated with the use of credit. First, there is the interest cost for the use of borrowed funds. This is a cost which is recognized by all. Second, a potential cost is the increased financial risk which goes with a higher leverage position (higher debt/asset ratio). The third cost is the risk of loss of future access to credit. This latter cost refers to the risk that one may not be able to borrow in the future because of increased use of credit now, or that business risk or business failure with a highly leveraged financial position will hinder acquisition of additional credit.

Credit institutions and policies, therefore, affect access to the rights to purchase additional assets or services and to benefit from income, value appreciation, and reorganization of productive assets. Property rights are thought to play an important role as they affect both ownership and control of financial resources. The contractual nature of credit arrangements indicates how the associated property rights are taken into account. Credit arrangements typically provide for:

1. transfer of property rights in case of default (not meeting the terms of the loan),
2. terms concerning security of the loan and for retirement of the legal-financial claim against the property being used to secure financing, and
3. determination of the amount which can be borrowed within prudent lending limits reflecting safety margins for riskbearing.

4.4 The Distribution Process

The distribution process being advocated can be summarized by means of a diagram as illustrated in figure 4.1. The diagram represents a form of causal loop. A causal loop diagram is a graphic model which identifies the variables believed to be significant in the system being modeled. Arrows in a causal loop are employed to indicate processes or components in the system. The diagram shown is a form of causal loop since the variables which are identified are not all strictly variables, but rather in some cases, are concepts which represent underlying variables. A second modification of the standard causal loop is that no signs (positive or negative) are included at the arrowheads to indicate the direction of causation since the stimulus in most cases can have different effects depending upon the farm resource situation.

The distribution process as illustrated in figure 4.1 is consistent with the set of premises which were established earlier. The framework incorporates aspects of functional distribution (rates of return on productive assets) and personal distribution (the distribution of asset ownership). Also, the process has the potential for integrating institutional parameters and aspects of the marginal productivity theory of distribution.

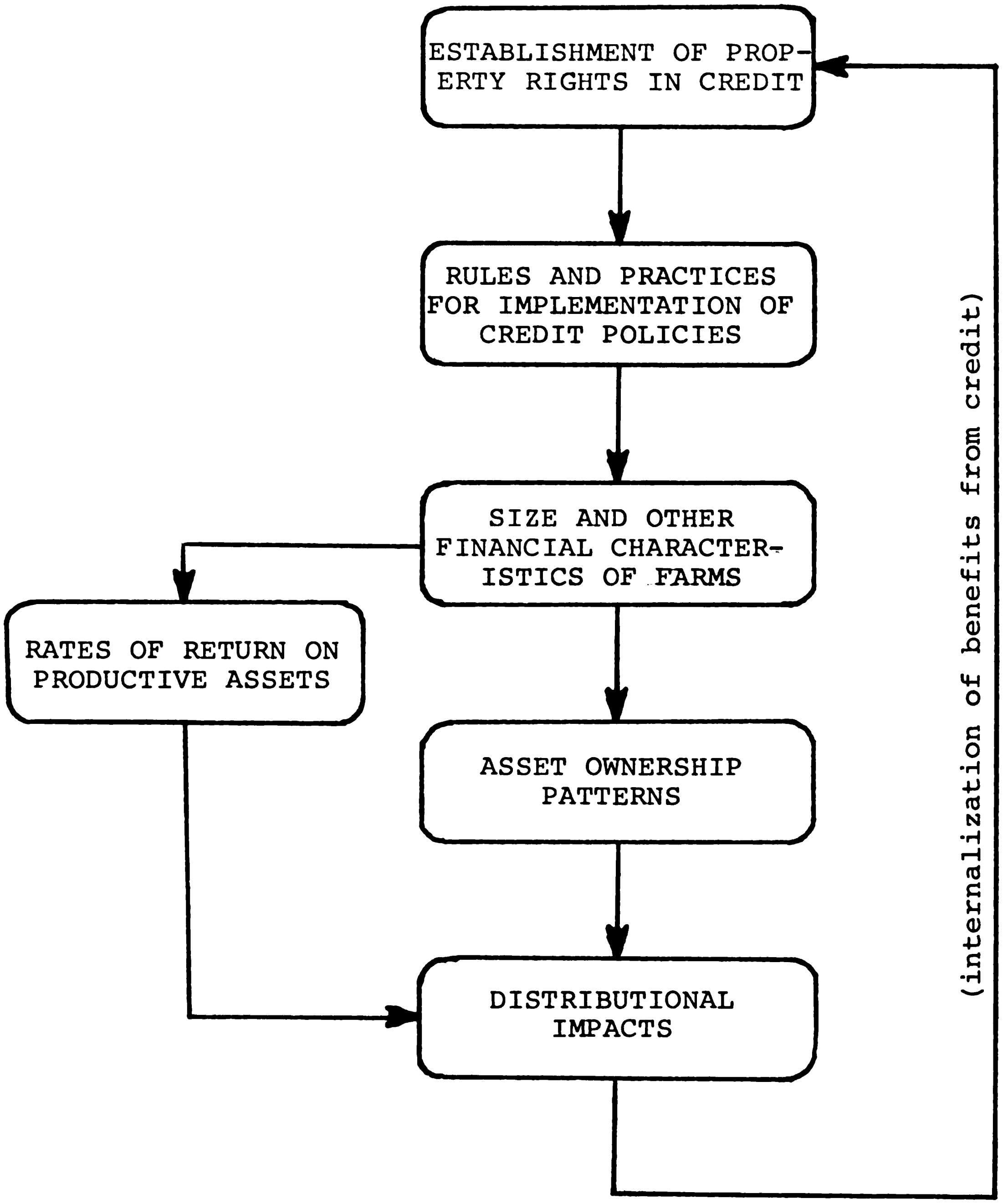

Figure 4.1. Causal Loop Diagram of the Distribution Process for Considering Alternative Credit Policies

4.4.1 Size and Other Financial Characteristics of Farms

An important link in the distribution process as outlined in figure 4.1 is the impact which credit policies, rules, and practices have on size and other financial characteristics of farms. Three financial characteristics of assets are of theoretical relevance to our conceptual framework; (1) liquidity, (2) leveragability, and (3) price-sensitivity.

4.4.2 Liquidity

Liquidity refers to a potential change in the value of an asset depending on whether one has made a decision to buy or sell that asset. That is one form of liquidity. In that context liquidity is a time-dependent concept in the sense that once one has decided to sell an asset the present value of the asset may depend upon how long it takes to find a buyer.

Baker and Hopkin (1969) used a definition of liquidity which determines the degree of liquidity within the context of the value of the firm.

> We conceive the value of a firm to be the amount that could be obtained from sale of the firm as a complete aggregate. The sale of asset(s) within the firm will in general reduce the value remaining in the firm by as much as, or more than, receipts from the separately sold asset(s). If the cash acquired from separate sale equals exactly the loss in firm value, one concludes that the asset(s) is(are) perfectly liquid. For those assets whose sale would contribute less to cash than to the reduction of remaining firm value, the asset(s) is(are) less than perfectly liquid. (p. 1058)

While the above operational definition of liquidity applies to the sale of an asset, it is also important to consider an operational definition of how credit contributes to firm liquidity, given that many assets are incorporated into the firm's financial structure as a basis for credit, and not in anticipation of separate sale. Operationally, then, we can distinguish between a <u>sale</u> form of liquidity and a <u>credit</u> form of liquidity.

The concept of "credit-liquidity" is not new. It was first suggested by Barry and Baker (1971) as one important means by which farm managers can reduce risk. Credit-liquidity can be operationalized if we consider the value of an asset from its potential sale.

The use of assets to obtain credit is expected to increase the financial base of the firm by some proportion of the potential sale value. If the credit reserves acquired are equal to the value of the assets then those assets are said to be perfectly credit-liquid. To the extent that this is not the case the asset or portfolio of assets are less than perfectly credit-liquid.

As suggested above the credit form of liquidity is both more available and more frequently used. Liquidity has value to the firm since we can assign it either an explicit (interest) cost or an opportunity cost. In the case of credit-liquidity the value of the financial characteristic is suggested to derive in part from rights established under alternative credit policies, rules, and practices.

4.4.3 Leveragability

Leveragability is defined as the ability of the owner to borrow against the value of an asset. For example, farmland and farm machinery provide leverage while growing crops typically do not. Leverage is increased when credit is used to purchase an asset. That credit may be obtained through a loan secured by another asset, or by an unsecured loan.

Leverage and credit-liquidity are near perfect substitutes in the financial management of the firm. While unused credit provides credit-liquidity, the exchange of credit for loans decreases credit-liquidity and increases financial leverage. This suggests that there are some important costs/returns trade-offs to be considered by the farm manager. The costs associated with greater credit-liquidity are interest costs of maintaining reserves and opportunity costs of using those funds (the increased returns to be gained by the use of leverage). The returns associated with greater credit-liquidity are derived from reduced exposure to risk (the increased costs which would be incurred if a higher leverage position were taken instead).

A frequently used operational definition of leverage is the ratio of total debt to total equity. Of course there are a number of such leverage ratios possible for a firm, ranging from a lower limit of zero (no debt) to some upper limit. The upper limit is expected to be a function of both the type of loan being made (real estate, nonreal estate, operating) and the amount of financial risk a lender is willing to assume at a given rate of interest.

Within the observed range of leverage ratios what factors can be identified which account for the observed differences between firms? Real estate provides for potentially greater leverage than nonreal estate. One possible explanation for this involves a consideration of security requirements.

> While collateral security is almost universally required for real estate loans, little unanimity of opinion exists among lenders concerning collateral for nonreal estate loans. Some lenders make a large percentage of their nonreal estate loans on an unsecured basis; others make few such loans that are not protected by specific collateral. There are also wide differences geographically that seem to be a matter of custom. (Nelson, et.a., 1973, p. 244)

As a consequence, those firms which control greater real estate assets may theoretically derive greater leverage potential.

Leverage is a financial characteristic which has value to the firm. Although no explicit cost can be attached to the use of leverage beyond interest charges, the use of leverage does have an explicit return associated with its use. The use of debt acts as a multiplier with respect to the marginal value product of those resources which are added to the firm. The economic value of leverage is expected to originate with the rights exercised by the owner.

Credit policies, rules, and practices place important restrictions on the use of those rights.

4.4.4 Price-sensitivity

Price-sensitivity of an asset depends upon how freely the market value of an asset appreciates or depreciates with changes in the general level of prices. Real estate, farm machinery and equipment, livestock, and crop inventories exhibit varying degrees of price-sensitivity. Farm real estate is certain to be considered as the most price-sensitive of the physical assets listed, although livestock and crop inventories show greater price volatility.

Price-sensitivity is potentially valuable to farmers operating subject to a capital constraint. Increases in the price level and accompanying increases in value-appreciating assets increase the purchasing power of those assets relative to other sources. Equity increases become the property of the asset owner. Traditionally these equity increases are thought to be of value when they accrue as capital gains when the asset is liquidated. Yet, price-generated increases in equity potentially have another value.

Land price-generated increases, for example, can be viewed as increased reserves which improve financial ratios (reduce the degree of financial leverage) and/or increase financial flexibility. In this way price level increases can yield associated increases in equity value on a flow or annual basis.[8]

An important precondition for price-sensitivity to have a continuing impact of firm growth is that credit policies be in existence to provide additional credit to the borrower on the basis of the improvement in financial ratios. If these credit policies were not enacted there would be no monetary advantage to the farmer in addition to the right to the capital gains he would receive at the time of sale. Credit policies, rules, and practices are once again influential in determining the rights to benefits from credit. As long as the terms of the loan are met asset value appreciation, potential or realized, is the right of the owner as well as the right to be taxed at the lower capital gains rate.

4.4.5 Size Distribution of Farms

The foregoing discussion of financial characteristics of assets and firms in the context of credit policies has relevance to the issue of size distribution of farms. Although several measures of size are possible, value of total assets controlled or alternatively equity are useful to consider, as well as the composition of those assets.

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[8]For further discussion of this point see, Plaxico and Kletke, (1979), pp. 327-328.

It has been argued that the initial resource endowment is a crucial factor in realizing the benefits from credit. Prospects for growth in size of the farm operation are intimately connected to credit policies, rules, and practices which may offset uneven initial distribution of factor ownership. In the process of redistributing the access to credit, credit policies effectively modify the size distribution of farms, initially and perhaps for subsequent periods. One motivation for increasing the size of operation may lie in the empirical evidence that increasing, or at least constant, returns to size may exist over significant ranges of farm production activities (Scott, 1977; Madden, 1967).

One possible explanation for differences in rates of expansion and financial growth between large, high-equity and small, low-equity farms might be the initial equity position and the debt-servicing obligation rather than farm size factors such as acreage. This points to an important consideration of initial leverage position versus initial endowment of land resources and how credit policies affect farm growth rates under variations in each factor.

4.4.6 Credit Distribution, Asset Distribution, and Rights Distribution as a Distribution Process

Our conceptualization of the distribution process advocates that several distributions (viz. credit, asset ownership, and rights) are variables which are germane to the distributional impacts of credit policies, rules, and practices. Moreover, those distributions are affected either directly or indirectly by technological change and changes in the levels of prices.

There exists a close relationship between property rights and pecuniary externalities (external costs and benefits which can be expressed in monetary terms and whose effects can be transmitted through the market). Property rights perform important allocative and distributive functions as they facilitate the ability of firms and households to internalize those effects.

> Changes in knowledge result in changes in production functions, market values, and aspirations. New technologies, new ways of doing the same things, and doing new things - all invoke harmful and beneficial effects to which society has not been accustomed ... property rights develop to internalize externalities when the gains of internalization become larger than the cost of internalization. Increased internalization, in the main, results from changes in economic values, changes which stem from the development of new technology and the opening of new markets, changes to which old property rights are poorly attuned. (Demsetz, 1967, p. 350)

The importance of the link between technology and credit has been recognized for some time. Tinnermeier (1973) states that, "agricultural credit will be ineffective without technology which is profitable to the farmer."[9] During technological change the formerly external benefits, which accrue as increased output, are internalized by the

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[9]Tinnermeier (1973), p. 94.

adopting firm through its borrowing and investing activities. Liquidity and leveragability of the firm's assets are instrumental to the internalization of those benefits.

Price level changes have been shown to be related to increases in the firm's equity. If the firm already owns the price-sensitive assets it has effectively internalized the benefits. However, a farmer who is just getting established may lack ownership and control. One investment strategy is to consciously seek out opportunities to invest in value-appreciating assets. There are definite limits to which that financing strategy can be pursued. One important limitation is the cash flow required to service the increased debt.

Price level and technological changes are two external economic forces which redistribute costs and benefits among firms and households. The maintained hypothesis which serves as the basis for our conceptualization of the distribution process is: In a dynamic economic environment characterized by technological change and price level increases the distribution of monetary benefits (and costs) is internalized in accordance with existing rights as they are established or subsequently modified by credit policies, rules, and practices.

4.5 Credit Policies and Their Implementation

Although the conceptualization is sufficiently general to be useful for evaluating several lending alternatives, two primary lending criteria are under examination here. These two criteria form the basis for several credit policy alternatives. Those two criteria are repayment or debt-servicing capacity and risk-bearing capacity of the firm. The importance of these two criteria in credit policy formulation is well recognized.

> The conventional processes of achieving owner-operatorship are being supplemented by various forms of low-equity financing. Probably most critical in our present situation is a need for more emphasis on productivity of resources and repayment capacity, in contrast to a traditional emphasis on equity of the borrower. This development in lending practice is of particular significance in that it still has relevance when resource ownership and operatorship are at least partially separated. Government programs (largely in Farmer's Home Administration) have pioneered the development and application of this concept and associated techniques to agricultural credit. In the purely commercial credit field it still has application but encounters legal and institutional limits. (Staniforth, 1972, p. 58)

The loan contract is an instrument which interprets credit policy. The contractual arrangement is an implementation of the particular credit policy design which is chosen. This implementation is carried out by means of several lending rules and practices. Four general rules can be identified:

1. screening rules which select viable borrowers from among all potential borrowers, that is to say who qualifies for credit,

2. lending limitations which vary by type of loan, security offered, amount of borrower assets, repayment potential, etc.,
3. terms of repayment, that is, length of repayment period, schedule for repayment, options for refinancing, etc., and
4. specification of loan uses where funding is tied to specific use categories, (e.g., land or dwelling improvement, purchase of machines and implements, storage facilities, operating capital, etc.).

These four rules represent different, yet interrelated, types of credit regulations. Shaffer (1979) suggests that such regulations structure the opportunity set, modify behavior and shape performance in important ways. The distribution process outlined above is such a regulatory process. The rules and practices of lenders regulate the distribution of credit using the four types of rules identified.

Shaffer identifies five types of regulations two of which are relevant here. Lenders allocate credit according to custom and standard operating procedures. Statutory law has to be considered in the case of usury laws, which place legal limits on the rate of interest which can be charged, and auxilliary legislation such as "truth in lending" laws. Our main concern here is with informal rules and practices (the customs and standard operating procedures) which often become formalized in the loan contract.

Lending limitations represent frequently used standard operating procedures of lenders for dealing with risk.

> Interest rates on farm loans from the cooperative Farm Credit System, rural banks, and other lenders may increase to build reserves for expected loan losses, but these rates seldom vary among borrowers. The brunt of risk pricing for farm debt is expressed in terms of loan limits that differ among borrowers - a more inefficient and less effective pricing mechanism. (Barry and Fraser, 1976, p. 294)

These standard operating procedures have been accompanied by lenders' requirements for higher margins of borrower equity and additional security.[10]

Rules of thumb are frequently used by lenders to implement these credit policies. These rules provide for a simple, uniform means of making decisions about when and when not to lend. For example a loan application can be approved or disapproved on the basis of the borrower's net capital ratio (total assets/total debt), or debt:equity ratio (total debt/total net worth).

It is customary for a loan contract to include a schedule of repayments indicating both the amount of each installment and the date on which it is due. The terms of repayment reflect lending custom in the sense that amortization schedules, length of repayment, and even options to refinance a loan often reflect the same business practices and lending arrangements which have traditionally been used. For example, real estate mortgages traditionally

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[10] Barry and Fraser (1976) suggest that these and other conservative lending practices have increased the effective costs of debt.

have a life of 20 to 30 years with equal amortization payments over the life of the loan. Variations to extend the length of loan or allow for an accelerated or deferred loan payment schedule are possible, but not frequently employed.

A second aspect of the terms of repayment is the amount of down payment which is customarily required of the purchaser to secure financing of an asset. It is well recognized that the larger the down payment, the smaller are the necessary installments to amortize the loan. Some borrowers may not have the cash to make a conventional down payment of, say 20 percent. These same borrowers may, however, have sufficient income-generating potential to make the required repayments if a lower percentage down payment were instituted.

Specification of loan uses represents another customary lending practice as observed by Baker (1968).

> We found primary lenders (banks and production credit associations) to prefer loans that are (1) self-liquidating and (2) asset-generating.
>
> A self-liquidating loan is one in which the proceeds are so used that the payoff occurs within the maturity of the loan. An example is a one-year loan for nitrogenous fertilizer. An asset-generating loan is one in which the proceeds are used to add an asset that can be formally pledged as a lien in support of the loan. A machinery loan has this property. (p. 519)

Lenders' preferences for loans with these two characteristics indicate that the specification of loan uses may be a more subtle means of regulating the distribution of credit among borrowers. Although no explicit regulation is in force, the lender's discretionary control over credit for certain uses represents an important lending custom. Preference for both self-liquidating and asset-generating aspects may be interpreted as being favorable to loans which have the potential for both debt-servicing and risk-bearing, although this need not be the case.

4.6 Summary

A conceptualization of the distribution process largely reflects what is taken into account. A "systems approach" integrates aspects of institutional economics and marginal productivity theory of distribution.

Our conceptual framework considers the benefits and costs of credit as they are internalized through rights to income, assets appreciation or depreciation, and other financial benefits. It is useful to view credit policies as effectively modifying the distributions of credit, assets, and ultimately rights to benefits from the use of credit as suggested in the causal loop diagram presented. The maintained hypothesis is that the benefits and costs of credit in a dynamic environment are internalized according to the exercise of existing rights, as they are established or subsequently modified by credit policies, rules, and practices. Implementation of credit policies through enactment and institution of lending rules and practices leads to important modifications of intended credit policy distributional impacts.

The distribution process identified is functionally similar to other regulatory processes which employ customs and standard operating procedures to implement policies. The distribution process is evolutionary in nature as lending rules and practices gradually change over time. To analyze the distributional impacts generated under alternative credit policies there is a need to identify the major participants, their motivations and behavior, and specify in greater detail the interactions between participants in the distribution process over time.

CHAPTER V

A Mathematical Model of the Distributional Impacts of Credit

5.1 Introduction

The previous chapter outlined a conceptualization of the process by which credit has distributional impacts. Credit is hypothesized to have two major impacts: (1) an income redistributional impact and (2) an asset redistributional impact. Both impacts are hypothesized to be more pronounced in a dynamic environment where productive opportunities and the distribution of assets change over time. In addition the cumulative impacts of credit policies are expected to be quite different depending upon the degree to which those policies emphasize the value of assets controlled or income-generating capacity of the borrower. In this chapter a theoretical model will be developed which can be used to illustrate those differences.

Dynamic elements of the distributional process, as identified, will be emphasized in the theoretical model. Those elements include; (1) changing commodity price distributions and price expectations, (2) growth in the value of assets, (3) technological change, and (4) changes in the availability of credit.

5.2 Model Participants and Their Economic Behavior

Major components of the theoretical model include; (1) the participants, (2) the markets in which they interact, and (3) the assets which they control. Three general types of participants are identified in the model; (1) representative farm firm-households, (2) a lending institution, and (3) a government. These actors participate in three markets; (1) a commodity market (a real market), (2) a market in physical assets (also a real market), and (3) a market in financial assets (a paper market). Three types of assets are considered in the model; (1) real estate, (2) all other productive physical assets (machinery, equipment, and crop inventories), and (3) cash. The financial market consists of transactions in cash, ownership claims, and contracts. The physical assets market is a market in durable capital and nondurable inputs. Finally, the model has only one commodity - corn.

5.2.1 Farm Firm-households

Farm firm-households are complex, integrated economic decisionmaking units which undertake several activities to simultaneously meet the current needs of the farm business and household. They are also planning units making decisions about future activities with limited information about what economic conditions will prevail as those plans are executed.

In each period the needs of the business and household compete for basically the same set of resources. Each firm-household is assumed to derive utility from consumption and net worth.

Firm growth is achieved through numerous decisions and economic activities which place varying weights on consumption and net worth in the utility function. Consumption and net worth in turn are complex variables which depend upon preferences for liquidity, risk preferences, and minimal or subsistence requirements.

Firm-households participate in all three markets. Their portfolios consist of ownership claims to physical assets, crop inventories, and cash reserves. The economic activities of firm-households include:

1. production and sale of corn,
2. investing in physical, productive assets from earnings,
3. borrowing and repaying loans,
4. earning off-farm income,
5. paying income and social security taxes, and
6. consuming durable and nondurable goods from after-tax income.

5.2.2 Lending Institution

The credit institution participates in the market for financial assets.[11] It determines and implements credit

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[11]For our purposes this lending institution (continued)

policies in accordance with several broad objectives. Two suggested objectives are; (1) to minimize the costs of lending activities and (2) to remain viable as a lending institution. Those two goals may conflict when specific credit distribution policies are considered. Allocating large amounts of credit to a few borrowers may minimize the costs of lending. Yet, in a risk situation where repayment is not guaranteed the lender may become insolvent if a few such borrowers default by nonrepayment of their loans. Conversely, a policy of allocating smaller amounts of credit to all borrowers drives up transaction costs for the lender.

Economic activities of the lending institution are initially assumed to be quite simple. The lender provides cash balances in exchange for credit. In turn repayment is received for the principal amount loaned plus an interest charge. The lender's portfolio consists of cash and financial contracts.

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[11](continued) abstracts from individuals and other private lenders who finance the transfer of real estate and some nonreal estate through contract for deed or other informal means of financing. That is not to imply that private individuals are of no consequence to the distributional impacts which are under investigation. These individuals and other private lenders held approximately 40 percent of farm real estate debt in the U.S. from 1960 to 1978 (Board of Governors of the Federal Reserve System, 1977, pp. 14-15). Their role has been somewhat less significant in the area of farm nonreal estate debt. The concern here is with formal lending institutions such as commercial banks, Federal Land Banks, Production Credit Associations, and the Farmers Home Administration. The lending institution being described is representative for those formal lenders.

The behavior motivations of the lender are expected to be different from those of the borrowing farmer. Unlike the farmer, the lender does not participate in profit expectations. Also, the lender may be asked to finance the acquisition of a long-term asset with loans of a shorter maturity. The payoff period for the lender may in this case be significantly shorter than that for the borrower (Baker, 1968).

5.2.3 Government

Government participates in two of the three markets - the commodity market and the financial market. A highly simplified set of behavioral assumptions is made about the government. Its objective is to stabilize returns from farming for farm firm-households. To accomplish that goal the government uses a support price program which operates to set a floor price and a ceiling price for corn. Support prices are operationally set to a percentage of the cost of production (excluding land charges) plus an arbitrary percentage rate of return on land to cover taxes and maintenance costs.

To finance its commodity programs the government collects income taxes from farm households in each period. In addition to cash (in the form of tax receipts) the government portfolio consists of contracts with farms for delivery of the crop inventories which are being stored on farms.

Our description of the participants and their behavioral characteristics is purposely simplified in both behavior and organization. This degree of abstraction is thought necessary to focus on the essential distributional impacts of credit policies in an otherwise complex dynamic economic environment.

5.3 A Systems View of the Representative Farm Firm-household

Representative farms have already been briefly identified in terms of their behavioral characteristics and financial activities. There is still a need to consider the firm-level financial structure within which those behavioral interactions occur.

Figure 5.1 is a block diagram which illustrates the financial structure for a representative farm. Block diagrams symbolically use blocks to denote physical and behavioral processes, or sets of interactions. The arrows connecting the blocks represent financial flows. Inputs (stimuli) are shown as arrows into a block, and outputs (responses) are indicated by arrows which leave a block. With the exception of the production process the connecting arrows are cash flows. In this way the diagram is useful as a modified cash flow approach to the modeling of the impacts of credit.

Decisions about which processes to include in the diagram were based upon economic theory and other modeling

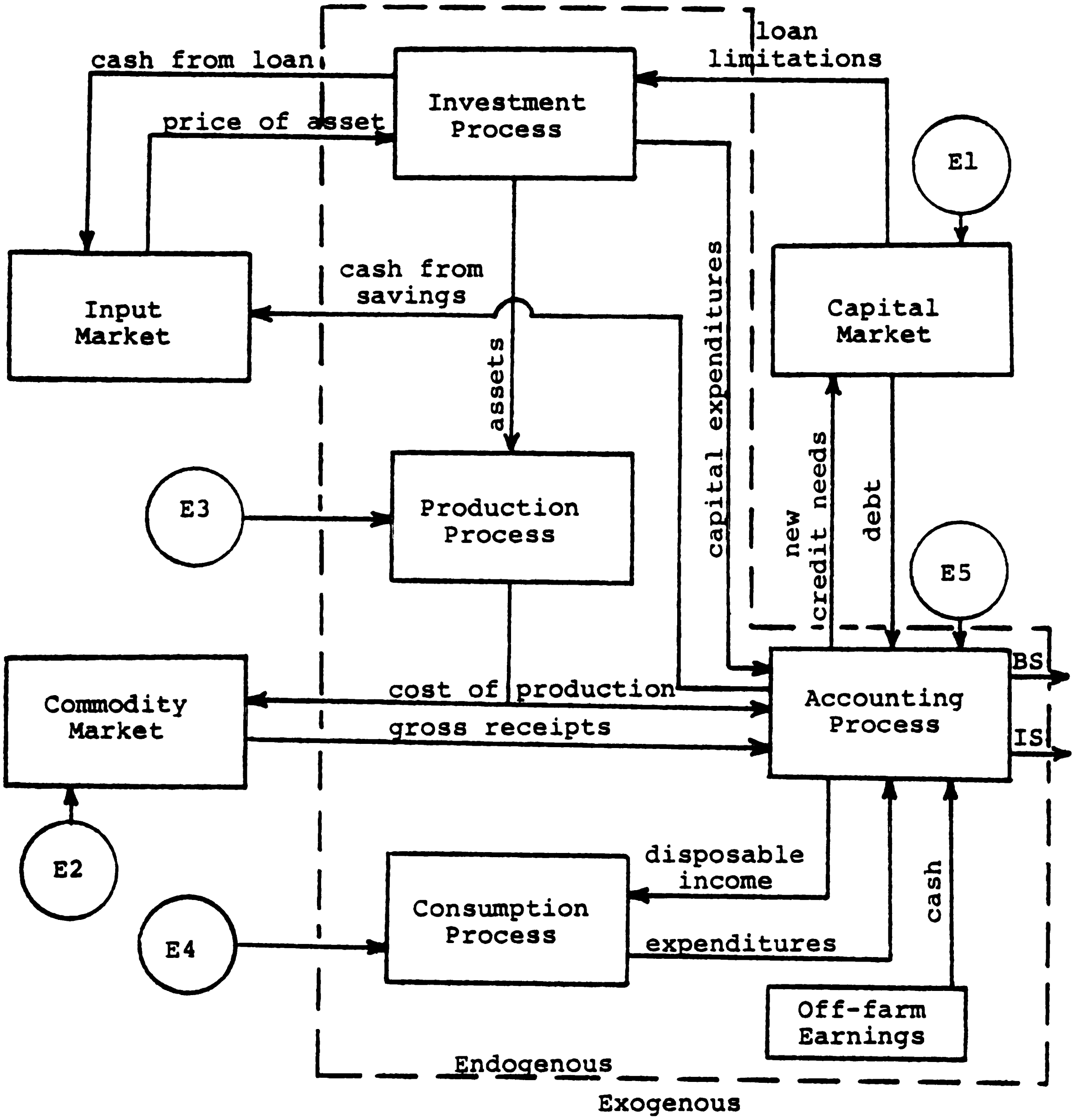

Figure 5.1. General Block Diagram of Representative Firm and Firm-Household Financial Structure

considerations. For example, theory of the firm suggests that the rate of investment will affect farm production capacity and the rate of output. Similarly, consumption levels affect the availability of funds for reinvestment in the farming enterprise. Each block in the diagram represents one or more functional relationships or equations which relate inputs to outputs.

The block diagram provides for an emphasis on financial structure, yet requires that a certain amount of detail be omitted. Processes such as production and investment are structurally different from market processes such as the commodity and financial markets. Conceptually, the diagram may be inadequate for a detailed consideration of farm-level structure. It does, however, identify the major linkages between internal processes of the farm and certain key markets.

Boundaries of the farm firm-household are indicated by the broken line. The boundaries illustrate the extent to which managerial decisions and control are exercised in the allocation of resources within the farm. In this formulation the exogenous factors and policy parameters are: E1 (credit policy limitations, interest rates), E2 (government programs), E3 (weather, technological progress), E4 (price levels, changes in price levels), and E5 (taxes, changes in price levels).

5.4 Specification of the Theoretical Relationships

Numerous alternative theoretical models could be specified and used to illustrate various aspects of the conceptual approach described in Chapter IV. To integrate the production, investment, and consumption activities of the firm-household unit with credit policies and government support price policies, however, requires a somewhat unique set of model relationships. What follows is a mathematical description of the theoretical relationships which were identified in figure 5.1. The theoretical arguments draw from several sources: Boehlje and Griffin, 1979; Henderson and Quandt, 1971; Vickers, 1968; and others.

5.5 Production and Cost Relationships

A simple production function can be specified for a farm producing a single output, Q, from two variable inputs, X_1 and X_2, and a fixed level of service inputs, F, from a durable factor as follows:

(5.1) $Q = f\ (X_1,\ X_2,\ F)$

The rate at which services are extracted from the durable during the year is given by the function,

(5.2) $F = F\ (X_3,\ I|S)$

where X_3 = a variable input

I = level of net investment during the year

S = beginning stock of the durable in the current year.

Net investment is chosen instead of gross investment since the rate of depreciation is not explicitly considered.

The variable cost function, C, is defined for varying levels of X_1 and X_2 as the least-cost combination of those inputs for given levels of Q and F.[12]

(5.3) $C = C\ (Q, F)$

Variable costs as specified in equation 5.3 comprise an important part of the total production costs. Total production costs include other costs which are independent of the level of output. An expression for the total costs of production is,

(5.4) $TC = VC + MC + OC + MGT + LC$

where, TC = total production costs

VC = variable costs

MC = machinery ownership costs

OC = overhead costs

MGT = management costs

LC = land charges

Equations 5.3 and 5.4 represent static relationships which hold for the current period. A dynamic total cost relationship can be specified as,[13]

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[12]The variable cost function can be analytically derived from the production function, the cost equation (for the variable inputs) and the expansion path. See Henderson and Quandt (1971, p. 84) for such a derivation using a two-factor Cobb-Douglas production function.

[13]Dynamic in this context refers specifically to the fact that current values of the variable depend upon past values of that variable.

(5.5) $TC_t = TC_{t-1} (1. + \theta_1)$

where θ_1 = a parameter for the annual rate of increase of total costs, $0 \leq \theta_1$

The production relation in equation 5.1 could, alternatively, be interpreted as a function of the productive assets of the farm. Reformulating equation 5.1, the production relation for the t-th period is,

(5.6) $Q_t = g_t (A_t)$

$= \phi A_t (1. + \theta_2)^{t-1}$

where, A_t = total productive assets in period t, in dollars

= (nondurable + durable + real estate)

θ_2 = a parameter to account for rate of technological change in the form of increased yields per unit of input, $0 \leq \theta_2$

ϕ = yield in bu./acre

Total productive assets, A, represents a set of inputs which is combined in those proportions which are necessary for the firm to operate along its theoretical expansion path. A necessary condition for the firm to operate along that growth path is,

(5.7) $-dX_i/dX_j = P_j/P_i$

Equation 5.7 simply states that for a firm to produce a desired level of output in a least-cost way, it should combine those inputs in such a way as to equate the ratio of the marginal products to the ratio of the input prices.

This result from static production theory assumes that all net investments occur out of the firm's own internal financial resources.

5.6 Investment and Financing Relationships

Consider now the possibility that the firm cannot obtain all the productive assets it needs without a limit. Rather, the firm must rely on borrowed funds to finance (at least partially) the purchase of the needed inputs. The new optimizing condition is,[14]

$$(5.8) \quad -dX_i/dX_j = \frac{P_j + m_j}{P_i + m_i}$$

where, m_i, m_j = the marginal costs of finance for each unit of input acquired using borrowed funds, for the i-th and j-th inputs, respectively.

If the ratio m_j/m_i equals the ratio P_j/P_i, the same result obtains as in equation 5.7. There exists, however, the opportunity for a significant departure from the expansion path combination of inputs, depending upon lender responses to, and credit policies concerning, loan requests to finance the needed investments. In this way credit rules and practices become potentially important determinants of the marginal costs of financing.

The most readily recognized factor affecting the marginal cost of financing is the rate of interest charged on

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[14] C.B. Baker (1968), pp. 508-513.

the loan. Interest rates may vary by type of loan, and the kind of assets being financed (e.g., loans to finance purchase of operating inputs versus those to purchase durable inputs).

In addition to these explicit cost factors we could consider the effects of loan limits. Suppose that the rate of interest for all loans is fixed at the market rate. Lenders may exercise varying loan limits depending on the type of loan. Credit may be absorbed more rapidly in the purchase of certain lumpy, indivisible assets. If unused credit has value to the firm, the amounts of each input purchased by the firm will reflect the implicit costs associated with loss of liquidity.

There are other potential costs of financing; (1) the added risk which accompanies a higher leverage position, and (2) the added risk that future credit may not be available if credit is exhausted earlier.

Credit policies which alter the effective cost of inputs acquired by the firm are expected to lead to changes in the productive organization of the firm. The assumption of equation 5.6 that production occurs with optimally-combined sets of assets appears quite restrictive when considered in the context of various credit policies and associated financing costs. An alternative to scale adjustments is to use additional variable inputs to substitute for land. Some important substitutes for land are biological and chemical inputs (e.g., new seed varieties, fertilizers, pesticides, and herbicides).

Figure 5.2 illustrates the long run variable cost function of equation 5.3 as farm size (number of tillable acres) increases the variable costs decline initially at a rapid rate and then at a gradually slower rate. This cost curve is consistent with that found on Illinois farms by Scott (1977), and Mueller and Hinton (1975) for corn. These economies of size are eventually exhausted according to Scott.

In the context of credit policies which place limitations on the amount of credit available to purchase land, machinery and other lumpy inputs an important alternative is the purchase of land substitutes. In any given period the producer can apply more of the variable inputs and move along the short run marginal cost curve which becomes the individual firm's supply curve. Theory of the firm suggests that the profit-maximizing producer moves along the upward sloping portion of the marginal cost curve to the point where the marginal output cost just equals the market price. Figure 5.3 illustrates the firm's short run marginal cost curve and the theoretical profit-maximizing level of output for the perfectly competitive producer.

An explicit expression can be derived for the marginal cost curve in figure 5.3. Quantity produced is defined as the yield per acre, Y, multiplied by the number of acres cultivated, L.

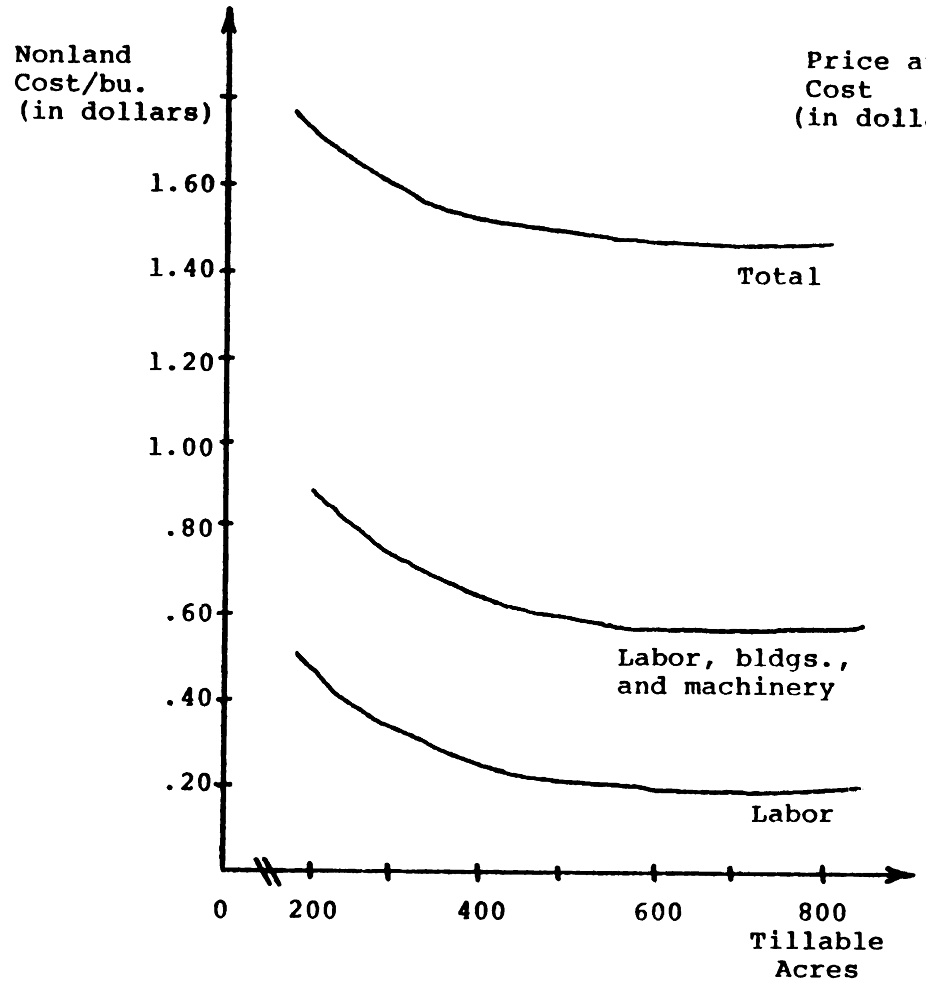

Figure 5.2. Nonland Cost/bushel Versus Tillable Acres

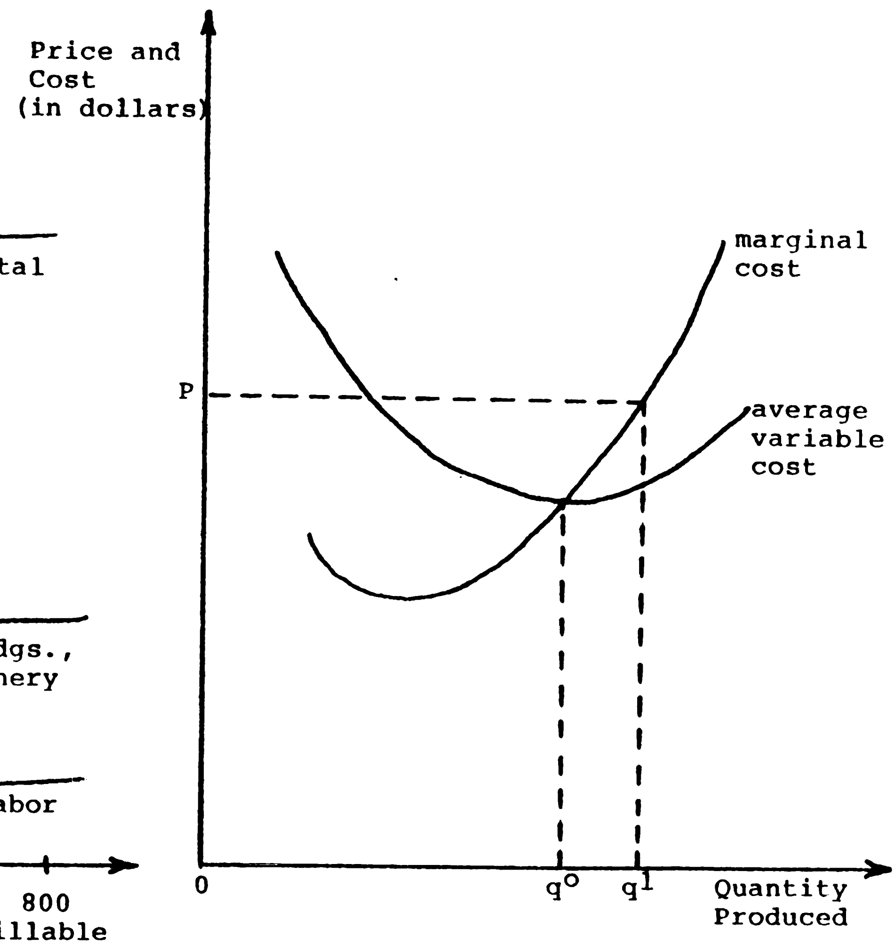

Figure 5.3. Theoretical Short Run Marginal Cost and Average Variable Cost Curves of the Firm

(5.9) $Q = Y \cdot L$

Yield can be expressed as a function of the amount of variable inputs used per acre.

(5.10) $Y = Y_o X^{\beta}$

where, Y_o = some initial level of output per acre, a constant

X = variable inputs per acre, measured as the variable assets used

β = a yield response parameter, $0<\beta<1$

Solving a cost equation for X, substituting into equation 5.9, then solving for the cost variable, C, we have the short run cost function. The marginal cost function is derived by differentiating with respect to the level of output,

(5.11) $$\frac{\partial C}{\partial Q} = \left[\frac{P_X}{Y_o \beta L} \cdot \frac{Q}{Y_o L}\right]^{1-\beta/\beta}$$

Since a dollar of variable inputs has a price of one, equation 5.11 can be simplified and equated to the price of the output to obtain the profit-maximizing level of variable inputs, X^*, and the associated yield, Y^*,

(5.12) $Y^* = Y_o \cdot (P_Q \beta L)^{\beta/1-\beta}$

(5.13) $X^* = (Y^*/Y_o)^{1/\beta}$

Cost functions such as in equations 5.3 and 5.11 can be usefully combined to illustrate a firm level growth process. While a firm may continue to expand by acquiring more acreage it may not always have the financial resources to do so. If credit policies restrict a firm from making these lumpy investments in land the farmer may elect to use available liquid assets and operating credit to purchase greater variable inputs to substitute for land. The costs of increasing yields and total output with variable inputs involve higher cost alternatives as input substitution becomes more difficult. This suggests the upward sloping marginal cost function as in equation 5.11.

The behavioral assumption underlying the implied ratchet-like growth process is that the farmer determines first if he is able to purchase additional land with equity capital and long term credit. If those financial resources are not sufficient to acquire land, then he utilizes his liquid assets and available operating credit to move up the short run marginal cost curve toward the profit-maximizing level of output using variable inputs to increase yields. The extent to which the farmer is able to purchase the additional variable inputs to increase yields depends upon his available liquid assets and short run credit policies. Each year the farmer is faced with the same set of investment alternatives. In implementing this behavior it will be assumed that the farmer is not able to invest in both land and increased variable inputs in a given year.

5.7 Investments and Value of the Firm

The value of an asset or the firm in the current period, V_o, can theoretically be found by capitalizing the expected future stream of income at the appropriate rate.[15] If we consider just the income stream and ignore the value of the asset or firm at resale, we have the valuation formula,

$$(5.14) \quad V_t = E(R_t)/k_t$$

where, $E(R_t)$ = the expected return in period t

k_t = the capitalization rate

The expected income stream is defined as

$$(5.15) \quad E(R_t) = \left[E(P_t) - TC_t\right] \cdot Q_t - rD_t$$

where, $E(P_t)$ = the expected price in period t

TC_t = total production costs in period t

Q_t = output level in period t

rD_t = the interest on debt in period t

The capitalization rate, k_t, is specified as a function of several other rates following the specific functional form developed by Lee (1976). The general functional relationship is,

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[15]If R is the expected return in each period and r is the interest rate on borrowed funds, then current value is comprised of two parts; (1) the discounted value of the asset or firm when sold, $V_o/(1+r)^n$, and (2) the discounted earnings,

$$(1) \quad S = \frac{R}{(1 + r)} + \frac{R}{(1 + r)^2} + \cdots + \frac{R}{(1 + r)^n}$$

Since equation 1 is the sum of a geometric series, it can be simplified. An equivalent expression for S is,

$$(2) \quad S = R\left[1 - (1 + r)^{-n}\right]/r$$

Substituting this value for S into the two-part valuation formula and taking the limit, we have an expression similar to that in equation 5.14,

$$(3) \quad V_o = R/r$$

with the interest rate, r, substituting for the capitalization rate, k.

(5.16) $k_t = k$ (CC, MTR, r, DP, GNI, GLV)

where, CC = the opportunity cost of capital, a percentage

MTR = the marginal tax rate, a percentage

r = the interest rate, a percentage

DP = the down payment required on a real estate loan

GNI = the expected rate of growth in net income

GLV = the expected rate of growth in land values

Lee developed a discounted cash flow approach to arrive at a formula for the maximum bid price for land. The maximum bid price is the maximum price that a prospective buyer of farm land could afford to pay if he based his decision to invest or not to invest on net present value calculations as suggested by Barry, Hopkin, and Baker (1979, Chapter 13).

The opportunity cost of capital variable, CC, is a function of the variability of output price and the risk free rate.

(5.17) $CC = MAX\ (V_1, V_2 - \delta/\sigma^2_{P_t}$

where, V_1 = the risk free rate

V_2 = the maximum allowable opportunity cost of capital

$\sigma^2_{P_t}$ = variance of the price expectations distribution

δ = a parameter to account for risk aversion of potential land purchasers, $\delta > 0$

Since potential land buyers are assumed to be risk averse the maximum opportunity cost of capital variable is reduced to account for output price risk. The effect of increasing σ (while holding V_2 constant) is to decrease the after-tax cost of capital, CC, which in turn increases the maximum bid price for land in the model developed by Lee.[16] This appears to be a logical result. A decrease in the opportunity cost of capital would increase the likelihood that the yield or internal rate of return on land would exceed the opportunity cost of capital making land an acceptable investment alternative.

5.8 Household Consumption Activities

Expenditures for family living are significant to the model of distributional impacts of credit for two reasons. First, consumption both directly and indirectly affects the ability of the farm to acquire additional productive assets. Living expenses act as a direct drain on cash flow and, thereby, reduce the debt-servicing capacity of the firm in the current and future periods. Secondly, family expenditures reflect the standard of living the farm family can expect to achieve as expansion occurs.

Considerable controversy has surrounded the household consumption function. Keynes (1936) noted a tendency in cross-section data for the marginal propensity to save to

[16] Op. Cit.

rise as income increased. The work of Modigliani and Brumberg (1954) and later Friedman (1957), in attempting to reconcile the apparent inconsistency between aggregate time-series data, and cross-section and budgetary data, showed that such a relationship cannot be derived from cross-section data. Modigliani and Brumberg pointed out that such differences in the propensities to consume could reflect different net worth positions of households at varying levels of income and stages of the life-cycle.

In their investigation into the distributional effects of the financial system in Mexico, Reynolds and Corredor (1976) hypothesized that the cross-sectional savings function is quite nonlinear at low levels of income, but becomes linear as incomes rise over time. As a result marginal propensities to save converge across income levels as incomes rise.

Although little research has been done on a consumption function which is easily used in farm growth models, Brake's (1968) empirical study of rural farm household consumption provides some useful information. Brake fitted a Cobb-Douglas type function to published data using after-tax income and family size as regressors. The functional form fitted to the arithmetic means of the data classes gave a reasonably good fit. Results indicated that the elasticity of current consumption out of after-tax income is approximately 0.59.

Two aspects of this empirical work provide input into our modeling effort. First, the function was fitted to after-tax, disposable income. Second, the functional form suggests that the marginal propensity to consume out of after-tax current income declines as incomes increase for the rural farm household.

The basic form of the household consumption function to be used is consistent with Brake's findings. A subsistence level of consumption is specified along with a log-linear part using after-tax income,

(5.18) $HC_t = \text{Max.}\ (S_t,\ Y_t^{\alpha})$

where, HC_t = household consumption in period t

S_t = the minimum or subsistence level of consumption for a family of four

Y_t = after-tax income

α = a parameter for the elasticity of family consumption out of current after-tax income, $0 < \alpha < 1$.

5.9 Commodity Market

A government price support program is operative in the commodity market. Price expectations are directly affected as the support price program modifies the price distribution. The price support activity provides for a dynamic price adjustment mechanism in the commodity market. Government is assumed to follow current farm policy programs which include provisions to increase the support levels for feed grains depending upon increases in costs of production. Those increased costs of production reflect changes in input prices and production technology. This support price adjustment process reflects an indexation of support prices to the rate of inflation.

The support price adjustment mechanism is specified as,

(5.19) $SL_t = G(\Pi, TC_t)$

where, SL_t = the support price level per unit of output

Π = a policy variable which specifies which costs are to be included and at what levels

TC_t = production costs per unit of output

The policy variable is specified as to the percentage of total costs of production which will be supported by the price program. Included in the support program is a mandated return to land.

Price support programs modify the price distribution by truncating the lower tail of the distribution at the support level. The modified distribution of price expectations is comprised of two parts, the portion above the support price (the first integral), and the portion below the support price (the second integral),

$$(5.20) \quad E(P_t) = \int_{SL_t}^{\infty} N(p, P_t^*, \sigma^2_{p_t^*})\, p\,dp + \int_0^{SL_t} N(p, P_t^*, \sigma^2_{p_t^*})\, dp\, SL_t$$

where, $E(P_t)$ = the price expectation in period t

P_t^* = the expected price for the normal distribution of prices assuming no support

$= P_o^* \ (1. + \Theta_2)^{t-1}$

P = the price variable, a random variable

$\sigma_{p_t}{}^{*2}$ = the variance of the normal distribution of prices

$= (\pi P_o^*)^2$

The price expectations model in equations 5.20 and 5.21 assumes that the unmodified price distribution is normal, although other price distributions could be specified.[17]

The variance of the price expectation is defined as the second moment of the modified price distribution,

$$(5.21) \quad \sigma^2_{P_t} = \int_{SL_t}^{\infty} N(p, P_t^*, \sigma^2_{p_t^*})\, p^2 dp + \int_0^{SL_t} N(p, P_t^*, \sigma_{p_t^*}{}^2)\, dp\, SL_t^2 - E(P_t^2)$$

Price supports have been shown to have an impact on asset values over time, particularly land prices (Reynolds and Timmons, 1969). The indexation of price support levels

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[17]The technique which will be used to redistribute the truncated portion of the price distribution is to stack those probabilities at the support level. This is the procedure used by Boehlje and Griffin (1979).

to costs of production provides a direct linkage between governmental support activities and the escalation of land values. Boehlje and Griffin (1979) have illustrated the potential financial impacts from alternative percentage levels of support of production costs. Indexed support prices are expected to increase the guaranteed cash flow of the farm business and reduce the financial risk. Bid prices for land and other durable assets increase. Additionally, the improved equity position which results from land value appreciation increases debt-carrying capacity, financial leverage, and the rate of firm growth.

5.10 Capital Market and Credit Policy Relationships

Two forms of credit will be considered in the numerical analysis - investment credit and operating credit. Investment credit is defined as credit used to acquire land and the machinery complement to land. Operating credit applies to those uses of funds which require cash purchases. Operating loans are usually used to purchase seeds, fertilizer, fuel, pesticides, and hire additional labor and other resources.

As suggested earlier, investment credit and operating credit are subject to credit limitations based upon (1) risk-bearing capacity of the farm (i.e., the net capital ratio) or (2) the repayment, debt-servicing capacity of the farm (i.e., expected repayment capacity). Consistent with those policy choices the following constraints are placed upon the current availability of debt capital,

(5.22) $D_t \leq \rho_1 A_t$

(5.23) $D_t \leq \rho_2 E(R_t)$

where, A_t = total assets in period t

A_t = 0_t (equity) + D_t (debt)

$E(R_t)$ = expected annual income of the firm available for debt-servicing (after consumption and taxes).

The dynamic nature of these and other credit policy choices is reflected in the movement of individual firms along the identified cost curves. From an initial resource position to a position in a subsequent period the movement of a firm along the cost curves represents a firm growth process. As the firm continues to gain control over additional resources through the availability of credit the distributional benefits of credit are realized. This dynamic financial adjustment process is conditional upon the indexation of credit availability either to the net capital ratio and risk-bearing capacity or the firm's expected repayment capacity.

CHAPTER VI

The Numerical Model

6.1 Farm Resource Situations

Three farm situations will be analyzed using the firm-household systems framework. Those three farms differ according to two resource categories - physical resource endowment and financial resource endowment.

In the physical resource dimension the major consideration is size of farm operation in terms of tillable acres. Acreage farmed represents an important aspect of size for a couple of reasons. First, the ability to generate output and farm income in an amount sufficient for current consumption and investment needs is partly constrained by the available land base. Second, the allocation of farm operator and family labor between on-farm and off-farm employments is likely to require a decision which is influenced by number of acres per laborer. This issue of on-farm versus off-farm employment is certainly a complex issue. All that is being suggested is that size of farm operation is likely to be a key variable in a consideration of resource use and availability across farms.

Initial financial resources in terms of total farm assets reflect the land base of the farm since real estate comprises the majority of all farm assets. Yet, the land base does not fully describe the financial situation of the farm firm. Various equity positions are possible ranging from zero net worth to complete equity ownership. In addition to the initial equity position the debt servicing obligation of the farm needs to be specified as an initial condition of resource control.

It is assumed that yields and land price do not systematically vary by size of farm. Based upon available data from Michigan Telfarm business summaries the former assumption is reasonable.[18] The latter assumption is somewhat harder to substantiate, empirically. Yet, if land is valued initially on the basis of its expected yield, the equal-price assumption is consistent and reasonable. These and other initial conditions are summarized later in this chapter.

Farm type A represents a small land base farmer, typical of the young, beginning operator. Due to the recent establishment of the farming operation the farm operator is assumed to have limited initial equity. Therefore, a 70 percent debt/asset ratio (30% equity) is initially assumed in this resource situation.

Farm type B is more typical of an average Michigan cash grain operation. While all three farm situations represent growing farms this average size unit is in what might more accurately be labeled the growth stage of the

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[18]Yields on farms with less than 400 acres, 400 to 800 acres, and over 800 acres showed no systematic variation by size of farm for 1977 or 1978, either on rented or owned land.

firm life cycle.[19] The land base of farm B is 320 acres as an initial condition. Financially, farm B is in a somewhat lower risk position than farm A. Farm B's operator initially has 50 percent equity in the operation.

Farm type C is representative of a well-established farmer with a 640-acre land base. The size of operation is intended to reflect a somewhat more advantageous physical and financial resource position. It is assumed that farm C has a relatively low debt obligation with a 30 percent debt/asset ratio.

Annual debt service which represents payment of principal and interest on outstanding debt is assumed to be approximately equal to 10 percent of total farm debt. Although various assumptions about the debt-service load could be made, the initial assumption will be that these costs are equal in proportion across farms.

To initialize the marginal tax rate variable it was necessary to calculate income after expenses on each farm for the initial year of the simulation and then find each farm's marginal rate in the tax table. During subsequent iterations of the model the 1979 U.S. tax table is automatically used to calculate both the amount of Federal income tax due and estimate the marginal tax rate for each firm.[20]

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[19]The life cycle of the firm is usually categorized by establishment, growth, consolidation, and disinvestment phases.

[20]Commerce Clearing House, Inc., 1978.

6.2 The Simulation Model[21]

Figure 6.1 illustrates the major components of the simulation model and the associated data requirements. Sequencing of the components represents a logical process where decisions or outcomes from preceding processes are required as inputs into subsequent, or related processes. The diagram appears to emphasize seriability of the activities, yet this aspect of the model is not strictly correct. Time is incremented only after all components of the model have been executed. If in fact all activities were completed strictly on the basis of information generated in the current period, problems of simultaneity would arise. In operation the model carries forward certain "state" variables for use in a subsequent time period. An example of this lagging of a state variable would be the acquisition of assets after net returns and value of the firm have been determined. Newly acquired inputs then become available for use the following year.

There exists a close correspondence between the simulation model components in figure 6.1 and the processes which were identified in the block diagram for the representative firm-household unit in figure 5.1. To illustrate that correspondence we shall sequentially go through figure

[21]The simulation model presented here is adapted from an already existing model developed by Boehlje and Griffin (1979). Certain modifications were made upon that model to generate the numerical results which are reported in a subsequent chapter of this study.

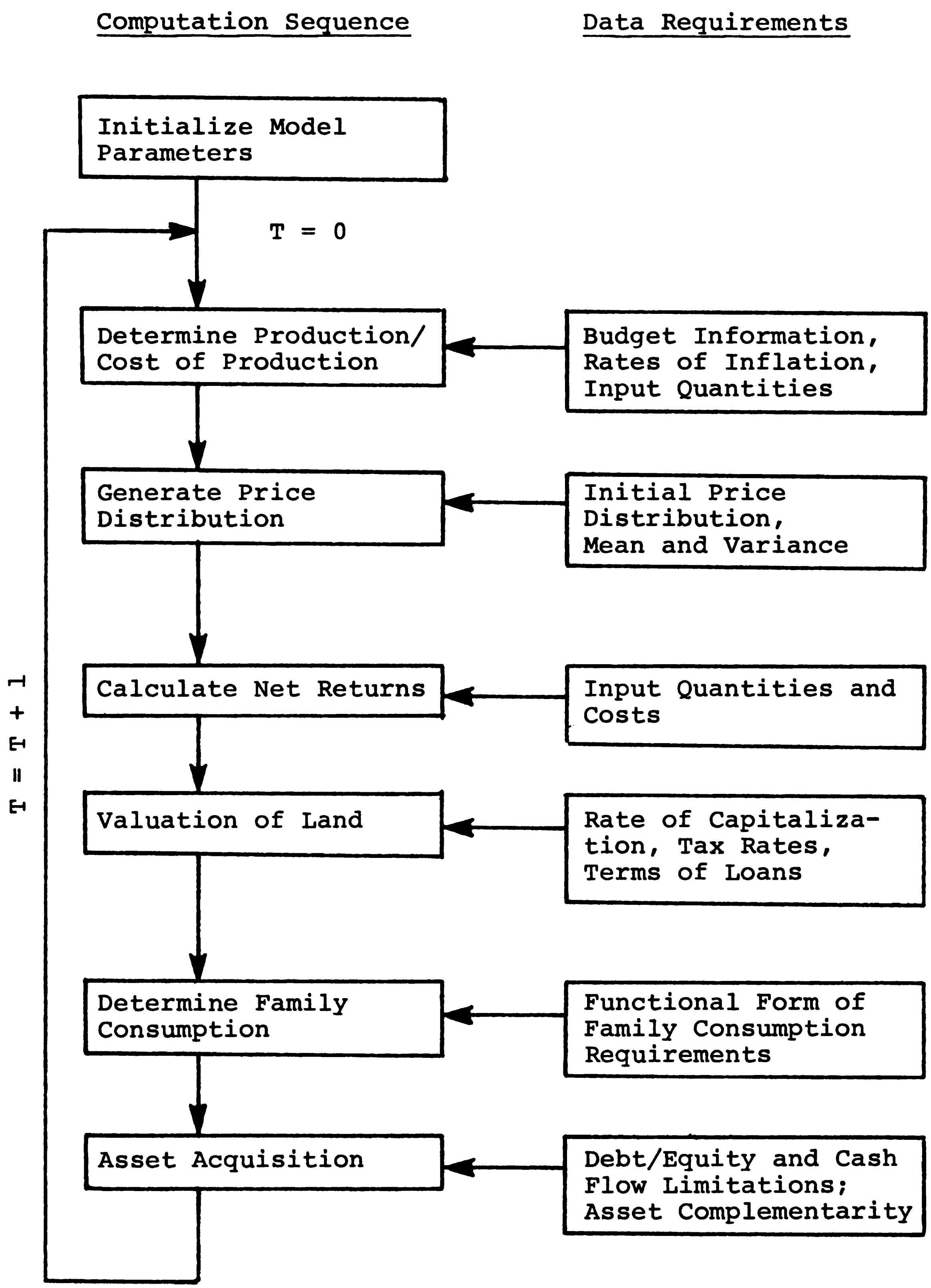

Figure 6.1. The Simulation Model

6.1 briefly describing the set of processes which are involved and the subroutine(s) of the simulation model which accomplish the indicated computations. The main program and subroutines being referenced are listed in Appendix A.

6.2.1 Production and Cost of Production

Instead of modeling the production process in figure 5.1 itself, by the use of production functions, the simulation model employs cost curves to estimate variable and fixed costs for each farm situation. To estimate variable costs per bushel of corn for farms of varying size a quadratic function was fit (using ordinary least squares) to published Illinois farm budget data (Scott, 1977). The estimated equation is,

$$(6.1)\quad VC = 107.24 - 2.139\ A + .04015\ A^2$$

$$R^2 = .989,\ \text{s.e.(at 640 acres)} = .06$$

The coefficients are in cents per bushel of corn and the independent variable, A, is hundreds of acres under cultivation. The variable cost function in equation 6.1 exhibits economies of size in corn production.

A similar function was fitted to the Illinois data to estimate the fixed or ownership costs per bushel for farms of varying size. The estimated equation is,

$$(6.2)\quad FC = 46.56 - 1.462\ A + .03425\ A^2$$

$$R^2 = .983,\ \text{s.e.(at 640 acres)} = .031$$

Ownership costs in this context refer to machinery ownership costs and general farm overhead (primarily building maintenance). Adding equations 6.1 and 6.2 together yields an estimate of total non-land costs (in cents per bushel) of corn.

$$(6.3) \quad NC = 153.8 - 3.601\,A + .0744\,A^2$$

By comparison with other published estimates on Lake States and Corn Belt cash grain farms equation 6.3 appears to yield reasonable estimates of the cost function coefficients (Black, 1979).

Equations 6.1 - 6.3 are used throughout the simulation program but are listed in the initializations section. Adjustments are made to the Illinois data to make the cost estimates comparable to Michigan corn grain budgets.

6.2.2 The Price Distribution

To generate an expected price and an associated variance of price consistent with government support program objectives and the theoretical framework of Chapter 5, the simulation employs a subroutine, PEM, and two auxilliary functions, FUNCX and SIMPI.

Function FUNCX provides the functional form of the initial price distribution (in this case a normal density) to SIMPI. Function SIMPI is a Simpson's integration algorithm which numerically integrates the area under the price density function between any two bounds. In the preceding chapter it was shown that the government support program truncated the price distribution at the support price. Function SIMPI integrates the lower portion of the truncated density function and that area is then "stacked" at the support price by subroutine PEM. Once the modified density function is constructed PEM again uses Simpson's integration to compute the first and second moments of the modified price distribution between the support price and the release price for corn.

Since the support price is set at a percentage of the non-land cost of production the simulation model replicates the interaction between the production process and commodity market in figure 5.1.

6.2.3 Valuation of Land

Land is valued in the model by a higher level of interaction between the capital market, the investment process, and the input market in figure 5.1.

The simulation model employs subroutine MAXBID based upon Lee's capital budgeting framework for investment in land. Subroutine MAXBID receives variables such as annual net returns, interest rates, marginal tax rates, and the opportunity cost of capital for each farm situation and determines the maximum bid price a farmer would pay under those economic conditions.

The land valuation aspect of the simulation models only the demand side of the land market. A critical assumption under which the model operates is that land is available but to get it the price of land is bid to its maximum price before it is acquired. Therefore, land always carries its potential market price. One might be concerned with this aspect of the model if deflationary conditions were to be modeled.

6.2.4 Value of the Firm and Household Consumption

As illustrated in figure 5.1 the consumption process and the accounting process are directly related. Both processes and the off-farm earning activity are modeled in subroutine FAM.

Subroutine FAM has an income section and a balance sheet section. The income section calculates gross receipts, net farm income, income after taxes and household consumption expenditures. Additionally, the income section computes the debt service load and net reinvestment income. The balance sheet section determines total assets, total debts, equity, and the rate of growth of equity.

6.2.5 Asset Acquisition

Productive assets can be of two basic types - land and its machinery complement or operating inputs. Therefore, two acquisition activities are modeled. These activities represent interactions between the input market, investment process, capital market, and the accounting process in figure 5.1.

Land acquisition occurs in subroutine LAM which contains three primary real estate loan options; (1) the net capital ratio (acres 1), (2) availability of liquid assets for down payment (acres 2), and (3) ability to generate sufficient income for loan repayment (acres 3).

If the operator's financial position and credit policies do not allow a land purchase, subroutine VAM is called to provide the option to purchase additional operating inputs from liquid assets. Subroutine VAM allocates operating credit if liquid assets are insufficient to purchase the desired level of variable inputs per acre. Operating loans are made on the basis of ability to generate net income to repay the loan.

6.3 Data Requirements and Sources

A conjectural simulation model such as described in the proceeding section has the advantage of requiring little in the way of input data for it to operate. An associated disadvantage is that the model may be highly sensitive to the data which is provided and, therefore, values for key variables must be chosen to reflect the actual situation and with an understanding of how each variable is used. Three classes of data must be provided;

(1) initial farm resource situations, (2) structural and behavioral parameters, and (3) policy parameters.

6.3.1 Farm Resource Initializations

Initialization of each farm situation is summarized in table 6.1. Assets for farm type B are based upon the average Michigan cash grain farm business summary for 1978 (Kelsey & Johnson, 1979). The summary data reflects 67 farms in southern, lower Michigan. Total assets reflect farm capital owned with land valued at $910 per acre.[22] Farm types A and C are initially set at one-half and twice the total assets of farm B, respectively. Debt-service costs in each farm situation are set at approximately 10 percent of total liabilities. In fact debt-service costs could vary greatly due to type of financing of each farm (short, intermediate, or long term), the corresponding interest charges, and associated lengths of loan. The equal percentage of debt-service costs provides a useful benchmark for comparing alternative assumptions about these loan maintenance costs.

Off-farm earnings in each farm situation reflect wages, salaries, interest earnings, dividends, pensions, Social Security benefits, and rental income from non-farm property

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[22]The price of land is set at $910 per acre since that represents the best available published estimate of average farm real estate values in Michigan in 1978 (USDA/ESCS, 1979).

Table 6.1. Initial Conditions in Three Michigan Corn Producer Resources Situations

	Farm A	Farm B	Farm C
Production Situation:			
Size (tillable acres)	160.	320.	640.
Yield (bu./acre)	95.	95.	95.
Nonland cost of production ($/bu.)	1.87	1.81	1.71
Total cost of production ($)	2.20	2.15	2.05
Financial Situation:			
Land price ($)	910.	910.	910.
Assets ($1000)	203.6	407.1	814.3
Liabilities ($1000)	142.5	203.6	244.3
Equity ($1000)	61.1	203.6	570.0
Annual debt service ($1000)	13.6	20.3	26.3
Other Items:			
Marginal tax rate (%)	22	32	50
Off-farm income ($)	8500.	5500.	4500.

as reported in the 1974 Census of Agriculture.[23] Each off-farm income figure in table 6.1 is the estimated geometric mean for farm families with off-farm incomes by size of farm (acreage).[24]

6.3.2 Structural and Behavioral Parameters

The structural variables which are of concern are those which relate to the cost structure and production activities of each farm. Cost parameter estimates were obtained from published 1977 FEDS budget data (Krenz, 1978). Based on an expected yield of 95 bushels per acre:

1. total variable cost per acre (TVC) = $100.70
2. ownership costs per acre (OWN) = $32.97
3. overhead cost per acre (OVH) = $23.37
4. land charges per acre (XLC) = $47
5. land taxes per acre (XLTAX)[25] = .016/$ market value
6. management charges (as percent of items 1-4), (XMC) = 7 percent
7. general farm overhead (to include minimum family consumption expenditures), (OVHEAD) = $10,000.

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[23]U.S. Department of Commerce, Bureau of the Census, 1977.

[24]The computed geometric mean is brought up to a 1978 basis by inflating the 1974 extimate by an inflationary parameter of 6 percent per year.

[25]This value represents an average tax rate for agricultural land in southern Michigan in 1978. (Michigan State Tax Commission, 1978).

In addition to the above cost parameters four other structural variables must be assigned values. The minimum land parcel which can be purchased (ACMIN) is 40 acres. Land can be acquired in single acre increments once the 40 acre minimum parcel has been purchased. Short-run production response to added operating inputs is determined by the output elasticity parameter, BETA. It is initially set at .05, but can realistically vary between zero (no response) and .075 (a response which increases current yields to roughly twice the long-run yield level). The government price support program contains two policy parameters. Percentage of support of cost of production (PCT) is set at 90 percent of the non-land costs of production. The return to land (RETL) is set at 1.5 percent of land value. Both policy parameters could be varied from one simulation to another but initially these values appear consistent with the 1978 program.

Two behavioral variables are of major importance. First, the consumption response of the farm family to increased income after taxes is determined by the elasticity parameter, GAMMA. Initially this elasticity is set at .95, which means that for each 1.0 percent increase in after-tax income the level of consumption expenditures increases by .95 percent with .05 percent going to savings. Other assumptions could be made about the magnitude of GAMMA. Second, the liquidity preference of the farm operator is specified in parameter, DELTA. Since liquid assets are theoretically held for transactions and/or precautionary purposes each farm operator is assumed to make available only DELTA-percent of each year's beginning liquid assets. Initially, DELTA is set at 50 percent. The assumption which is common to both elasticity of consumption and liquidity preference is that these variables are constant across farm-household types. In fact these parameters could be uniquely specified to reflect different behavioral characteristics on each farm.

6.3.3 Credit Policy Parameters

Several credit policy variables are of great importance to an evaluation of alternative lending criteria. There are three sets of credit variables to consider; (1) interest rates, (2) length of loan parameters, and (3) acquisition constraints.

Interest rates on real estate mortgages are lower than the rate charged on machinery loans and short-term operating loans. Farm real estate interest rates are set at the 1978 average Federal Land Bank rate of 8.75 percent. The FLB rate represents an intermediate choice since it is typically below rates charged by life insurance companies yet above rates which exist on seller-financed real estate loans. Machinery loans and operating loans are charged an annual rate of 10 percent. That interest rate represents an average rate charged by Production Credit Associations and rural banks on non-real estate farm loans in 1978.[26]

Length of loan parameters are used to compute the amortization payments on real estate and non-real estate loans. Each firm's investment planning horizon (in years) is used to compute the debt service costs on real estate. This planning horizon varies between 20 and 30 years. A second parameter is the number of years to amortize machinery and other debts. These non real estate loans are assumed to be repaid in 7 years. Operating loans are assumed to be repaid within one year.

To effectively constrain the acquisition of assets two credit policy parameters are manipulated (both in real lending situations and in the context of the simulation model). A debt/asset ratio ceiling is assigned for all farms in their borrowing activities. Farms below the ceiling are permitted to borrow for land and machinery purchases, those above the ceiling cannot. Since the ceiling is defined by the total debt/total asset ratio the constraint is also binding on operating loans. The debt/asset ceiling is initially set at 50 percent.

A second acquisition constraint is the down payment requirement. Percentage down payment may vary by type of loan (long-term, intermediate-term) and in conjunction with

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[26]Although interest rates vary over time and between lending institutions, the term structure of those rates remains relatively constant. The particular values chosen were compiled from USDA published data (USDA/ESCS, 1978).

the repayment schedule. Down payment may be an effective barrier to firm growth by means of credit. This is expected to be especially true for lumpy investments. Initially the down payment is set at 25 percent of the asset purchase price. This percentage will be varied to determine how sensitive the firm growth and distributional impacts are to it.

6.3.4 Additional Model Parameters

In addition to those parameters identified above there are some rates of growth and change which should be mentioned. Direct costs per bushel increase by six percent per year in the basic model. Land prices grow at an annual rate of five percent. Corn market prices are assumed to increase by two percent each year to reflect an outward shifting demand curve. The expected growth in net income per acre is one percent per year. Finally, corn yields are expected to increase along a long term trend line at a rate of one percent per year. This latter increase in yields reflects a constant rate of technological progress.

6.4 Strategy for Policy Evaluation

A number of hypotheses have been advanced relating to the anticipated distributional impacts of credit. Our working hypothesis is that benefits and costs of credit use within a dynamic environment are modified by credit policies, rules, and practices. More specifically, lending criteria redistribute the benefits and costs of credit when technological change and price level increases are jointly considered. These benefits and costs of credit are expected to vary between farm resource situations under different assumptions about; consumption behavior, investment decisions, production alternatives, interest rates, and down payment requirements.

In order to systematically evaluate alternative lending criteria to extract the greatest amount of information about the above behavioral, structural, and policy variables a basic model is initially constructed. That basic model uses values which were previously set in this chapter. Numerical solutions to the basic model will be used as the norm to which other solutions will be compared.

Variations on the basic model will be undertaken by changing individual parameters while holding all other parameters at their initial (basic model) levels. A simple comparison of numerical results for the same lending criterion under alternative parameter settings provides a useful test of model sensitivity. It also provides insights into the financial and distributional impacts which evolve over time.

The basic model and all subsequent variations on that model are essentially deterministic models. While the price of corn is a random variable (a distribution of corn prices exists about which expectations are formed), there is no purely random or stochastic element in the model.[27]

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[27]The potential for including such a random element exists in the determination of short run yields.

CHAPTER VII

Review and Analysis of the Numerical Results

7.1 Results from the Basic Model

The numerical simulation model is an analytical tool which provides a means for evaluating the distributional impacts by farm situation of variations in lending criteria, initial equity and debt load, repayment terms, consumption behavior, and other key variables which affect firm growth. A major objective of the simulation exercise is to identify some of the necessary conditions for credit to have certain redistributional effects. Hopefully, the results will indicate the relative importance of various credit design and implementation considerations, which is a major objective of the study. Results are drawn from selected years to indicate the magnitudes and rates of growth of the performance variables.

Initially, the basic model is reviewed in greater detail to observe the growth and distribution processes as they evolve. Summaries of the basic model cash flow, income statement, and balance sheet are compared at 5 year intervals. Variations of the basic model are reviewed and contrasted on the basis of their cumulative effects by looking at values in year 15 of the simulation.

7.1.1 Cash Flow of the Basic Model

Our basic analytical approach was to employ a modified cash flow approach to evaluate the financial impacts of credit. Tables 7.1 and 7.2 present summaries of the cash flow situation on each farm over time. Credit is allocated to each farm up to the minimum of either repayment capacity, risk-bearing capacity, or ability to make the required down payment.

Total cash available is composed of initial cash on hand, money borrowed during the year, and gross income (gross farm receipts, off-farm earnings, plus other income). Cash expenditures include cash farm expenses, investments, debt service costs, family consumption, income taxes, and savings.

In table 7.1 gross income rises gradually onall farms through year 10, as both price of corn and corn yields increase. Gross income moves up sharply during the last 5 years as prices increase more rapidly and farms expand in size. Borrowing, which primarily represents intermediate and long term debt for acquisition of land and machinery, occurs during the expansion years (years 12 to 15). The large farm (farm C) alone uses operating credit in most years. Year 11 was the highest in this regard, when $20,500 of short term credit was used to supplement cash reserves.

Table 7.1. Annual Cash Flow of the Basic Model in Selected Years for 70 Percent Initial Debt/Asset Ratio by Firm Situation[a/]

Item	Farm A[c/]				Farm B				Farm C			
	year											
	1	5	10	15	1	5	10	15	1	5	10	15
	$1,000											
Cash Inflows:												
Beginning cash	67.3	87.5	118.8	106.9	139.1	119.5	107.5	90.8	308.6	138.2	136.7	135.6
Borrowings	--	--	--	62.2	--	--	--	88.0	--	--	--	--
Gross income	42.5	51.2	53.4	144.4	73.4	94.0	113.8	176.8	140.3	185.3	222.4	369.8
Total cash available	109.8	138.7	172.2	313.5	212.5	213.5	221.3	355.6	448.9	323.5	359.1	495.4
Cash Outflows:												
Operating expenses	37.6	42.1	51.0	136.6	81.2	89.6	107.8	165.5	187.9	178.7	211.6	278.7
Investments	--	--	--	73.4	--	--	--	117.3	--	--	--	--
Debt service cost[b/]	13.6	13.1	12.7	34.4	28.4	27.1	25.4	40.6	61.3	56.6	51.1	66.8
Family consumption	7.1	10.0	8.4	11.3	8.1	12.9	13.9	11.3	13.8	20.3	51.1	66.8
Taxes	.7	1.9	1.2	.7	1.1	3.4	4.1	.7	4.0	10.5	14.3	35.0
Savings	5.8	8.3	8.3	7.8	6.5	11.0	14.0	7.5	6.6	14.1	20.7	35.0
Total cash expenditures	64.8	75.4	81.6	264.2	125.3	144.0	165.2	342.9	273.6	280.2	320.5	448.5
Ending Cash Balance	45.0	63.3	90.6	49.3	87.2	69.5	56.1	12.7	175.3	43.3	38.6	45.4
(Cultivated Acres)	(160)	(160)	(160)	(362)	(320)	(320)	(320)	(456)	(640)	(640)	(640)	(822)

[a/] Cash flow results are abstracted from Model V.

[b/] Principal only, interest is included in operating expenses.

[c/] Farm A initially has 160 acres and a D/A ratio of .70. Farm B starts with 320 acres and a D/A ratio equal to .50. Farm C initially has 640 acres and its D/A ratio equals .30.

Table 7.2. Annual Cash Flow of the Basic Model in Selected Years for 30 Percent Initial Debt/Asset Ratio by Farm Situation[1/]

Item	Farm A				Farm B				Farm C			
	year											
	1	5	10	15	1	5	10	15	1	5	10	15
	$1,000											
Cash Inflows:												
Beginning cash	59.9	71.8	91.3	137.8	117.5	98.2	166.0	235.4	236.3	223.4	328.8	410.6
Borrowings	--	--	34.1	80.9	--	--	83.8	152.5	--	55.6	206.9	245.1
Gross income	42.5	91.4	138.0	314.6	73.4	186.8	269.2	578.5	140.3	306.7	566.6	1128.6
Total cash available	102.4	163.2	263.4	533.3	190.9	285.0	519.0	966.4	376.6	585.7	1102.3	1784.3
Cash Outflows:												
Operating expenses	27.2	75.0	118.3	276.0	53.2	126.9	225.7	476.1	101.9	240.0	439.0	887.9
Investments	--	--	45.4	107.8	--	--	111.7	203.3	--	74.1	275.9	326.8
Debt service cost[b/]	5.8	15.0	25.0	59.4	12.2	33.6	52.0	109.2	26.3	73.0	116.5	211.1
Family consumption	10.5	15.6	12.0	18.4	14.4	25.6	21.3	35.5	23.5	29.0	42.3	60.8
Taxes	2.1	5.4	2.9	8.1	4.4	19.1	11.9	41.4	15.4	26.2	62.1	133.0
Savings	8.8	14.8	15.7	29.7	13.0	24.7	26.1	47.8	20.5	24.8	41.0	78.1
Total cash expenditures	54.4	125.8	219.4	499.7	97.2	229.9	448.7	913.3	187.4	467.1	976.8	1697.7
Ending Cash Balance	48.0	37.4	44.0	33.6	93.7	55.1	70.3	53.1	189.2	118.6	125.5	86.6
(Cultivated Acres)	(160)	(301)	(461)	(815)	(320)	(639)	(939)	(1525)	(640)	(1308)	(2001)	(2992)

[a/] Cash flow results are abstracted from Model V.

[b/] Principal only, interest is included in operating expenses.

On the cash outflow side farm operating expenses increase throughout the period due to rising costs of production inputs. Operating costs make significant jumps in those years when farm expansion occurs. Family consumption expenditures set a relatively constant pattern on all farms. Consumption on farm A is at or just above the minimum subsistence level in most years. This result supports the generally made assertion that small land base operations find it difficult to generate sufficient disposable income when a heavy debt load is also carried.

Taxes and savings show somewhat similar patterns of increase. Farm C's tax burden rises sharply in the later years along with income. The two smaller farms show lower taxes in part due to operating costs and debt service costs which cut into earnings. Savings fall during the expansion years on farms A and B as one would expect, yet farm C continues to increase its level of savings throughout the last 5 expansionary years. Farm C's savings pattern is in response to the increase in net returns per acre, which escalate sharply in years 10 to 15. Withdrawals for taxes and family consumption directly influence the amount of reinvestment income or savings of the firm-household units. Since investment tax credits are not considered in the model the taxes paid each year are overstated for all farms. Other factors such as propensity to consume are equally important, since they significantly alter an operator's or a lender's percentage of future repayment capacity and ability to expand.

Ending cash balances generally reflect the process of expansion, then consolidation, then expansion again. On farm A expansion occurs in years 12 to 15. Farm B depletes cash throughout the period as it uses cash to purchase additional operating inputs. The reduction of cash reserves from year 10 to year 15 is also due partly to expansion which occurs in the intervening years. Farm C starts out with large cash reserves but depletes them rapidly as yields and returns are boosted by acquisition of additional operating inputs in the early years. Cash is kept low on the large farm as expansion occurs in years 12 to 14.

Generally, none of the farms reach the point where additional short term credit is needed to meet current debt obligations on time.[28] Farm B is close to depleting its cash reserves in year 15 when major enlargement of the farm occurs.

The seventy percent initial debt/asset (D/A) ratio is the most severe debt-servicing situation in the model. A simple comparison with the corresponding entries in table 7.2 reveals that the cash flow situation is more flexible

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[28] In the context of a deterministic model such as this, low cash balances present no special problem. Yet, in a situation where considerable variation occurs in gross receipts (due to yield or price variability), low cash balances could easily translate into cash flow shortages.

when the debt load and debt service costs are reduced across farms of varying size, as one might expect. This general result allows for firm expansion to occur significantly earlier in all cases and allows all farms to achieve a larger terminal size of operation.

In table 7.2 the lower debt load (greater equity) position leads to significant increases in consumption expenditures and savings by the firm-household unit. The magnitude of change in these and other variables underscores the importance which initial financial position of the firm potentially has in leading to a realization of the benefits associated with growth, holding the initial size of each farm constant.

7.1.2 Variations of the Basic Model

Several modifications are made in the basic model to determine the importance which key variables have for level of income, capital accumulation, debt position, and overall growth of each firm. In table 7.3 several models are identified along with the values each of the items take for those simulations. The basic model, which generated the preceding cash flow results and which will be used as the standard for comparison, is model V. Models I-IV represent the primary lending alternatives under consideration; (1) A1 refers to lending on the basis of the net capital ratio and value of assets of a borrower (i.e., risk-bearing

Table 7.3. Model Numbers and Values Assigned to Items in the Basic Model and Variations of the Basic Model

Model Number	Items varied in the model				
	Lending criterion 1/	Length of loan	Down payment required	Maximum allowable D/A ratio	Other
		years	percent	percent	
I.	A1	N	.25	.50	--
II.	A2	N	.25	.50	--
III.	A3	N	.25	.50	--
IV.	EQ	N	.25	.50	--
V.[b/]	AMIN	N	.25	.50	--
VI.	AMIN	N + 10	.25	.50	--
VII.	AMIN	N	.10	.50	--
VIII.	AMIN	N	.25	.75	--
IX.	AMIN	N + 10	.10	.50	--
X.	AMIN	N	.25	.50	Linear consumption function
XI.	AMIN	N	.25	.50	Increase yield response to oper. inputs
XII.	AMIN	N	.25	.50	Land values appreciate at 6%
XIII.	AMIN	N	.25	.50	Land appreciates at 8%, interest rates increase to 12% (real estate), and 14% (non-real estate), cost of inputs rise 8%
XIV.	A2	N	.25	.50	
XV.	A3	N	.25	.50	
XVI	AMIN	N	.25	.50	Purchase land only if the bid price is greater than or equal to the market price

[a/] A1 refers to lending on the basis of value of assets or risk-bearing capacity.
A2 refers to lending to all borrowers who can make the required downpayment.
A3 refers to lending on the basis of ability to repay the loan out of reinvestment income.
EQ refers to a lending strategy which applies equal weight to criteria A1 and A3.
AMIN refers to lending on the basis of the most limiting situation, the maximum of A1, A2, or A3.

[b/] This is the basic model to be used in subsequent model comparisons.

capacity), (2) A2 denotes lending on the basis of the borrower's ability to make the required down payment out of his liquid assets, (3) A3 represents the situation where loans are made on the basis of ability to generate excess income which can be used to repay the loan (i.e., repayment capacity), and (4) EQ is a mixed lending rule which applies equal weight to criteria A1 and A3.

Models VI through IX explore variations in length of loan, down payment requirement, and maximum allowable debt/ asset ratios. Essentially all four of these variations of the basic model represent relaxations of the conditions for either receiving credit or repaying the loan. Models X through XVI explore alternative assumptions about consumption, production, and investment activities. These latter model specifications also perform sensitivity tests on key parameters in the numerical model.

7.1.3 Firm Growth in the Basic Model

In table 7.4 the growth experiences of the three firm-household units are summarized for comparison across farm resource situations. Farm A starts from the highest D/A ratio and represents a young farm operator's financial situation. Farms B and C start with greater initial equity and lower D/A ratios.

Annual net income per acre illustrates a severe cost-price squeeze for farm A in years 1 through 10. The decline

Table 7.4 Income, Assets and Debt Statement by Farm Situation for Selected Years, Model V.[a/]

Farm Situation	Year	Income Less Taxes ($1000)	Family Consumption ($1000)	Annual Net Income ($/acre)	Capital-ization Rate (%)	Land Bid Price ($)	Acres in Farm (acres)	Total Land Value ($1000)	Total Farm Assets ($1000)	Total Farm Debt ($1000)	Total Equity ($1000)	Annual Growth in Equity (%)	Debt/asset Ratio
Farm - A	1	11.3	7.1	33.93	4.84	700.	160.	151.9	215.7	141.4	74.3	19.7	.66
	5	16.2	10.0	10.14	2.53	400.	160.	138.1	228.3	137.1	91.3	8.1	.60
	10	13.5	8.4	-11.37	b/	b/	160.	172.3	298.5	131.9	166.6	10.0	.44
	15	11.3	11.3	43.07	2.82	1530.	362.	734.2	872.3	359.0	513.4	14.2	.41
Farm - B	1	18.6	11.4	38.86	4.98	780.	320.	303.9	429.7	201.1	228.6	11.6	.47
	5	29.0	17.4	47.57	5.84	814.	366.	315.9	467.7	223.4	244.3	3.6	.48
	10	18.8	11.5	43.61	4.59	950.	468.	504.2	663.2	281.8	381.4	6.3	.42
	15	30.9	18.4	73.21	3.77	1941.	887.	1779.6	2014.5	693.8	1320.8	12.5	.34
Farm - C	1	39.9	23.5	71.01	6.87	1034.	640.	607.8	860.4	239.4	621.0	8.6	.28
	5	49.9	29.0	74.18	7.41	1001.	1308.	1128.2	1382.9	664.8	718.0	4.6	.48
	10	74.0	42.3	87.03	7.10	1226.	2001.	2155.7	2536.0	1060.6	1475.4	9.5	.42
	15	108.6	60.8	105.58	4.78	2208.	2992.	6073.0	6721.0	1992.8	4798.2	14.2	.29

a/ Estimates of financial variables in real dollar terms are obtained by deflating current values in the table by the assumed 6 percent rate of inflation.

b/ Values are ommitted since to get a positive price for land the capitalization rate would need to be negative.

in net returns per acre is reflected in the falling bid price for land, even as the capitalization rate decreases. That trend is reversed in year 12 when the farm expands by 52 acres, thereby making more efficient use of fixed productive resources as it moves downward along the long run cost curve. Neither of the other two farms experience such a prolonged decline in net income per acre.

Reduction of the capitalization rate for land primarily reflects the effects of the government price support program. The support price theoretically truncates the expected price distribution and thereby reduces the variance. With a fall in the variance of price the opportunity cost of capital falls due to decreased risk, and as the cost of capital falls so does the capitalization rate on land. The guaranteed cash flow aspect of the support program is effectively capitalized into the bid price for land.

Land bid prices reflect the annual net incomes generated in each farm situation. Farm C generates substantially higher net returns per acre and is capable of paying more for land in this framework. By year 15 the market price for land has more than doubled going from $910 to $2030. In real dollar terms, however, there is no change in the market price. In this same period farm size has increased significantly. Farm A more than doubled its acreage, farm B increased more than 2.5 times its initial size, and farm C grew more than 4.5 times its starting acreage.

By looking briefly at the summary data from the balance sheets it is clear that all farms have greatly increased both their total assets and net worth positions. A majority of the increase in total assets and net worth in the farm operation is accounted for by the increase in land and the value of land. Final total land value of each farm increases approximately 2.2 times due to land value appreciation alone. Net worth on farms A and B increase more than 6 times over the fifteen year period while farm C's equity capital increases more than eight times its initial value. The debt/asset ratios of farms A and B decrease dramatically by year 15 due primarily to appreciation of land assets which inflate total assets and each farm operator's net worth. Farm C's debt/asset ratio remains near .30 since unit C increased its acreage and land-based debt throughout the period. The reduction in the D/A ratio between years 10 and 15 is again a reflection of land value increases.

7.1.4 The Influence of Rising Land Values on Firm Growth

A number of references have already been made to the role of increasing land prices in the basic model. Land value appreciation has two primary sources in the basic numerical model. First, government commodity price supports serve to increase the operator's expected cash flow by (1) raising the expected output price and (2) exerting downward pressure on the capitalization rate (by reducing the variance of the output price distribution). Second buyers' expectations of land price increases are explicitly included in the capital-budgeting subroutine in which the maximum bid price of land is determined.

Escalating land values, by whichever means, lead to two somewhat opposing conditions. The stream of unrealized capital gains from land raise a firm's net capital ratio and provide an increased borrowing base for continued expansion. Running contrary to that effect is the necessity for cash flows (specifically, net reinvestment income) to keep pace with the rise in land prices. Otherwise, ability to service the greater debt load becomes a constraint to further expansion.

In order to evaluate how sensitive firm growth in the basic model is to buyers' expectations a run was made with that expectation parameter set equal to zero. Bid prices for land by the end of the period were higher than they were at the start of the simulation, but were unchanged in real terms. Those land prices were significantly below bid prices generated in the basic model. When compared with the basic model results farm sizes were sharply reduced on small and intermediate-sized farms where initial D/A ratios were initially higher. Those farms with low initial D/A ratios (30 percent) dramatically increased in size. Apparently, the reduction in land price-generated equity increases greatly diminished the borrowing base of highly leveraged firms. Meanwhile, relatively cheaper land augmented the financial resources and ability of other farm units to expand their sizes of operation. In this regard smaller, 160-acre farms with adequate equity participated in firm expansion along with larger, 640-acre operations indicating that cash flow was adequate for expansion regardless of initial farm acreage.

7.2 Distributional Impacts of Alternative Lending Criteria[29]

7.2.1 Lending According to Value of Assets Controlled (Model I)

When risk-bearing capacity is the sole criterion for lending, all farms increase both in size of operation and operator net worth. Table 7.5 reports on the growth of the three representative farms. Lenders allocate credit on the basis of total assets and in direct proportion to the difference between the firm's current debt/asset ratio and the maximum allowable debt/asset ratio.[30] It is anticipated that farms with high net capital ratios (low D/A ratios) such as farm C will capture the greatest benefits from credit when lenders use this criterion.

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[29]Comparisons of nominal values generated under various lending alternatives in this section represent comparisons with those values obtained in the basic model unless otherwise stated.

[30]The risk-bearing capacity criterion is operationalized in the numerical model as follows: a lender sets available investment credit equal to $[1.-d/\bar{d}]$ times total borrower assets. Here, d is the borrower's current D/A ratio and $\bar{d}$ is the maximum allowable D/A ratio (.5 in the basic model).

Table 7.5 Income, Assets and Debt Statement by Farm Situation for Selected Years, Model I.[a/]

Farm Situation	Year	Income Less Taxes ($1000)	Family Consumption ($1000)	Annual Net Income ($/acre)	Capital-ization Rate (%)	Land Bid Price ($)	Acres in Farm (acres)	Total Land Value ($1000)	Total Farm Assets ($1000)	Total Farm Debt ($1000)	Total Equity ($1000)	Annual Growth in Equity (%)	Debt/Asset Ratio
Farm - A	1	11.3	7.1	33.93	4.84	700.	160.	151.9	215.6	141.4	74.3	19.6	.65
	5	16.2	10.0	10.08	2.51	401.	160.	138.5	228.8	137.1	91.7	8.1	.60
	10	19.3	11.8	-11.42	b/	b/	160.	172.5	301.1	131.9	169.3	10.2	.44
	15	10.8	11.3	43.52	2.82	1547	376.	772.3	909.2	378.4	530.8	14.4	.42
Farm - B	1	18.6	11.4	38.86	4.98	780.	320.	303.9	429.7	201.1	228.6	11.6	.47
	5	29.0	17.4	47.56	5.83	816.	367.	317.9	469.3	224.4	245.0	3.7	.48
	10	18.7	11.5	43.58	4.58	951.	468.	505.2	663.3	282.3	381.1	6.3	.43
	15	30.4	18.1	76.74	3.86	1991.	971.	1994.1	2219.7	808.4	1411.3	12.9	.36
Farm - C	1	39.9	23.5	71.01	6.87	1034.	640.	607.8	860.3	239.4	620.9	8.6	.28
	5	50.0	29.1	74.52	7.41	1005.	1328.	1149.7	1400.2	678.3	678.3	4.7	.48
	10	74.0	42.2	87.02	7.09	1227.	2005.	2162.9	2541.2	1064.0	1064.0	9.5	.42
	15	87.3	49.4	80.14	3.85	2084.	3795.	7794.4	8792.8	3023.8	3023.8	15.4	.34

a/ Estimates of financial variables in real dollar terms are obtained by deflating current values in the table by the assumed 6 percent rate of inflation.

b/ Values are ommitted since to get a positive price for land the capitalization rate would need to be negative.

Comparison of the values in table 7.5 with those in table 7.4 provides evidence that farm A is able to achieve slightly larger size of operation. This growth occurs, as before, in the last 5 years when the firm's total assets inflated sufficiently for the D/A ratio to fall and credit became available. Expansion of farm A is inevitable at some point in time due to asset value appreciation, as long as operator A continues to meet the service costs on his initial indebtedness. This result is an illustration of the third benefit from credit, identified in Chapter IV as the right to appreciation of assets or investments as long as the terms of the loan are met. Farm A's equity increases slightly to $350,000 ($234,600 in real terms) under the risk-bearing criterion as total land value rises by more than total farm debt. The fact that current income and family consumption are essentially unaltered by the change in lending rule indicates that most of the impact of the rule change is on the firm's debt-asset structure.[32]

Farm B's experience under the lending rule change is similar to that of farm A. Expansion occurs earlier on farm B since it starts from a lower initial D/A ratio. Farm size increases by 84 acres when the lender considers just assets controlled and the operator's net capital ratio. Total equity grows by 7 percent to just over $1.4

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[31]Since consumption occurs totally out of current income the increase in net worth has no immediate impact on the level of consumption expenditures. A modification of the basic model would be to allow for consumption out of increases in equity as well.

million (just over $.6 million in real dollars) 86 percent of which is accounted for by real estate.

Farm C shows the most dramatic effects of the change in lending criterion. Changes occur in both income statement and balance sheet statistics. Cultivated acreage expands to 3795 acres by year 15. That size of operation is larger than the minimum long run average cost acreage. Since economies of size are exhausted the annual net income per acre declines by $25 per acre. Resultant changes occur in disposable income and consumption expenditures.

The bid price for land also declines with the fall in net income per acre. The lower bid price is not sufficiently large, however, to offset the larger farm size and both total assets and operator net worth increase dramatically. Farm C's equity in the final period grows to $5.77 million ($2.55 million in real dollars) for a 20 percent increase over the basic model result.

7.2.2 Lending on the Basis of Ability to Make the Down Payment (Model II)[32]

The distributional impacts of this lending criterion are substantially different from those we have just seen. In table 7.6 the summary data indicate that farms A and B obtain substantial benefits from the change in lending rule.

[32]Ability to make the required down payment on land and machinery is defined in the numerical model by the expression; [total liquid assets/(price of land and machinery per acre times percentage down payment)] .

Table 7.6 Income, Assets and Debt Statement by Farm Situation for Selected Years, Model II.[a]

Farm Situation	Year	Income Less Taxes ($1000)	Family Consumption ($1000)	Actual Net Income ($/acre)	Capital-ization Rate (%)	Land Bid Price ($)	Acres in Farm (acres)	Total Land Value ($1000)	Total Farm Assets ($1000)	Total Farm Debt ($1000)	Total Equity ($1000)	Annual growth in Equity (%)	Debt/Asset Ratio
Farm - A	1	11.3	7.1	33.93	4.84	700.	160.	151.9	215.6	141.4	74.3	19.7	.66
	5	12.1	7.6	8.80	2.19	403.	160.	152.1	245.7	137.1	108.7	11.5	.56
	10	9.4	8.4	34.00	4.79	711.	465.	475.2	592.0	350.8	241.2	13.7	.59
	15	40.5	23.8	42.90	2.93	1466.	666.	1314.7	1511.6	524.4	987.1	18.6	.35
Farm - B	1	18.6	11.4	38.90	4.98	780.	320.	303.9	429.7	201.1	228.6	11.6	.47
	5	20.6	12.5	55.90	5.98	935.	650.	618.1	759.2	415.1	344.0	10.5	.55
	10	27.8	16.7	56.20	5.93	948.	1019.	1040.0	1252.2	652.1	600.1	10.8	.52
	15	50.5	29.4	81.00	4.08	1986.	1587.	3132.4	3461.9	1135.5	2326.4	16.2	.33
Farm - C	1	39.9	23.5	71.00	6.87	1034.	640.	607.8	860.4	239.4	620.9	8.6	.28
	5	51.5	30.0	77.30	7.31	1058.	1560.	1483.9	1689.4	840.5	848.9	8.0	.50
	10	70.0	40.1	79.40	7.44	1067.	2266.	2313.9	2649.1	1241.7	1407.4	9.0	.47
	15	94.4	53.2	85.30	4.25	2009.	3070.	6058.7	6729.5	1859.2	4870.3	14.3	.28

[a] Estimates of financial variables in real dollar terms are obtained by deflating current values in the table by the assumed 6 percent rate of inflation.

Although net income per acre on farm A does not change the size of operation expands by 304 acres in year 15. One important change does occur in net income per acre. Farm A no longer receives a negative net return as it had formerly. Expansion occurs earlier for farm A under this lending criterion and the larger size of operation leads to reduced costs per acre. Consequently, income after taxes increases by nearly $30,000 and family consumption doubles to $23,800. The combination of a substantially larger operation and slightly lower land prices translates into a $475,000 increase in equity for operator A. The increase in equity is reflected by the 4 percent increase in the rate of growth. Operator A also achieves a lower risk position with a .35 D/A ratio in year 15.

Farm B obtains a substantial increase in benefits from the rule change. By year 15 farm size has grown by an additional 700 acres. The increase in farm size leads to economies of size and a corresponding increase in net returns per acre. Disposable income rises by $20,000 in year 15 and family consumption is higher in years 10 through 15. The higher land price and increased farm size are the primary contributors to a one million dollar increase in net worth by the final year. Equity grows at an annual rate of 16.2 percent over the 15 year period, the largest growth rate of all three farms.

The impact of the rule change on farm C is a mix of financial gains and losses. Farm size has again increased but is only slightly higher than in the basic model at 3070 acres. Net income per acre has again fallen indicating that the farm is operating on the upward-sloping segment of the long run cost curve. Both after-tax income and family consumption expenditures are lower in the later years than their levels in the basic model. Total operator's net worth is up slightly to $4.87 million ($2.15 million in real dollars) due to a combination of larger farm size and lower farm debt. The D/A ratio is essentially unchanged from the basic model, but is lower than the corresponding value in model I.

7.2.3 Lending According to Ability to Generate Income Sufficient for Repayment (Model III)

Credit is extended under this policy option in proportion to repayment capacity of the borrower. Repayment capacity is operatinally defined as the amount of income after taxes and consumption which is available to service debts.[33] Defined in this way, the availability of credit is highly dependent upon the consumption behavior of the household.

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[33]A borrower's ability to repay a real estate loan was determined in the numerical model by the following expression:

(current net reinvestment income times present value factor for that annuity taken N years into the future)

The present value factor is the one determined by the mortgage rate of interest on real estate loans.

The pattern of distributional impacts is quite similar to that in model II. In table 7.7 farm A experiences lower levels of consumption on somewhat lower disposable income. Size of operation is 201 acres larger than in the basic model, and expansion occurs considerably earlier. The effects of both aspects of growth is to raise the value of total farm assets and operator's net worth by the fifteenth year. Net worth on farm A increases by over 50 percent as a result of the credit rule change.

As in model II, the financial benefits which accrue in this lending model (model III) are relatively greater for farm B than for either of the other two farm situations. Farm B increases current disposable income by nearly $22,000 in year 15. Family consumption also responds to the change in income under the rule change. This illustrates the second benefit from credit which is the right to the income from the assets and/or investments acquired with credit. Greater income and consumption as benefits arise from the implied growth process. Improved access to credit over time promotes larger farm size and associated cost economies in production. These adjustments lead to gains in net returns per acre and net farm income. Farm B nearly doubles its size of operation and increases final net worth by 82 percent over the value achieved in the basic model. The debt/asset ratio remains at .35 due to rapid expansion of the farm operation throughout the period being modeled.

Table 7.7 Income, Assets and Debt Statement by Farm Situation for Selected Years, Model III[a/]

Farm Situation	Year	Income Less Taxes ($1000)	Family Consumption ($1000)	Annual Net Income ($/acre)	Capital Rate (%)	Land Bid Price ($)	Acres in Farm (acres)	Total Land Value ($1000)	Total Farm Assets ($1000)	Total Farm Debt ($1000)	Total Equity ($1000)	Annual Growth in Equity (%)	Debt/ Asset Ratio
Farm - A	1	11.3	7.1	33.93	4.84	700.	160.	152.0	215.7	141.4	74.3	19.6	.65
	5	12.2	7.6	9.41	2.38	396.	160.	146.1	239.8	137.1	102.8	10.4	.57
	10	13.0	8.4	26.74	4.06	659.	252.	255.3	391.1	196.6	194.4	11.6	.50
	15	10.7	11.3	43.05	2.88	1491.	563.	1133.2	1290.9	505.1	785.7	17.0	.39
Farm - B	1	18.6	11.4	38.95	4.98	780.	320.	303.9	429.7	201.1	228.6	11.6	.47
	5	19.8	12.1	53.94	6.03	894.	570.	520.3	668.3	365.2	303.0	8.0	.55
	10	26.5	15.9	50.86	5.39	942.	746.	755.7	995.3	462.5	532.8	9.6	.46
	15	52.4	30.5	89.35	4.27	2091.	1675	3374.7	3713.7	1309.6	2404.1	16.5	.35
Farm - C	1	39.9	23.5	71.04	6.87	1034.	640.	607.8	860.4	239.4	620.9	8.6	.28
	5	52.7	30.6	77.86	7.49	1038.	1556.	1420.4	1627.7	847.8	779.9	6.3	.52
	10	72.2	41.3	83.95	7.49	1120.	2238.	2268.4	2611.3	1226.3	1385.0	8.9	.47
	15	91.9	51.9	73.54	3.71	1982.	3661.	7375.1	8202.8	2585.1	5617.7	15.2	.32

a/ Estimates of financial variables in real dollar terms are obtained by deflating current values in the table by the assumed 6 percent rate of inflation.

Financial growth of farm C in model III is also similar to that in model II (where availability of liquid assets for the down payment determined access to credit). Current income less taxes and consumption expenditures are somewhat lower than reported in the basic model. Larger average farm size raises gross income but reduces income after operating and overhead costs are deducted. For the first time annual net returns per acre are less on the large farm than they are on farm B. A main contributor to this result is the general shape and position of the long run cost curve. Under the repayment capacity policy farm C achieves an operation of 3661 acres which is 669 acres larger than the final acreage in the basic model. As a result equity in the farm operation increases by $820,000 over the basic model. The growth rate on equity reflects this increase.

7.2.4 Equal Weighting of the Repayment and Risk-bearing Capacity Criteria (Model IV)

As an alternative to employing any of the above criteria exclusively, it is useful to consider combinations of the above lending policies which provide lenders with more loan security and provide borrowers with potentially greater financial benefits. One such possiblity would be to employ a rule which gives equal weight to value of assets controlled and ability to generate income for loan repayment.

Results from model IV indicate that the distributional impacts of this lending rule modification are substantially the same as obtained under the repayment capacity criterion (in model III). Farm A's operation reaches 506 acres by year 15. Total farm equity capital grows to $692,000 ($305,900 in real dollars). Little change occurs in farm A's current income situation.

Farm C again shows substantial increase in size of operation by expanding to 3739 acres, up 747 acres from the basic model result. Total equity of operator C increases by $1 million (in nominal terms) over the basic model value.

Farm B is the apparent gainer in relative terms from the rule change. Farm B's disposable income, family consumption, size of operation, and final net worth are all greater than the basic model results. Farm B's financial growth parallels that achieved under the lending rule considered in model III.

7.3 Sensitivity of Distributional Impacts to Initial Equity Position

Models I-V provide some insight into the magnitude of the financial impacts on farms of different size and initial equity positions. To determine how important the initial equity position is to these impacts a comparison is made of the growth paths of the three farms when the debt/asset ratio alone is varied. Table 7.8 contains

Table 7.8 Sensitivity to the Initial Equity Position and Debt Servicing Obligation of the Firm by Farm Situation [a]

Item	(units)	Initial Debt/Asset Ratio Equals .30 [b]			Initial Debt/Asset Ratio Equals .70		
		Farm A	Farm B	Farm C	Farm A	Farm B	Farm C
Costs, Returns & Valuation:							
Nonland costs	($/bu.)	3.73	3.41	3.33	4.03	3.96	3.73
Total costs	($/bu.)	3.98	3.66	3.58	4.28	4.21	3.98
Annual net income	($/acre)	69.60	97.98	105.58	43.07	49.12	69.98
Capitalization rate	(%)	3.68	4.43	4.78	2.82	2.86	3.66
Land bid price	($/acre)	1892.	2210.	2208.	1530.	1715.	1913.
Acres owned	(acres)	815.	1525.	2992.	362.	456.	822.
Income data:							
Net income	($1000)	38.6	102.4	240.8	7.8	11.3	91.1
Income after taxes	($1000)	30.9	61.6	108.6	11.3	11.1	57.1
Family consumption	($1000)	18.4	35.5	60.8	11.3	11.3	33.0
Balance Sheet data:							
Total assets	($1000)	1860.	3421.1	6720.9	872.3	1046.3	1898.7
Total liabilities	($1000)	619.5	1081.5	1922.8	358.6	401.7	608.0
Equity	($1000)	1240.4	2339.8	4798.2	513.4	644.6	1290.7
Growth rate of equity	(%)	14.4	14.0	14.2	14.2	11.1	11.1

a/ Results are drawn from year fifteen of the basic model. Financial variables are expressed in nominal dollar terms.

b/ Standard reference to representative farms A, B, and C in this chapter has been to farms with initial D/A ratios of .7, .5, and .3, and initial acreages of 160, 320, and 640, respectively. Here, we look at what changes would likely result if just the initial debt load is changed in each farm situation.

final period values on costs and returns, income, consumption, and balance sheet items.

Results of the change in beginning operator equity are substantial for all farms indicating that financial leverage and debt-servicing obligation play as important a role as farm size, depending upon which performance variables are being evaluated.

Farm A's nonland and total costs of production are lower under the reduction of the debt load due primarily to the increased size of operation. Annual net income also increases reflecting the reduction in variable costs per acre. The higher net income per acre is reflected in the bid price for land, which inflates by 24 percent for farm A given the change in D/A ratio. Corresponding to the increase in land price and size of operation farm A's final net worth increases to $1.24 million ($.55 million in real dollars) which is over 8 times greater than the initial equity of the firm. Some of the more dramatic impacts of the change are the increases in net income, income after taxes and family consumption expenditures. These benefits to the firm-household unit occur in response to farm expansion and the increase in cash available for consumption at an earlier point in time.

Financial growth of farm B parallels that experienced by farm A. Acreage under cultivation on farm B expands to 1525 acres with a corresponding drop in costs of production and a doubling of net returns per acre. Operator's net worth increases to $2.34 million. Net income, after-tax income and family consumption of unit B increase the most of any farm situation. Disposable income grows to nearly six times the value achieved under the lower equity position.

Simple comparison of farm size illustrates that farm C expands by an additional 2170 acres when the debt load is reduced from 70 percent to 30 percent of total assets. Even though farm size is beyond the minimum cost point by the fifteenth year, net returns per acre are also substantially higher. Final net worth is also dramatically higher at $4.8 million when the D/A ratio is initially at 30 percent.

The rates of growth in equity for all three farms are somewhat lower under the higher debt/asset ratio. This result is not apparently consistent with the Baker-Hopkin (1969) model of leveraged growth. According to the Baker-Hopkin hypothesis, as long as the marginal rate of return on capital exceeds the marginal cost of using nonequity capital, the owner may increase his level of income by increasing his financial leverage. By reinvesting some of this income in the farm business or repaying farm debts with the suprlus, net worth will increase over time. The implication is that farms with a higher leverage ratio, other factors held constant, can expect their equity to grow at a somewhat faster rate under the assumptions of the static, linear model. In fact, Table 7.8 indicates that over time the Baker-Hopkin result need not hold.

A closer examination of the first few years of growth in the basic model shows that the annual rate of growth in equity is greater for the more highly leveraged operation. But over time that pattern changes across different leverage positions as farms expand in size. Several factors may be responsible: (1) consumption behavior, (2) asset value appreciation, (3) production opportunities, or (4) taxes. Unlike the Baker-Hopkin model our basic model incorporates a non-linear consumption function. As incomes increase with farm size, a larger proportion of the additional income is plowed back into the farm business. Consequently, the larger farm with the lower leverage ratio expands acreage and net worth faster as land appreciates in value and propensity to consume out of current income falls.

A third factor is the nonlinear cost function. Baker and Hopkin assume linear production relationships, hence no economies of size. Farm expansion does lead to economies of size in the model developed here. The associated increases in net returns per acre along with the guaranteed cash flow effect of the government support program are soon capitalized into the price of land and lead to accelerated growth in net worth.

A fourth and final influential factor is the nonlinear income tax function. The federal income tax schedule is progressive and that should reinforce the leverage effect which Baker and Hopkin hypothesize (since interest expenses are written off against taxable income).[34]

Results from table 7.8 indicate that farm size and financial leverage are important factors in explaining the observed differences in expansion rates and financial growth under alternative lending criteria. Comparison of growth effects across farms with the same debt/asset ratio and across leverage ratios for the same size of farm lead to the following two observations. First, adjustments in financial leverage have relatively greater impact on the performance variables in the balance sheet (total farm assets and operator net worth). Second, changes in farm size (holding the D/A ratio constant) have relatively greater effects on current income and consumption.

7.4 Impacts of Alternative Repayment Policies

Three variations of the basic model are explored to evaluate what distributional impacts arise when the length of loan and the down payment requirement are altered. The expectation is that a lengthening of the loan repayment period will generally reduce annual debt service costs. A reduction in debt payments should increase reinvestment

[34]A final observation worth noting about the Baker-Hopkin hypothesis is that it is closely followed under lending criteria such as in models II and III. This is not the case in model I where the net capital ratio is the lending criterion.

income and promote firm growth, even though the final sum of principal and interest payments is greater. Similarly, a reduction in the down payment requirement is expected to promote firm expansion. A lower down payment theoretically makes expansion easier for all farms. Depending upon a firm's ability to generate sufficient income to maintain the loan contract, the reduced percentage of down payment should improve the growth potential of even low-resource base farms. Once again, comparisons are made with the results obtained in the basic model situation.

7.4.1 Effect of Increasing the Length of Loan (Model VI)

In model VI the repayment period of all three farms is increased by ten years. As expected, debt service costs declined and net reinvestment income increased in all three representative farm situation. Farm size acreage increased by 45 acres. Farm C actually decreased in size but that seems consistent with the increase in land prices. With a greater amount of reinvestment income available, firms bid up the price of land, making firm expansion progressively more difficult. Other cumulative effects contribute to the observed changes in farm size. The ability of farm B to expand to a larger operation means that net income per acre is also greater and land can be bid higher.

When compared with the basic model, operator's net worth increases for farms A and B reflecting growth in farm acreage and increased liquid assets. Operator C's equity is reduced by about $400,000. Disposable income and family consumption expenditures are at lower levels for all three farms by year 15.

A comparison of farms with equal initial size, but different initial D/A ratios, indicates that higher leveraged farms generally increase in size while farms with lower leverage ratios do not expand as much when length of loan is increased. This may be expected since relatively greater benefits in the form of reduced annual debt payments should go to those operators furthest in debt. The impact of the change on consumption and final net worth is mixed. Owner equity increases on the highly leveraged farms but falls somewhat on farms with lower D/A ratios when compared with the basic model. This result is attributable to changes in farm size and the price of land. Disposable income and consumption are little changed by year 15 for those smaller farms with higher initial equity (lower leverage ratio). No significant changes occur in disposable income or consumption between large farms with identical initial size but different beginning leverage ratios.

As a general result, lengthening the loan repayment period promotes greater farm expansion for small and intermediate size farms during the 15 year period. Additionally, relatively greater benefits are conferred on highly leveraged firms when compared with identically sized operations. Both impacts follow from a reduction in annual debt service costs.

7.4.2 Reduction of the Down Payment Requirement (Model VII)

The percentage down payment is reduced from 25 percent to 10 percent in model VII. Liberalizing the down payment requirement plays a key role in two somewhat opposing processes. It affects the ability of a farmer to successfully arrange financing of a land purchase, since he must have the initial equity to meet the requirement. The percentage down payment also affects the land bid price. It is anticipated that the former effect is stronger in the early years, before the change in down payment requirement has greatly affected the availability of liquid assets for making the down payment. In the later years higher land prices are expected to dilute the expansionary effect of the change.

A review of the results from model VII indicates that the above two effects do occur but that their impacts are not the same for all farm situations. Farm B expands more rapidly in the early years (years 1-9) and slowly in years 10 to 15 due to the anticipated land price increases. Farm A is not able to increase farm acreage in the early years due to its debt load which exceeds the maximum allowable D/A ratio. In the expansion years farm A is unable to acquire as many acres as in the basic model due to the inflated price of land. Farm C is also unable to expand to the acreage achieved in the basic model due to land price increases which are accelerated by the reduction in down payment requirement.

A review of the other impacts which result from liberalizing the down payment shows that final operator net worth is reduced for all three representative farms. This is due both to smaller farm sizes and increased indebtedness when compared with the basic model. The increase in indebtedness is directly attributable to the lower down payment. Disposable income and family consumption are little affected by the change in equity requirement.

Effects of the reduced down payment across firms with different leverage ratios parallel those experienced by the three representative firm-households. Expansion does not occur in the early years on highly leveraged operations due to the maximum allowable debt/asset ratio. Lower leveraged firms benefit initially from the lower percentage down payment as was the case for farm B. The 320- and 640-acre farms with initial D/A ratios of 30 percent do not expand to the size achieved in the basic model due to the escalation of land prices, as a result of the credit rule change. The 160 acre farm expands slightly by year 15. Disposable income and consumption are generally reduced from their basic model levels across farms with different initial equity positions.

Generally, the credit rule change which permitted a lower percentage down payment led to an escalation of land bid prices and a decline in farm size, operator equity and level of family consumption. The immediate benefits of increased farm size were not available to highly leveraged units due to the maximum allowable D/A ratio. Expansion in the later years was arrested by the increase in the price of land.

7.4.3 Effect of Liberalizing the Down Payment Requirement and Extending the Length of Loan (Model IX)

In model IX an attempt was made to examine the joint impact of liberalizing both conditions for extending credit. The effects were only slightly different from those observed for either of the individual rule changes. The combined effect is to increase size of farm B by 100 acres to 984 acres and to reduce the final acreage on both farms A and C when compared with the basic model. Owner equity increases slightly for operators A and B, but is down for operator C from the basic model level due to a lower value for real estate. Family consumption remains at the minimum level for unit A, but declines for both representative units B and C. The lower disposable income on farms B and C in models VII-IX is largely due to the increased debt service costs on land incurred as farm size increases. Generally, the impacts of changing both credit factors is similar to those found when only the length of loan was increased, holding all other credit conditions constant.

7.4.4 Impacts of Raising the Maximum Allowable Debt/Asset Ratio (Model VIII)

Lending limits can take many forms. Some are absolute limits defined in dollars per borrower. One application of this latter type of constraint is the establishment of a maximum allowable D/A ratio. In model VIII the distributional impacts of raising the maximum D/A ratio from .50 to .75 are examined.[35]

It is logical to expect that the main beneficiaries of such a rule change would be those farm units with D/A ratios greater than the maximum. But that conclusion may be incomplete. Other farm units with significantly lower D/A ratios find that they too can borrow up to the higher maximum. This latter right broadens the distributional impacts of the change in credit policy.

Relatively greater benefits do go to farm A in the form of greater gross income, disposable income, total farm assets, total equity and rate of growth in equity. By the

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[35]This issue of maximum allowable D/A ratios has also been examined by Thompson and Hanson (1979). In that study it was found that cash grain farms typically had maximum feasible D/A ratios between .20 and .35 in the historical period 1966-75. Additionally, it was shown that these debt ratio ceilings were highly sensitive to length of loan in the case of cash grain farms, where real estate comprises a large part of total farm assets. These maximum D/A ratios were commonly in the .40 to .65 range for mixed cash grain-livestock operations.

fifteenth year fram A had doubled the size it had attained in the basic model. Corresponding to the increase in acreage was a dramatic rise in owner equity to $1.04 million ($460,000 in real dollars) by year 15. Annual growth in net worth was 18.9 percent in that year.[36] This latter rate of growth reflects appreciation of land values and a higher rate of return on the farm operation. Finally, farm A moves to a lower D/A ratio which suggests a lower-risk financial position.

Farm B also realizes substantial benefits from the higher D/A ratio maximum. Farm size reaches 1624 acres, or twice that achieved in the basic model. Operator B's net worth reaches over $2 million, double the basic model result. In addition to those significant changes on the balance sheet, current disposable income and family consumption reach levels of $51,300 and $49,800 by the fifteenth year.[37]

Owner's net worth and family consumption are both lower on farm C as a result of the change in credit limitation when compared with the basic model. Factors contributing to the decline are lower net income per acre and

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[36]The estimated rate of growth in equity reflects the rate at which owner's net worth grew over the entire preceeding period.

[37]The increase in net farm income and income after taxes reflects the indirect effects of the credit policy change which speeds the expansion process and increases net returns per acre.

reduced price of land. The lower net returns per acre result from a lower price for corn which is $3.44 per bushel in the basic model but $3.24 in model VIII in year 15. The lower price for corn itself reflects lower costs of production and support levels. These lower costs in turn arise from larger farm size on average, larger farm size which was spurred by the change in credit policy. The lower price of land on large farms such as unit C also reflect the lower net returns per acre.

A comparison of the impacts of the credit policy change across farms with different initial leverage ratios, but identical initial acreages, reveals that on the basis of increases in net worth and levels of family consumption the greatest benefits went to farm-household units with initial D/A ratios of .5 and above. Relatively smaller benefits went to firm-households with lower initial D/A ratios. Apparently, the D/A ratio ceiling was even more restrictive on firms with low net capital ratios such as farms A and B.

7.4.5 Comparison of the Relative Distributional Impact of Variations on the Basic Model

Preceeding sections have examined the impacts of changes in various aspects of extension and repayment of credit. Most of the above analysis was on the basis of absolute changes or deviations from the basic model. To better grasp the relative distributional impacts of these changes the values of selected performance variables are compared at the end of year 15 by the use of index numbers. Table 7.9 summarizes each of the above nine models for the purpose of comparison. Each of the index numbers represent percentages of the initial value for that variable. All index numbers were computed after current dollar values were deflated and, therefore, represent constant dollar comparisons over time.

The performance variables chosen are usefully broken into two classes -- those relating to the current income situation (disposable income, consumption expenditures, and net reinvestment income) and those which reflect changes in the asset position of the firm-household unit (total assets, total debts, and net worth). The following comments will assess the relative impacts according to those two categories whenever possible. Changes in these two categories of performance variables constitute the income redistribution and asset redistribution effects alluded to in Chapter III.

In the case of farm A the greatest income benefits occur under the credit policy which emphasizes ability to make the required down payment (model II) and the greatest benefits in the form of assets occur when the allowable maximum on D/A ratio is raised (model VIII). A closer examination of the results from model II indicates that the increase in income was due to the increased use of operating inputs and short-term credit to boost yields. Lending

Table 7.9 Comparison of Basic Model Results with Alternative Lending Criteria and Credit Policy Variables by Farm Situation[a/]

Item	Initial Value	I [c/]	II	III	IV	V	VI	VII	VIII	IX
Farm A[b/]	($1000)	---percent of initial value---								
1. Income after taxes	11.3	48	158	42	46	46	42	42	61	39
2. Consumption	7.1	67	148	70	70	67	70	70	70	70
3. Reinvestment income	5.8	59	247	86	83	55	66	42	147	54
4. Total Assets	203.5	149	309	264	239	146	154	180	330	195
5. Total Debts	142.5	88	153	148	138	87	93	111	169	122
6. Net Worth	61.1	291	674	536	472	284	296	342	708	365
Farm B[c/]										
1. Income after taxes	18.6	72	120	124	130	73	69	53	122	54
2. Consumption	11.4	70	114	118	123	71	67	52	115	53
3. Reinvestment income	9.8	131	195	206	206	124	145	94	199	127
4. Total assets	407.2	227	355	380	359	206	223	220	359	253
5. Total debts	203.6	166	233	268	252	142	168	180	234	220
6. Net Worth	203.6	290	477	491	464	270	279	260	483	284
Farm C[d/]										
1. Income after taxes	39.3	97	104	102	103	120	110	106	102	82
2. Consumption	23.2	92	100	98	98	114	105	102	98	80
3. Reinvestment income	20.3	219	163	157	229	168	193	118	156	145
4. Toral assets	814.4	450	345	420	436	344	329	369	332	348
5. Total debts	244.3	515	318	441	454	328	350	442	309	502
6. Net Worth	570.1	422	356	411	430	351	320	338	341	282

a/ Results are drawn from year fifteen of the simulation. Table percentages represent real dollar value comparisons.

b/ Farm A initially has 160 acres and a D/A ratio equal to .70. Farm B initially has 320 acres and a D/A ratio of .50. Farm C starts out with 640 acres and a .30 D/A ratio.

c/ Model V is the basic model in which investment is set equal to the minimum of value of farm assets, available liquid assets for down payment, or net reinvestment income on each farm unit. In model I credit is extended on the basis of asset value and D/A ratio. Model II uses liquid assets for the down payment as the lending criterion. Model III allocates credit on the basis of ability to generate net reinvestment income for loan repayment. Model IV allocates credit by giving equal weight to value of assets and income generated for repayment. Model VI lengthens the loan repayment period by 10 years. Model VII reduces the down payment requirement to 10 percent. Model VIII raises the maximum allowable D/A ratio to .75. Model IX combines more liberal down payment and longer loan repayment conditions.

up to the fifteenth year, however, current income and consumption expenditures were not significantly different from those in the basic model. If that event is disregarded, the increase in maximum D/A ratio leads to the greatest overall benefits for farm A.

The two least satisfactory policies to pursue from operator A's perspective would be the basic model lending strategy in conjunction with a reduction in the down payment requirement. The benefits of expansion in the early years are prohibited because of the D/A ratio ceiling and in the later years land prices become prohibitively greater. Two lending criteria which do promote firm expansion and growth in net worth are ability to repay (model II) and available cash for down payment (model III), which was expected.

Farm B clearly receives the greatest benefits from credit when repayment capacity is the criterion (model III). Unit B similarly does well under a policy which provides equal weight to risk-bearing capacity (determined by the firm's D/A ratio and value of assets) and ability to repay the loan (model IV). One interpretation of this result is that operator B has a relative advantage in his ability to generate income. This appears to be consistent with farm B's ability to expand, move along the long run cost curve, and increase net returns per acre.

The policy of reducing the down payment holding all other credit conditions unchanged results in somewhat slower growth on farm B. Again, this slower growth is explained to a significant degree by the higher land price.

On farm C it appears that there is no single lending alternative which is clearly more advantageous. Depending upon the relative weights (or utility) the family places upon consumption versus net worth, the basic model or a combination of credit policies (such as in model IV) may lead to greater benefits for well-endowed farms. The implication appears to be that while farm C has a relative advantage in total assets, unit C's ability to generate revenues to repay a loan is also quite good.

Significantly less beneficial to farm C are attempts to improve access to credit by lengthening the loan maturity and reducing the down payment (as in models VI, VII, and IX). Within the structure and limitations of the model these credit policy adjustments contribute to higher land prices and greater indebtedness on farm C.

In summary, it appears that no single credit policy alternative is "best" for all farms given the limited ability of the simulation model to depict the actual growth and distribution processes at work in the real world. Model IV, which provides for an equal weighting of value of farm assets and D/A ratio, and ability to generate income for repayment, comes closest to providing relatively greater benefits across farms of unequal initial size and equity endowments.

Some final comments are in order on the relative financial impacts of the various credit policy alternatives. There is likely to be a high degree of complementarity between policy actions. For instance, an increase in the length of loan is likely to stimulate growth to a greater degree when the lending criterion is repayment capacity (as in model III). Another example would be a reduction in the down payment requirement in association with lending on the basis of available liquid assets for making the down payment. Of course, all of these policies stimulate greater expansion on highly leveraged farms if they are enacted jointly with an increase in the maximum allowable D/A ratio.

7.5 Summary of the Effects of Other Model Parameters

In Chapter III several factors were identified which play key roles in the determination of distributional impacts from credit use. This section provides a summary of the effects which result from changes in those behavioral and structural model parameters. All comparisons referred to in the following sections are with the basic model results unless otherwise stated. Selected numerical results from these model sensitivity tests are reported in table 7.10.

Table 7.10 Comparison of the Basic Model Results with Results Generated Under Alternative Parameter Assumptions[a]

Farm Situation	Model No.[b]	Income Less Taxes ($1000)	Family Consumption ($1000)	Debt Service Costs ($1000)	Net Reinvestment Income ($1000)	Annual Net Income ($/acre)	Acres in Farm (acres)	Total Land Value ($1000)	Total Farm Assets ($1000)	Total Farm Debt ($1000)	Total Equity ($1000)	Annual Growth in Equity (%)	Debt/Asset Ratio
Farm - A[c]	V	11.3	11.3	34.4	7.7	43.07	362.	734.	872.	359.	513.	14.2	.41
	X	26.3	19.7	22.8	13.5	40.85	256.	524.	651.	238.	413.	12.8	.37
	XI	10.8	11.3	33.2	7.2	41.87	351.	713.	845.	347.	498.	14.0	.41
	XII	23.2	14.0	28.9	16.4	35.85	279.	901.	1027.	302.	725.	16.5	.29
	XIII	26.1	15.7	24.3	17.3	45.07	212.	1900.	2031.	195.	1836.	22.7	.10
	XIV	-9.8	14.6	41.5	-12.2	42.94	399.	3181.	3283.	377.	2906.	25.7	.11
	XV	2.3	14.7	30.6	-4.1	36.17	256.	2034.	2134.	245.	1889.	22.9	.12
Farm - B	V	30.9	18.4	70.0	27.5	73.21	887.	1780.	2015.	694.	1320.	12.5	.34
	X	26.8	20.1	53.2	19.4	68.48	701.	1435.	1612.	527.	1085.	11.1	.33
	XI	24.5	14.8	54.1	23.1	63.73	714.	1448.	1630.	536.	1095.	11.2	.33
	XII	21.3	12.9	67.1	21.6	66.85	795.	2561.	2757.	664.	2092.	15.5	.24
	XIII	55.1	31.9	54.0	38.1	74.71	563.	5047.	5266.	420.	4845.	21.1	.08
	XIV	37.7	22.2	79.1	34.1	71.39	773.	6156.	6375.	616.	5760.	22.3	.10
	XV	3.1	14.7	87.1	7.3	79.34	806.	6415.	6604.	709.	5895.	22.4	.11
Farm - C	V	108.6	60.8	211.1	78.3	105.60	2992.	6073.	6721.	1993.	4798.	14.2	.29
	X	104.1	78.1	162.1	50.6	115.67	2474.	5065.	5547.	1476.	4071.	13.1	.27
	XI	108.1	60.8	211.3	77.9	105.01	2994.	6074.	6723.	1925.	4798.	14.2	.29
	XII	85.4	48.4	180.7	55.6	109.01	2351.	7580.	8041.	1645.	6397.	16.1	.20
	XIII	66.0	37.8	245.3	58.3	145.17	2187.	19,595.	20,047.	1806.	18,241.	23.1	.10
	XIV	132.5	73.4	208.6	89.5	126.54	2180.	17,365.	17,903.	1536.	16,366.	22.4	.10
	XV	70.1	40.1	262.2	61.8	133.44	2438.	19,405.	19,913.	1972.	17,941.	23.0	.10

a/ Numerical results are drawn from the fifteenth year of the simulation. All values are expressed in nominal terms.

b/ Model numbers correspond to those identified in Table 7.3. Model V is the basic model in which investment credit equals the minimum of; value of assets, available liquid assets, or net reinvestment income of each farm unit. Model X assumes that consumption equals 75% of disposable income. Model XI assumes short run yield response to additional operating inputs improves. Model XII assumes land appreciates at 6%. Models XIII-XV assume land appreciate at 8% and interest rates increase. Model XIII uses the basic model lending rule. Model XIV uses liquid assets for the downpayment as the credit rule. Model XV uses net reinvestment income for loan repayment as the credit rule.

c/ Farm - A initially has 160 acres and a .7 D/A ratio. Farm - B initially has 320 acres and a .5 D/A ratio. Farm - C starts with 640 acres and a .3 D/A ratio.

7.5.1 Effects of Changing the Household Consumption Function (Model X)

An assumption of the basic model was that the household consumption function was logarithmic with a constant consumption elasticity equal to .95. An alternative assumption used by Boehlje and Griffin (1979) and suggested elsewhere is that the consumption function is linear or becomes linear as income increases. In model X a strictly proportional consumption function is specified in which 75 percent of income after taxes is consumed, regardless of income level.

As expected, the linear consumption function leads to an increase in family consumption expenditures on all farms with a resultant decrease in net reinvestment income. There is a corresponding decrease in farm size by the fifteenth year for all farms. Debt service costs are also lower for all three representative farms.

By year 15 total farm equity is generally lower, lower by $100,000 on farm A, $240,000 on farm B, and $727,000 on farm C (as shown in table 7.10). The annual rate of growth of equity is also reduced indicating that consumption is indeed a drain on a firm's financial resources and tends to retard the growth process. The percentage reduction of equity, across farms with different initial sizes but identical beginning D/A ratios, is greater for small farms than for larger sized operations. No discernible pattern emerges across farms with identical size but different financial positions.

7.5.2 Effects of Alternative Assumptions About Investment Behavior and Productive Opportunities

In the basic model investment behavior and investment opportunities pivoted on the decision or ability to buy land and its machinery complement. Models XI and XVI explore the growth and distributional implications of changing the rate of return on operating inputs and of changing the decision rule for buying land, respectively.

In former versions of the basic model it was assumed that farm operators acquired land at the market price for land, if they could arrange the financing.[38] In model XVI a farm operator is assumed to purchase land only if his maximum bid price is equal to or greater than the market price. This decision rule in effect states that the net present value of the decision to buy land must be positive when budgeted using the mortgage interest rate on real estate debt.

Results of the numerical analysis indicate that most farms do not expand in size during the 15-year period. Farms with initially high leverage ratios, such as farm A, do not increase in size regardless of initial size of firm.

[38]The market price is computed as the weighted average of the individual firm maximum bid prices in each year. The assumption is that there is a single real estate market.

Those farms with leverage ratios of 1.0 (debt equals equity) were able to expand farm size. An exception to that pattern was farm B. Again in the low D/A ratio group the 160-acre and 640-acre units expanded, yet the 320-acre farm remained unchanged. Farm C was the only farm situation which actually expanded to a size of operation greater than it had in the basic model.

Accompanying farm C's increased size in year 15 were increases in operator net worth, disposable income and consumption expenditures. Higher income for farm C is partially attributable to the higher price for corn. Farm B experienced a reduction in final net worth, level of consumption expenditures and net reinvestment income when compared to the basic model results. Although operator A's net worth is reduced, unit A's disposable income, family consumption, and reinvestment income are up over basic model levels. Land bid prices on both farms A and B are lower under the change in investment decision rule.

An additional outcome in model XVI was an increase in the use of operating inputs which in effect increased farm revenues by raising corn yields. Farms A and B also greatly reduced their financial leverage as land appreciated in value and as they continued to make the annual debt payments.

To determine what changes in distributional impacts might result from a change in the rate of return on operating inputs the coefficient on the short run yield response function was increased from .05 to .075 in model XI. That slight adjustment has the potential for approximately doubling the short-run yield response to additional operating inputs.

A review of the results from model XI showed no conclusive result from the change in yield response parameter. Farms A and B and other small, highly-leveraged farms benefited in the early years of the simulation when farm expansion was not possible. Those benefits took the form of increased disposable income, family consumption, and reinvestment income. However, in the later years when the increase in reinvestment income should have aided firm growth, it did not. Farm size, operator equity, disposable income, consumption, and reinvestment income are reduced in year 15 from their basic model levels as shown in table 7.10. Farm C is unaffected by the change in yield response parameter.

One explanation for the unexpected decline of farms A and B is the lending criterion which is operating in the basic model. Purchase of additional operating inputs must occur out of available liquid assets. These same liquid assets are required to make the down payment on land. In the early expansion years when liquid assets are the limiting financial resource, firm growth is reduced. Since firm growth is retarded in the early years, the other benefits of asset ownership (increased equity and greater net returns) do not accrue to the small farm units.

7.5.3 Effect of Increases in the Rate of Land Value Appreciation and Accompanying Changes in the Level of Prices and Interest Rates

Our assumption to this point has been that land prices appreciate at an annual rate of 5 percent per year. The recent experience in Michigan and elsewhere in the U.S. is that land prices have increased in excess of 10 percent in some years. In models XII and XIII through XV we examine what the cumulative distributional effects of increasing the rate of land value appreciation are, given that farms start from different initial size of operation and/or equity position. In addition models XIII - XV assume that costs of production inputs also rise faster and that there is a corresponding rise in interest rates.

The expectation is that an increase in the rate of land value appreciation (as in model XII), all other factors constant, will lead to significant benefits for large farm operators in the form of greater net worth and lower relative debt position, therefore, lower financial risk. Levels of disposable income and consumption may or may not increase depending upon the ability of each farm to increase in size and realize greater net returns per acre.

Operator's final net worth is increased across all nine farm resource situations when compared with the basic model. Comparison of the three representative farms in table 7.10 reveal that operator A's final net worth increased slightly more in relative terms than either of the other two farms. This result appears to be consistent with the Baker-Hopkin hypothesis in view of farm A's higher initial leverage position. Farm size in year 15 is reduced relatively more on farm C where a reduction of 641 acres occurs from the basic model level. Farms A and B are also reduced by the escalation in land prices, but by smaller percentages. Disposable income, family consumption and net reinvestment income are lower on all farms due primarily to the reduction in farm size. Debt service costs, as a percentage of gross farm income, increase slightly for farms B and C due to the need to finance higher priced land, even though farm size is significantly lower.

Rate of growth in operator's net worth varies by initial farm size and equity. Smaller, 160-acre operations generally increase their net worth relatively more than 320-acre and 640-acre units. Across farms of varying size but identical leverage positions, however, the pattern indicates that lower leveraged units on average increase their net worth relatively more than those units with somewhat higher leverage ratios. This latter result is largely explained by the relatively faster expansion of the lower leveraged units in the early years, when they are not effectively constrained by the D/A ratio maximum. In the later years these same units receive relatively greater benefits on average due to the increase in appreciation in assets and owner equity.

In models XIII through XV land is assumed to appreciate at 8 percent each year. Cost of purchased inputs and consumption goods are also assumed to increase each year by 8 percent. Interest rates are raised to 12 percent on real estate loans and 14 percent on nonreal estate loans. Both rates are in nominal terms. In effect the real rates of interest are not changed from their values in the basic model. Corn prices are still assumed to increase at a 2 percent annual rate. The opportunity cost of capital is assumed to increase to 9.5 percent.

The above situation of increases in costs and interest rates without a corresponding rise in corn output price is expected to lead to reduced cash flow for household consumption and for reinvestment in the farm business. Factors contributing to the expected cash flow problem are increased price of land and reduced farm size. Table 7.10 provides numerical results for models XIII through XV under three alternative lending criteria.

Generally, the results indicate that land prices and corn prices are significantly higher by year 15. Net returns per acre are not greatly changed for farms A and B, but are actually higher in all three models for farm C. The rate of capitalization for land is significantly lower for all farms in all three models. Lower capitalization rates result from joint increases in the expected growth in land values, interest rates, and the opportunity cost of capital, all of which tend to increase the price of land when net returns per acre are held constant.

As expected, all farms experience a reduced cash flow, especially the 160-acre and 320-acre units. Disposable income and net reinvestment income on farm A are severely reduced and become negative during several years. Farm A's problem with regard to cash flow are less severe in model XIII where credit is extended according to the minimum of the three basic lending criteria. In that model firm growth is reduced and along with it the debt service costs.

Cash flow is not as problemmatic on farm C where size of operation appears to be sufficient to generate an adequate level of revenues to meet expanded consumption requirements and debt-servicing costs.

Farm size is significantly smaller in most farm situations than observed in the basic model. An exception to that trend was farm A in model XIV, where the operation increased by 40 acres. Operator's net worth increased in all 9 farm resource situations as expected due to the more rapid growth in land prices. Also, leverage ratios decreased dramatically over the 15-year period due to the rapid growth in equity and assets and relatively smaller increase in farm debts.

Comparison of the relative impacts on growth in operator's net worth across farm situations indicates that operators with lower initial leverage positions, regardless of farm size, increased their equity relatively more under the lending criteria which employed minimum credit capacity and ability to repay out of current income (models XIII and XV, respectively). This result is consistent with that found in model XII where growth on these farm units occurred in the early years before land prices were able to dampen the expansion process. Conversely, operators which had higher initial D/A ratios, regardless of size, experienced relatively greater growth in net worth when ability to make the down payment was the lending criterion.

No consistent pattern emerges concerning increases in net worth across farms of identical initial size but different levels of equity. Farms starting with 320 acres experience relatively less growth in net worth regardless of which lending rule is followed. Small, 160-acre units on average do relatively better in lending models XIII and XV, but increase net worth by a greater amount in model XIV where the basis for lending is the ability to make the down payment out of cash reserves.

CHAPTER VIII

Summary and Conclusions

8.1 Review of the Conceptual Approach and Underlying Assumptions

This study has been undertaken in response to the need for additional knowledge about the distribution of benefits from credit. It focused upon a firm-level analysis of the distributional impacts which are likely to arise under various conditions on loan extension and repayment. The research approach confined the class of distributional impacts to just the monetary and financial impacts. Consistent with that class of impacts the two performance dimensions used to evaluate alternative policies are: (1) changes in current household income and consumption levels, and (2) growth in operator's net worth. These two performance criteria are assumed to be important arguments of the household utility function.

A modified cash flow approach was developed to simulate and evaluate the potential distributional impacts which result under alternative credit policies, rules, and practices. This approach was useful in a number of ways. First, it allowed for a comparable means of evaluating specific financial impacts across credit policy choices or options. Second, the approach was useful in identifying systematic variations in initial resource situations of representative firm-household units and associated distributional impacts. Third, it facilitated an examination of several assumptions about structural and/or behavioral aspects of farm firm-household units, or general economic conditions, and what roles they likely play in the determination of these financial impacts.

The modified cash flow approach was placed within a growth model framework. What resulted was an analysis of two ongoing processes - a growth process and a distributional process. At this juncture there were two possibilities for analysis: (1) the effect which growth has on distrubution, and (2) the effect which distribution has on growth. One hypothesis which has been advanced is that credit is a means of offsetting an unequal initial distribution of factor ownership. Our approach accordingly examined the effect which distribution, more specifically credit distribution, had on financial growth of the firm-household unit and ultimately on the distribution of benefits from credit.

Our systems view of the representative firm-household initially made certain simplifying assumptions about behavior. Consumption expenditures of each household represented a four-person family unit with a minimum consumption requirement.

Operators' decisions to invest were confined to on-farm opportunities. Acquisition of land and its machinery complement were motivated by; (1) cost economies of size and (2) increases in operator's net worth as land appreciates in value. If financing of the land purchase decision could not be obtained, the operator was assumed to utilize liquid assets (subject to a liquidity constraint) and operating credit, as needed, to purchase additional operating inputs to raise yields and net returns per acre. Although optimizing decisions with regard to investment and production alternatives were not explicitly considered, they could be incorporated. The systems view and cash flow approach are compatible in their emphasis on financial flows to and from the farm business including: revenues generated on the farm, income from off-farm sources, use and repayment of debt, consumption withdrawals, payment of taxes, and reinvestment of earnings.

Additionally, government was assumed to intervene in the commodity market. Government did not actively manage the commodity program but did act to support the market price of corn at 90 percent of the nonland cost of production. A dynamic price adjustment mechanism operated to shift the commodity price distribution upward corresponding to increases in demand and modifications introduced by the price support program.

Lenders were assumed to employ some basic criteria in their allocation of credit. They were motivated to use these standardized operational rules to reduce costs of allocating credit and reduce the likelihood of nonrepayment of the loan. To minimize this risk it was initially assumed that lenders use a mixed strategy of providing investment credit up to the most limiting financial characteristic of the borrower. Other credit policy emphases as well as modifications in the terms of repayment and down payment were explored to evaluate certain assumptions about the impacts of liberalizing the conditions under which credit is extended.

8.2 Summary of the Numerical Results

A computer simulation model was developed for corn grain farmers in southern Michigan consistent with the above approach and assumptions. The model provided 15 years of simulated firm-household growth starting from 9 initial resource situations. Summary statements which follow are interpretations of the simulated firm-level impacts.

1. Three single lending criteria were contrasted with the results obtained in the basic growth model. Distributional impacts under all three lending criteria were sensitive to initial farm size and operator's initial equity position. No single credit policy provided all farm resource situations with the greatest potential for growth.

When risk-bearing capacity of the borrower was emphasized and that capacity was interpreted by reference to value of assets and borrower's net capital ratio, units such as farm C received relatively greater financial benefits from credit. Those benefits took the form of increased current income (both before and after taxes), higher levels of consumption and reinvestment income, and growth in owner's equity in the farm business. Farm C represented a well-established operator who initially owned 640 acres and started from a low D/A ratio position. Farms A and B, both less-well-endowed farms with higher but different initial D/A ratios, realized small increases in operator's net worth but not as a direct result of the change in credit rule. Appreciation of land values gradually led to improvements in each firm's equity position, and thereby, improved access to investment credit. No significant changes from the basic lending model occurred in consumption or net reinvestment income on farm A or farm B.

Changes in credit policy which increased the weights attached to either borrower's repayment capacity or ability to make the required down payment led to a redistribution of benefits. Farm units A and B (with initial sizes of 160 acres and 320 acres, respectively) exhibited improved growth potential. Although farm A still experienced low levels of consumption due to low cash flow, there was slightly greater reinvestment income available. Operators A and B both substantially increased their net worth by the end of the 15-year period while operator C's net worth and disposable income were somewhat reduced from their levels in the basic lending situation. Farm B obtained significantly greater benefits from credit as gross income, disposible income, consumption expenditures, and reinvestment income all increased. Farms A and B appeared to have a relative advantage in obtaining credit when the lending agency emphasized income-generating capacity.

2. An examination of the financial impact of extending the loan repayment period illustrated that representative farms A and B obtained relatively greater benefits from the rule change. The predominant impact was upon each operator's net worth. In effect the model converted the longer repayment period into an increase in the demand for land and, consequently, higher land prices. The implicit assumption was that the reduction in annual debt service cost and associated increase in net reinvestment income is quickly used to bid up the price of land. These higher land prices generally led to reductions in farm sizes when compared with the normal repayment period policy.

Significant in a different way was the general reduction in disposable income and consumption level variables which resulted across farm units. This appeared to be a reflection of decreased farm size and lower net returns per acre when compared with the basic lending situation. The credit rule change also led to slightly higher debt loads and D/A ratios indicating generally higher risk financial positions.

3. The financial impacts which resulted from a liberalization of the down payment requirement were qualitatively quite similar to those generated by an extension of the loan repayment period. Once again, by assumption the bid price on land rose when the percentage of down payment was reduced. Implicitly, the lower equity requirement made more liquid assets available for purchasing add-on units

of land. This effect also illustrated that if a buyer can suddenly borrow 90 percent of the purchase price where he could formerly borrow only 75 percent the increase in financial leverage has value if the opportunity cost of capital exceeds the after-tax rate of interest on the mortgage.

The down payment rule change made available greater expansion in the early years. Farms A and B were constrained by the D/A ratio limitations during those years and, consequently, attained smaller size of operation by the final year when contrasted with the basic model result. Both of these farm units also experienced lower disposable incomes, consumption levels, and reinvestment incomes. Farm C achieved smaller farm size and reductions in net worth, disposable income, and family consumption expenditures as a result of the reduced down payment requirement. Changes in the current income situation on all three farms were attributable to a significant degree to increased debt service costs which accompanied the heavier debt load.

Concurrently longer repayment periods and lower down payment requirements appeared to accentuate the growth retarding impact of higher land prices. Farms A and B received the primary benefits from the simultaneous change in those credit rules in the form of increased owner equity.

4. By far the most expansionary credit policy adjustment was the increase in maximum allowable debt/asset ratio. Both units A and B experienced substantial farm growth, and

increases in disposable income and net worth. Conversely, farm C did not achieve the levels of disposable income, consumption, and net worth than it had when the D/A ratio ceiling was more restrictive. One interpretation of this result is that risk-averse behavior whether by borrower or lender is a significant deterrant to more rapid farm growth on farms where financial capital is a limiting factor.

5. In general the credit policy alternatives evaluated here had relatively greater distributional impacts across firms with different initial equity positions. Initial farm size, as measured by acres under cultivation, was not as critical a factor in determining the distributional impacts across firms. Greater sensitivity of the model to the initial equity position reflects the underlying behavioral and structural assumptions inherent in the model.

6. Consumption behavior modifies firm growth potential in important ways. Household consumption expenditures directly reduced net reinvestment income and the rate at which the farm business potentially expanded. The amount withdrawn for consumption was frequently greater than income available for reinvestment. Linear and log-linear consumption functions were assumed. As expected, all farms experienced more limited growth under the linear consumption function case. Higher income farms such as unit C were affected relatively more by the change in functional form. Since consumption was assumed to occur out of disposable income, the income tax schedule also

played an important role in modifying the levels of consumption expenditures across farm-household resource situations.

7. When the rate of land appreciation was accelerated to 6 percent without an accompanying rise in interest rates, levels of owner equity increased. The general pattern indicated that farms with lower leverage positions, regardless of initial farm size, improved their relative net worth positions. Disposable income, family consumption expenditures and net reinvestment income were lower on all farms when contrasted with conditions involving less rapid land price increases. Consequently, smaller farm size and increased debt service costs contributed to the reduction in current income levels.

When the acceleration in land prices was matched by an equal increase in interest rates but not in commodity prices, the change in relative prices was net income decreasing. By comparison with the basic model results both land prices and the expected price of corn were higher than they were under less inflationary conditions. Farm size and net cash flow were generally reduced. Small units such as farm A had severe cash flow problems in several years.

8. Decisions to buy land were evaluated under two alternatives. If the buyer was willing to accept a lower rate of return than the discount rate used to budget the investment decision, he was generally able to expand his

operation regardless of farm size or initial equity position. If small landbase operators were not willing to accept lower rates of return on the investment, they were not able to successfully bid for land. Large farm operators continued to successfully bid for land due to their higher annual net returns per acre.

8.3 Conclusions

Four policy questions were posed relevant to the issue of distributional impacts of credit. In response to those questions the following statements can be made with reference to the conceptualization which has been developed and application of the numerical model.

1. Within the limited scope of this analysis, credit (its extension, use, and repayment) is expected to have important distributional impacts at the firm-household level. Those impacts are financial in nature and can be identified by changes in current income and/or in net worth.

2. Credit policies, rules, and practices affect the distribution of potential benefits from credit by establishing four rights for effectively internalizing the financial benefits. The four rights include;

    1. a right to invest the loan proceeds or acquire additional assets with the loan proceeds,
    2. a right to the income from those assets or investments,

3. a right to the appreciation or depreciation of the assets or investments, and
4. the right to sell, lease, collateralize, or otherwise use the property acquired with credit.

In addition there are some important real and potential costs associated with the use of credit. The distribution of net benefits from credit depends upon the ability of firms in different resource situations to gain access to credit and productively use it over time.

3. Changes in credit policies potentially redistribute the benefits from credit by changing the relative weights (or emphases) which are attached to the initial resource endowments or anticipated productive opportunities of borrowers. The redistributional impacts vary across firm-household units in view of existing variations in initial resource endowments and the cumulative changes which occur in productive opportunities when economies of size are possible.

4. Policy design and implementation considerations which appear to have the greatest redistributional impacts are those which redefine the criterion or basis for lending. Low resource base, highly leveraged firms obtain relatively greater financial benefits when more emphasis is placed upon repayment capacity of the borrower. Conversely, large resource base firms with low leverage ratios

obtain relatively greater financial benefits when value of assets and net capital ratio are given greater weight.

It is likely that the traditional emphasis on value of assets as collateral results from an increased risk aversion, in view of revenues that do not cover debt service costs, and from the high costs of acquiring more reliable information concerning borrowers' repayment capacities. Collateral requirements appear to restrict credit availability to those who already own sufficient assets. The lack of acceptable collateral need not, however, indicate an inability to repay the loan. Repayment capacity is conditional upon productive opportunities, consumption, reinvestment, and other behavioral responses of the borrowing unit.

The implementation of liberalized lending rules appeared to affect the form in which distributional impacts are potentially realized. Extension of the loan repayment period and reduction of the down payment were effectively capitalized into land values and reflected in operators' net worth positions. This result followed from assumptions which were used in model construction. Yet, it raises an important question on how to implement policies for redistributing credit, given that lending rules which increase net reinvestment income may well serve to stimulate bidding for land resources with no direct impact on ability to generate income.

8.4 Implications and Limitations

Whenever a study of this type is undertaken, a number of implications may follow. These implications are prescriptive in nature, indicating what should or ought to be done. This particular study has direct implications for lenders and policymakers, and indirect implications for borrowers.

8.4.1 Implications for Lenders and Policymakers

Within lending policies, rules, and practices exists the potential for modifying certain aspects of the structure of agriculture. Although this study does not look explicitly at the size distribution of farms, some insights can be obtained from the numerical results.

For instance, lender reliance on value of assets and net capital ratios in allocating credit over an extended period of time greatly aids potential growth of initially larger resource base farms. This is illustrated in lending model I where the large-farm/small-farm acreage ratio went from 4:1 to 10:1 in just 15 years. By comparison this farm size ratio went to just 5:1 when lenders employed a policy which emphasized a borrower's income-generating, repayment capacity (model II). The inference is that the size distribution of farms becomes more skewed under the former lending policy.

An aspect closely related to structure is the ability of farmers in different resource situations to bid for land and other productive assets. In all lending models presented large farm operators were able to make higher bid offers on land, given that land was being valued on the basis of capitalized net returns per acre. If this situation were to persist with scarce land resources being bid away from small operators the trend toward fewer and larger farms may be accelerated, or at least continue.

The most general welfare implication of the study is that credit confers certain potential benefits to those who have access to it. Lenders and policymakers who design and/or implement credit policies might well consider their distributional impacts over time. These impacts arise not only when interest rates change. They arise when the criteria for lending and/or the rules concerning loan repayment are altered.

8.4.2 Some Implications for Borrowers

Conditions for loan extension and repayment appear to be influential in determining borrowers' benefits. In lieu of interest rates which vary little between lenders, the analysis suggests that time spent negotiating aspects of the loan agreement has a potentially large return for the farmer using debt financing for expansion.

The analysis indicates that expansion of farm size remains difficult during periods of rapid price increases. One of the primary constraints is the need for increased cash flow. Higher input costs coupled with higher interest rates reduce repayment capacity and the ability of an operator to take on additional debt. The analysis indicates that this problem of inadequate cash flow is most severe on small farming operations. On these units off-farm earnings are essential to supplement existing farm earnings.

A third implication of the analysis is that taxes and consumption outlays alter the potential for farm growth, especially in the early years of expansion. Consumption expenditures reduce repayment capacity and, therefore, debt-carrying capacity. A beginning farmer with low initial equity may find that his growth potential is substantially improved by judicious management of both tax liability and consumption outlays.

8.4.3 Limitations and Areas for Further Research

Emphasis has been placed upon an evaluation of alternative lending policies and rules in the conceptual approach. The numerical model was used as an illustration of that conceptual approach. Certain limitations of the numerical model need to be recognized. These limitations represent useful areas for extending the applicability of model and associated concepts to the problem of financcial impacts.

First, a single cropping activity was used to illustrate the impacts of credit, yet additional cropping or production alternatives could usefully be incorporated. In this way more information about existing on-farm production and investment opportunities in various farm resource situations could be included.

Second, it is likely that the distributional impacts of lending policies and rules are modified in important ways by firm-household behavior and operator goals. The numerical model used does not have the capability of evaluating growth potential under alternative operator goals. This capability plus an ability to consider additional cropping activities could be developed by the use of a linear programming component in the simulation model. The LP component would also provide a means for explicitly including leasing arrangements as an option for establishing control over productive assets.

Another behavioral aspect relates to operators' investment decisions. The model would be greatly improved by utilizing an investment decision framework. Currently, land is the focus of the investment decision. However, the decision to buy land could be weighted against other investment and production alternatives in terms of expected rate of return.

In conjunction with this decision framework the land market needs to be modified to reflect competitive conditions where land may be bid away from other farm units. Certain instances of farm expansion in the analysis do not reflect land availability limitations which characterize local real estate markets.

A final limitation is the high degree of sensitivity of the model to variations in parameters which affect the bid price for land. Two such parameters are the opportunity cost of capital and the expected rate of growth in land values.

The conceptual issues raised concerning the distribution process, as it has been identified, need further consideration and development. A careful development of that process will provide; (1) a more thorough understanding of how policy and behavioral parameters modify credit policy actions and (2) additional hypotheses on which to perform empirical tests.

APPENDIX

The Computer Simulation Model

```
      PROGRAM MAGIC(INPUT=256,OUTPUT=256,TAPE11,TAPE5=INPUT,TAPE6=OUT
     2    PUT,TAPE9=256,TAPE10=256,TAPE12=256,TAPE13=256,TAPE14=256,
     3    TAPE15=256,TAPE16=256,TAPE17=256,TAPE18=256,TAPE19=256,
     4    TAPE20=256,TAPE21=256,TAPE22=256,TAPE23=256,TAPE24=256,
     5    TAPE25=256,TAPE26=256,TAPE27=256,TAPE28=256,TAPE29=256,
     6    TAPE30=256)
      REAL MTR,IR,INF,INFP
      INTEGER T,OPT
      DIMENSION AINF(10),AGNI(10),APCT(10),AGGWL(10),AGGWC(10)
      DIMENSION RETL(10),ALAND(10),ACOST(10),XPS(10),CAPR(10)
      DIMENSION EINF(10),OPCC(10),IUN11(50)
      COMMON/A/ CONST,PILE,XINC,SL,UP,ZBAR,SIGMA
      COMMON/INT/ MM1,ISW
      COMMON/LAND/ ANI,CC,DP,GNI,INF,IR,MTR,TSTAR,PBAR,T,N
      COMMON/TEMP/ SIGL,ZBARL,TAREA
      COMMON/COST/ TVC,OWNC,XMS,XLC,COP,YLD,EXPR,EFF,OPERCA,YLDSR,
     1    XINCOM,COPEXP,TAXES
      COMMON/ASSET/ ACRES,XLANDP,OTHERA,ASSLIQ,TASSET,DEBT,DEBTL,
     1    DEBTO,EQUITY,DSER,SDA,EXINC,BDA,DDP,XNET,EQO,OPCRED
      COMMON/DATA/ ACREO,OTHEO,OPT,ICLASS,IPH
C
C   DEFINE FUNCTION STATEMENTS
C   PRESENT VALUE OF A UNIFORM SERIES
      PVUS(XI,N) = (1.0-(1.0+XI)**(-N))/XI
C   COST OF PRODUCTION SCHEDULE (EXCLUDING LAND) WITH ECONOMICS OF SIZE
      BUCOST(AC,CDIFF) = CDIFF+(153.8-3.6014*AC+.0744*AC*AC)/100.
      OWNCST(AC,ODIFF) = ODIFF+(46.56-1.46212*AC+.03425*AC*AC)/100
      TVCOST(AC,TDIFF) = TDIFF+(107.24-2.1393*AC+.04015*AC*AC)/100.
C
C       *** INITIALIZATIONS ***
C
C
C   EXPECTED INFLATION RATE IN THE PRICE OF LAND (TO BE CAPITALIZED)
      DATA AINF/0./
C   PERCENT OF "COST OF PRODUCTION" TO USE AS SUPPORT LEVEL
      DATA APCT/.90/
C   MANDATED RETURN TO LAND IN C-O-P CALCULATIONS
      DATA RETL/.015/
C   EXPECTED GROWTH IN NET INCOME PER ACRE (TO BE CAPITALIZED)
      DATA AGNI/.01/
C   EXPECTED INFLATION (OR GROWTH IN DEMAND)  IN CORN (OUTPUT) PRICES
      DATA EINF/1.02/
C   OPPORTUNITY COST OF CAPITAL
      DATA OPCC/.08/
C
      CALL OPENMS(11,IUN11,50,0)
      IDA = 11
C   NUMBER OF ALTERNATIVE SETTINGS FOR SELECTED PARAMETERS
      IINF = 1
      IGNI = 1
      IPCT = 1
      IRETL = 1
      IEINF = 1
      IOPCC = 1
C   NUMBER OF FARM TYPES UNDER STUDY
      NOF = 9
C   INITIALIZE THE FARM DATA FILE
      CALL ZEROF(NOF)
      IZERO = 0
      AZERO = 0.
      SIGL = 0.
      ZBARL = 0.
      XINC = 0.
      EFF = 0.
      MAXF = 9
      IFTYPE = 3
C
      DO 102 J = 1,MAXF,IFTYPE
C   AGGREGATION WEIGHTS FOR THE INDIV. FARM PART. TO THE NAT"L LAND MKT.
      AGGWL(J) = .10/3.0
      AGGWL(J+1) = .20/3.0
      AGGWL(J+2) = .70/3.0
C   AGGREGATION WEIGHTS FOR THE INFIV. FARM PART. TO THE NAT"L C-O-P
      AGGWC(J) = .10/3.0
      AGGWC(J+1) = .20/3.0
      AGGWC(J+2) = .70/3.0
  102 CONTINUE
C
      DO 1102 J = 1,MAXF
      ACOST(J) = 0.
 1102 ALAND(J) = 0.
C
      TAREA = 1.0
      PRO = 2.1
C   EXPECTED PRICE OF CORN PER BUSHEL
```

```
      ZBARO = 2.1
      Z78 = 2.2
      ZPCT = .70
C   STANDARD DEVIATION OF CORN PRICE EXPECTATIONS
      STDP = .16
      SIGMA = STDP*ZBARO
C   PROPORTION OF EXPECTATIONS PILED
      PROPP = 1.0
C   YIELD OF LAND IN BUSHELS OF CORN
      YLDO = 95.
      YLDSR = 0.
C   RATE AT WHICH YIELDS ARE EXPECTED TO INCREASE
      YLDINF = 1.01
C
C   PRODUCTION COST DATA//
C   TOTAL VARIABLE COSTS (FERTILIZER, PESTICIDES, FUEL, ETC.)
      TVCO = 100.7/YLDO
C   OWNERSHIP COSTS (MACHINERY, EQUIPMENT, ETC.)
      OWNO = 32.97/YLDO
C   OVERHEAD COSTS IN CENTS PER BUSHEL OF CORN
      CVHO = 23.37/YLDO
C   MINIMUM GROSS FARM OVERHEAD (INCLUDES FAM. CONSUMP.)
      OVHEAD = 10000.
C   BUDGETED LAND CHARGE
      XLCO = 47./YLDO
C   AVERAGE PRICE OF LAND, HIGH GRADE,//
      PLAND = 910.
C   LAND TAXES BASED ON A PERCENT OF CURRENT LAND VALUE
      XLTAX = .016
C   MANAGEMENT CHARGE AS A PERCENT OF COST-OF-PRODUCTION(LESS MGMT)
      XMC = .07
      COPO = TVCO + OVHO + OWNO + XLCO
      XMSO = COPO*XMC
C   TOTAL COST OF PRODUCTION (INITIAL CONDITION)
      COPO = COPO + XMSO
C   BASE IOWA BUDGET FARM SIZE  (HUNDREDS OF ACRES)
      BASEAC = 3.80
      BACRES = BASEAC*100.
C   MINIMUM PARCEL ONWHICH TO ESTIMATE A LAND BID PRICE
      ACMIN = 40.
C   COST OF PRODUCTION DIFFERENTIAL BETWEEN ILL. DATA AND IOWA BUDGETS.//
      CDIFF = 0.
      CDIFF = COPO - BUCOST(BASEAC,CDIFF)
      ODIFF = 0.
      ODIFF = OWNO - OWNCST(BASEAC,ODIFF)
      TDIFF = 0.
      TDIFF = TVCO - TVCOST(BASEAC,TDIFF)
C   INFLATION OF DIRECT COSTS PER BUSHEL (NOT COMPENSATED FOR BY YIELD)
      DCINF = 1.06
C   REAL ESTATE MORTAGE INTEREST RATE BASED ON AVERAGE FLB RATE
      IR = .0875
C   DOWN PAYMENT REQUIRED IN BUYING LAND
      DP = .25
      DDP = DP
C   ACCURACY TOLERANCE FOR INTEGRATION PROCEDURE
      TOL = .0005
C   NUMBER OF YEARS TO BE SIMULATED
      IYEAR = 15
C   OPPORTUNITY COST OF CAPITAL FOR A LONG-TERM RISK-FREE INVESTMENT
      RISKFR = .05845
C   INTEREST RATE FOR MACHINERY AND OTHER DEBTS
      XMIR = .10
C   NUMBER OF YEARS TO AMORT. MACHINERY AND OTHER DEBTS
      MYR = 7
C
      WRITE(9,777)
      WRITE(10,777)
C
      DO 21 JJ =1,NOF
C   READ MARKET PARTICIPANT CHARACTERISTICS
      READ(5,1) OPT,ICLAS,IPH,MTR,ACREO,OTHEO,DEBT,DSER,SDA,BDA,
     1     TSTAR,EXINC
C
      T = IPH
      N = T
C   IPH      PLANNING HORIZON OF THE FIRM IN YEARS
C   MTR      MARGINAL INCOME TAX RATE
C   ACREO    NUMBER OF ACRES INITIALLY OWNED AND OPERATED BY THE FIRM
C   OTHEO    VALUE OF NON-LAND ASSETS OF WHICH 60 PERCENT ARE LIQUID
C   DEBT     INDEBTNESS OF THE FIRM
C   DSER     YEARLY DEBT SERVICE OF THE FIRM IN INTEREST AND PRINCIPLE
C   SDA      DEBT TO TOTAL ASSET RATIO FOR THE INITIAL CONDITION
C   BDA      DEBT TO TOTAL ASSET RATIO AS AN ACQUISTION CONSTRAINT
C   TSTAR    CAPITAL GAINS TAX RATE
```

```
C   EXINC   EXTERNAL OFF-FARM INCOME
C
C   EXPECTED INFLATION RATE IN THE PRICE OF LAND//
       INF = AINF(IINF)
       INFP = 100.*INF
C   EXPECTED GROWTH IN NET INCOME FROM LAND//
       GNI = AGNI(IGNI)
       GNIP = 100.*GNI
C   PERCENT OF THE COST-OF-PRODUCTION SUPPORTED BY GOV"T PROGRAMS
       PCT = APCT(IPCT)
       PCTP = 100.*PCT
       IF(PCT.EQ.0.) PRO = 0.
C   MANDATED RETURN TO LAND AS A PERCENT OF CURRENT LAND VALUE
       RETLD = RETL(IRETL)
       RETLDP = RETLD*100.
       CCO = OPCC(IOPCC)
       CCOP = CCO*100.
C   GROWTH IN EXPECTATIONS OF CORN PRICES PER YEAR
       EXINF = EINF(IEINF)
       EXINFP = (EXINF-1.0)*100.
       IWRT = IDA + JJ
       IPRT = IDA + NOF + JJ
C
       WRITE(IWRT,4) OPT,ICLASS,PCTP,RETLDP,EXINFP,CCOP
       WRITE(IPRT,4) OPT,ICLASS,PCTP,RETLDP,EXINFP,CCOP
C
C      *** INITIALIZE  OUTPUT  VARIABLES ***
C
       XLANDP = PLAND
       PBAR = PLAND
       PSTAR = PLAND
       XPS(JJ) = PLAND
       PSTARP = 0.
       ALANDL = PLAND
C   INITIALIZE THE ASSET AND LIABILITY POSITION OF THE FIRM
C
       ACRES = ACREO
       AC100 = ACRES/100.
       YLD = YLDO
       OWNC = OWNCST(AC100,ODIFF)
       OVH = OVHO
       TVC = TVCOST(AC100,TDIFF)
C   TOTAL LAND VALUE
       TLANDV = ACRES*XLANDP
C   TOTAL VALUE OF OTHER ASSETS
       OTHER = OTHEO
C   TOTAL VALUE OF OTHER, NON-LIQUID, NON-LAND ASSETS
       OTHERA = ACRES*OWNC*YLD*PVUS(XMIR,MYR)/
     1     (1.0+PVUS(XMIR,MYR)*XMIR)
C   TOTAL VALUE OF LIQUID ASSETS
       ASSLIQ = OTHER-OTHERA
C   TOTAL ASSETS
       TASSET = TLANDV + OTHER
C   DEBT TO TOTAL ASSET RATIO
       DER = SDA
       DEBT = TASSET*SDA
       DEBTL = DEBT
       DEBTO = 0.
       OPCRED = 0.
       OPERCA = 0.
       EQO = TASSET - DEBT
C   TOTAL EQUITY
       EQUITY = EQO
C   TOTAL DEBT SERVICING COMMITTMENTS
       DSER = DEBTL/PVUS(IR,IPH) + DEBTO/PVUS(XMIR,MYR)
       GROWTH = 0.
       FCONS = 0.
       XINCLT = 0.
       ZBAR = ZBARO
       SIGMA = STDP*ZBAR
       SM = SIGMA
C   DIRECT COSTS EQUAL TOTAL VARIABLE COSTS PLUS OWNERSHIP COSTS
       DC = TVC + OWNC
C   CALCULATE THE RETURN TO LAND AS MANDATED
       XLC = RETLD*XLANDP/YLD
C   MANAGEMENT CHARGE IS A CONSTANT PERCENT OF COST OF PRODUCTION
       XMS = XMC*(DC + XLC + OVH)
C   CALCULATE THE COST OF PRODUCTION (INITIAL)
       COP = DC + XLC + XMS + OVH
       XNONLC = DC + XMS + OVH
C   CALCULATE ANNUAL NET INCOME ABOVE DIRECT COSTS AND TAXES
       OVHN = OVHEAD-(OVH*ACRES*YLD)
       IF(OVHN.LT.0.) OVHN = 0.
       OVHN = OVHN/(ACMIN*YLD)
```

```
      IF(OVHN.GT.OVH) OVHN = OVH
C   ANNUAL NET INCOME = GROSS MARGIN - TAXES - OVERHEAD (IF NEEDED)
      ANI = ((Z78-(TVC+OWNC+OVHN))*YLD)-XLTAX*XLANDP
      CC = CCO
      CALL MAXBID(PSTARO)
      SUPRL = PRO
      SUPR = SUPRL
      EXPR = ZBAR
C   CALCULATE THE IMPLICIT CAPITALIZATION RATE
      CRATE = ANI/PSTAR
      CRP = CRATE*100.
C
C   DISPLAY ZERO YEAR INITIAL CONDITIONS
      WRITE(IWRT,976)
  976 FORMAT("0YR    NL.COST     L.COST      C.O.P.      E(P)",
     1 5X,"STD(P)      SUP.P      A.N.I.      CAP.RATE    N.P.L.",
     2 2X,"BID.P.L.      O.C.CAP")
      J = 0
      IYR = 0
      WRITE(6 ,6 ) J,XNONLC,XLC,COP,Z78,SM,SUPR,ANI,CRP,PSTAR,PSTARO,CC
      WRITE(IWRT,6)J,XNONLC,XLC,COP,Z78,SM,SUPR,ANI,CRP,PSTAR,PSTARO,CC
  777 FORMAT("0YR   ACRE   TOTLANDV   OTHERA    TOTASSET   LANDDEBT   ",
     1 "   TOTDEBT    EQUITY     D/A      EGROW     DSERV     FCONS ",
     2 "   XINCLT      XNET   LIQASS    OPCRED")
      WRITE(IPRT,777)
      WRITE(IPRT,17)IYR,ACRES,TLANDV,OTHER,TASSET,DEBTL,DEBT,EQUITY,
     1      DER,GROWTH,DSER,FCONS,XINCLT,AZERO,ASSLIQ,OPCRED
      WRITE(9,17)     IYR,ACRES,TLANDV,OTHER,TASSET,DEBTL,DEBT,EQUITY,
     1      DER,GROWTH,DSER,FCONS,XINCLT,AZERO,ASSLIQ,OPCRED
      WRITE(10,17)    IYR,ACRES,TLANDV,OTHER,TASSET,DEBTL,DEBT,EQUITY,
     1      DER,GROWTH,DSER,FCONS,XINCLT,AZERO,ASSLIQ,OPCRED
C
      CALL PUT(JJ)
   21 CONTINUE
      WRITE(30,9)
    9 FORMAT(1H0,T4,*J*,T7,*JJ*,T13,*YLD*,T22,*YLDSR*,T31,*TVC*,
     1     T40,*OWNC*,T49,*XLC*,T58,*XMS*,T67,*COP*,T74,*OPERCA*,
     2    T83,*XINCOM*,T93,*COPEXP*,T104,*TAXES*)
C
C
C     *** BEGIN TIME LOOP ***
C
      DO 11 J = 1,IYEAR
      IYR = J
      WRITE(9,777)
      WRITE(9,2)
      WRITE(10,777)
      WRITE(10,2)
C
      ACOP = 0.
      DO 111 KFARM = 1,NOF
      CALL GET(KFARM)
      AC100 = ACRES/100.
C   DIRECT COSTS MAY BE INFLATED (DEFLATED) OVER TIME
      OWNC = OWNCST(AC100,ODIFF) * DCINF**(J-1)
      TVC = TVCOST(AC100,TDIFF) * DCINF**(J-1)
      DC = TVC + OWNC
      YLDINF = 1.01
      YLD = YLDO*YLDINF ** (IYR-1)
      OVH = OVHO*DCINF ** (J-1)
C   LAND CHARGE = F (RETURN ON LAND, LAND PRICE, CROP YIELD)
      XLC = RETLD * XLANDP / YLD
      XMS = XMC * (DC + OVH + XLC)
C   COST-OF-PRODUCTION = F (DIRECT COSTS, MGMT CHARGE, LAND, OVERHEAD)
      XNONLC = DC + XMS + OVH
      COP = DC + XMS + XLC + OVH
      ACOP = ACOP + AGGWC(KFARM)*COP
      ACOST(KFARM) = COP
      CALL PUT(KFARM)
  111 CONTINUE
      XACOP = ACOP / (DCINF**(IYR-1))
C   THE SUPPORT LEVEL IS BASED ON A NATIONAL COST OF PRODUCTION
      WRITE(6,201) ACOP,XACOP
  201 FORMAT("0NATIONAL COST OF PRODUCTION IS CALCULATED AS: $",F7.3,
     1  "   DEFLATED C-O-P $",F7.3)
      WRITE(6,976)
      SUPR = PCT * ACOP
C   SUPPORT PRICES ARE HELD TO AT LEAST INITIAL LEVEL
      IF(SUPR.LT.PRO) SUPR = PRO
C   SUPPORT PRICES ARE INFLEXIBLE DOWNWARD
      IF(SUPR.LE.SUPRL) SUPR = SUPRL
      SUPRL = SUPR
C
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

```
C      *** PRICE EXPECTATIONS MODEL ***
C
C   YEARLY ADJUSTMENT PROCESS FOR MEAN OF ORIGINAL EXPECTATIONS DISTR.
       ZBAR = ZBARO * EXINF ** (J-1)
C   MEAN OF UNDERLYING PRICE EXPECTATIONS CAN NOT BE BELOW
C   ZPCT OF THE NATIONAL C-O-P
       ZLOW = ZPCT * ACOP
       IF(ZBAR.LT.ZLOW) ZBAR = ZLOW
C   YEARLY ADJUSTMENT PROCESS FOR VAR. OF ORIGINAL EXPECTATIONS DISTR.
       SIGP2 = .197
C   SET THE GOVERNMENT SUPPORT LEVEL
       SL = SUPR
C   STOCKS RELEASE POINT (TRUNCATING THE UPPER PART OF THE DIST)
       RPPCT = 10.
       RP = SL * RPPCT
       CALL PEM(PROPP,TOL,FM,SM,RP)
C
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
       ALANDP = 0.
       DO 112 JJ = 1,NOF
       CALL GET(JJ)
C   THE EXPECTED PRICE EQUALS THE FIRST MOMENT OF THE MODIFIED
C   EXPECTATIONS DISTRIBUTION.
       EXPR = FM
       OVHN = OVHEAD - (OVH * ACRES * YLDO)
       IF(OVHN.LT.0.) OVHN = 0.
       OVHN = OVHN/(ACMIN * YLDO)
       IF(OVHN.GT.OVH) OVHN = OVH
C   ANNUAL NET INCOME = GROSS MARGIN - TAXES - OVERHEAD (IF NEEDED)
       ANI = (EXPR*YLD)-((TVC+OWNC+OVHN)*YLDO)-(XLTAX * XLANDP)
C
C   LINEAR PARAMETER RELATING THE OPPORTUNITY COST OF CAP. TO PRICE RISK
C   SET THE OPPORTUNITY COST OF CAPITAL GIVEN THE INITIAL PRICE RISK
C   AND RISK-FREE RATE.
       CCMAX = .10
       CCO = OPCC(IOPCC)
       CC2 = .01/160.
       CC1 = (CCMAX - CCO) * SIGP2*SIGP2
C
C   ADJUST THE OPPORTUNITY COST OF CAPITAL BY THE PRICE RISK
       CC = CCMAX - CC1/(SM*SM)
       IF(CC.LT.RISKFR) CC = RISKFR
C
C************  LAND PRICE MODEL  ************
C
C   DETERMINE THE MAXIMUM BID FOR ADDITIONAL LAND
       PBAR = ALANDL
       CALL MAXBID(PSTAR)
C   CAPITALIZATION RATE    K = I/V
       CRATE = ANI/PSTAR
       CAPR(JJ) = CRATE
C   CALCULATE LAND VALUE GIVEN INDIVIDUAL"S RISK-UTILITY FUNCTION
       PSTARP = ANI/CAPR(JJ)
       XPS(JJ) = PSTARP
       XLANDP = PSTARP
C
       CALL PUT(JJ)
       ALAND(JJ) = PSTARP
       ALANDP = ALANDP + AGOWL(JJ)*PSTARP
  112  CONTINUE
       CCRF = CC1/(CCMAX-RISKFR)
       CCRF = SQRT(CCRF)
       WRITE(6,699) CCRF
  699  FORMAT(" STD(P) AT RISK-FREE RATE OR LOWER:",F7.3)
C
C   LAND PRICES ARE INFLEXIBLE DOWNWARD
       IF(ALANDP.GT.ALANDL) ALANDL = ALANDP
       DO 113 JJ =1,NOF
       CALL GET(JJ)
       IWRT = IDA + JJ
       JK = JJ + NOF
       XLANDP = ALANDP
C*********************** FIRM ASSET MODEL ***********************
C
       CALL FAM (XMIR,MYR,IR,IPH,XLTAX,DCINF,YLDO,J,JK)
C
C******************** LAND ACQUISTION MODEL *********************
       CALL LAM(XMIR,MYR,IR,IPH,YLDO,XPS(JJ))
C
       CRP = CAPR(JJ)*100.
       XNONLC = COP - XLC
C   DISPLAY RESULTS OF YEAR SIMULATED
       WRITE(IWRT,6) J,XNONLC,XLC,COP,EXPR,SM,SUPR,ANI,CRP,
     1     XLANDP,XPS(JJ),CC
```

```
      WRITE(6,6) J,XNONLC,XLC,COP,EXPR,SM,SUPR,ANI,CRP,
     1     XLANDP,XPS(JJ),CC
      WRITE(30,9913) J,JJ,YLD,YLDSR,TVC,OWNC,XLC,XMS,COP,OPERCA,
     1     XINCOM,COPEXP,TAXES
 9913 FORMAT(1H ,2I3,7F9.3,4F10.2)
C
      CALL PUT(JJ)
  113 CONTINUE
C  CUT-OFF YEARLY ITERATION IF LAND VALUE EXCEEDS $20 THOUSAND/ACRE
      IF(PSTAR.GT.20000.) GO TO 10
C
   11 CONTINUE
C
   10 CONTINUE
C
      WRITE(6,2)
C  END EXECUTION OF THE PROGRAM
      STOP
C
C            FORMAT  STATEMENTS
C
    1 FORMAT(A4,I1,I3,F4.0,F5.0,E7.0,E8.0,F8.0,3F4.0,F5.0)
    2 FORMAT(1H )
    4 FORMAT("1FARM LEVEL IMPACTS OF GOVERNMENT PRICE SUPPORT POLICIES
     1                  GLENN PEDERSON"//
     2"    FARM:  ",A4,"      SALES CLASS: ",I3/
     3"    PERCENT OF COST-OF-PRODUCTION SUPPORTED BY GOVT: ",F6.2/
     4"    MANDATED RETURN TO LAND (PERCENT OF CURRENT VALUE):"F6.2/
     5"    EXPECTED INFLATION IN PRICES RECEIVED FOR CORN: ",F6.2/
     6"    INITIAL-STATE OPPORTUNITY COST OF LONG-RUN CAPITAL: ",F6.2/)
    6 FORMAT(1H ,I2,4F10.3,F10.4,3F10.3,2F10.0,F10.4)
   17 FORMAT(1H ,I2,F6.0,6F10.0,F8.4,F8.2,6F8.0)
      END
C
C
      SUBROUTINE LAM(XMIR,MYR,IR,IPH,YLDO,BIDP)
C  LAND ACQUISTION MODEL
      REAL IR
      COMMON/ASSET/ ACRES,XLANDP,OTHERA,ASSLIQ,TASSET,DEBT,DEBTL,
     1     DEBTO,EQUITY,DSER,SDA,EXINC,BDA,DP,XNET,EGO,OPCRED
      COMMON/COST/ TVC,OWNC,XMS,XLC,COP,YLD,EXPR,EFF,OPERCA,YLDSR,
     1     XINCOM,COPEXP,TAXES
      PVUS(XI,N) = (1.0-(1.0+XI)**(-N))/XI
      OPERCA = 0.
      OPCRED = 0.
      YLDSR = 0.
      DER = DEBT/TASSET
      IF(ASSLIQ.LE.0.) RETURN
      IF(XNET.LE.0.) RETURN
      BUYMIN = 40.
      XMOA = OWNC * YLDO * PVUS(XMIR,MYR) * (1.0-XMIR)
      AVDOL = (BDA-DER) * TASSET/BDA
C  DEBT/EQUITY LENDING CONSTRAINT
      ACRES1 = AVDOL/(XLANDP + XMOA)
C  CASH LIQUIDITY CONSTRAINT
      ACRES2 = ASSLIQ/((XLANDP + XMOA) * DP)
C  CASH SURPLUS TO SERVICE LAND DEBT
      ACRES3 = XNET * PVUS(IR,IPH)/((XLANDP + XMOA)*(1.0-DP))
C  NUMBER OF ACRES FEASIBLE TO BUY
      BUY = AMIN1(ACRES1,ACRES2,ACRES3)
      IF(BUY.LT.BUYMIN) GO TO 10
      IF(BDA.LT.DER) RETURN
      ACRES = ACRES + BUY
C  INCREMENT INDEBTNESS AND LIQUID ASSETS
      DEBTL = DEBTL + (1.0-DP)*XLANDP*BUY
      ASSLIQ = ASSLIQ - DP*XLANDP*BUY
      RETURN
   10 CALL VAM(XMIR,MYR,IR,IPH,YLDO)
      RETURN
      END
C
C
      SUBROUTINE VAM(XMIR,MYR,IR,IPH,YLDO)
C  VARIABLE ASSETS MODEL
      REAL IR
      COMMON/ASSET/ACRES,XLANDP,OTHERA,ASSLIQ,TASSET,DEBT,
     1     DEBTL,DEBTO,EQUITY,DSER,SDA,EXINC,BDA,DDP,XNET,EGO,OPCRED
      COMMON/COST/ TVC,OWNC,XMS,XLC,COP,YLD,EXPR,EFF,OPERCA,YLDSR,
     1     XINCOM,COPEXP,TAXES
      PVUS(XI,N) = (1.0-(1.0+XI)**(-N))/XI
C  BETA IS A YIELD RESPONSE PARAMETER FOR ADDITIONAL VAR. INPUTS
      BETA = .05
C  DELTA IS A LIQUIDITY PREFERENCE PARAMETER FOR WORKING CAPITAL
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```
      DELTA = .5
      DER = DEBT/TASSET
      IF(ASSLIQ.LE.0.) RETURN
      IF(XNET.LE.0.) RETURN
      AVDOLA = ((BDA-DER)*TASSET/BDA)/ACRES
      XNETA = XNET/ACRES
      AVLIQ = DELTA * ASSLIQ
C   YLDMAX IS POTENTIAL OUTPUT AT WHICH MC IS SET EQUAL TO E(P)
      YLDMAX = YLD * (EXPR*BETA*ACRES) ** (BETA/(1.0-BETA))
C   OPCMAX IS THE LEVEL OF OPERATING INPUTS CORRESPOND. TO YLDMAX
      OPCMAX = (YLDMAX/YLD) ** (1.0/BETA)
C   GROSS RETURNS PER ACRE
      GRMAX = YLDMAX * EXPR
      OPERCA = AVLIQ/ACRES
      IF(OPERCA.GT.OPCMAX) OPERCA = OPCMAX
      IF(OPERCA.LE.0.) OPERCA = 1.0
      Z1 = ALOG(YLD) + BETA*ALOG(OPERCA)
      YLDSR1 = EXP(Z1)
      GRA1 = YLDSR1*EXPR
      IF(GRA1-GRMAX) 20,10,30
   10 YLDSR = YLDSR1
      GO TO 30
   20 SHORT = OPCMAX - OPERCA
C   OPCRED IS OPERATING CREDIT
      IF(XNETA.GE.SHORT) OPCRED = SHORT
C   OPERAT. CREDIT IS CONSTRAINED BY THE AVAIL. OF LIQUID
C   ASSETS FOR REPAYMENT
      IF(XNETA.LT.SHORT) OPCRED = XNETA
      IF(OPCRED.LT.0.) OPCRED = 0.
      OPERCA = OPERCA + OPCRED
      IF(OPERCA.LE.0.) OPERCA = 1.0
      Z2 = ALOG(YLD) + BETA*ALOG(OPERCA)
      YLDSR2 = EXP(Z2)
      YLDSR = YLDSR2
   30 CONTINUE
C   UPDATE LIQUID ASSETS OF THE FIRM
      ASSLIQ = ASSLIQ - ((OPERCA - OPCRED)*ACRES)
      RETURN
      END
C
C
      SUBROUTINE FAM  (XMIR,MYR,IR,IPH,XLTAX,DCINF,YLDO,IYR,IFARM)
C   FIRM ASSET MODEL
      REAL MTR,IR,INF,INFP,XREAL(13)
      INTEGER T
      COMMON/ASSET/ ACRES,XLANDP,OTHERA,ASSLIQ,TASSET,DEBT,DEBTL,
     1     DEBTO,EQUITY,DSER,SDA,EXINC,BDA,DDP,XNET,EQO,OPCRED
      COMMON/COST/ TVC,OWNC,XMS,XLC,COP,YLD,EXPR,EFF,OPERCA,YLDSR,
     1     XINCOM,COPEXP,TAXES
      COMMON/LAND/ANI,CC,DP,GNI,INF,XR,MTR,TSTAR,PBAR,T,N
      PVUS(XI,N) = (1.0 - (1.0+XI) **(-N))/XI
      GAMMA = .95
      IW = 6
      IWRT = IFARM + 11
      INFP = 100 * INF
C
C          INCOME SECTION
C
      IF(YLDSR.LE.0.) YLDSR = YLD
C   TOTAL GROSS INCOME EQUALS CROP INCOME + EXTERNAL EARNINGS
      XINCOM = EXPR*YLDSR*ACRES + EXINC
C   CASH OPERATING EXPENSES = DIRECT COSTS + TAXES + INTEREST
      COPEXP = ACRES*YLDO*TVC + (XLTAX*XLANDP*ACRES) + IR*DEBTL +
     1     XMIR*(DEBTO + OPCRED) + OTHERA/MYR
C   TAXABLE INCOME
      TINC = XINCOM-COPEXP+(XMIR*ASSLIQ)
      EXEMP = 4000.
      TINLEX = TINC - EXEMP
C   INCOME TAXES
      TAXES = 0.
      IF(TINLEX.GT.0.) CALL TAX(TINLEX)
C   INCOME LESS TAXES
      XINCLT = TINC-TAXES
C
C   FAMILY CONSUMPTION
      FCONSM = 5000.*DCINF**(IYR-1)
      IF(XINCLT.LT.0.) GO TO 27
      FCONS = XINCLT**GAMMA
   27 CONTINUE
      IF(XINCLT.LT.0.) FCONS = FCONSM
      IF(FCONS.LT.FCONSM) FCONS = FCONSM
C
C   DEBT SERVICING (PRINCIPLE ONLY)
      DSER = DEBTL/PVUS(IR,IPH)
```

```
C  NET INVESTMENT INCOME OR SAVINGS
      XNET = XINCLT-FCONS-DSER+(IR*DEBTL)-(OPCRED*XMIR)+OTHERA/MYR -
     1     OPCRED
C
C          BALANCE SHEET SECTION
C
      TLANDV = ACRES*XLANDP
      ASSLIQ = ASSLIQ+XNET
      OPERC = (OPERCA-OPCRED)*ACRES
      IF(ASSLIQ.LT.0.) DEBTO = DEBTO-ASSLIQ
      IF(ASSLIQ.LT.0.) ASSLIQ = 0.
      OTHERA = ACRES*OWNC*YLDO*PVUS(XMIR,MYR)/(1.0 +
     1     PVUS(XMIR,MYR)*XMIR)
      OTHER = ASSLIQ + OTHERA + OPERC
      TASSET = TLANDV + OTHERA + ASSLIQ + OPERC
      DEBTL = DEBTL-DEBTL/PVUS(IR,IPH)+(IR*DEBTL)
      DEBTO = DEBTO - DEBTO/PVUS(XMIR,MYR) + (XMIR*DEBTO)
      DEBT = DEBTL+DEBTO
      DER = DEBT/TASSET
      EQUITY = TASSET-DEBT
      GROWTH = 0.
      IF(EQUITY.GT.0.  .AND.  EQO.GT.0.)
     1     GROWTH = ALOG(EQUITY/EQO)*100./IYR
      WRITE(IWRT,10) IYR,ACRES,TLANDV,OTHER,TASSET,DEBTL,DEBT,EQUITY,
     1     DER,GROWTH,DSER,FCONS,XINCLT,XNET,ASSLIQ,OPCRED
      WRITE(9,10) IYR,ACRES,TLANDV,OTHER,TASSET,DEBTL,DEBT,EQUITY,DER,
     1     GROWTH,DSER,FCONS,XINCLT,XNET,ASSLIQ,OPCRED
   10 FORMAT(1H ,I2,F6.0,6F10.0,F8.4,F8.2,6F8.0)
      XINFL = 1.0/(DCINF ** (IYR - 1))
      XREAL(1) = TLANDV*XINFL
      XREAL(2) = OTHER*XINFL
      XREAL(3) = TASSET*XINFL
      XREAL(4) = DEBTL*XINFL
      XREAL(5) = DEBT*XINFL
      XREAL(6) = EQUITY*XINFL
      XREAL(7) = DER
      XREAL(8) = GROWTH
      XREAL(9) = DSER*XINFL
      XREAL(10) = FCONS*XINFL
      XREAL(11) = XINCLT*XINFL
      XREAL(12) = XNET*XINFL
      XREAL(13) = ASSLIQ*XINFL
      WRITE(10,10) IYR,ACRES,XREAL
      RETURN
      END
C
C
      FUNCTION FUNCX(X,SIGMA,XBAR)
      REAL NEXPF
      COMMON/INT/MM1,ISW
      SQRTF(X) = SQRT(X)
      NEXPF(X) = EXPF(-X)
      IF(ISW) 10,20,30
   10 OTHER = 1.0
      GO TO 40
   20 OTHER = X
      GO TO 40
   30 OTHER = X*X
   40 FUNCX = (1.0/SQRTF(6.2832*SIGMA**2))*NEXPF((X-XBAR)**2/
     1     (2.0*SIGMA**2))
      FUNCX = FUNCX * OTHER
      RETURN
      END
C
C
      SUBROUTINE PEM(PROPP,TOL,FM,SM,RP)
      COMMON/A/CONST,PILE,XINC,SL,UP,ZBAR,SIGMA
      COMMON/INT/MM1,ISW
      COMMON/TEMP/SIGL,ZBARL,TAREA
C
C***  INITIALIZATIONS
      MM1 = 0
      NITER = 1
      IR = 5
      IW = 6
      CONST = 1.0
      STD = 4.0
      XINCR = .10
C  PROPD  -- PROPORTION PLACED UPON THE MEAN OF THE DISTRIBUTION
      PROPD = 1.0-PROPP
      XL = ZBAR-STD*SIGMA
      UP = ZBAR+STD*SIGMA
      IF(XL.GT.(SL-SIGMA)) XL = SL-SIGMA
      IF(XL.LT.0.) XL = 0.
```

```
      IF(UP.LT.(SL+SIGMA)) UP = SL+SIGMA
      ZB = ZBAR
      SI = SIGMA
      XLX = XL
      UPX = UP
      SLX = SL
      RPX = RP
      IF(RP.GT.UP) RPX = UP
      IF(SIGMA.EQ.SIGL .AND. ZBARL.EQ.ZBAR) GO TO 10
C***  FIND THE AREA UNDER THE UN-STANDARDIZED NORMAL CURVE
      ISW = -1
      TAREA = SIMPI(ZB,SI,TOL,XLX,UPX)
C  IF A LOGICAL RESULT HAS NOT OCCURRED DUMP ALL PARAMETER VALUES
      IF(TAREA.LE. .01) CALL EXITX
   10 SIGL = SIGMA
      ZBARL = ZBAR
      SL = SL-XINCR
      DO 40 ITER = 1,NITER
      SL = SL+XINCR
      SLX = SL
C***  CONST = 1.000 / TAREA
C*** FIND THE AREA BELOW THE SUPPORT PRICE
      ISW = -1
      PILE = SIMPI(ZB,SI,TOL,XLX,SLX)
      PILE = PILE*CONST
      OPILE = PILE
      IF(PROPP.NE.0.) PILE = PILE*PROPP
      CONST = CONST*((TAREA-PILE)/(TAREA-OPILE))
C*** FIND THE AREA ABOVE THE RELEASE PRICE
      ISW = -1
      PILE1 = 0.
      IF(RPX.LT.UPX)PILE1 = SIMPI(ZB,SI,TOL,RPX,UPX)
      PILE1 = PILE1*CONST
      OPILE1 = PILE1
      IF(PROPP.NE.0.) PILE1 = PILE1*PROPP
      CONST = CONST*((TAREA-PILE1)/(TAREA-OPILE1))
C***  FIND THE AREA OF THE RESULTING DISTRIBUTION
      AREA = SIMPI(ZB,SI,TOL,SLX,RPX)+PILE+PILE1
C***  FIND THE FIRST MOMENT OF THE RESULTING DISTRIBUTION
      ISW = 0
      FM = SIMPI(ZB,SI,TOL,SLX,RPX)+PILE*SLX+PILE1*RPX
C  IF A LOGICAL RESULT HAS NOT OCCURRED DUMP ALL PARAMETER VALUES
      IF(FM.LT.ZBAR) CALL EXITX
C***  FIND THE SECOND MOMENT OF THE RESULTING DISTRIBUTION
      ISW = 1
      SM = SIMPI(ZB,SI,TOL,SLX,RPX)+PILE*SLX*SLX+PILE1*RPX*RPX
      IF((SM-FM**2).LE.0.) GO TO 20
      SM = SQRT(SM-FM**2)
C  IF A LOGICAL RESULT HAS NOT OCCURRED DUMP ALL PARAMETER VALUES
      IF(SM.GT.SIGMA) CALL EXITX
      GO TO 30
   20 CALL EXITX
   30 CONTINUE
   40 CONTINUE
   50 RETURN
      END
C
C
      SUBROUTINE EXITX
      WRITE(6,10)
   10 FORMAT("OEXITX HAS BEEN CALLED.")
      RETURN
      END
C
C
      FUNCTION SIMPI(XBAR,SIGMA,TOL,XMIN,XMAX)
C  SIMPSON"S RULE 1: EXAMPLE FOR NORMAL DENSITIES  (ZELLNER.P.404)
      REAL NEXPF
      COMMON/INT/MM1,ISW
      COMMON/A/DUMMY(7)
      DIMENSION D(2)
      ABSF(X) =  ABS(X)
      NEXPF(X) = EXPF(-X)
      FLOATF(I) = FLOAT(I)
      GAMMAF(X) = GAMMA(X)
      LOGF(X) = ALOG(X)
      LGAMAF(X) =  ALOGF(GAMMAF(X))
      SQRTF(X) =  SQRT(X)
      SIMPI = 0.
      IF(XMIN.GE.XMAX) GO TO 65
      H = (XMAX-XMIN)/2.0
      E = FUNCX(XMIN,SIGMA,XBAR)
      G = FUNCX(XMAX,SIGMA,XBAR)
      C = H*(E+G)
```

```
      D(2) = 3.*C
      N = 1
      MINITR = 64
      MAXITR = 5000
   10 S = 0.
      DO 15 L =1,N
   15 S =S+FUNCX(XMIN+(FLOATF(2*L-1))*H,SIGMA,XBAR)
      D(1) = C+4.*H*S
      C = (C+D(1))/4.
      D(2) = D(1)
      N = 2*N
      H = .5*H
      IF(N-MINITR) 10,20,20
   20 S = 0.
      DO 25 L =1,N
   25 S = S+FUNCX(XMIN+(FLOATF(2*L-1))*H,SIGMA,XBAR)
      IF(N-MAXITR) 30,30,45
   30 D(1) = C+4.*H*S
      IF(ABSF(D(1)-D(2))-3.*TOL) 40,40,35
   35 C = (C+D(1))/4.
      D(2) =D(1)
      N = 2*N
      H = .5*H
      GO TO 20
   40 B = D(1)/3.
      GO TO 55
   45 WRITE(6,50)N,C,S,D(1)
   50 FORMAT(I10,3F20.5)
      B = D(1)/3.
   55 CONTINUE
   60 CONTINUE
      SIMPI = B
   65 RETURN
      END
C
C
      FUNCTION EXPF(Y)
      X = Y
      IF (X.GT.160. .OR. X.LT.-160.) GO TO 5
      GO TO 6
    5 CONTINUE
      WRITE(6,7) X
    7 FORMAT("0***WARNING*** X > 160 OR X < -160",10X," X =",F12.5)
      IF(X.GT.160.) X = 160.
      IF(X.LT.-160.) X = -160.
    6 EXPF = EXP(X)
      RETURN
      END
C
C
      SUBROUTINE MAXBID(PSTAR)
C  PGM TO DETERMINE THE MAXIMUM BID PRICE FOR LAND GIVEN CERTAIN PARAMETERS
C  SOURCE:  LEE,WARREN F. AND NORMAN RASK.  "INFLATION AND CROP
C           PROFITABLITY: HOW MUCH CAN FARMERS PAY FOR LAND?"
C           AJAE 58 (1977): 984-990.
C  ANI   -- EXPECTED ANNUAL NET RETURNS PER ACRE BEFORE TAXES
C  CC    -- BUYER"S OPPORTUNITY COST OF CAPITAL AFTER TAXES
C  DP    -- PROPORTION OF PURCHASE PRICE PAID DOWN
C  GNI   -- EXPECTED ANNUAL RATE OF GROWTH IN ANI
C  INF   -- EXPECTED ANNUAL RATE OF INFLATION IN LAND PRICES
C  IR    -- NOMINAL RATE OF INTEREST CHARGED ON THE MORTGAGE
C  MTR   -- BUYER"S MARGINAL INCOME TAX RATE (FEDERAL AND STATE)
C  N     -- BUYER"S PLANNING HORIZON IN YEARS
C  PBAR  -- AVERAGE PRICE PER ACRE FROM RECENT SALES OF COMPARABLE PARCELS
C  PSTAR -- MAXIMUM BID PRICE
C  T     -- AMORTIZATION PERIOD OF LOAN IN YEARS
C  TSTAR -- CAPITAL GAINS TAX RATE
      REAL MTR,IR,INF
      INTEGER T
      COMMON/LAND/ ANI,CC,DP,GNI,INF,IR,MTR,TSTAR,PBAR,T,N
C
      PSTAR = PBAR
      IF(ANI.LE.0.)  RETURN
      SUM1 = 0.
      SUM2 = 0.
      ONE = 1.0
C
C  DISCOUNTED VALUE OF ANNUAL NET INCOME ADJUSTED FOR INCOME TAXES
      DO 10 I = 1,N
      SUM1 = SUM1 + (((ONE+GNI)/(ONE+CC))**I)*ANI*(ONE-MTR)
   10 CONTINUE
C
C  PRESENT VALUE OF EXPECTED CAPITAL GAINS WHEN SOLD IN THE N-TH YEAR
      ALPHA = (((ONE+INF)/(ONE+CC))**N)*(ONE-TSTAR)
```

```
      SUM1 = SUM1 + ALPHA*PBAR
C
      DO 20 I =1,T
      SUM2 = SUM2 +(ONE/((ONE+CC)**I))*((ONE+IR)**(T-I+1)-ONE)
     1    /(IR*(ONE+IR)**(T-I+1))
   20 CONTINUE
C
      SUM3 = DP + (ONE-DP)*((((ONE+CC)**T)-ONE)/(CC*(ONE+CC)**T))
     1    * ((IR*(ONE+IR)**T)/(((ONE+IR)**T)-ONE))
     2  - ((ONE-DP)*MTR*IR*((IR*(ONE+IR)**T)/(((ONE+IR)**T)-ONE))*SUM2)
     3  - (TSTAR/((ONE+CC)**N))
C
      PSTAR = SUM1/SUM3
      IF (PSTAR.LE.0.)  GO TO 25
      RETURN
   25 CONTINUE
      WRITE(6,26) SUM1,SUM2,SUM3,ALPHA
   26 FORMAT("1SUM1,SUM2,SUM3,ALPHA =",4F16.6)
      WRITE(6,27) ANI,CC,DP,GNI,INF,IR,MTR,N,T
   27 FORMAT("0ANI,CC,DP,GNI,INF,IR,MTR,N,T =",7F12.6,2I4)
      STOP
      END
C
C
      SUBROUTINE TAX(DUMMY)
      REAL MTR
      DIMENSION BTAXR(16),PCT(16),ARG(16)
      COMMON/LAND/ ANI,CC,DP,GNI,INF,IR,MTR,TSTAR,PBAR,T,N
      COMMON/ASSET/ ACRES,XLANDP,OTHERA,ASSLIQ,TASSET,DEBT,DEBTL,
     1     DEBTO,EQUITY,DSER,SDA,EXINC,BDA,DDP,XNET,EQO,OPCRED
      COMMON/COST/ TVC,OWNC,XMS,XLC,COP,YLD,EXPR,EFF,OPERCA,YLDSR,
     1     XINCOM,COPEXP,TAXES
      DATA ARG/0.,3400.,5500.,7600.,11900.,16000.,20200.,24600.,
     1     29900.,35200.,45800.,60000.,85600.,109400.,162400.,215400./
      DATA BTAXR/0.,0.,.05345,.08289,.11798,.14156,.16203,.18313,
     1     .20739,.23187,.27773,.32797,.39138,.43459,.50163,.54552/
      DATA PCT/0.,.14,.16,.18,.21,.24,.28,.32,.37,.43,.49,.54,.59,
     1     .64,.68,.70/
      DO 10 I = 1,16
      IF(DUMMY.GE.ARG(I)) GO TO 10
      TAXES = BTAXR(I-1)*ARG(I-1) + PCT(I-1)*(DUMMY-ARG(I-1))
      MTR = PCT(I-1)
      RETURN
   10 CONTINUE
      TAXES = BTAXR(16)*ARG(16) + PCT(16)*(DUMMY-ARG(16))
      MTR = PCT(16)
      RETURN
      END
C
C
      SUBROUTINE PUT(IFARM)
      COMMON/ASSET/ FASSET(17)
      COMMON/COST/ FCOSTS(13)
      COMMON/LAND/ FLAND(9),ILAND(2)
      COMMON/DATA/ RDATA(2),IDATA(3)
      INDEX = 4*(IFARM-1)+1
      CALL WRITMS(11,FASSET,17,INDEX,-1)
      INDEX = INDEX + 1
      CALL WRITMS(11,FCOSTS,13,INDEX,-1)
      INDEX = INDEX + 1
      CALL WRITMS(11,FLAND,11,INDEX,-1)
      INDEX = INDEX + 1
      CALL WRITMS(11,RDATA,5,INDEX,-1)
      INDEX = INDEX + 1
      RETURN
      END
C
C
      SUBROUTINE ZEROF(N)
      DIMENSION A(17)
      DO 10 J = 1,17
      A(J) = 0.
   10 CONTINUE
      DO 12 J = 1,N
      INDEX = 4*(J-1) + 1
      CALL WRITMS(11,A,17,INDEX,-1)
      INDEX = INDEX + 1
      CALL WRITMS(11,A,13,INDEX,-1)
      INDEX = INDEX + 1
      CALL WRITMS(11,A,11,INDEX,-1)
      INDEX = INDEX + 1
      CALL WRITMS(11,A,5,INDEX,-1)
      INDEX = INDEX + 1
   12 CONTINUE
```

```
      RETURN
      END
C
C
      SUBROUTINE GET(IFARM)
      COMMON/ASSET/ FA(17)
      COMMON/COST/ FC(13)
      COMMON/LAND/ FL(9), IL(2)
      COMMON/DATA/ RD(2), ID(3)
      INDEX = 4*(IFARM-1) +1
      CALL READMS(11, FA, 17, INDEX)
      INDEX = INDEX + 1
      CALL READMS(11, FC, 13, INDEX)
      INDEX = INDEX + 1
      CALL READMS(11, FL, 11, INDEX)
      INDEX = INDEX + 1
      CALL READMS(11, RD, 5, INDEX)
      INDEX = INDEX + 1
      RETURN
      END
*EOR
*EOF
```

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