Capital as an element of growth in farm firms

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CAPITAL AS AN ELEMENT OF GROWTH 
IN FARM FIRMS

by

Keith Daniel Rogers

A Thesis Submitted to the 
Graduate Faculty in Partial Fulfillment of 
The Requirements for the Degree of 
MASTER OF SCIENCE 

Major Subject: Agricultural Economics

Signatures have been redacted for privacy

Iowa State University 
Of Science and Technology 
Ames, Iowa

1966
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IOWA FARM BUSINESS ASSOCIATIONS
INTRODUCTION

Micro-economic study has long concentrated upon analysis of the producing unit which usually is visualized as a firm. Loosely, a firm has been characterized as some type of industrial organization which produces goods and services as a main objective. Much effort has been devoted to analysis of site location, factor-factor mix, factor-product mix, product-product mix, cost functions, and profit maximization. In the presence of unlimited entry into an industry, sustained excess profits have traditionally promoted competition and the motive for firm expansion to incorporate scale economies, factor discounts, product marketing efficiencies, or any number of similar benefits which are often obtained at expanded production levels. Studies of firm growth have been relatively productive in explaining the WHY, but have generally ignored or failed to explain the HOW of growth.

Particularly, there has been an absence in research concerning growth of a farm firm. As expansion of farm firms is promoted under present conditions, increased demand for capital assets are being experienced. For continued expansion under present farm credit policies, a firm must be capable of accumulating capital internally either for direct reinvestment or debt retirement. Expanded need for present and future farm firms is putting new burdens upon credit agencies to appraise growth potential of operations for which financing is provided
if the agency is to concern itself with promoting the financed firm and not just recovering its loan. The need for further understanding of growth in a farm firm has prompted the present investigation. The general approach will be to review available literature for concepts and elements of the general industrial firm, proceed to an isolation of growth components in an industrial firm, add the restrictions imposed by the uniqueness of a farm firm, and finally generate a basic theoretical framework for analyzing growth of a farm firm. To isolate the elements which seem essential for growth of a firm, it seems necessary to begin with basic concepts of the structures involved.

A Concept of a Firm

Penrose suggests that a firm is an administrative unit plus a collection of productive resources which are at the disposal of the administrative unit as to use and time allocation (18, p. 24). The primary economic function of the firm is to make use of the productive resources according to some plan developed and put into effect within the firm.

Administration

Functionally, the administrative organization is responsible for establishing or altering structures within the firm, laying down general policies, and making decisions on matters where no clear-cut principles have been set out. The firm is
confronted with two types of economic activity. One is the activity within a firm and the second is activity within the market. As suggested by the functions of the administration, the unit is capable of responding to conditions which are either internal or external to the firm, but the action which is taken must be internal since the management has no direct control of external elements, assuming a purely competitive system. Indirectly, the firm may be able to exert influence externally in the market through factor demand, product supply, pricing, and promotions, but the effect is far more indirect and difficult to regulate.

**Productive resources**

The productive resources can be classed into three groups—human, natural, and capital. Human resources subdivide further to management and labor. It is appropriate that human resources be discussed at this point because of the dual classification which can seem to overlap between the administrative portion and the resource portion.

The human resource may be found in either portion of the firm, but in large real world industrial firms it seldom, if ever, is the same resource. Administration uses one class of human resource while production uses a distinctly different one. Smaller firms, like a farm firm, do not usually have this clear-cut distinction and present problems of allocation that will be considered in later sections.
Natural resources are those things which were God given and not the result of human endeavor. Distinctive of this class are land, water, and air, but many more are involved. In agriculture, land for example can be broken down to location, soil, and nutrients. It is natural resources to which man has applied his ingenuity and creativeness to fashion the products around us which we know as manufactured or processed goods.

Capital resources are the man-made items or man-modified natural resources. Capital resources include such items as money, machinery, buildings, domesticated livestock, tools, and various equipment. Each item of the capital class is completely or partially attributable to man's effort whether it be a finished or an intermediate product. An example of products completely attributable to man would be synthetic fibers such as nylon while a product only partially attributable to man would be processed goods like gasoline as a refinement of naturally occurring crude oil.

The Concept of Growth

If one accepts that the primary function of a firm is to convert natural resources into marketable products or services, then it is logical that growth could be viewed as an expansion of capacity to turn out the refined product or service. Depending how capacity is measured, expansion could occur under any of the four following conditions: (1) without
changes in technology\(^1\), (2) technological change which lowers the cost functions, (3) technological change which raises the revenue functions, or (4) change resulting entirely from external conditions.

**Four types of growth**

Without changes in technology or efficiency, the use of larger and larger amounts of resources to produce proportionately larger amounts of output would clearly be viewed as growth in physical capacity, but from here identifying growth becomes a little more sticky. Changes in technology which would lower the cost functions or raise the revenue functions, if associated with static market structures, would allow for increases in net profit. To a private owner, this increase would be viewed as growth in terms of increased reward for his efforts. For the corporation where all increases in profit may not be felt directly by the share holders, the growth would be less observable but still obvious from the standpoint of financial statements. One should avoid jumping to the conclusion that all increases in gross receipts denote growth since inflation alone can and does increase the value of sales from year to year without, necessarily, any changes within the firm. The problem of inflation can be handled by calculating a time index for value of the dollar and adjusting prices or quantity by this index. Such adjustment will give an accurate comparison over a short period of time, but is less effective

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\(^1\)Technology in this writing refers to science applied by an individual firm rather than science of the industry.
over longer periods of time due to its failure to account for quality changes in the product. Looking at net receipts has some of the same problems as observing gross receipts, and in some cases, the problem is even more difficult to cope with. The problem is magnified with industries which face noticeably different rates of inflation between the factor and product market.

Change in receipts, as evaluated in dollars, which is not associated with change internal to the firm does not merit consideration, especially in this study, as growth.

Sources of growth

If growth involves some measurable change within the firm, then by definition of the firm it must take place within the administrative unit, the productive resources, or a combination of the two. The first is reflected in terms of technological input. Variation in technology could be in the form of improved productivity practices which become available to all firms of an industry, increased technical information within an individual firm by replacing present members of the administrative unit with more competent members, or simply physically expanding the administrative unit and pool of technology in such a manner that production likewise was expanded. Change which occurred through the productive resources could come from more efficient combination of the present resources, use of higher quality resources, or physical expansion of
resource use. More efficient combination of resources leads to a technological change rather than a resource change and therefore falls under the administrative sector rather than resource sector. Use of higher quality resources also is not a change in the present resources, but again associated with technical change. A higher quality resource is really a distinctly different resource which in most market situations would be priced accordingly. Physical expansion of resource use, assuming a competitive market system, would reflect in production costs or resource cost the same as higher quality resources.

Motives for growth

In rejecting the biological approach to explaining growth of a firm, which excludes human motivation and conscious decision, Penrose states that "All the evidence we have indicates that the growth of a firm is connected with attempts of a particular group of human beings to do something......" (18, p. 2). The basis to the traditional approach to explaining firm growth, which Penrose represents, is solidly backed by the assumption that growth doesn't just happen, but is logically the result of purposeful planning and decision making by the management of the firm to reach specific goals or objectives. According to Cyert and March, the group objectives may be directed to any of several areas of which production, inventory, sales, market share, and profits are a few of the
most important (7, pp. 41-43). The objectives of a firm's administrative unit may vary significantly depending upon the degree to which administration is removed from resource ownership. For smaller firms where the administration rests primarily in the hands of the resource owners, profit to the firm may be the owners' major income source, and a minimum return on investment may be essential to provide sufficient income. A similar case where profit might be the major motivating goal is with a beginning or expanding company which wishes to return sizable dividends to attract outside investment. Profit as a motive is usually expressed as some dollar level or minimum return on investment. Production may take over the picture in some large firms which are not in the process of critical expansion. An example, characteristic of this group, might be GMC which aspires to some minimum profit level to guarantee satisfactory dividend returns, but beyond this is concerned with maintaining public image in terms of total production or continuous flow which will keep the assembly lines moving and both the customers and employees happy. For firms which produce a somewhat seasonal product or one subject to runs, inventory levels may be the guiding principle. For success it is essential that a firm be able to supply the consumer with an unbroken flow of goods. In the case of seasonal demands or runs, sizable inventories may be required to act as a buffer until the production line can get tuned up to a level significantly above either normal or
some established minimum level of operation. Sales can be associated closely with production goals. Here the goal may be units of product, dollars of sale, minimum levels of either, or minimum levels of both. Likewise, a given share of the market may be associated with a production goal. Relative market share may be necessary to maintain public image, and as mentioned under production, may be either relative or absolute compared to another specific firm or to an industry as a whole. The market share may nearly replace or complimentarily support sales goals or even production efforts because of the close association.

**Evaluating growth**

The varying goals, which have just been mentioned as among the most important, suggest that growth might be movement in any of several directions depending upon motives of the particular firm or rather the particular administrative unit. When growth might be directed along any of several channels depending upon the view of growth held by the administrative unit, hopes of developing a standard for defining or distinguishing it in terms that can be evaluated seem to be successfully destroyed, but this is no more destructive than realizing that one cannot guarantee that a specific tree will continue to grow for the next five years. One could maintain accurate evaluation of height, trunk size, leaf area, or other significant measures which would verify growth over
a period of time, but this tells us nothing about growth in the future and really doesn't allow for comparisons among trees of different species where the nature and latitude of growth vary significantly. Likewise, it would be difficult to compare growth between two firms when one firm concentrates on production and the other on profit, but as the previous discussion has implied, both could be considered as growth. What then, in the biological case, could be said about future growth? It is certain that growth cannot possibly occur if any of certain essential elements such as water, light, or nutrients are missing. With the firm there also seems to be certain essential elements which must be present to allow for growth of the firm to occur.

**Essential elements of growth**

Penrose views enterprising direction, efficient management, sufficient capital-raising ability, adaptability to changing circumstances, normally successful judgement, and moderately good luck as necessary elements for growth, but hastens to say these are only necessary and not sufficient to guarantee growth (18, p. 7). Enterprise, management, capital base, and adaptability are among the items listed as essential by many economics writers, but successful judgement and good luck are usually not listed as essentials. These two points apparently are not so extremely important in a larger industrial firm, but they have more importance in a discussion of
smaller firms which are characterized by an administrative unit which often does not have the quality of personnel or benefit of established judgement guidelines which are expected in larger industrial firms. Since growth is a dynamic concept which cannot be guaranteed, it must, in practice, be observed over time instead of determined in advance. If growth does indeed refer to capacity expansion, then a measure of size must be established which can serve as an intrafirm comparison over time, but also serve as an interfirm comparison as well.

**Measuring growth**

In discussing growth as development in the administrative and resource sectors of the firm, a foundation has been established for measurement of size. With two distinctive sectors exhibiting potential for growth, both must be observed to evaluate capacity. As pointed out in the discussion of growth in relation to the administrative unit, it is at least implicit that technological changes would be reflected as changes in revenue and/or cost functions. From strictly an economic stand, new technology would not be adopted unless the margin between revenue and cost had been widened. A size measurement which would be appropriate when only technological change was effective, assuming a fixed or given resource supply, would be net profit. Justification of this alternative rests on the assumption of a purely competitive market so that any change in technology resulting in increased
production will be rewarded in the market place by increased gross return. For some industrial firms an assumption of pure competition would not necessarily apply, but for an Iowa farm firm of the size and scale included in this study, the condition certainly would hold.

The second case for measurement is the situation where growth occurs entirely within the resource sector while no changes are observed in the technological process. According to the definition of resource change as stated earlier, this situation would simply be a case of using larger quantities of productive resources. With no change in the production function, proportionate expansion of production would be observed. With unchanged use of technology, the size of the operation could be measured either in terms of total resources used or total goods produced. Since many firms certainly do not observe constant marginal returns, it is appropriate to pursue this point further. Decreasing marginal returns with fertilizer on corn, beyond a certain point, is a good example in the farm firm where constant returns are not obtained. It is difficult at this point to select between resources and products as an appropriate measure of size, but the justification for resources can be made strongest. Because of the continual concern by economists for efficiency, it is difficult not to relate it to growth in some way. By using total resources as a measure of growth in the resource sector, returns to investment can easily be developed which allow for interfirm
comparisons not only within the industry, but also with firms outside the industry. Discussion of the third and most common case will further support the decision to use total resources as the evaluation of size in that sector.

The third case and by far the most common is that involving increases in both technology and resources. Combination of the two makes it difficult to distinguish growth patterns between the two sectors and makes interfirm comparisons difficult. If net profit is a satisfactory measure of technological change and total resources used can successfully measure resource changes, each time with all other factors constant, then these estimates deserve consideration in the case where both are changing. Both are still satisfactory measures, but in combination provide an even stronger determinate. Profit per unit of resource provides a measure of efficiency in addition to the knowledge and comparisons of size which can be made using net profit. By using the three in combination comparisons between firms can be made even though their motivating goals are not the same and their efforts toward growth are guided in separate directions. With like firms, all three comparisons would be meaningful while in other cases only one or two of the measures would be comparable. In any case at least one of the three measures would reflect a firm's internal growth in terms which could be compared over time.
The Concept of Sustained Growth

As implied in the preceding discussion, a clear-cut definition is rather elusive unless a time, place, and purpose setting can be established, but continued growth is most usefully viewed as the continual extension of range or nature of activities in which a firm is engaged. Defining growth in such a manner leaves open the possibility of including expansion or major alterations in product lines as a part of growth. Changes in the product line to meet movements in market demand would reflect well upon the ability of the administrative unit, but would not reflect well in a size measurement of the firm which used change in the resource sector to measure product output change. In using resources as a measure, alteration of the product line will not interfere with time comparisons in measuring growth.

Summary of Concepts Reviewed

Starting with a definition of a firm, which in this writing is attributed to Penrose, the ideas relating to growth follow through a logical sequence to a conclusion that growth can be viewed as a change in the productive capacity size of a firm, which in turn can be measured by some gauge of productive resources employed. With resource measurement has been coupled the concept of measuring technological change through net profit and providing a comparison which will serve
between unrelated as well as related firms. Ideally, evaluation of the resources used should be measured in present value so that purchase of a long life resource will not in itself cause great fluctuation in the periodic estimate of size.

Growth and Financial Expansion

Another form of change, related to growth, exists but has not been reviewed in the preceding discussion. In most definitions, dependent of course upon the purpose, and particularly in this study, the concept of growth shall be understood to exclude financial expansion to other firms when the extended financial strength is not coupled with extension of the managerial influence. Particularly, reference is made to the types of expansion where one firm makes an investment in another but does not obtain any portion of the management opportunities. Clearly, the new investment does represent capital, and in fact, it probably represents additional resources. Yet in looking at the original firm, its capacity has not been expanded in any relative way. The investment in the new firm simply represents a change in the form of capital. If the investment can be accomplished without decreasing the production of the original firm, then the capital apparently was not productive in the original firm. Financial expansion should not be viewed as growth unless it is associated with obtaining management supervision over the new firm and, thus, extending the management and resource capacity of
the original firm. Once again it is predominate that resources are not the only part of growth and that management is an integral part.

Uniqueness of Farm Firm

The preceding discussion has been directed almost entirely to the traditional industrial firm, and has been supplemented by only a few examples relating to agriculture. At this point it is appropriate to look at how the farm firm is unique from conditions pertaining to a general industrial firm.

Inter-relation of production and consumption

Traditionally economic theory has separated the analysis of firm and household. The theory of the firm has been applied to some type of business unit while consumption theory has been applied to the household. In the industrial world this dichotomy may be meaningful where the production unit and the consumption unit are functionally separated, but in agriculture the planning and utilization of resources by the producing unit are closely interlocked with utilization by the consumption unit. In fact, use of resources for one portion of the farm unit often causes a sacrifice for the other portion. Separate analysis of the two units with their interlocking, overlapping nature is not satisfactory to handle the real world problem.
Implications of inter-relationship

In agriculture decisions with regard to use of capital for productive purposes have a direct impact on household consumption. Disregarding windfall, capital can come from only one of two sources: excess over expenditure in a previous accounting period or outside credit. Expenditure by the farm firm no longer means simply cost of production, as in the traditional firms but also includes household consumption. To further complicate the matter, household consumption cannot be considered a constant variable but is a dependent variable which is a function of past profit, present needs, and future expectations. In addition to the resource demand, both from the producing unit and the consuming unit, the administrative unit is not a separate organization, but in many cases singularly the head of both the producing and consuming unit. The overlap is further complicated by the fact that the administrative unit is probably the owner of the productive resources. Unification of administration and ownership of resources, according to Penrose, leads to unwillingness to accept responsibility for expanding extensively and a hesitance to delegate management authority (18, p. 6). These reactions have their seat in reluctance by the owner to personally accept liability for actions and financing. With the farm firm, there are additional restrictions on the rate or magnitude of growth which can be anticipated.
Factors related to growth of farm firm

In a study by Arnold, the following factors were identified as significant in affecting rate of growth in the farm firm: size of business, use of credit, management ability, enterprise selection, education, background training and experience, age when starting farming, non-farm income, and family size (2, pp. 19-20). Size of business and use of credit are related in the sense that a certain minimum level of consumption must be reached before an excess resulting from the productive process can be channeled back into the business for growth purposes. Family size is related in terms of establishing the minimum amount necessary for consumption. Management ability, enterprise selection, education, background, and age all reflect upon the owner's ability to run an effective administrative unit. In some cases non-farm income has a positive effect on growth by providing the necessary excess above consumption while the firm is small and incapable of doing so, but in other cases non-farm employment leads to a decline in the business through reduced interest and attention. All of these, however, fit into the administrative and resource structure which was described earlier.
CONCEPT OF CAPITAL

Historical Review

Capital has, through time, carried two distinct characteristics when discussed in economic theory. In production, capital is presented as a tool or factor of production, while in distribution it is demonstrated as a source of income and generally denoted by its revenue producing nature. The former case is the one upon which attention is concentrated in relation to production within the farm firm.

The theory of capital has its start in the Latin word capitale which was an adjective derived from the noun, caput, meaning head. It was first used to mean the principal sum of money of a loan, the primary part of the loan, as distinguished from the interest. Use of the word in this connotation was influenced by the Greeks who likewise had an adjective derived from the corresponding noun meaning head. The "principal sum" definition became naturalized and appears to have remained the only sense in which the word was used well into the modern era when it still denoted an interest-bearing sum of money. Gradually the meaning underwent important alterations. As the practice of reinvesting borrowed money in various industrial projects became more and more frequent, it slowly became common to think of these investments earning a return just as the original loan would return interest on the principal sum. Quickly acceptance came for thinking of or evaluating the
investments in terms of the dollar value and calculating returns just as was done on the principal loan. In both the original loan and the investment the yield-producing wealth now was viewed as capital, and its yield could be regarded as the interest derived from that capital. Through this combination of thought, the point was finally reached where not only interest bearing sums of money were considered capital, but any resource collection which could be viewed as "working capital" and thought of as interest bearing.

Turgot generally receives credit for the second historical concept of capital.

In Section 59 of his *Reflexions sur la formation et la distribution des richesses* he says, "Whoever acquires each year more goods than he finds necessary to consume, can lay aside the excess and accumulate it. It is these accumulated goods that are called capital...... It is a matter of complete indifference whether this accumulation of goods, this capital, consists of a quantity of metal or other things. For money represents every kind of goods, just as, conversely, all other kinds of goods represent money" (3, p. 19).

A third concept soon replaced or clarified Turgot's definition since he had omitted all reference to the basic idea of independent interest producing ability. Adam Smith authored the corrections to Turgot's thoughts by distinguishing between two groups of accumulated goods. One group is explicitly for immediate consumption while the other is expressly designed to yield income for the owner. Smith singled out the latter and identified it as the only one which could honestly bear the name capital. Smith made further comment on the matter which
became the source of rather important consequences in the development of a capital concept. He remarked that capital or accumulated goods could be applied to a society as well as an individual, however, the concept has different meaning when applied to the two. Individuals can derive gains not only from new goods but from lending, for a consideration, various goods which would normally fall in the consumption class. In contrast the society can only derive gain from the production of new goods. Obviously in the case of the society the narrower definition of capital, which had been suggested earlier, fits more closely. The significant point is that Smith had taken the initial step to distinguish between private and social capital. Beginning with Smith and generated through his followers, the ambiguity arose in defining capital primarily because these early thinkers failed to recognize that they were using capital to talk of two distinctly different concepts.

Throughout the history of economic theory there have been differences of opinion concerning the acceptable working definition of capital. Hermann's definition centered around the thought of capital as a source of income. For this reason he included all goods which have a basis for service and can be represented by an exchange value. In his all-inclusive definition he grouped land as well as some durable intermediate consumptive goods such as furniture even though they are employed by the owner for his own personal use.
Menger brought into his definition the ideas of a present stock of production goods for future use. His definition differs from Hermann's by excluding the consumptive goods, but adding the productivity of labor. Kleinwächter went to the extreme in narrowing the concept of capital. He characterized capital as having the faculty to lighten the burden of production. By this classification he excluded all materials of production except tools. His definition would show all other factors of production as being passive to the process and participating only to the extent of being worked upon.

Jevons, like Kleinwächter, limits the concept, but in a different direction. Jevons also considered capital an accumulation of goods which rendered production easier, but this was accomplished by enabling the worker to wait out the period until production of a good was complete. The waiting approach restricted the concept to a worker's means of subsistence, and only these items.

Marx developed a unique idea of capital which would fit into his later theories. Since Marx viewed interest as being "booty" gained by the capitalist from exploitation of the workers, he was so dedicated to the idea of exploitation that he incorporated it as a delimiting feature of capital. For him, capital was those goods which, in the hands of the capitalist, allowed him to exploit the worker. The same stock of goods in the hand of the worker would not be considered capital at all. Obviously this dual classification has lead to
considerable controversy throughout economic history.

Karl Knies took the problem in hand and sat down to develop a concept of capital broad enough to include all the existing suggestions. At last he concluded the one thought which was paramount in the various definitional attempts was a dedication of goods to service in the future. Consequently he defined capital to be the quantity of available goods, whether consumption, acquisition, or production, which could be applied to the needs of the future.

Walras opened up a new classification which confounded the problems even more. His effort was concentrated in the area of distinguishing between capital and income. Under his division, capital included all goods which could be used more than once. This would include land, people, and other durable resources, but would exclude foodstuffs, fuel, raw materials, and other consumable goods. Wicksell, however, stood exactly opposite the thoughts of Walras. Wicksell applied capital or capital goods to consumption goods. Goods which were durable in nature were termed income-producing. Only in a broad sense would he allow capital goods to refer to income-bearing durable goods. Landry agreed partially with Wicksell when he agreed on the consumptive nature of capital, but he went further and thus sat himself aside from all previous economists. Landry's contribution was the idea of capital goods being consumption goods, immediate enjoyment of which the owner sacrificed for future gain. One can see that this
gave rise to the present concept of capitalization. The point here is that Landry opened the door to define capital not only as the stock of present goods, but also to include some non-existent goods which, by the act of being foregone, had not yet been created.

J. B. Clark emphasized the importance of distinguishing between true capital and material goods. True capital, he associated with a durable or permanent fund of productive wealth. Material goods were those items which make up the productive wealth and are being continuously altered or consumed. Irving Fisher looked upon the capital dilemma as the result of economists attempting to develop a classification which would break down the broader concept of wealth into capital and non-capital. Fisher viewed all wealth as capital. He proposed, however, a second concept which, instead of being exclusive, was more of a sub-class. The sub-class which he referred to was income. Wealth, he felt, should be viewed at a point in time or over a period of time, the former being capital and the latter being income. From this he derived his final definition of the two concepts such that capital represented a stock of wealth at a given time while income was a flow of services during a period in time.

Alfred Marshall spent much time and major portions of several volumes considering concepts of capital. His conclusions generally sum up to viewing several reasonable definitions of the concept since as he sees it, for each specific
case there seems to be a particular central idea which best limits the range of goods placed in this category.

Study Definition

As verified in the previous section, the development of a concept of capital has proceeded from the very limiting definition given by the Latin origin to the multiple definition framework in which Marshall works. For purposes of this study, capital will take the broad general definition of recent thought so that it will include all resources of the firm, except management, which can be purchased or reduced to a base of dollars. As commonly referred to, capital will include land, buildings, machinery, equipment, feed, livestock, and cash balances. The broad definition just described is chosen partially because of the short life nature of the farm firm as compared to an industrial firm and partially because of the nature of records and accounting procedures available for the study. The rise and liquidation of a farm firm with each generation is not a necessity but is the majority case due to the structure of individual ownership. The short life of accumulation and disaggregation suggests that management is the only resource of a unique nature and all other resources are capable of purchase or sale such that they can be reduced to dollars. Management can be purchased also, but has a competitive price to estimate its productivity and distinguishes it from management provided by the operator.
The theory of capital use is primarily a theory of production factors dealing with the way in which various resources are used in a production plan. Each firm has some plan of production which is supported either by an explicitly defined or implicitly implied functional relationship among the various capital resources. The function may be viewed as showing the units of output produced by adding one unit of capital or the additional units of capital needed to produce one additional unit of output.

Capital as an Aggregate

Statement of capital theory in the above manner should not be misinterpreted to imply that capital is a homogeneous aggregate. Underlying such a statement of capital theory is the assumption that a price has been established for each of the heterogeneous factors in the broad class of capital resources. In our existing market structure, the price is stated in terms of dollars and allows for a common denominator of comparison among unlike resources. The common denominator states only the relative value of the various resources in units of still another resource, money, which in itself has no value in production except as an instrument of exchange.

Through money as an instrument of exchange, resource elements can be compared by using their dollar value as a
common denominator. Through the common denominator of dollars, one unit of capital can be added without concern for physical units of the resources under consideration. In addition, the output can also be measured in dollar units and direct comparisons of return measured. Throughout this discussion capital will be used as an aggregate term only in the sense of a common denominator representing the dollar value of the heterogeneous resources used.

Types of Capital Production Functions

Production functions with respect to the use of capital might take any of three forms as shown in figures 1, 2, and 3. Figure 1 represents an increasing marginal product function, where each additional unit of capital would result in a larger marginal output than was obtained from the previous unit of capital. With this function, one unit of capital, $C_1$, would produce an output of $Q_1$, but by adding the next unit of capital, $C_2$, an output of $Q_2$, which obviously is larger than $Q_1$, would be obtained.

Figure 2 represents a linear or constant marginal return function, where each additional unit of capital will obtain the same marginal output as the previous unit of capital. With the linear function, $Q_1$ and $Q_2$ are observed to be equal and correspond to $C_1$ and $C_2$, which are equal units of capital input. Figure 3 shows a decreasing marginal product function, which reacts inversely to the increasing
Figure 1. Hypothetical situation depicting a production function with increasing marginal returns
Figure 2. Hypothetical situation depicting a production function with constant marginal returns.
Figure 3. Hypothetical situation depicting a production function with decreasing marginal returns.
function observed in figure 1. Here $C_1C_2$ obtains $Q_1Q_2$ output, but the next unit of capital, $C_2C_3$ which is equal to $C_1C_2$, only provides an output of $Q_2Q_3$ which is less than $Q_1Q_2$.

A Theoretical Production Function

Figure 4 shows a combination of the three functions where OA has increasing marginal product and ABCD has decreasing marginal product. At point A the function changes from increasing to decreasing and thus has the nature of a linear or constant marginal return function. For any firm, the problem is to determine where on the production function operation can be most profitably conducted.

To facilitate a production decision, the production function can be divided into three stages. For this discussion an arbitrary function, $Y = 1.5x + 2.2x^2 - 0.1x^3$, is used since it has characteristics of functions relating to the use of capital. The three stages of production are identified by the relationship of the marginal and average product curves as shown in figure 5. Stage I is characterized by the area where marginal product is greater than average product. In figure 5, since marginal and average product are equal at Point S, Stage I would exist from the origin to an input of eleven units where average and marginal product are equal. At the intersection of average and marginal product, average product is at a maximum. On the total product curve, the point of maximum average product corresponds to Point B in figure 5.
Figure 4. Hypothetical situation depicting a production function with three stages of production.

Figure 5. Average and marginal product curves corresponding to function OABCD in figure 4.
Figure 4

Figure 5
where a ray from the origin is just tangent to the total product curve and has a steeper slope than any other ray drawn from the origin to the total product curve. Mathematically Point B in figure 4 and Point S in figure 5 are determined by the following equations:

(1) Total Product =
\[
1.5x + 2.2x^2 - 0.1x^3
\]
(The equation of \(\text{OABCD}\))

(2) Average Product = \(\frac{TP}{x}\) =
\[
1.5 + 2.2x - 0.1x^2
\]
(The equation of \(\text{OUSVW}\))

(3) Extreme Value for Average Product = \(\frac{d\text{AP}}{dx} = 0\)
\[
2.2 - 0.2x = 0 \text{ and } x = 11
\]
(4) Verification of Maximum = \(\frac{d^2\text{AP}}{dx^2} = -0.2\)

In defining Stage I to end where average product reaches a maximum, Stage I has increasing average product throughout, as can be seen in figure 5 by observing OUS. Marginal product increases for a time and then decreases, but always is greater than average product. Total product, like average product, increases throughout. Stage II is defined as beginning where average and marginal product are equal, (and non-zero), and extending to the point where marginal product equals zero and total product equals its maximum. In figure \(\mathcal{E}\), Stage II is defined as the area from Point S at 11.0 units input to Point T at 15.0 units of input. Correspondingly on
the total product curve of figure 4, Stage II is the area from Point B to Point C. The mathematical equations for defining Stage II are in two sets. The first set obviously is the same as those determining the end of Stage I since Stage II starts where Stage I ends. In addition we need the second set which determines the end of Stage II.

(1) Total Product = 
\[ 1.5x + 2.2x^2 - 0.1x^3 \]
(The equation of OABCD)

(5) Marginal Product = \( \frac{dTP}{dx} = 1.5 + 4.4x - 0.3x^2 \)
(The equation of ORST)

(6) Extreme Value for Total Product where \( MP = 0 \)
Therefore an extreme value at \( \frac{dTP}{dx} = 0 \)
\[ 1.5 + 4.4x - 0.3x^2 = 0 \] and \( x = 15.0 \)
\( (MP = 0 \) at \( T \) on ORST \)

(7) Verification of Maximum = \( \frac{d^2TP}{dx^2} \) at 15.0 = \( -4.6 \)
\[ 4.4 - 0.6x = 4.4 - 0.6 (15.0) \]

Stage II is so defined that both marginal product and average product are positive but decreasing throughout, while the total product is still increasing. The third stage of production begins where Stage II ends and continues throughout the remainder of the production function. In Stage III the marginal product is negative, average product is decreasing, and total product is now decreasing. The three stages of production can be identified as follows:
Stage I

\[ MP > AP \text{ or } \frac{d TP}{dx} > \frac{TP}{X} \]

Figure 5 --- ORS > OUS

Stage II

\[ MP < AP \text{ or } \frac{d TP}{dx} < \frac{TP}{X} \]

\[ MP > 0 \text{ or } \frac{d TP}{dx} > 0 \]

Figure 5 --- ST < SV

ST > 0

Stage III

\[ MP < AP \text{ or } \frac{d TP}{dx} < \frac{TP}{X} \]

\[ MP < 0 \text{ or } \frac{d TP}{dx} < 0 \]

Figure 5 --- TX < VW

TX < 0

Stage I can be divided into two substages, but the subdivision has no effect upon production decisions. Division of Stage I occurs where marginal product reaches a maximum and the total product curve changes concavity. In Stage Ia, from the origin to the point of inflexion at Point A in Figure 7 or the maximum point of the marginal product curve at Point R in Figure 7, marginal product is not only greater than average product, but it is also increasing. In Stage Ib, AB in Figure 4 or RS in Figure 8, marginal product is still greater than average product, but has begun to fall.
Rational Area of Production

From an economic standpoint the only rational area of production with pure competition is in Stage II. In Stage Ia both increasing marginal and average returns persist, and total product is increasing at an increasing rate. In this stage production would be irrational since each additional unit of capital would produce greater returns than the last, making expanded production desirable. In Stage Ib marginal production begins to fall, but nothing is unsatisfactory about this since average product and total product are still rising. Now, however, total product is increasing at a decreasing rate. Expanded production is still desirable since average return is rising even though the marginal return is diminishing. Assuming competitive markets where a constant price prevails, it would be profitable to expand to the beginning of Stage II if production in Stage I was profitable at all since each additional unit would produce a greater output than the one previous to it, and therefore return a greater margin between factor cost and output value.

It is more obvious that Stage III is an irrational area of production. During the third stage, marginal and average production both continue to fall, but marginal production has become negative. This implies that each additional input not only fails to result in additional output but actually reduces the total output which had been obtained up to that point. It
may be a bit difficult to visualize diminishing total product with capital as the variable input when most farmers find capital a limiting factor of production, and it is true that most farmers could profitably use additional capital in the operation. However, as we look at the production function, we look at the whole range of capital use as compared to only a small sector which a farmer probably visualizes as his production function. Looking beyond the small sector of the function which the farmer recognizes as effective, probably early in Stage II or in many cases still in Stage I, it isn't difficult to see how additional capital could result in diminishing returns. Use of capital to purchase fertilizer is in no way unique, but it is easy to follow to diminishing returns. It is an accepted fact that fertilizer could be added to a point where corn will actually burn up. The effect of using capital for additional fertilizer would be to first increase the yield to some point of efficient factor combination after which another factor would become limiting, and additional units of fertilizer would be toxic enough to the plants to cause a reduction in yield.

With Stage I identified as an irrational area of production because of increased efficiency as expansion moved the production level toward Stage II, and Stage III eliminated as economically inefficient since any level of production in Stage III would also be obtained in Stage I or II with less factor input, Stage II should be the level around which
production goals are based. It should, however, be pointed out that there is a distinct difference between naming Stages I and III as irrational areas of production. Stage III should not be entered under any condition since the same production could be obtained with lower inputs. Production could and does take place in Stage I on many farms simply from the external limit placed upon the firms' factors of production. If a farm firm is restricted to Stage I on an aggregate production function for the farm, then in most cases it would be profitable to drop some enterprises from the operation so the resources can be reallocated and entry into Stage II of production functions for each of the remaining enterprises can be accomplished. Movement into Stage II of production functions for each enterprise, and thus Stage II of the aggregate production function, will still not guarantee the most efficient operation, but it does guarantee a more efficient operation. For these reasons production in Stage I is not undesirable in the same way as is production in Stage III, but it should indicate that there is a more profitable level of production, namely higher, which should be worked toward.

Optimum Production Level

Once Stage II has been reached, how is the most profitable level of production within this range determined? The optimum production level within Stage II is determined by the ratio of the price per unit of output to the price per
unit of input which here is capital. The point of maximum profit is shown in figure 6 which is an enlargement of Stage II of the production function in figure 4. For a given capital to output price ratio, say eight to one, the point of profit maximization would be where the slope of the price ratio line is equal to the slope of the production function or where the two are just tangent at Point E. Given a production function with a Stage II of BC and a capital-output price ratio of 8:1, the most profitable operation would be at 13.0 units of capital producing 171.6 units of output since the marginal physical product at 13.0 units of capital is equal to 8.0 or just equal to the capital-output price ratio. In equation form this would be:

\[
(8) \quad MPP = \frac{\Delta \text{Output}}{\Delta \text{Capital}} = \frac{\text{Price of capital}}{\text{Price of output}}
\]

Alternatively, the point of optimum operation can be formulated in marginal value product terms instead of marginal physical product terms. Assuming perfect competition, which is approached in agriculture, we can obtain the marginal value product by multiplying the marginal physical product by the price. Since during Stage II each successive unit of capital will result in a smaller increment of output and prices are assumed constant, the marginal value product curve which corresponds to the section of production function shown in figure 6 will be downward sloping. Plotting marginal value product on the vertical axis and capital input on the hori-
Figure 6. Hypothetical situation depicting equation of marginal product with price ratio for optimum production.
zontal axis gives the marginal value product curve shown in figure 9. The point of profit maximization now becomes the point where marginal factor cost equals marginal value product and is at 13.0 units of capital input, the same as determined using marginal physical product. Mathematically this results from clearing the fraction in equation 8.

\[
(8) \quad \frac{\Delta \text{Output}}{\Delta \text{Capital}} = \frac{\text{Price of capital}}{\text{Price of output}}
\]

\[
(9) \quad \text{MPP} \times \text{Price of output} = \text{Price of capital}
\]

or

\[
(10) \quad \frac{\Delta \text{Output} \times \text{Price of output}}{\Delta \text{Capital} \times \text{Price of capital}} = 1
\]

\[
(11) \quad \text{Therefore: MVP} = \text{MFC}
\]

Use of Capital with Uncertainty

Throughout the production cycle, farmers are faced with numerous conditions of unpredictable outcome. Common to all industries, the farmer is faced with technological change and its effect upon the present factors of production. More important in agriculture than other industries are the effects which weather, disease, and insects have upon the output. Due to these and other conditions which affect production in an adverse way, farmers tend to view their production possibility as a range with extremes at the best and worst outcome expected. In an attempt to minimize loss, at the sacrifice of some quantity of production, a farmer views his production function as being somewhat lower than the potential shown in figure 9.
Figure 7. Hypothetical situation depicting marginal product with marginal factor cost for profit maximization.
In so doing he reduces total, marginal, and average product which in turn will reduce marginal value product and the level of production that seems optimum for his firm. Figure 8 shows how uncertainty causes internal capital restrictions to be placed upon the firm which in fact cause production to be carried on at a sub-optimum level with 12.0 units of capital when 13.0 units would have maximized profit.

In contrast to the internal limits imposed by a firm's subjective evaluation of the production function, external restrictions may be imposed through credit sources. Even when a firm views its production function objectively without any discounting for uncertainty, it may still be restricted by lack of its own capital supply or opportunity to rent capital from other sources. For example, most finance institutions make loans based upon the firm's equity. The total available capital becomes a function of the original equity either directly or indirectly through borrowing which is based upon the original capital supply. For farmers who have an original capital resource which is small, it may be impossible to borrow or rent capital beyond a given quantity. Under conditions where maximum capital is borrowed, the price effectively goes to infinity and in turn drives marginal factor cost to infinity also. The profit maximizing farmer is still faced with equating marginal factor cost and marginal value product subject to the new marginal factor cost. Figure 9 shows a situation where, for example, the maximum capital which can be
Figure 8. Hypothetical situation depicting internal capital rationing
Figure 9. Hypothetical situation depicting external capital rationing
obtained for the operation is 11.5 units. At 11.5 units of capital the price and marginal factor cost go to infinity and profit would be maximized, subject to the external restraint, at the same point that maximum available capital was used.

In both the internal and external rationing just discussed, the limits happened to fall within the Stage II of the original production function. It is entirely possible for either condition to limit capital use severely enough to force production back into Stage I. In that case, the use of fixed resources should be re-evaluated, leaving some fixed resources idle if necessary, and a combination of the remaining fixed resources and the available variable resources determined which would allow for Stage II production.
NECESSARY COMPONENTS OF A FARM FIRM

A review of past research and writing shows that production analysis has concentrated primarily upon the efficiency of factor and product combinations while leaving proof of the producing unit's existence to assumption. Milk processing, meat packing, machinery manufacturing, and a whole list of similar operations would quickly and easily be identified as activities of producing units which could be classified as a firm. What do these organizations possess which distinguishes them from an individual raking a lawn, an empty building, a newspaper boy on the corner, or any of numerous other functional objects which are not normally considered firms?

Resources, Management, and Interaction

Common usage would identify land, labor, and capital as the components of a firm when making reward to the factors of production, but these three elements can often be found together without being classified as a firm. For example, the individual raking his lawn represents the lawn as land, the man as labor, and the rake as capital. The elements are obviously combined in a meaningful fashion, but have something missing which would denote them as a firm. The distinction seems to be in the purpose for which the three elements are combined. A firm does not exist until some unit of management is committed for a period of time to an interaction with
a group of resources in such a manner that production of goods and/or services persists according to a regular schedule, determined by the kind of output, and meets specified objectives set forth by the administrative unit. Planning which takes the role of decision making, and is a part of management, would not qualify as a firm even if the planning involved specific resources since, at this point, there is no interaction between management and the resources. A manager cannot be productive without resources and likewise resources will not be productive without a manager unless accidentally combined. If the firm is to stay alive and in existence, it must maintain a flow of goods or services over time. The flow need not be uniform throughout the life of the firm since demand for different products follow varying patterns. However, the firm must provide a regular flow of goods and/or services in the sense that it meets the demand pattern which is unique for that good or service. Failure to do so would remove the firm from the market and thus from existence by nature of its apparent failure to maintain an interaction, between management and resources, which is forthcoming with goods and services.

Growth and Expansion

If death and stagnation are to be avoided, then growth must take place. As in biological specimens, this growth can take place in any of several directions. Growth of a firm
can best be described as expansion either through quantity or quality. In agriculture where the market structure approaches pure competition, changes in either quantity or quality are rewarded by increased returns. By using output, reduced to a common denominator of dollars, per unit of input, likewise reduced to dollars, both physical enlargement and efficiency can be measured at the same time. Expansion can be viewed as either positive or negative, but it appears clearer to speak of negative expansion as contraction and neutral expansion as stagnation. In this context expansion can be used to always mean positive growth.

Minimum Requirements for a Firm

Defining a firm to be an interacting combination of resources and administration dedicated to a production schedule of goods and/or services leaves management, geographics, and resources as the three essential components of the firm.

Management

The minimum unit necessary for management would be one man who could provide the thinking and decision making apparatus for administering the operation. Obviously, most firms in the industrial world have administrative staffs much larger than one individual, but this results from the complex nature and size of the firm involved. Many such firms had their origin with one individual handling the management of the
young firm. With time and growth the staff enlarged to handle the expanding load, but the single individual would have been adequate to meet minimum management requirements at the time the firm was born.

Geographics

Minimum geographics for a firm vary widely among firms, but only in size and not nature. Some location on the earth, below the earth's surface, on the ocean, under the ocean surface, or in outer space is always involved. This location as a minimal requirement must provide area and volume for the firm to be situated such that a time and position can be identified. Once identified with a location, several conditions are relatively fixed as far as the firm is concerned. Location immediately puts the firm within the jurisdiction of some government form and prevailing government controls or support. For some firms the government control or support is small, but in other cases, actions of the government may completely dominate the operation of the given firm. Location dictates the climatic factors which must be taken into consideration even from the time the firm is planned. Climatic conditions have their effect whether it be through the growing conditions for plants and animals, deterioration of buildings and equipment, or working conditions for the laborers or machines. In any case, some expected set of conditions are dictated by the geographic location with which a firm is
identified. Location dictates the population which must be considered in terms of actual or potential markets, labor force, and social needs. Each firm must have or anticipate a market for the goods and services which it produces if it is used to combine resources for those productive ends. In many cases the market and labor force are closely related in objectives of the firm and especially if the firm is rather isolated by lack of transportation. Social needs of the population which occupy the same relative geographic area may bring strong forces to bear upon the firm directly or through the government. As just mentioned, transportation may be dictated by the physical location of the firm. Various geographic restrictions may limit or facilitate different modes of transportation to the extent that actual or potential markets are extensively broadened or severely limited. Supporting transportation facilities may stimulate the firm's activity or even determine the original location within a geographic space. Labor force, markets, and transportation might also be grouped to determine the economic space of the firm. With severe barriers such as mountains or oceans, the economic space may coincide to the geographic space, but without such natural boundaries the two may differ significantly. In the latter case, the firm will still have a time and place location which can be identified in physical terms, and although the additional economic space occupied by the firm is different, it still is much influenced by the geographics of the physical location.
Resources

Resources necessary for minimum levels of firm operation vary significantly with the good and/or service which is being produced. To define the minimum levels necessary, obviously, would require a careful identification of the nature of the firm both in terms of raw materials and finished products or services. Even without identification with the actual production, however, the classes can be identified further. In speaking of resources in general, the whole range is included so that we have resources from "1" to "n" with the "nth" resource being money which is the common denominator in which the value of the n-1 resources have their exchange value stated. Among the n-1 resources are land, labor, machinery, buildings, tools, equipment, etc. Most farms require some quantity of land, quality dependent upon the purpose, either to produce feed for livestock or crops directly for sale. For the farm firm the land requirement is much larger than for many industrial firms and the geographies are extremely important in dictating the way the firm must be operated. Further breakdown of the minimum amount of land necessary for various farm firms cannot be accomplished without identifying the firm as to geographics and primary products. Operation of a unit as small as a fraction of an acre could qualify as a farm firm with the exception of one condition. Since the farm firm combines both consuming and producing units into one organization, a farm operation of this size in the U.S.
would hardly be conceived as self-sufficient and growth from within would be impossible.

In many cases labor requirements for a farm firm could be provided easily by one man. In fact, the person who provides the human element for decision making can be, and often is, the same person. At any rate, the one individual seems to fill requirements for necessary components of a farm firm dealing with management and the labor portion of the resources.

Machinery, buildings, equipment, tools, and other resources are so closely related to different types of production that they, like land, cannot be set at minimal levels until a clear identification has been made of the production objectives by which the particular firm is guided. Since money is a transaction or exchange resource, the amount needed depends entirely upon the operation and the amount of the n-1 resources which are already available. Money, unless exchanged for one of the n-1 resources, has no productivity in the farm firm. The sole purpose of its use stems from the need for one resource which can be exchanged easily for the other resources which are not controlled by the firm. In this capacity money is not unique since during certain seasons of the year grain functions as an exchange resource much the same as money, especially if used to obtain like resources. Money only shares the spotlight as an important resource if other resources are needed and a supply of them
is available.

Management Decisions and Minimal Components

Before a discussion of the minimal component requirements of a farm firm could be carried further, many basic appraisals of the operation would have to be made. Immediately a decision must be made as to whether the firm will be oriented according to geographics or product. In the former case decisions as to exact location would have to be made. Subject to the form of government, control, markets, and resources a decision could be made as to the goods and/or services which would be produced. Alternatively, if the firm is product oriented, a location must be selected which will provide conditions and resources for that particular production.

Once the location and products have been decided, the question becomes one of quantity and quality. This question is closely related to the location, resources, and markets which are available. Still another problem which is closely related to the quantity and quality question is what balance of labor and mechanization to use. In many cases the shift from labor to mechanization is associated with a sacrifice in quality, but with certain products that shift would mean stabilization of quality and expanded output. Each of these problems expands the demand for management input until the question centers around the size of the management unit and the quality thereof. All of these questions build up to the
quantity and quality of production and hinge upon the use of capital in the firm.

In a competitive market system larger output and/or better quality will both be rewarded and can be assumed desirable as growth. In a few cases lowering of quality could also be considered growth if the cost curve was lowered and the revenue function remained constant since this would result in increased profits. This case in agriculture is more unlikely than in some industrial firms.

Growth of a Farm Firm

Accepting growth as a desirable change, the discussion turns to how growth or expansion can take place. Growth can only take place when there is an accumulation of capital in excess of the amount needed for consumption or through changes in technology that occur everyday in various forms. Some of these are available to the public and some can only be purchased or rented through management. For the farm firm, capital accumulation is a measure of growth since profits from expanded production usually are consumed or reinvested within the firm. As an empirical investigation, profits are the best estimator of potential growth through capital accumulations. It follows that an efficient estimator for profits of a firm could be used to predict potential growth. Implicit in current agricultural loan policies is the assumption that capital is the best estimator of profits. Most loan agencies,
and especially banks, are bound to certain equity restrictions as collateral for loans, but the basing of loans on equity alone goes much farther than the imposed restrictions. The theory reviewed in the preceding sections suggests that profits are more than a direct function of managed capital assets alone. It is to this point that the study is directed in an attempt to expose the necessary components for estimating profits and providing a basis for predicting growth potential of a farm firm.
OBJECTIVES OF STUDY

The previous sections have been devoted to the conceptual framework of the farm firm. In summary, growth of the farm firm is a function of interactions between capital and management inputs when land and labor are allowed to be aggregated into the broad class of capital inputs. Further, it is apparent that most farm firms have a labor-management unit which comes in one package—the operator. With management and labor being provided by the owner and considered as one unit, accounting procedures for resource returns are much simplified. Hired labor, labor other than that of the manager, is still considered a capital input as mentioned above and no discrepancy in labor classification exists. It is not meant to be implied that the two-way classification of resources is the only breakdown which could be made from the previous conceptual analysis. The capital and "managerial labor"\(^1\) classification of the resources is, however, a logical conclusion from the conceptual framework and fits the objectives and data of this study.

The scope of the empirical investigation is narrowed to that portion of capital productivity which may be useful in explaining the nature of growth in a farm firm. In the past, many studies have been conducted in the field of capital use, but the focus of these studies has been on credit or capital

\(^1\)Managerial labor is used in this study to refer to the management and labor provided by the operator of the farm firm.
allocation within the firm. In structuring the study to an examination of the relationship between capital and growth, the need does not arise to distinguish between owned and rented capital since, once they are combined in the farm firm, it is nearly, if not totally, impossible to distinguish the two. The difficulty of distinguishing the two implies that the productive nature of the two is similar and justifies aggregation of owned and rented capital into one unit for purposes of the study. Investigations into the optimum mix of owned and rented capital is a related topic, but is outside the scope of this study.

An attempt is made in this study to explore basic relationships between capital and profit as a preliminary condition to growth in an attempt to establish a basing point for future studies relating to growth of the farm firm. As an exploratory study in the area of growth, secondary data have been used in the belief that sufficient evidence was not available to justify a primary study until more information was gained concerning the elements and relationships of growth as observed in the farm firm.

Specific objectives of this study are: (1) to develop a theoretical framework for analyzing growth potential of a farm firm, (2) to test the substitutability of management and capital in the production functions for farm firms, (3) to examine the effect which various classes of capital have on profits, (4) to examine the relationship between size of farm
and the contribution which capital makes to growth, and (5) to establish the necessary elements for further studies of growth in a farm firm.
DATA SOURCE

A very real problem exists in securing data to explore the problems outlined as objectives for this study. As an exploratory study with little or no background material found in the area of consideration, the study could only justify examination of a sample group of firms to assist in the formulation of basic assumptions for further studies. Secondary data were appropriate for the initial study since the exact nature of data needed for a complete study could not be determined from the background material which was available.

A review of various sources of secondary data such as "Cost and Returns on Iowa Farms" (6), "North Central Iowa Farm Business Summary" (15,16,17), "Annual Farm Census" (11), "U.S. Census of Agriculture" (20), and "Agricultural Statistics" (21) revealed that the aggregation of data and approach to summarization rendered these sources inadequate. Data used were obtained from the records of the Iowa Farm Business Association. The nature of these records approached primary data very closely since they are in almost the same form which would have been obtained through a field survey. In addition, the business analysis for which the records were prepared is entirely consistent with the objectives of this study and makes the data quite compatible for both the record analysis and the secondary use for which it was desired in the study.
At the present time, the state of Iowa is divided into seven farm business associations for administrative purposes. Through the grouping of the counties into the seven associations, as shown by map on page vi, some homogeneity of groups is obtained through similarity of soil type, weather conditions, and primary production. Of the seven associations, the greatest homogeneity exists in the North Central Iowa Farm Business Association and for this reason was chosen as the source of data for the study. Due to the uniformity of the soil type and the particularly high productivity of the Clarion-Webster soil involved, this area is best adapted to intensive cropping of corn and soybeans. The intensive cropping reduces grazing land to a minimum and restricts the number of dairy or beef cow herds. Resulting production of the area is corn and soybeans for crops and hogs or feeding cattle for livestock. The records of the farm business association provide still another unifying factor to the sample. As would be assumed and can be verified, the individuals who participate in the business associations are those with above average management input who are searching for progressive ways to improve their operations.

The above average level of management, high quality of land, and intensive production in the North Central Iowa Farm Business Association area provide the records of the association with a bias toward the high side of production in the state. However, the bias only tends to emphasize any results
obtained in the study since the high productivity has contributed to intensive competition for resources and forced technological progressiveness in the area. As a basic evaluation, capital productivity in the Central Association is above average and resulting conclusions about capital use for the state in general, based on data from this area, will be assured of allocating a fair share of productivity to capital.

In fact, the conclusions could be observed as a subjective floor under capital productivity with the range of productivity resting on the floor as a minimum and extending above the floor to possible heights even greater than the results of this study would indicate. Stated in another way, the conclusions are drawn from a sample biased with above average management and highly productive use of capital. Any evaluation from this sample will lead to a high appraisal of capital productivity when used as an integral resource in the farm firm. Looking at the data as a banker loaning to an average or below average manager, the minimum productivity of capital suggested by the study is expected to approach the upper limit that a less efficient manager might be expected to achieve from the capital.
ANALYTICAL FRAMEWORK

The analysis of data in this study was accomplished through the use of regressions. Examination of capital productivity was broken into general regression analysis to test the productivity of various types of capital and the effect of firm size on capital productivity, but the over-all contribution of capital to growth was tested with a special case of regression analysis which has been used in studies of industrial firms to measure the productivity of labor and capital. An application of fitting a CES (Constant Elasticity of Substitution) function is discussed by Minhas in his study of twenty-four selected industries of which more than half would be classified as agri-industries (14, pp. 18-26). Briefly, Minhas found the "B" value or regression coefficient was significantly different from both minus unity and zero which allowed him to reject the hypothesis of uniform elasticity of substitution. On this basis, he was able to establish that the Cobb-Douglas and fixed coefficient functions did not adequately describe the productive relationship which existed between capital and labor in the industries which were under test. The obvious advantage of this model is to test the productive relationship between two factors of production when a quantitative measure for only one of the factors is available.
For use in the current study the model was formulated in much the same manner as for the Minhas study except that capital input was the measured factor and managerial labor was the unquantified factor. The exact model was:

\[ \text{Model 1} \quad \log \left( \frac{Y}{V} \right) = \log a + B \log i + E \]

Where the variables are defined as:

- \( K \): Total capital input for land, buildings, equipment, machinery, feed, and livestock
- \( V \): Value added by productive activities of the firm
- \( a \): Y-axis intercept
- \( B \): Regression coefficient with expected negative sign
- \( i \): Interest rate
- \( E \): Error term

Since the regression analysis is based on the assumption of a CES function, the limits of "\( B \)" will be from zero to unity, but due to the inverse relationship between interest rate and capital use, the values will fall between zero and minus unity. Testing "\( B = -1 \)" and "\( B = 0 \)" will allow the following conclusions to be drawn about the productive relationship between capital and managerial labor. If "\( B = -1 \)", we have a Cobb-Douglas production function with unitary elasticity of substitution. If "\( B = 0 \)", we have a fixed coefficient function. If "\( B \neq -1 \)" and \( B \neq 0 \), we have a productive relationship with partial but not complete substitutability. Graphically, the conclusions will take the following form.
In addition to testing the value of \( B \), observation of the \( R^2 \), or coefficient of determination, will provide an indication of how much the quantified variable is affected by the variation in the independent variable. In Model 1, the extent to which interest rate affects the input of capital will be measured.

The second part of the study used the common form of linear regression to measure the effect of various classes of capital inputs on production and the effect which the same classes of capital had in firm operations when grouped by size according to total capital inputs. Below is the series of models used, all of which take the linear form.
Model 2  G.P. or N.P. = a + bL + E
Model 3  G.P. or N.P. = a + cI + E
Model 4  G.P. or N.P. = a + dF + E
Model 5  G.P. or N.P. = a + bL + cI + E
Model 6  G.P. or N.P. = a + bL + dF + E
Model 7  G.P. or N.P. = a + cI + dF + E
Model 8  G.P. or N.P. = a + bL + cI + dF + E

The variables are defined as:

G.P. = Gross profits = total sales plus home used products less purchased feed and livestock plus or minus inventory changes

N.P. = Net profits = gross profits minus operating and marketing expenses

L = Liquid or operating capital assets--feed, livestock, and cash balances

I = Intermediate capital assets--machinery and equipment

F = Fixed capital assets--land, buildings, and improvements

a = Y-axis intercept

b = Regression coefficient for operating capital

c = Regression coefficient for intermediate capital

d = Regression coefficient for fixed capital

E = Error term

Testing "b", "c", and "d" for significance and observing the "R^2" obtained with each model provides an evaluation of capital productivity for farm firms in the study.
RESULTS AND INTERPRETATIONS

CES Function

Results

From table 1, which provides a summary of the CES regressions when run on individual counties, inspection indicates the range of estimates for "b" far exceed the admissible range based on assumptions of the model. Further review of the results indicate that none of the "b" values fall within the minus unity to zero range, suggesting a failure of the model. "R^2" values ranging from 0.00003 to 0.72 resulted with the great majority falling between 0.005 and 0.03. Only five cases were observed where "R^2" took values above 0.05. Examination of correlation between total capital and interest rate also extended over a wide range for the various counties. Of significance is the symmetry which the range takes around zero so that in some county samples there was a positive correlation between capital and interest rate while in others there was an equally negative correlation between capital and interest. No pattern of consistency was observed in the fitting of value added when measured as gross profit compared with net profit. Some counties had the highest "b" for gross profit while others obtained the highest "b" with net profits. The same can be said for the values of "R^2" when compared for the two measures of value added.
Table 1. Summary of statistics from CES regression

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Observed</th>
<th>Acceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>B</td>
<td>-9.556</td>
<td>7.304</td>
</tr>
<tr>
<td>R²</td>
<td>0.00003</td>
<td>0.72</td>
</tr>
<tr>
<td>Phi</td>
<td>-0.30</td>
<td>0.44</td>
</tr>
</tbody>
</table>

Slightly more consistent results were obtained when the 960 observations from all fourteen counties and the three years under study were aggregated, but even these results were insignificant. For the aggregated sample using gross profit, "B" was found to be -1.23 with an "R²" of 0.003 while for net profit, "B" was found to be 3.00 with an "R²" of 0.008. Again in both cases the "B" value was outside the admissible range based on assumptions of the model and the "R²" indicated that interest rate contributed little to explain the amount of capital used. A correlation of 0.14 between interest and capital for the aggregate sample further verified that conclusion.

Interpretations

In contrast to the Minhas results, no conclusions can be drawn from these results concerning the nature of the production function since none of the values fell within the admissible range. From the model's failure to achieve the expected
results, the nature of the \( R^2 \), and capital-interest correlation values, three possible conclusions present themselves.

1. The model is irrelevant.
2. There is no meaningful relation between capital and interest for the farm firm.
3. Inadequate measurement of the variables lead to erroneous results.

Some support could be gathered for the first conclusion if the assumption had been that a Cobb-Douglas production function did exist in agriculture since many production economists would maintain this is not an appropriate production function for general agriculture. Although the general formulation begins with the Cobb-Douglas functional form, the nature of the analysis not only tests the possibility of a Cobb-Douglas function existing, but also allows for the entire range of functions from there to a fixed coefficient function. The test, therefore, does not rely upon the assumptions associated with any given function and only assumes constant elasticity.

At the level which most farmers are operating here in Iowa, constant returns to resources could be obtained as a minimum with increasing returns as a more likely possibility. For this reason Dr. Earl Heady and others would maintain that assuming the sum of the elasticities equal to unity is valid as a basic assumption for general agriculture.

There are other reasons why the model might not be appropriate for a study of the farm firm, but with the
extremely low \( R^2 \) and correlation values, the model can hardly be rejected without further investigation.

The wide range of correlation values for the relationship between capital and interest rate would suggest that no consistent relationship exists between the two variables. Being contrary to general theory of capital use, these findings would suggest fallacious results obtained from our model. There is, however, a condition which would help to explain part of the problem. Capital under study was determined by the total value of assets managed. In all cases a large percent of the capital was represented by the fixed and intermediate assets which are quite unresponsive to short-run interest rate. Secondly, examination of many of the firms will show that capital use is restricted, as shown in the theory section on capital use, to some point short of the production frontier where return to capital would be equated with interest rate. In cases where production is carried on with returns approaching capital cost, it may only be for certain enterprises and even then in a marginal sense. It is not surprising then, to find the firms unresponsive to interest rates in terms of total capital use when a major portion of the capital may be tied up in a semi-permanent form, or that returns on more liquid capital fall short of the production frontier such that equating interest rate to returns is not the decision criterion, but rather some subjective risk factor or external restriction which also is probably based on risk.
A factor which may have affected the calculated relation between capital use and interest rate is the method by which interest is determined on the Farm Business Association records. Interest rate is determined in an averaging process to help make records for a renter comparable with those of an owner. The averaging process amounts to adding into gross and net profit figures all interest paid out and in turn deducting an interest charge on all assets which is a consistent and reasonable charge for the area. Therefore, the interest charge shown in the records may not be the exact charge which the firm manager bases his decisions on. The variation in recorded interest rates from the actual interest paid falls under the third conclusion which was suggested.

In summary, the extremely low $R^2$ values and the wide range of correlation values for the relation between capital use and interest rate indicate that more accurate measures of interest are needed to test the proposed model. The low $R^2$ suggests that little validity can be attached to the values calculated for $B$ in an attempt to fit the CES function. The great scattering of observations when plotted suggest that most any $B$ can be plotted with nearly as good a fit as the calculated $B$ and verifies the low $R^2$ values which were obtained. In conclusion, there does not seem to be valid support for model rejection, even though the results obtained were fallacious, until a more accurate measure of interest is used and new results are obtained.
Geographic Clasping

Results

Table 2 provides a summary of results obtained for one county and the aggregated group using the second series of models to measure effect of capital upon gross and net profits. The county results which are presented tend to be higher than the average for the individual counties but bear out the relevant relationships. The range on \( R^2 \) for individual counties was from near zero to the high nineties with the majority ranging from the high twenties to the middle sixties. As expected, there were large variations in \( R^2 \) where the county had less than ten observations, but greater consistency and comparison with the aggregate group when the number of observations got into the twenties and higher. Throughout the entire series, the \( R^2 \) for gross profit was higher than the \( R^2 \) for net profit.

The "B", "C", and "D" regression coefficients were highly significant consistently throughout the series of counties. In cases where the \( R^2 \) was above thirty, the regression coefficients were significant at the 95 - 99% level with only a few exceptions. In the aggregate sample all regression coefficients were significant at the 99% level with one exception—the coefficient of intermediate capital when combined with both operating and fixed capital. The low significance of "C" when all three classes of capital were tested together also
Table 2. Summary of geographic regressions by single county and aggregation

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>$R^2$</th>
<th>Regression coefficient</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>County</td>
<td>Aggregate</td>
<td></td>
</tr>
<tr>
<td>Gross profit</td>
<td>.91</td>
<td>.72</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>Gross profit</td>
<td>.77</td>
<td>.42</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>Gross profit</td>
<td>.87</td>
<td>.61</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>Gross profit</td>
<td>.74</td>
<td>.30</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>Gross profit</td>
<td>.85</td>
<td>.69</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>Gross profit</td>
<td>.77</td>
<td>.42</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>Gross profit</td>
<td>.54</td>
<td>.67</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>Gross profit</td>
<td>.71</td>
<td>.38</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>Gross profit</td>
<td>.71</td>
<td>.45</td>
<td>B</td>
</tr>
<tr>
<td>Net profit</td>
<td>.69</td>
<td>.26</td>
<td>B</td>
</tr>
</tbody>
</table>
Table 2 (Continued)

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>$R^2$</th>
<th>Regression coefficient</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>County</td>
<td>Aggregate</td>
<td></td>
</tr>
<tr>
<td>Gross profit</td>
<td>.70</td>
<td>.49</td>
<td>C</td>
</tr>
<tr>
<td>Net profit</td>
<td>.46</td>
<td>.20</td>
<td>C</td>
</tr>
<tr>
<td>Gross profit</td>
<td>.57</td>
<td>.59</td>
<td>D</td>
</tr>
<tr>
<td>Net profit</td>
<td>.45</td>
<td>.37</td>
<td>D</td>
</tr>
</tbody>
</table>
appeared throughout the individual county samples and suggests that intermediate capital tends to have a balancing effect between fixed and operating capital since when combined with either of the two individually, it does show significance as well as when tested alone.

Interpretations

The "$R^2$" values which were obtained from this series suggests that capital explains about 30 - 60% of the variation in gross profits and a smaller percent of net profits. For an area as a whole the three classes of capital explained seventy-two percent of the variation in gross profits and forty-two percent of the variation in net profits. This would leave twenty-eight percent of gross profit and fifty-eight percent of net profit explained by other factors of production. Due to the accounting system used for the records, the only factors not taken into consideration are management and labor of the operator. The difference between the twenty-eight and fifty-two percent can then be attributed to "managerial labor" and provides an estimate of the relative contributions of capital and managerial labor in the productive process of the firm. From the "$R^2$" values obtained with the second model, it is suggested that capital and "managerial labor" assume something of a 70%:30% relationship in contributing to gross profit while the reverse or a 40%:60% relationship between capital and "managerial labor" exists in the contribution to
net profit. The implication here is consistent with credit policy of various agencies when repayment is the only concern since present credit policy for agriculture is primarily based on collateral loans. Based on the above findings, the repayment ability of the farmer could best be appraised through quantity of capital managed and is consistent with loan policy, but only in the short run. Growth and repayment ability are closely related since capital for both must come from net returns. In appraising a firm or individual's ability to repay or grow over time, it is apparent that net profit should be the focus of attention, and this focal point brings us to "managerial labor". The net profit regression suggests that sixty percent of the variation is due to sources other than capital, and for the study case the other resource is "managerial labor" with the obvious assumption that a reasonable quantity of capital resources are available for interaction between the capital and management.

As could be expected, the classes of capital contributed rather small amounts to measurement of net and gross profits when the classes of capital were tested individually. In pairs the classes did not have any significantly different effects except that the longer term capital tended to contribute slightly more than the shorter term capital. Such a conclusion is consistent with the theory since longer term capital should be more fixed in nature and less influenced in productivity by managerial decisions.
Results

Arbitrarily the farms were divided into three size classes based upon total capital managed. The three classes were less than $100,000, $100,000 to $200,000, and more than $200,000 with 160, 572, and 228 farms in each of the classes, respectively. First, the size classes were processed by individual year and secondly, aggregated over the three years. The resulting ranges on statistics for the CES model were 0.00005 to 0.20 for \( R^2 \), -9.18 to 3.59 for \( B \), and -0.14 to 0.13 for correlation between capital and interest. As in the case without the size classing, the \( B \) values exceeded the admissible range and as before had no values falling between minus unity and zero. Likewise, the majority of the \( R^2 \) values fell between 0.009 and 0.01 which made even the highest values extremely insignificant. Insignificant \( R^2 \) value and correlation values nearly equal to zero provide sufficient explanation for the occurrence of \( B \) values outside the assumed range.

From the linear regression on the size classes which are summarized in table 3, little difference was observed from the previous values obtained without size classification. Low \( R^2 \) and correlation values again make discussion of the \( B \) values irrelevant in many cases because of the poor fit. In most cases, the \( B \) values were, however, significant at the 90% level and many were significant at the 99% level.
Table 3. Summary of $R^2$ and correlation from size regression

<table>
<thead>
<tr>
<th></th>
<th>$R^2$</th>
<th>Correlation $k-1$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Less than $100,000</td>
<td>0.05</td>
<td>0.36</td>
</tr>
<tr>
<td>$100,000 to $200,000</td>
<td>0.02</td>
<td>0.40</td>
</tr>
<tr>
<td>More than $200,000</td>
<td>0.01</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Interpretations

Again with the size classing, the true picture seems to escape attention because of the low $R^2$ values obtained. The results by size class do suggest validity for the conclusions drawn in the previous section about the role of capital and management. When stratifying the observations according to capital use, the $R^2$ values drop significantly from those obtained without the uniform levels of capital. It appears that management definitely plays a major role in the productive process since, as the firms become more and more homogeneous in capital supply, the portion of variation in net and gross profits which is explained by management increases significantly. With capital within a given class explaining such a small portion of profit variation, the importance of management in appraisal of growth becomes extremely critical. The findings of the size classing compared to the findings
with geographic classing suggest that far more emphasis should be placed on the role of management when extending credit if growth and not simply repayment is the major objective.
SUMMARY

Reviewing and classifying elements of a firm displays three necessary components—resources, management, and an interaction. As viewed in terms of this study and relating to a farm firm, the components can be reduced to capital inputs, "managerial labor", and interaction. For a farm firm the concept of growth is based upon capital accumulation in excess of consumption and business expenditures. With growth being a function of capital accumulation, attention is focused upon profits, and more particularly net profits, as a means of evaluating growth potential. Theoretically it would appear that quantifications of capital and management could be used to estimate profits and in turn predict growth potential. As with biological growth, however, the emphasis must be on "potential", since growth may or may not be forthcoming even when the environment is provided because of the widely varying objectives of the management.

The nature of the relationship between capital and management in production and growth of the farm firm was investigated through the use of records from north-central Iowa. Records which were on file at Iowa State University provided data for the years 1962, 1963, and 1964. These secondary data were used for an exploratory study into the internal relationship which management and resources or capital inputs exhibit in the functioning of the firm. Due to lack of previous work in
the area of internal capital use by the farm firm, few assumptions could be drawn from the literature review concerning interaction of the two factors under study. From basic theory of the firm and growth, a theoretical framework was developed to explain growth of the farm firm. Three tests were used in analysis of the assumptions developed from the theoretical framework. These tests were (1) fitting of a Constant Elasticity of Substitution function, (2) estimating gross and net profit using geographic classification of data, and (3) estimating gross and net profit using size classification based on capital inputs.

Fitting the CES function was the method used in testing the actual relationship of inputs in the production function through a test of the elasticity of substitution. The test relies upon a measure of return to one of the factors which can be quantified. In the case of testing capital and "managerial labor", capital is the easiest to quantify and the return is interest on capital. From the records available, the only measure of return to capital was interest rate which under perfect competition would be equated to capital return at the point of profit maximization. Using interest as a measure of capital productivity lead to results that appeared fallacious but which can be explained by the poor fit of regression to the data. Consequently, conclusive decisions could not be made about the factor relationships.

Estimating net and gross profits from geographic classes of data allowed for testing of the contribution made by operating, intermediate, and long-term or fixed capital individually,
in pairs, and with the three together. The test with three obtained higher $R^2$ values than with pairs, as did pairs obtain better fit than the classes of capital taken individually. Two points were significant. First, capital was only able to explain up to approximately seventy percent of the variation in profits at best. Secondly, the fit for gross profits was always better than the fit for net profits. Since net profits are the source of future growth, it is important that the above two relations were found. The remaining portion of variation not explained by capital inputs is the result of "managerial labor". In the case of net profits, capital was only able to explain about forty percent of the variation, leaving sixty percent to management. Observing the important effect of management on net profits suggests that management plays a major role in growth potential and should receive major attention when appraising growth potential.

By comparing the results obtained from testing the influence of capital on profits from a geographic classing with results obtained from size classing based on capital inputs, a further conclusion can be drawn to support or refute the conclusion drawn from the geographic examination. When stratified into three arbitrary classes—farms with less than $100,000$ capital, those with $100,000$ to $200,000$, and those with more than $200,000$—the $R^2$ values fell consistently below $0.20$ with many falling below $0.05$. Since the same data and same variables were being used in both the geographic and
size test, the conclusion is that capital becomes less and less important and management increases in importance as the sample of observations become more homogeneous as to capital inputs. The increasing importance of management serves to substantiate conclusions drawn from the CES function and the geographic regression. Throughout the three tests, there is no consistent dominance by either capital or management, which suggests, as presented in the theory, that productivity and growth is an interaction of the two factors. The test did bear out the consistent shift from the importance of capital in estimating net profit to the importance of management as the samples were aggregated to homogeneous capital levels. If the variations in net profits had likewise become smaller and smaller with the stratification, capital could have been credited with the major contribution to net profit estimates, but since stratification by capital class had little effect on minimizing net profit variation, management is concluded to play the major role in contributing to net profit and ultimately to the growth potential of the firm.

As a result of knowledge gained from this study, future approaches to research on the topic might include: (1) repeated effort to fit the CES function for exact relationship between capital and management by obtaining both more accurate estimates of the exact interest rate paid by farmers and possible capital return estimates by enterprises or farm, (2) examining the difference between returns to capital realized
and interest rate paid, as suggested by internal or external rationing which limits production short of the frontier where return to capital is driven down to interest rate. (3) attempt to quantify management through some weighted production ratio so that capital and management could both be included in the equation for estimating profits, and (4) explore the relationship between household consumption and firm investment to determine if growth can be described as a constant or increasing function of net profits.
SELECTED REFERENCES


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